GREAT NORTHERN MANUAL

TABLE OF CONTENTS

DESCRIPTION OF EQUIPMENT AND CAR NAMES

SPICER GEAR DRIVE

AXLE GENERATING EQUIPMENT

DIESEL GENERATING EQUIPMENT

GENERATOR CONTROL AND REGULATION

AIR CONDITIONING EQUIPMENT AND CONTROLS

HEATING EQUIPMENT AND CONTROLS

ELECTRICAL SYSTEM

MOTOR ALTERNATOR

WATER SYSTEM

MECHANICAL EQUIPMENT

TRUCK - BRAKE AND PLATFORM EQUIPMENT

INDEX
(at back of book)

DESCRIPTION OF EQUIPMENT

New Sleeping Cars

built for

THE GREAT NORTHERN RAILWAY COMPANY

- - - - - - - -

The 41 new sleeping cars covered by these instructions were built by Pullman Standard Car and Manufacturing Company under lots No. 6877-6878-6889 and 6890.

Many devices new to sleeping car operation have been applied to these cars and the description of these devices in this manual will be of help to those responsible for the maintenance of the equipment. These instructions will supplement the instructions already issued to the districts.

In the tentative plan of operation the 33 cars of lots No. 6877-6878 and 6889 are to operate in the New Empire Builder while the 8 cars of lot 6890 are to operate in the Oriental Limited. Car names with builder numbers, lot number, plan and capacity follow:

16 Cars - Lot 6877 - Plan 4180 - 2 Compartment, 5 Double Bedroom, 6 Roomette

#1370	ROGERS PASS	GN
#1371	PITAMAKAN PASS	GN
#1372	AKAMINA PASS	GN
#1373	SANTIAM PASS	GN
#1374	PARK CREEK PASS	GN
#1375	JEFFERSON PASS	GN
#1376	HART PASS	GN
#1377	STATE PASS	GN
#1378	FIRE BRAND PASS	GN
#1379	BIG HORN PASS	GN
#1380	SUIATTLE PASS	GN
#1381	HAINES PASS	GN
#1382	BLEWETT PASS	GN
#1383	INUYA PASS	GN
#1384	LEWIS AND CLARK PASS	GN
#701	WAPINITIA PASS	SP&S

16 Cars - Lot 6889 - Plan 4181 - 1 Compartment, 3 Bedrooms, 8 Duplex Roomettes, (1 for Porter) 4 open Sections.

#1260	SKYKOMISH RIVER	GN
#1261	SUN RIVER	GN
#1262	SNOHOMISH RIVER	GN
#1263	MILK RIVER	GN
#1264	BAD AXE RIVER	GN
#1265	CHUMSTICK RIVER	GN
#1266	SHEYENNE RIVER	GN
#1267	SKAGIT RIVER	GN
#1268	MOUSE RIVER	GN
#1269	POPLAR RIVER	GN

#1270	TOBACCO RIVER	GN
#1271	FRASER RIVER	GN
#1272	SPOKANE RIVER	GN
#1273	PEND O'REILLE RIVER	GN
#1274	BOIS DE SIOUX RIVER	GN
#702	SNAKE RIVER	SP&S

1 Car - Lot 6878 - Plan 4109 A - 2 Double Bedroom, 1 Drawing Room, Buffet, Observation Lounge.

#1197	PRIEST RIVER	GN

8 Cars - Lot 6890 - Plan 4108 A - 4 Double Bedrooms - 16 Duplex Rmts.

#1181	KINTLA GLACIER	GN
#1182	AGASSIZ GLACIER	GN
#1183	HUDSON GLACIER	GN
#1184	CHANEY GLACIER	GN
#1185	PARADISE GLACIER	GN
#1186	PUMPELLEY GLACIER	GN
#1187	TAHOMA GLACIER	GN
#1188	TWO OCEAN GLACIER	GN

CAR STRUCTURE: The car structures are of Pullman-Standard welded girder type construction with plain sides. Structural members are of a high strength low alloy steel. Crossbearers are Pennsylvania type, tapered, of .250" high strength steel welded to the center sill with a continuous weld at webs and flanges. A PRR type re-inforcement plate is applied to the girder sheet and welded to the side sill angle. A re-inforcing plate 5 7/8" wide by .150" thick is welded to the leg of the side plate "Z" and runs continuous the full length of the car.

The sub or false floor is riveted to the top of underframe members and is of .030 stainless steel. Five floor stringers, running the length of the car are of 3" alloy steel "Z" bars. Poplar furring strips are fastened to floor stringers with self-tapping screws. Tucolith flooring 5/16" thick is used on top of .050 corrugated aluminum sheets.

General toilet floors are of Random Pattern Ceramic tile. Sparta Ceramic Co.'s 310 QN Vestibule floors are of rubber tile over steel floor plates. Removable steel plates cover a floor trench located along sides of car in which heat and water system piping is housed.

SPICER GEAR DRIVE

GREAT NORTHERN RAILROAD

DRIVE EQUIPMENT: The 24 cars having Safety Genemotors are equipped with Spicer drives, Model 6-1 with 2.54 gear ratio.

ASSEMBLY	WHERE USED	SPICER NUMBER	PULLMAN NUMBER
Axle Mounting Assembly	6 x 11 Axles	72052-3X	KE 13822
Torque Arm Assembly	All Cars	72041-15X	KE 13307
Torque Arm Mounting Assembly (Flex Type)	All Cars	72032-1X	KE 13308
Safety Arm Assembly (Type " W ")	All Cars	72042-11X	KE 13274
Automatic Clutch	All Cars	50009-1	KE 12911
Automatic Clutch Nut (Genemotor shaft)	All Cars	S-884 (1 1/8" x 12 T.P.I.	KE 13822
Gear Unit Assembly	All Cars	70001-1	
Drive Shaft-Tubular (41 1/2" Compressed length)	All Cars	7983-1 S.F.	K 8

A general description of the Spicer drive and its components follows: This general information applies to all the post-war styles of Spicer equipment and should be used in conjunction with the tabulation above.

SPICER GEAR DRIVES

The complete Spicer Manufacturing Co. drive consists of the gear unit mounted on car axle, drive shaft and clutch. The Spicer drive was designed for transmission of power from railroad car axle to generator. Several models have been in use for a number of years, and most yards are somewhat familiar with the old Models 3-2, 3-3 and 3-4. The older models are gradually being replaced by Models 6, 6-1 and 6-2, which are also being applied in large numbers to the new postwar lightweight sleeping cars. On all models the first number indicates the general design while the number following the dash indicates a style difference for that particular model. All models are equipped with hypoid gears running in a bath of oil and all bearing and gear adjustments are made at the factory. Figure 1 shows a typical application of the gear unit to car axle and Figures 2 and 3 show a detailed drawing of this application.

The Model 6 drive is a modification of the older Model 3's incorporating an improved quill bearing arrangement and the use of roller bearing at the pinion gear in place of ball bearing. This model has a quill diameter or bore of 7-7/8" which made it possible to mount the gear unit on all axles in use at the time it was designed. However, the wheel seat diameter on 6" x 11" axles was increased to 8-1/4" which was too large to allow mounting of the Model 6 gear unit. Therefore, the Model 6-1 was designed, and it has a quill diameter or bore of 8-9/32" so it can be mounted on the 6" x 11" axle with increased wheel seat diameter. In addition, axle mounting assemblies were designed so that the Model 6-1 can also be used on 5-1/2" x 10" as well as other special size axles. The Model 6-2 is a recently designed unit having the same general characteristics as the 6-1 but adapted to different truck arrangement. From the above it should be noted that the Model 6-1 can be used on any axle to replace a 6, but the Model 6 can only replace the 6-1 on an axle with wheel seat of 7-3/4" or less; the Model 6-2 cannot replace the 6 or 6-1 or vice versa. The model number on each unit can be found at the location indicated on Figure 14.

The preceding paragraph deals with the interchange of gear units on axles as this applies when mounting in the shop. The interchangeability of the complete mounted units will affect all yards where wheel exchanges are made and must be carefully watched. Most important is that all models come in several gear ratios; the four most commonly used are 2.54, 3.09, 3.44 and 3.76 to 1. Gear ratio of each unit is plainly marked on the inspection cover at the top of the unit as shown in Figure 14. Whenever it becomes necessary to remove this cover, it must be replaced on the same unit from which it was taken. The gear ratio on original drive for each car has been determined for the particular type generator used, and therefore only gear units of proper ratio should be used so that correct generator speed is obtained. Torque and safety arms used must always be the same style as original equipment because of the truck dimensions.

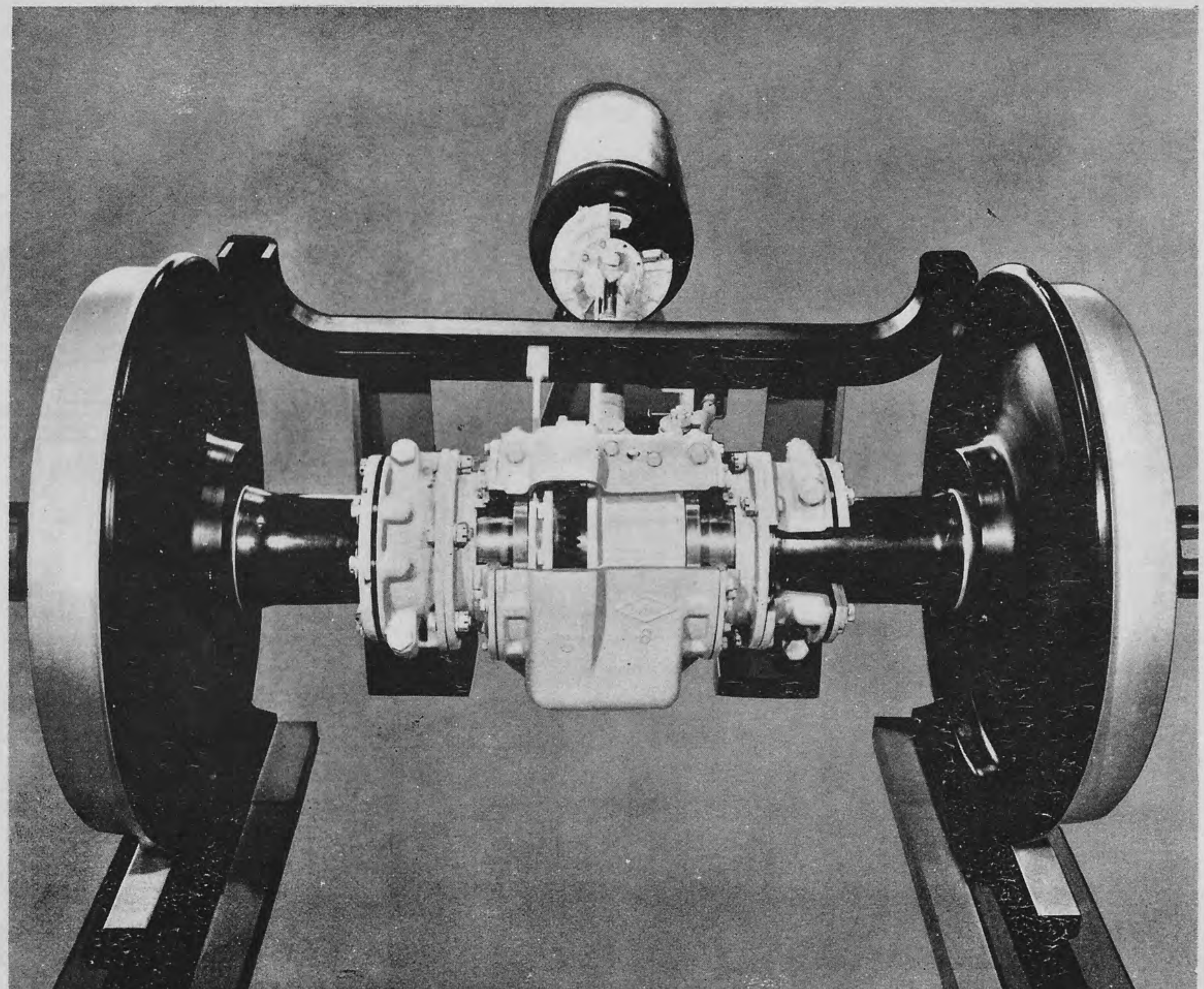
The major units making up a Spicer drive are explained in the following paragraphs covering maintenance of the various parts.

GEAR UNIT ASSEMBLY: To install the gear unit, one wheel is pressed on axle, axle is inserted in quill, the second wheel is pressed on, and unit is then secured to axle by means of axle mounting assembly. When the gear unit is centered equal distance from both wheels, the center line of pinion gear will actually be 11/16" closer to one wheel, as the pinion assembly is not located in the exact center of gear box assembly. Gear units are usually shipped less oil, and local arrangements must be set up to be sure oil is placed in unit before it is placed in service. Local arrangements should also be set up to exchange the oil in gear unit at each wheel turning.

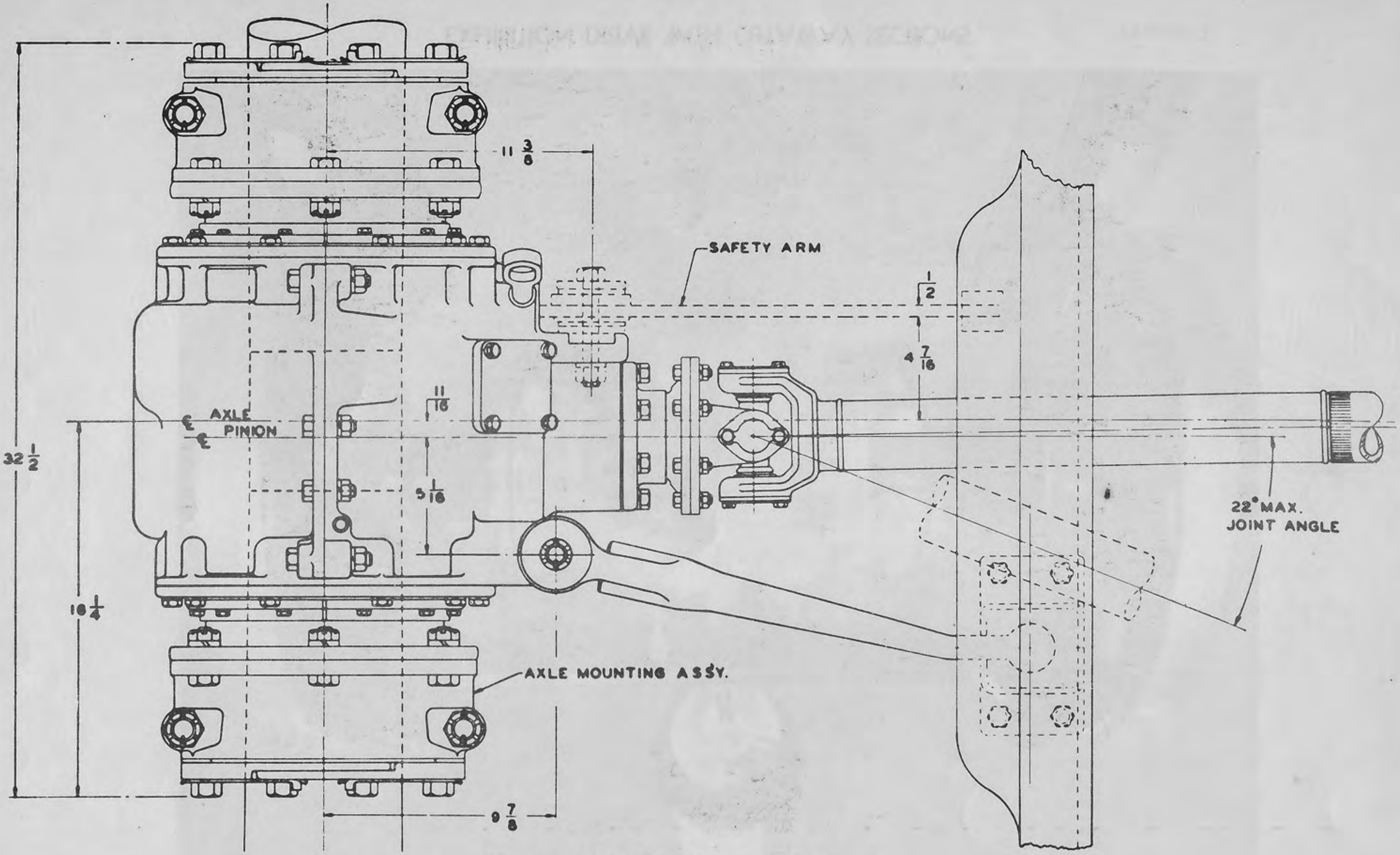
Proper lubrication of the gear unit is extremely important. A bayonet type oil gauge, located at right-hand side of unit near the safety arm, is used on all units to measure the oil level. The oil gauge has one marking " FULL ", as shown in Figure 4. Add only Catalog No. K-12141 gear oil if level as shown on gauge is 1/4" or more below " FULL " mark on gauge. Oil is added through filler opening just below gauge, and the total capacity of unit is 7 quarts. *CAUTION: Do not overfill!* A drain plug in bottom of unit is provided to drain out oil. This drain plug is wired to gear case and the wire must be replaced whenever drain plug is re-applied so that plug will not come out.

An air breather is located on top left side of gear unit, and its function is to prevent excessive pressure being built up inside the unit. The breather must be kept clean at all times, as excessive pressure in the gear unit will cause oil leaks at the pinion flange seal or quill flange seals.

AXLE MOUNTING ASSEMBLY: The axle mounting assembly consists of two tapered rubber bushings (halves), split clamp housing, and split compression ring for each end of gear unit. These mounting assemblies are made in three standard sizes; 5" x 9", 5-1/2" x 10" and 6" x 11", also several special sizes. These sizes are plainly marked on each assembly, and can be used only with axles of corresponding sizes. In each assembly are six bolts 3/4" - 16 x 2-1/8", Catalog No. KE-11621, hexhead cap screws 3/4" - 16 x 2", Catalog No. KE-11622, and two bolts 1" x 6-1/8", Catalog No. KE-11616, with nuts Catalog No. KE-11617. These bolts with nuts, cap screws, lock washers and cotters are the same on all mountings. Figure 5 shows the detail.

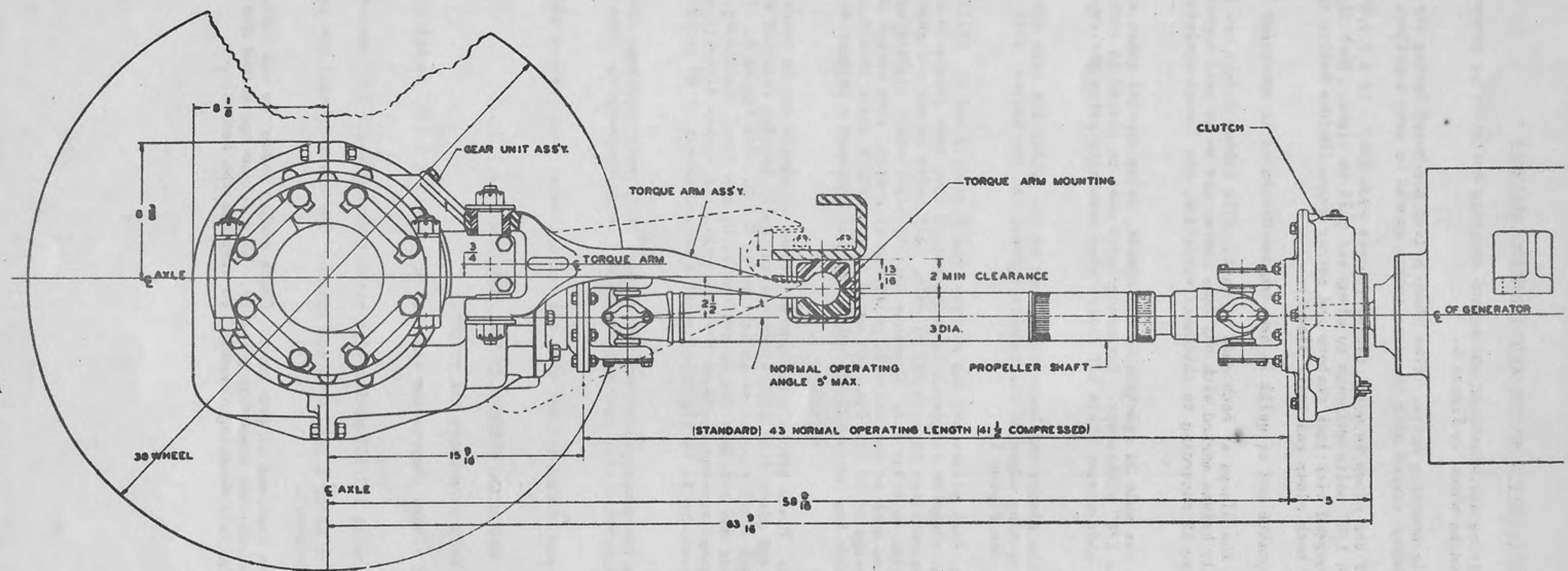


EXHIBITION DRIVE WITH CUTAWAY SECTIONS Figure 1



DETAILS OF APPLICATION (Top View)

Figure 2



TYPICAL INSTALLATION COMPLETE SPICER DRIVE—MODEL 6 AND 6-1

DETAIL OF APPLICATION (Side View)

Figure 3

APPLICATION OF THE AXLE MOUNTING ASSEMBLY

1. Check size of axle requiring new mountings and select mounting units having proper size stamped on compression rings and clamps as shown in Figure 5.

2. Dis-assemble the two axle mounting units. (The clamp halves are mated having the same mating number stamped on each half and only halves marked with the same number should be used together.

3. Fasten the two halves of the clamp to quill flange loosely with 3/4" - 16 x 2 1/8" bolts and nuts provided. Next, apply the 1" x 6 1/8" bolts and nuts to clamp and pull up tight. Then tighten the quill flange bolts. All bolts are provided with lock washers and cotter pins. (Before making application of clamps, clean the machined surface on both clamp and quill flange).

4. Apply other clamp to opposite end of quill in same manner described in operation No. 3 above.

5. Insert rubber halves in the clamps at both ends of quill. (The rubber halves are factory selected for size; mated and marked; only halves marked with the same number are to be used together in same clamp. The rubbers are marked from 1 to 12 according to thickness variation, the lowest numbers indicating the thinnest rubber).

6. Center the gear unit on the axle in relation to the wheels, using special gauge and expanding bolts shown in Figure 6. Tolerance is 1/4" either way. Expanding bolts must be placed in position to block gear unit against both wheels so that unit cannot shift off center when remaining parts are applied. See Figure 7.

7. Force the rubbers into the clamps and keep both halves of the rubber the same distance from clamp. If there is any space at the meeting edges of the rubbers between the two halves, this space should be filled with leather shims. See Figure 5.

8. Apply compression rings, lock plates and cap screws. See Figures 2 and 3. (It is important that overlapping joints of compression rings be staggered in order not to come over joints in clamps). Tighten two opposite bolts on compression rings at each end of unit. All bolts on one end should be drawn up a few turns and then repeat operation on other end. Continue this by alternately tightening both ends using torque wrench. Tightening up too much on one end will pull unit of center, even though the unit is blocked between the wheels. When average of 60 ft. lbs. per screw is reached, a check should be made through inspection hole to see if rubber has bottomed. If rubber has not bottomed a thinner set of rubbers will have to be used.

9. Check for concentricity. Place blocks under journal boxes so wheels can be rotated, see Figure 8. Hold gear unit stationary and place dial indicators against quill bearing retainer at location on Figure 8. Rotate the axle and check total run-out on indicators at D & E. See Figure 9. The total run-out must not exceed .015" at either end and this can be controlled by the final tightening of compression screws. At points where highest run-out shows on the indicator, the screws directly opposite require the most tightening. All screws are to be tightened until a wrench torque of 90 to 120 ft. lbs. is reached.

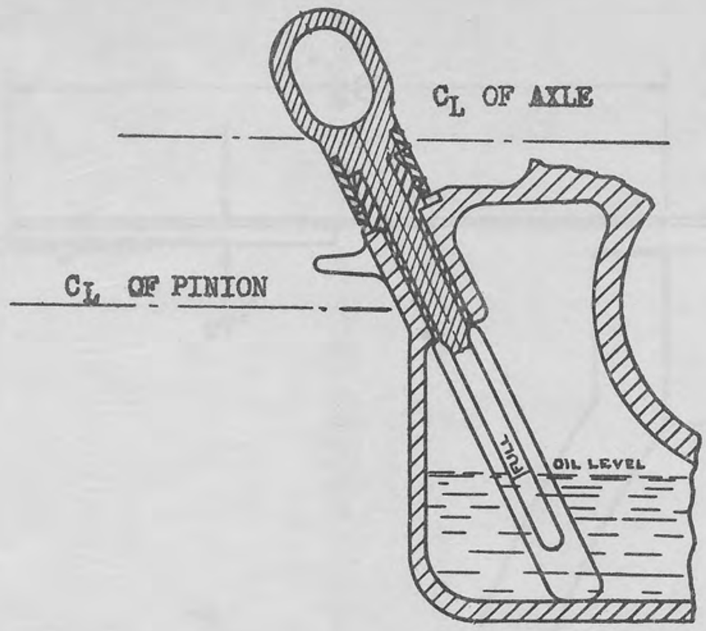
10. Check clearance between the compression ring and clamp. It is very important that this is never less than 1/64" at any point as rubbers will wear quickly if set under compression. See Figure 5. Dimension " C ".

11. Lock the compression screw plates and see that all screws, nuts, lock washers and cotter pins are in place.

REPLACING RUBBERS IN AXLE MOUNTING

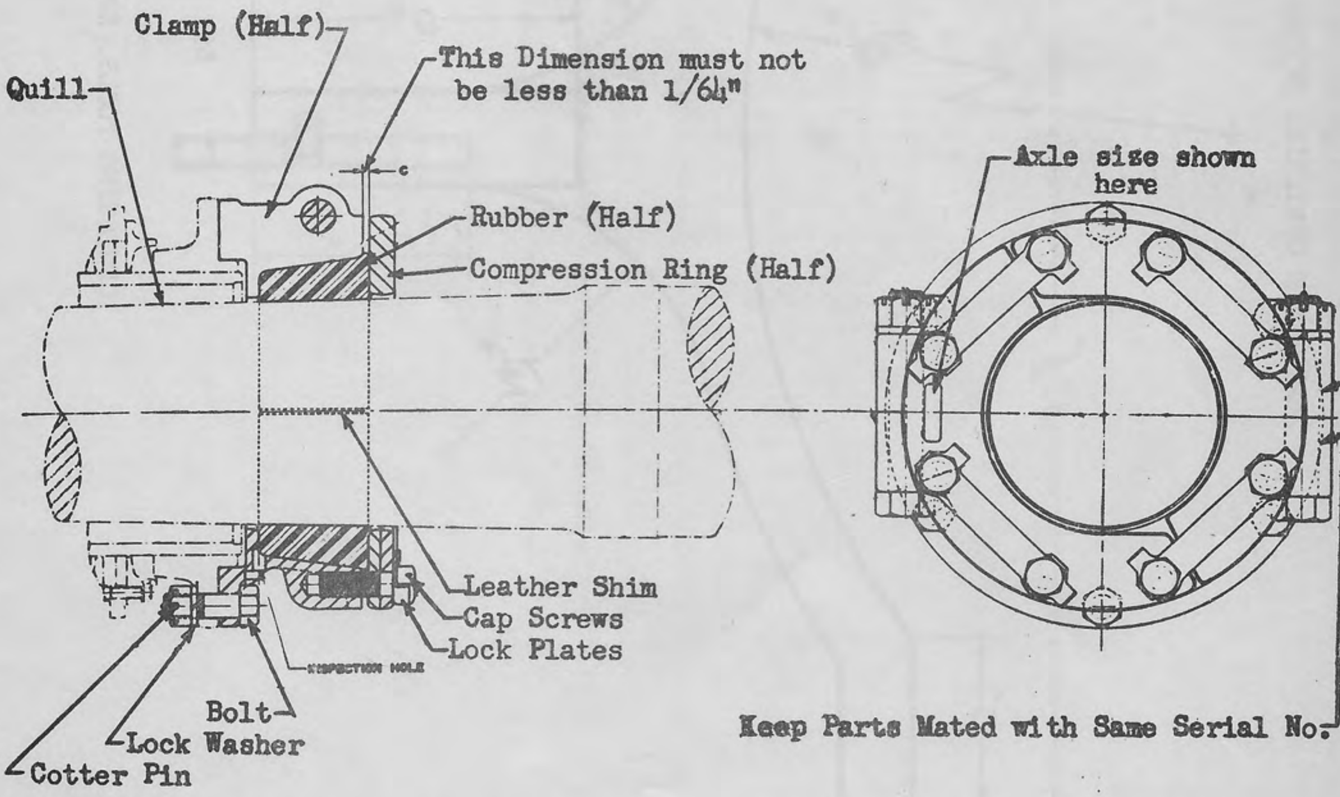
1. Place block under gear unit to support the weight.
2. Release lock plates and remove compression ring cap screws using 1 1/8" socket with ratchet wrench.
3. Remove two clamp bolts using 1 7/16" socket with ratchet wrench and 1 1/2" open end wrench.
4. Remove quill flange bolts using 1 1/8" open end wrench. The mounting will now come apart and old rubbers can be removed.

The same operation applies on each end of gear unit. Check number marked on old rubbers and obtain new rubbers from stock as close to this number as possible. Then follow operations Nos. 3 through 11 outlined under " Application of the Axle Mounting Assembly" to complete the assembly.



OIL LEVEL GAUGE

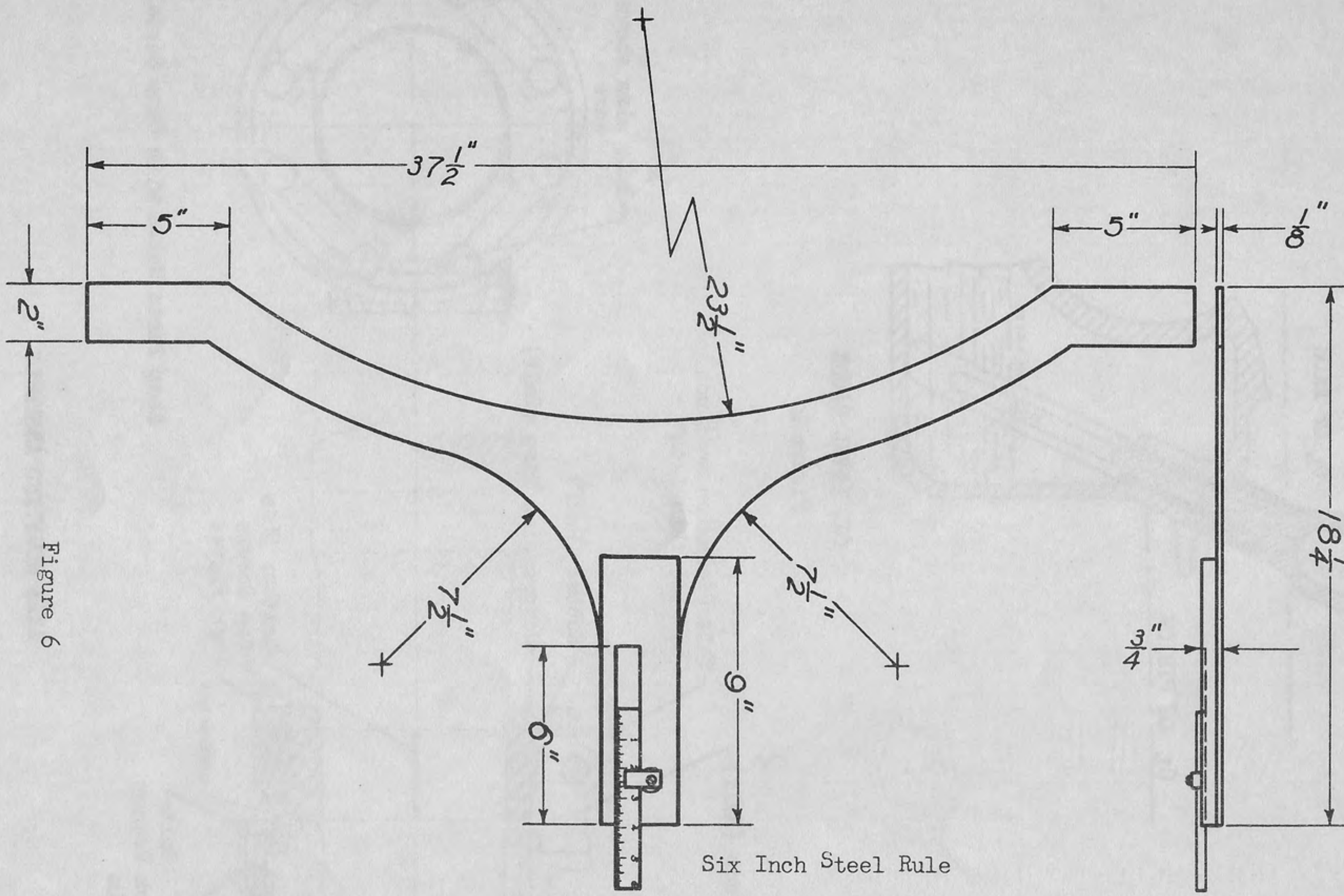
Figure 4



AXLE MOUNTING ASSEMBLY

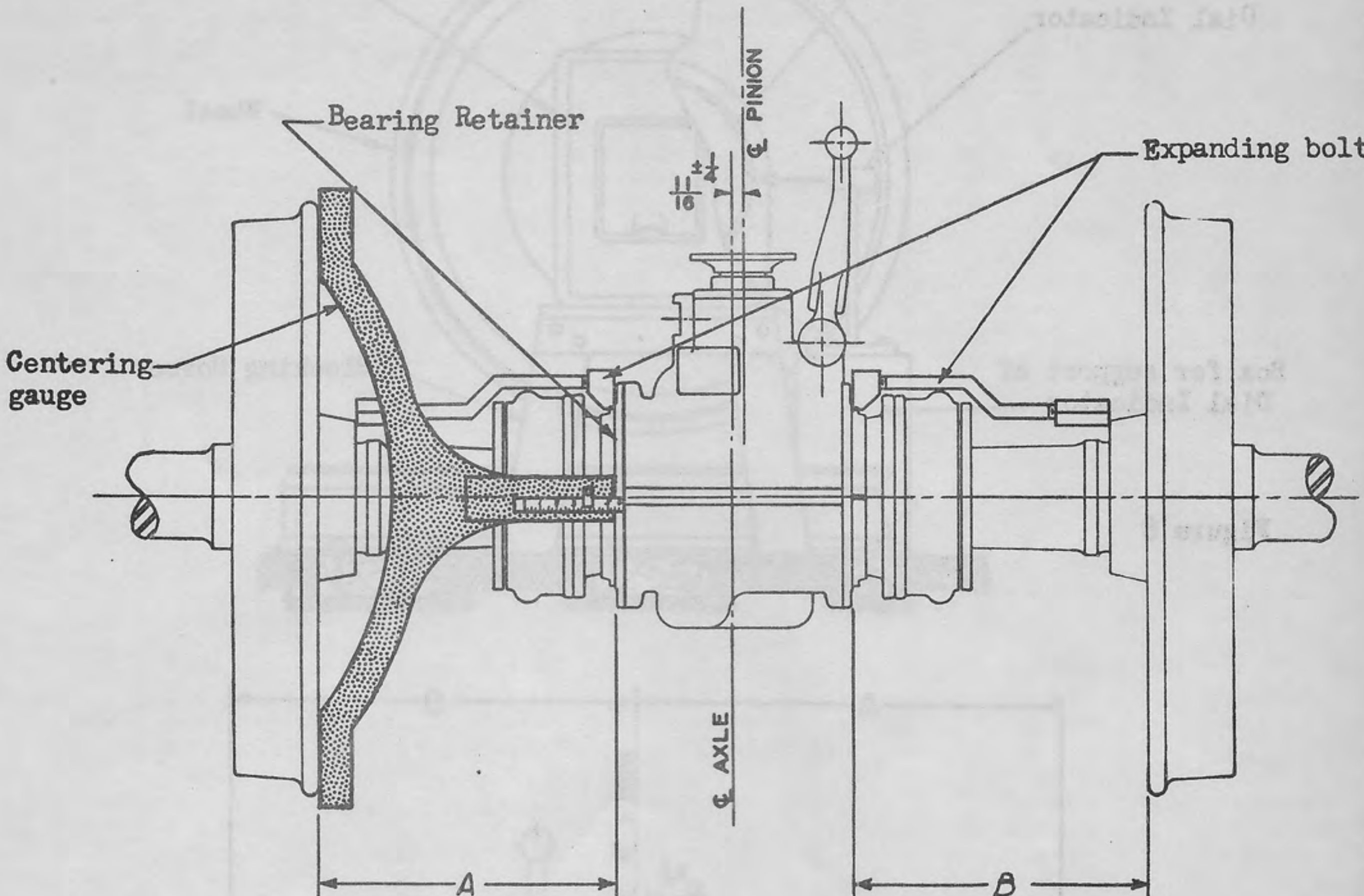
Figure 5

GAUGE FOR CENTERING SPICER GEAR UNITS ON AXLE

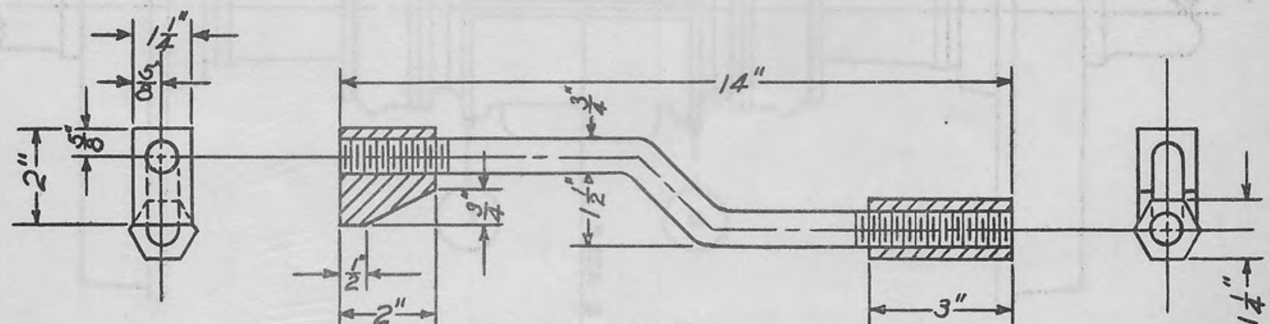


CENTERING TOOLS, SPICER DRIVE

Figure 6



Dimensions A and B should not differ more than 1/4 inch.



EXPANDING BOLT

Figure 7

CENTERING GEAR CASE ON AXLE

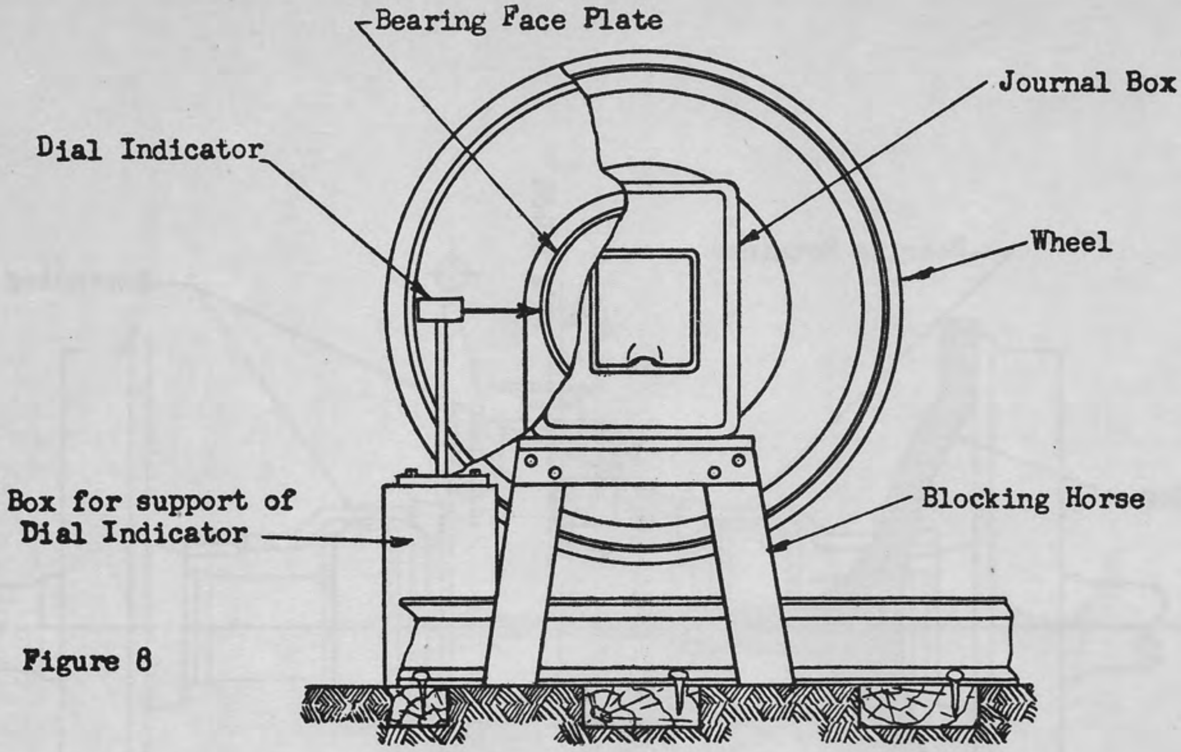
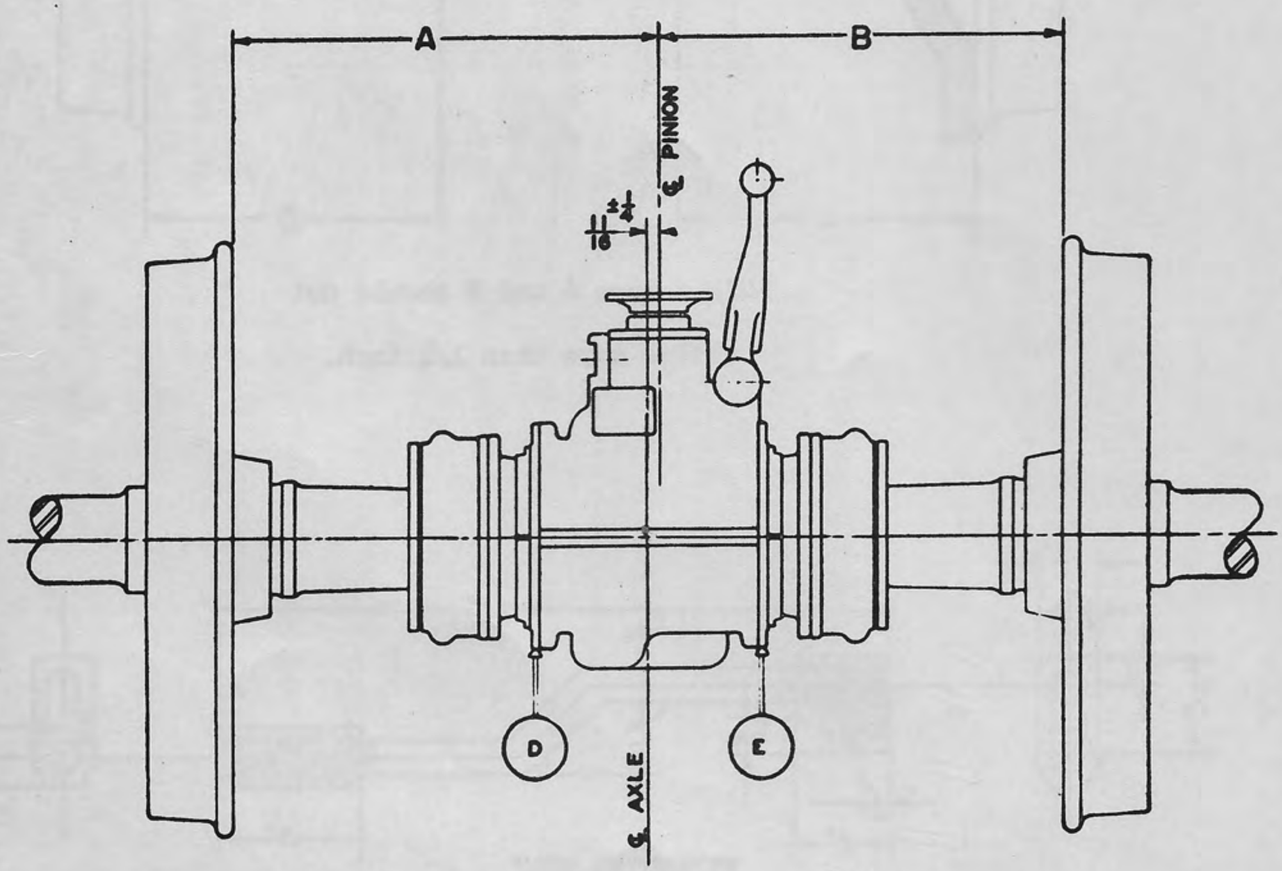


Figure 8



CONCENTRICITY TEST - SPICER DRIVE

Figure 9

REPLACING QUILL OIL SEAL:

1. Remove 1/2" cap screws in quill retainer. The quill retainer is in two halves with five cap screws in each half. See Figure 10.

2. Removing quill retainers exposes felt seal, which can be pulled out. Felt seal is in two pieces, each piece completely around the quill, with the ends fastened together by staples.

3. Soak new felts in light oil, and drain off surplus.

4. Wrap inner felt completely around quill, forcing in position, and trim to proper length. Fasten ends with staples, and keep the ends near top side of gear unit.

5. Assemble outer felt in same manner as for inner felt, but stagger the ends from those on inner felt.

6. Re-apply quill retainers and cap screws for same.

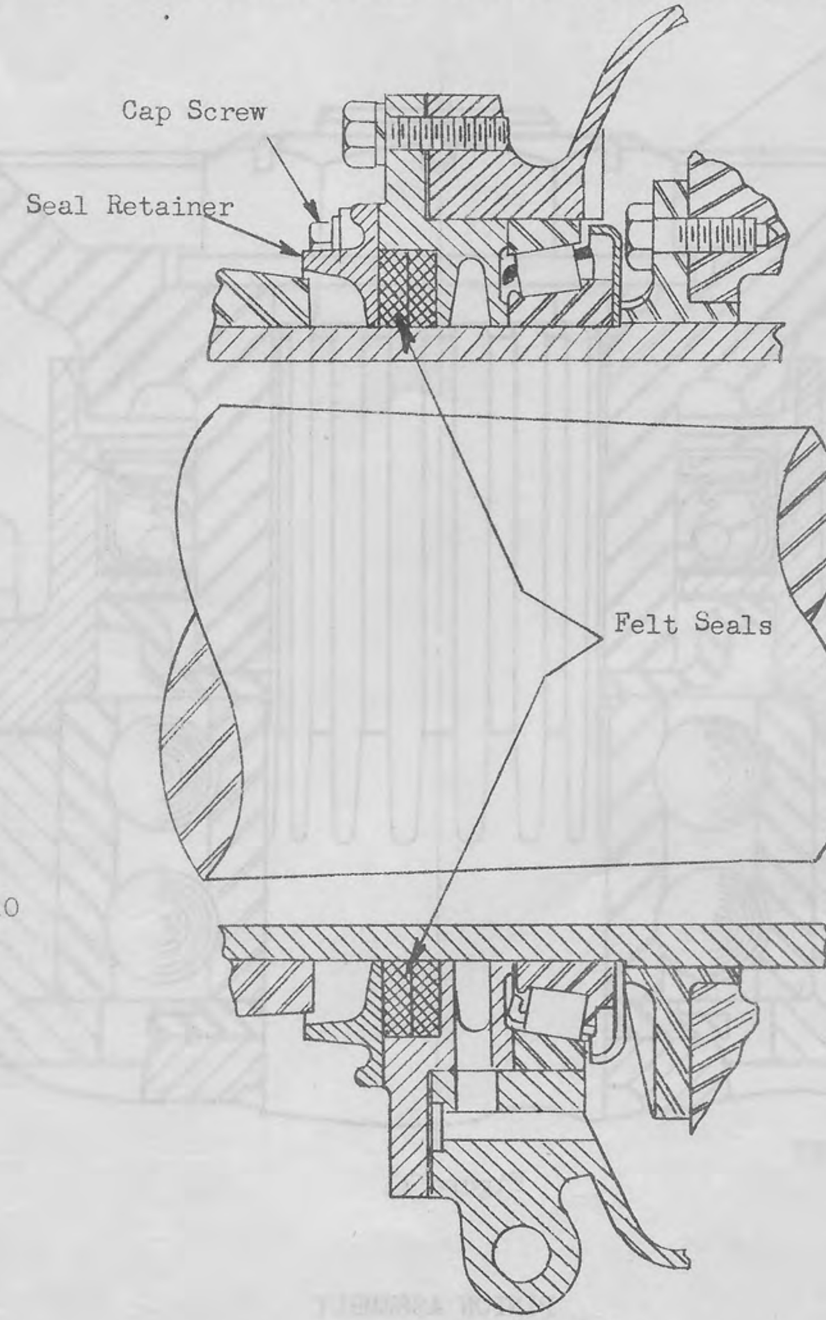


Figure 10

SPICER GEAR UNIT QUILL SEAL

REPLACING THE PINION OIL SEAL:

1. Disconnect drive shaft.
2. Remove pinion flange cotter key and nut using 2-1/8" socket and ratchet wrench.
3. Remove pinion flange with puller, shown in Figure 12.
4. Remove pinion bearing cap screws using 3/4" box or socket wrench.
5. Remove bearing cap and pry out old seal and gasket which is in bearing cap.
6. Apply new gasket in back of seal and then press in the new seal so that sealing edge is facing inward toward the bearing.
7. Apply new bearing cap gasket and apply bearing cap to gear unit.
8. Apply pinion flange with pusher tool shown in Figure 13.
9. Apply pinion flange nut and cotter.
10. Re-connect drive shaft.

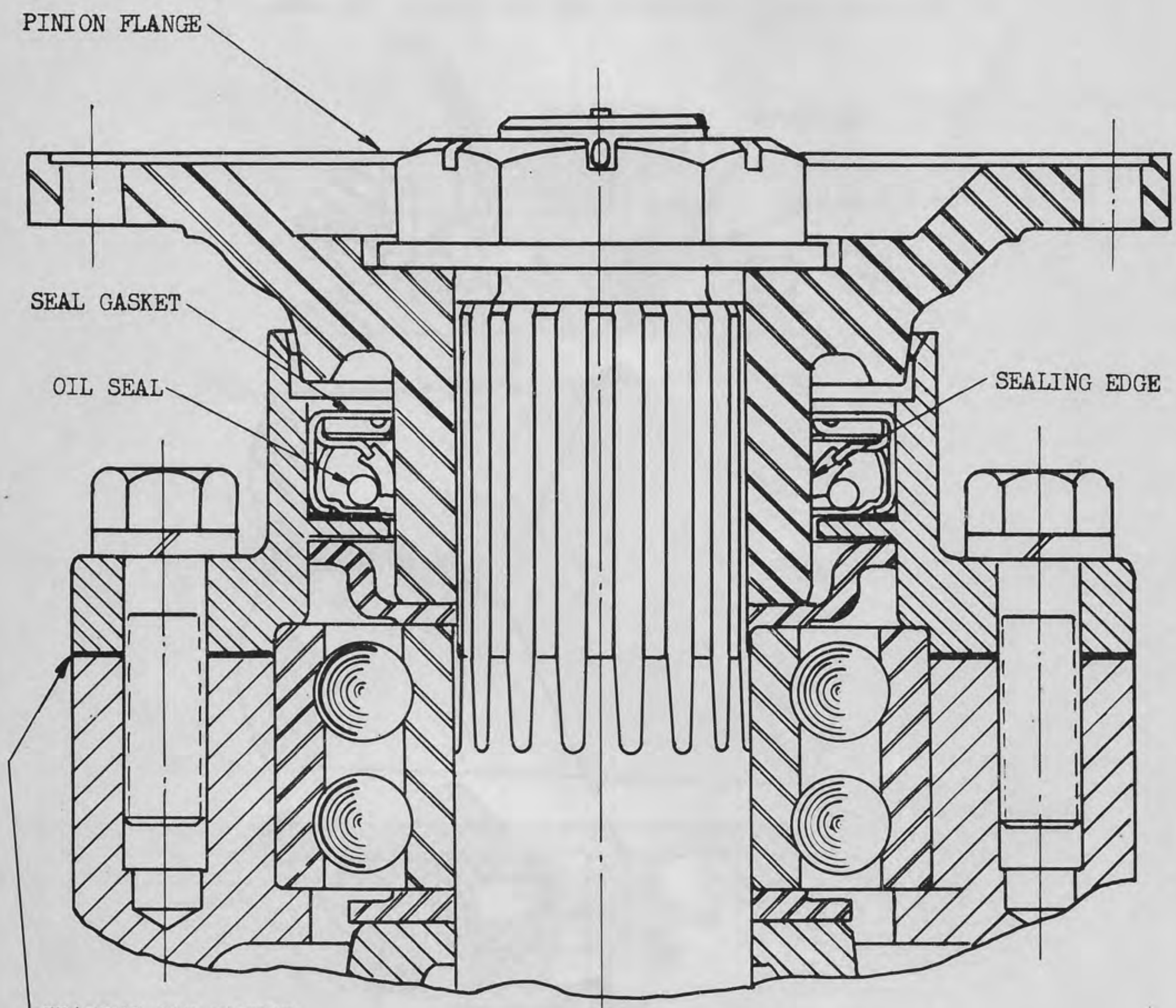


Figure 11

PINION ASSEMBLY

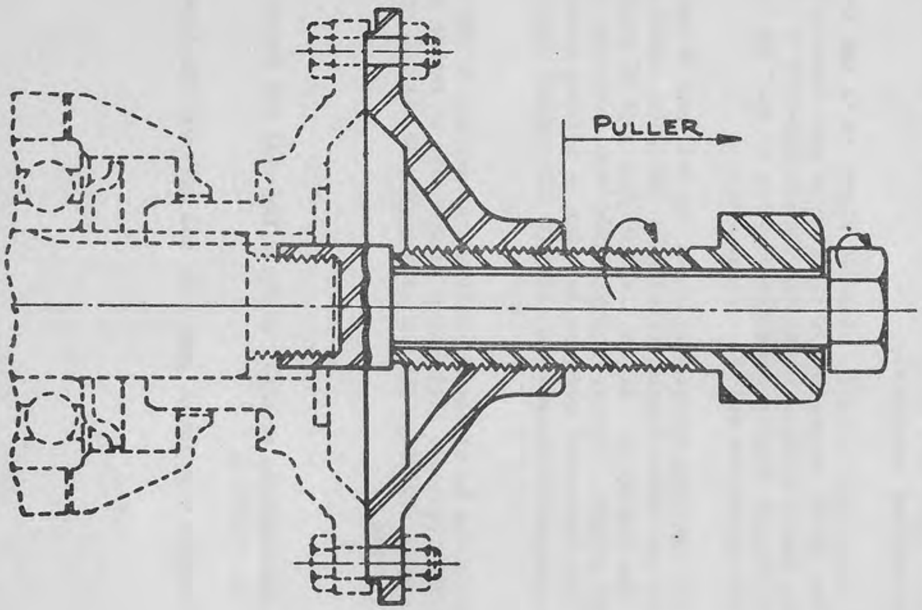


Figure 12

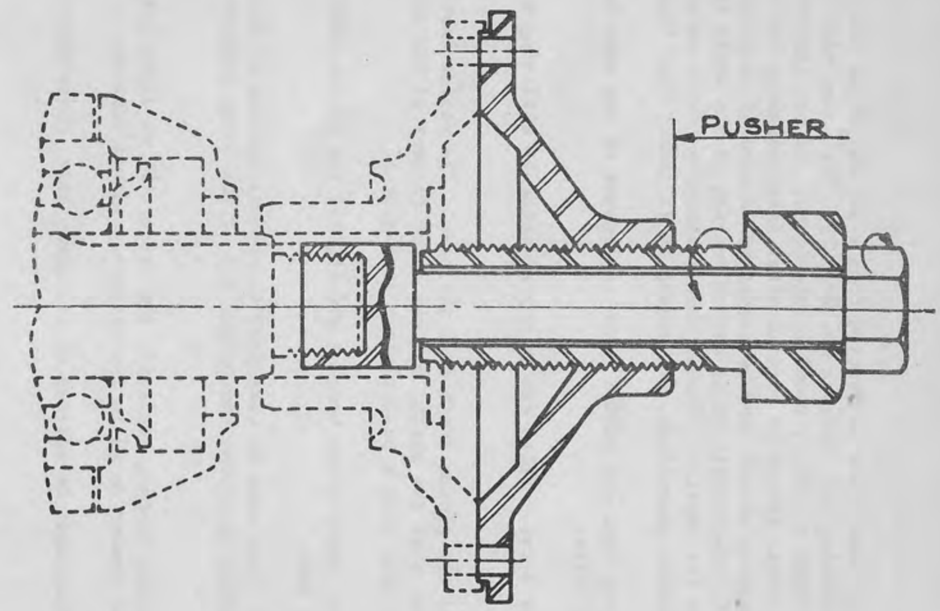


Figure 13

COMPANION FLANGE PULLER AND PUSHER

The COMPANION FLANGE PULLER AND PUSHER is used to remove and replace the companion flange on the gear unit and should always be used to remove or replace the companion flange. Never attempt to drive the flange on or off as this is likely to damage the gears or bearings.

To use as a puller, first remove the pinion cotter, nut and washer, then screw the inner nut of the puller on to the threaded end of the pinion as far as it will go. Turn the puller flange until it mates with the holes in the companion flange and fasten the two together with bolts. Now turn the large screw clockwise. When replacing the flange, first align the splines with those on the pinion then turn the large screw counter-clockwise forcing the flange on to the pinion. Apply washer and nut, pull down tight and lock with cotter.

REPLACING PINION BEARING: Whenever a Spicer Gear Drive is removed from a car for wheel turning, the gear case must be thoroughly cleaned out with flushing oil, Catalog No. K-13077. Drainings will be carefully screened with a mesh screen of No. 16 or finer to detect metallic particles. If any are found, the inspection plate, which is secured with 4 cap screws, should be removed after first cleaning the adjacent area of any loose dirt. The ring and pinion gears should then be inspected as closely as possible to determine their condition. If a defect such as a broken tooth or an uneven wearing of the teeth is found, the unit must be returned to the manufacturer for repairs. Should this inspection reveal no apparent defect, it will be necessary to remove the pinion assemblage, proceeding as follows: (See Figure 14)

1. *REMOVE* cap screws on pinion half of gear case and *LOOSEN* these cap screws on the rear half of the gear case. Also remove 9 housing bolts.

2. Lift off the entire pinion half of the drive. (This can be accomplished by utilizing a Yale 'Pul-Lift'.

3. Remove the pinion flange and press out the pinion shaft from the case. The roller bearing inner raceway and rollers will come out with the shaft, but the outer raceway of the roller bearing must be removed from the gear case with a puller shown in Figure 15.

4. Should the roller bearing be defective, apply a new bearing and install the pinion shaft into the assemblage and apply to gear case.

5. Re-assemble the gear drive. *CAUTION:* Care must be exercised to prevent bending or distortion of the gear case shims. These shims determine the proper fit of the large tapered roller bearings on the quill.

6. On drives that have had the pinion roller bearing replaced, the letter 'B' at least 1/4" high will be stamped adjacent to the serial number on plate for permanent identification.

Whenever a bearing is installed, this office must be advised of car name, date, drive serial number and wheel numbers.

It must be understood that no drive is to be taken apart until a representative from this office goes over this matter with your Foreman personally and, therefore, if any foreign matter, as described above, if found after flushing, this office is to be notified immediately.

TORQUE ARM ASSEMBLY: The main part of the torque arm assembly, shown in Figure 16 is the torque arm which takes the torque reaction of the gears. One end of torque arm is attached to gear housing by two tapered rubber bushings. Catalog No. KE-12555, which absorb shocks, vibrations and all movement by the flexing of the rubber. Torque arms are furnished in several lengths and types of bends to suit the location of truck end sill. All other parts of torque arm assemblies are interchangeable.

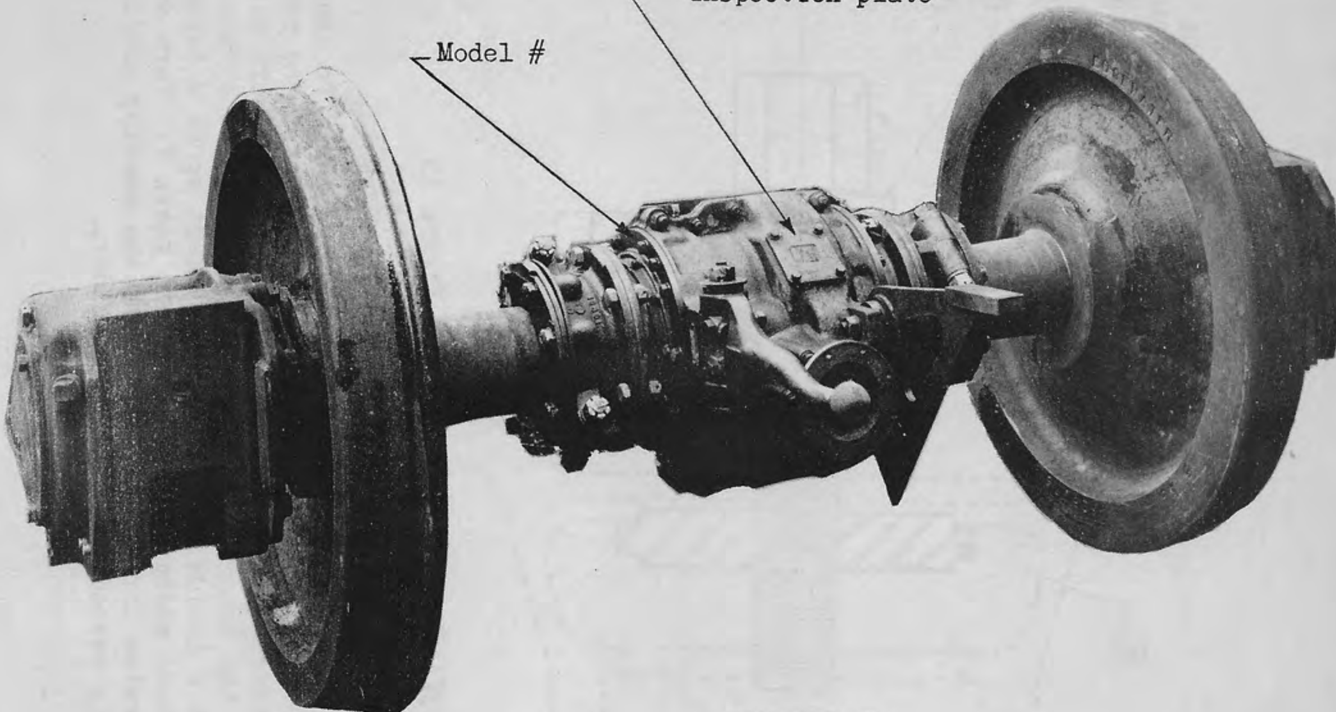
TORQUE ARM MOUNTING ASSEMBLY: The torque arm mounting assembly attaches the ball end of the torque arm to the truck end sill. The ball is surrounded by two rubber blocks, Catalog No. KE-12554, which are enclosed in metal housing which bolts to end sill. See Figure 17. In the standard flex type of mounting all movement, shock and vibration are absorbed by the rubber. Various special slide type mountings are used where extra movement is required. See Figure 17. This horizontal movement is taken by sliding action on manganese steel plates. The rubber blocks are interchangeable between the standard and special types, but the other parts are not.

The condition of the torque arm rubber blocks can be checked by noting the position of the safety arm. The end of the safety arm which is located in the truck end sill should be normally at center vertically. If there is any indication that the safety arm is striking, the end sill either on the top or bottom, the rubber blocks on the torque arm should be renewed.

REPLACING THE TORQUE ARM:

1. Remove the bolts which fasten torque arm mounting assembly to truck end sill and remove assembly from ball end of torque arm. See Figure 2.

2. Remove the nut and washer from *top* of torque arm pin at gear unit and lift out the tapered rubber bushing. See Figure 16.


Gear Ratio - shown on the inspection plate
Model #

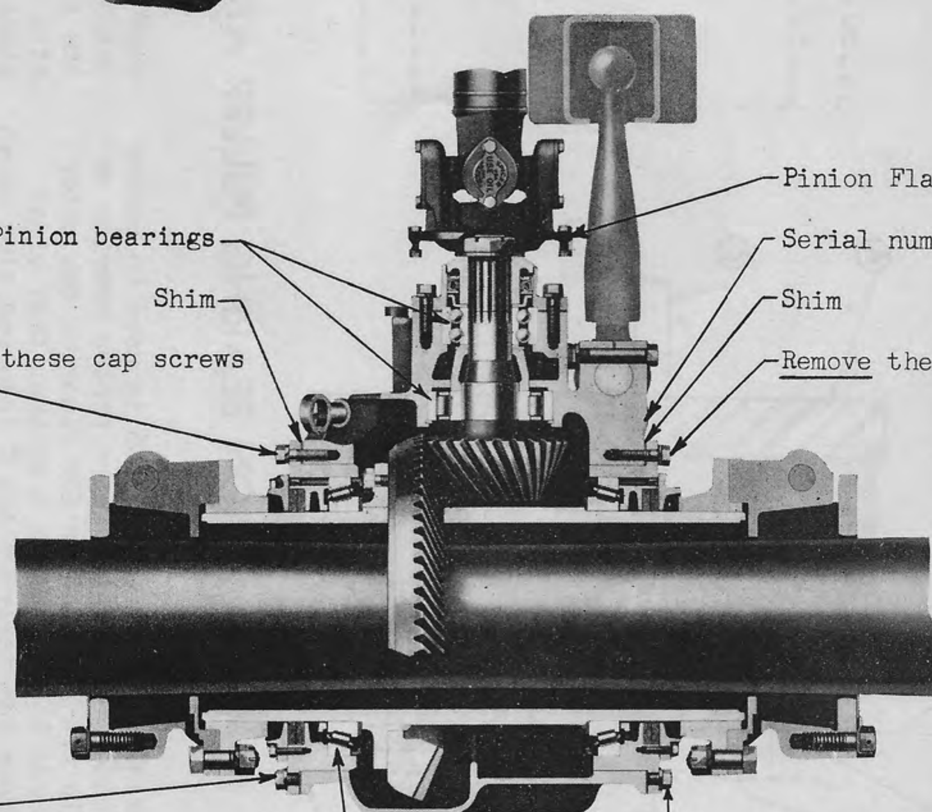
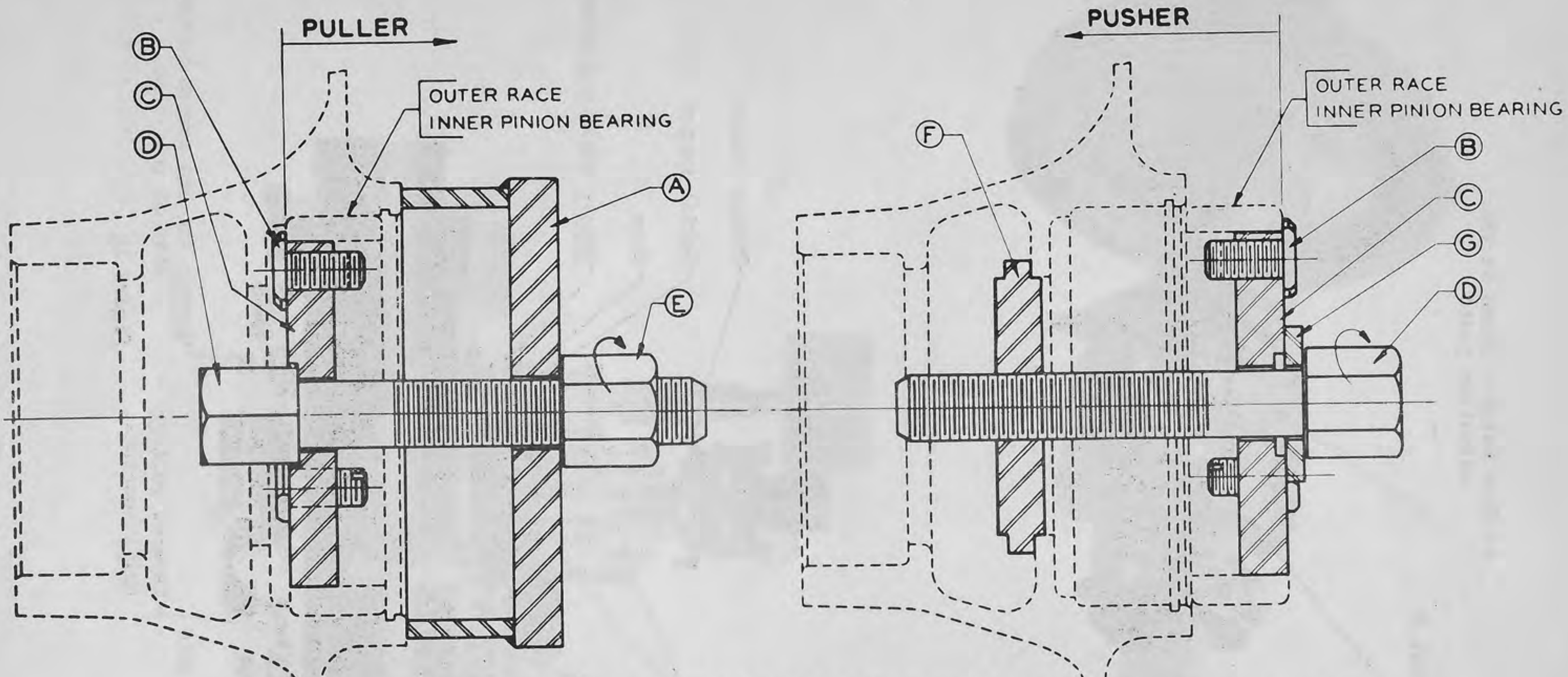

Pinion Flange
Pinion bearings
Serial number plate
Shim
Shim
Remove these cap screws
Remove these cap screws
Loosen the cap screws on this side of gear case
Tapered roller quill bearings.
Loosen the cap screws on this side of gear case.

Figure 14



PINION BEARING PULLER AND PUSHER

Figure 15

This PINION BEARING PULLER and PUSHER is used to remove and replace the outer race of the inner pinion bearing on the gear unit. To use as a puller for removing the outer race, turn the three T head screws B so that they clear the bore of the race and insert plate C into position shown. Now turn the T head screws B with a screw driver so that the tangs on all three screws are squarely in the recess back of the race. Insert screw D, plate A and nut E clockwise forcing the race out of the housing. To use as a pusher for replacing the race, first start the race into the housing by lightly tapping it. Now insert plate C with the tangs against the outer edge of the race and put plate F inside as shown, then insert screw D through hardened washer G and screw into plate F. Turn screw D clockwise forcing the race into the housing until it is firmly seated against the shoulder.

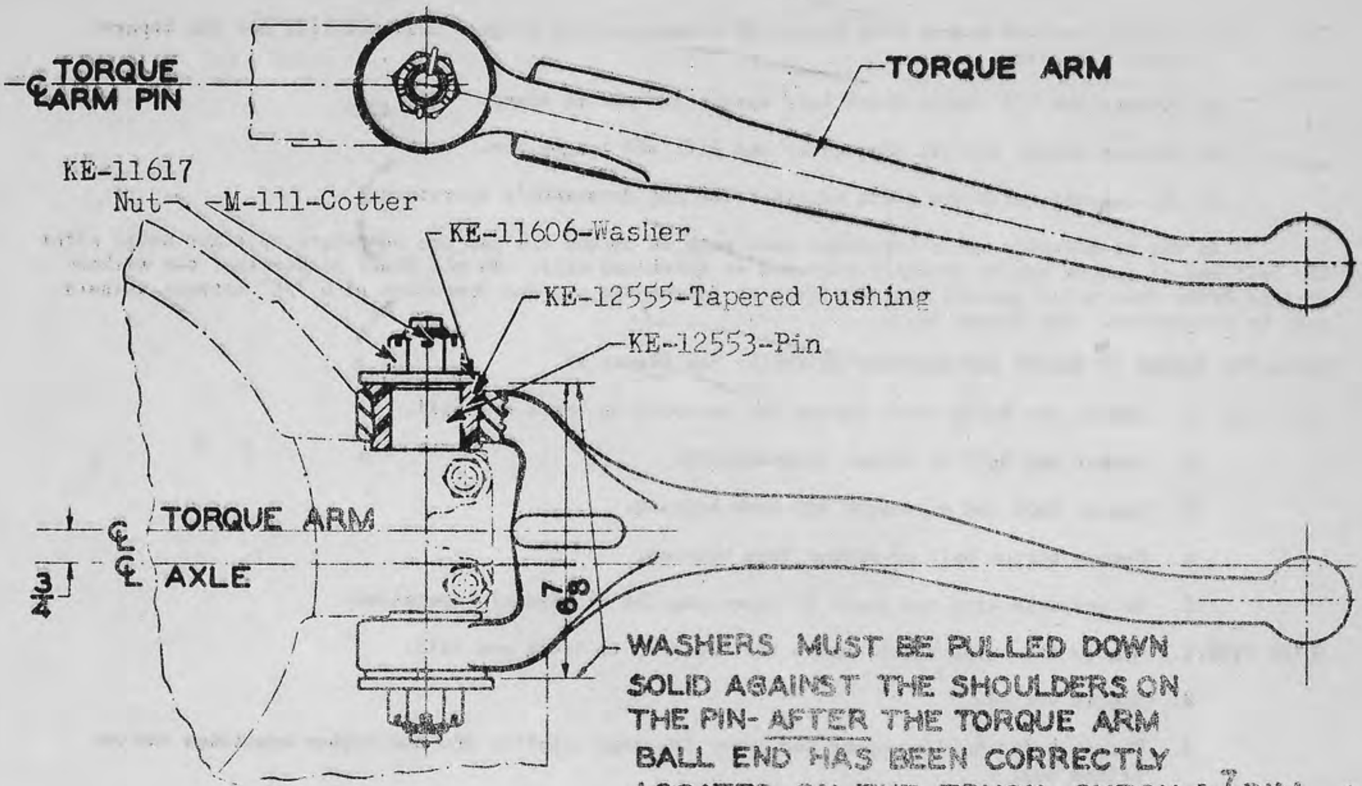


Figure 16

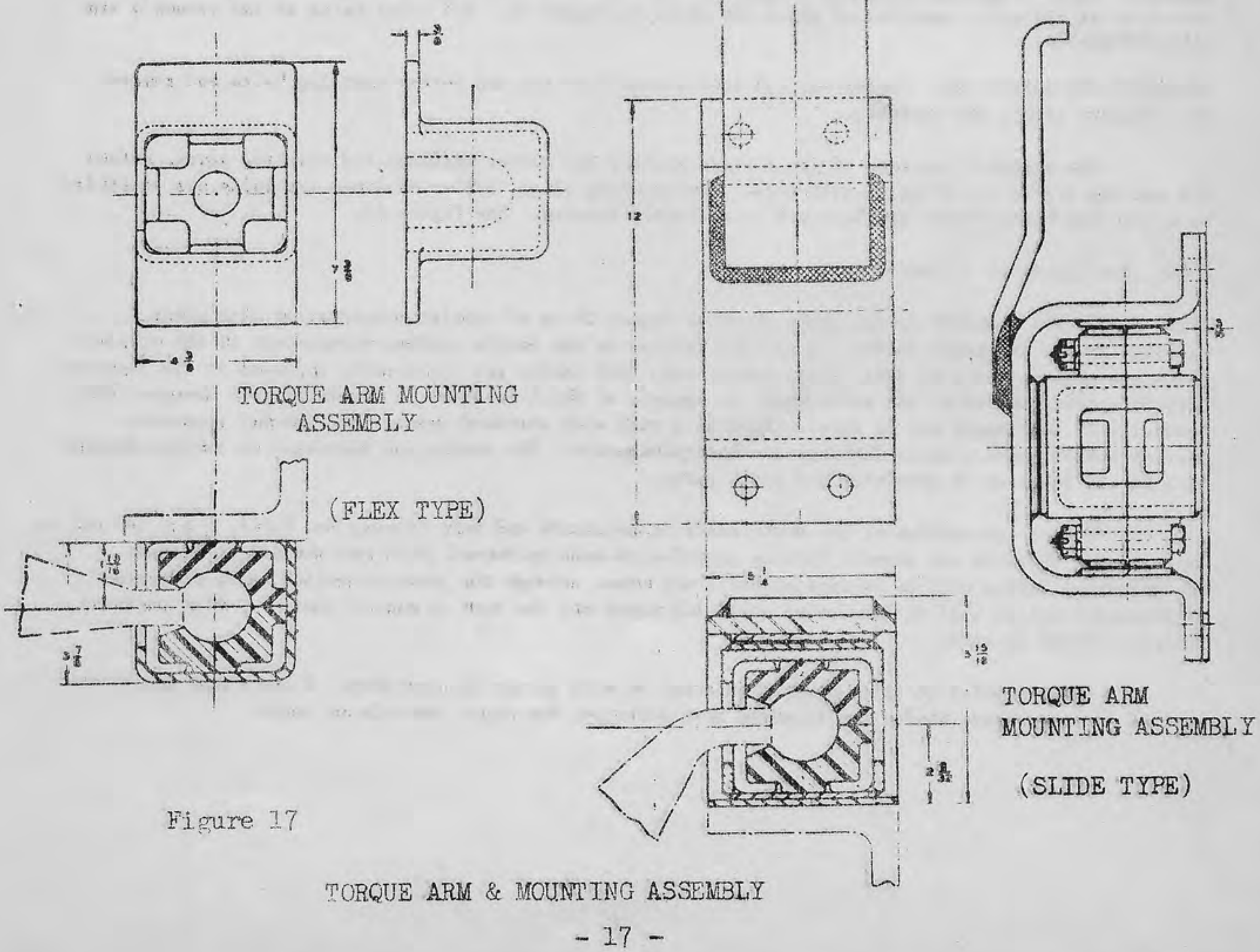


Figure 17

TORQUE ARM & MOUNTING ASSEMBLY

3. Remove nut and washer from bottom of torque arm pin at gear unit and lift out the tapered rubber bushing.

4. Loosen two 1/2" bolts which hold torque arm pin in clamp.

5. Remove torque arm pin from clamp and lift off torque arm.

6. Re-assemble with new parts by reversing the disassembly operation.

In the re-assembly it is important that nuts on torque arm pin are not drawn up tight until after the ball end of torque arm is securely fastened at truck end sill. In the final tightening, the washers must be drawn down solid against the shoulders on torque arm pin and dimension of 6 7/8" between washers must be maintained. See Figure 16.

REPLACING RUBBER IN TORQUE ARM MOUNTING ASSEMBLY: See Figure 17.

FLEX TYPE: 1. Remove the bolts which fasten the assembly to truck end sill.

2. Remove top half of rubber from housing.

3. Remove ball end of torque arm from housing.

4. Remove bottom half of rubber from housing.

5. Re-assemble with new parts by reversing the disassembly operation.

SLIDE TYPE: 1. Remove the bolts which fasten the assembly to truck end sill.

2. Remove bracket.

3. Remove bolts holding upper and lower housings together and the rubber mountings can be lifted out.

4. Re-assemble with new parts by reversing the disassembly operation.

SAFETY ARM ASSEMBLY: The safety arm, Figure 18, is provided solely as protection in case of torque arm failure. It is attached to gear housing with two bolts 3/4" x 4 1/2" Catalog K E-11598, four rubber bushings, Catalog No. K E-11601, two mounting plugs, Catalog No. K E-11600, and standard nuts, and washers. Safety arms are furnished in several types of ends and lengths to suit location and construction of end sill, examples of which are shown in Figure 18. All other parts of the assembly are interchangeable.

REPLACING THE SAFETY ARM: Remove nut and lock washer from top and bottom mounting bolts and remove the complete safety arm assembly.

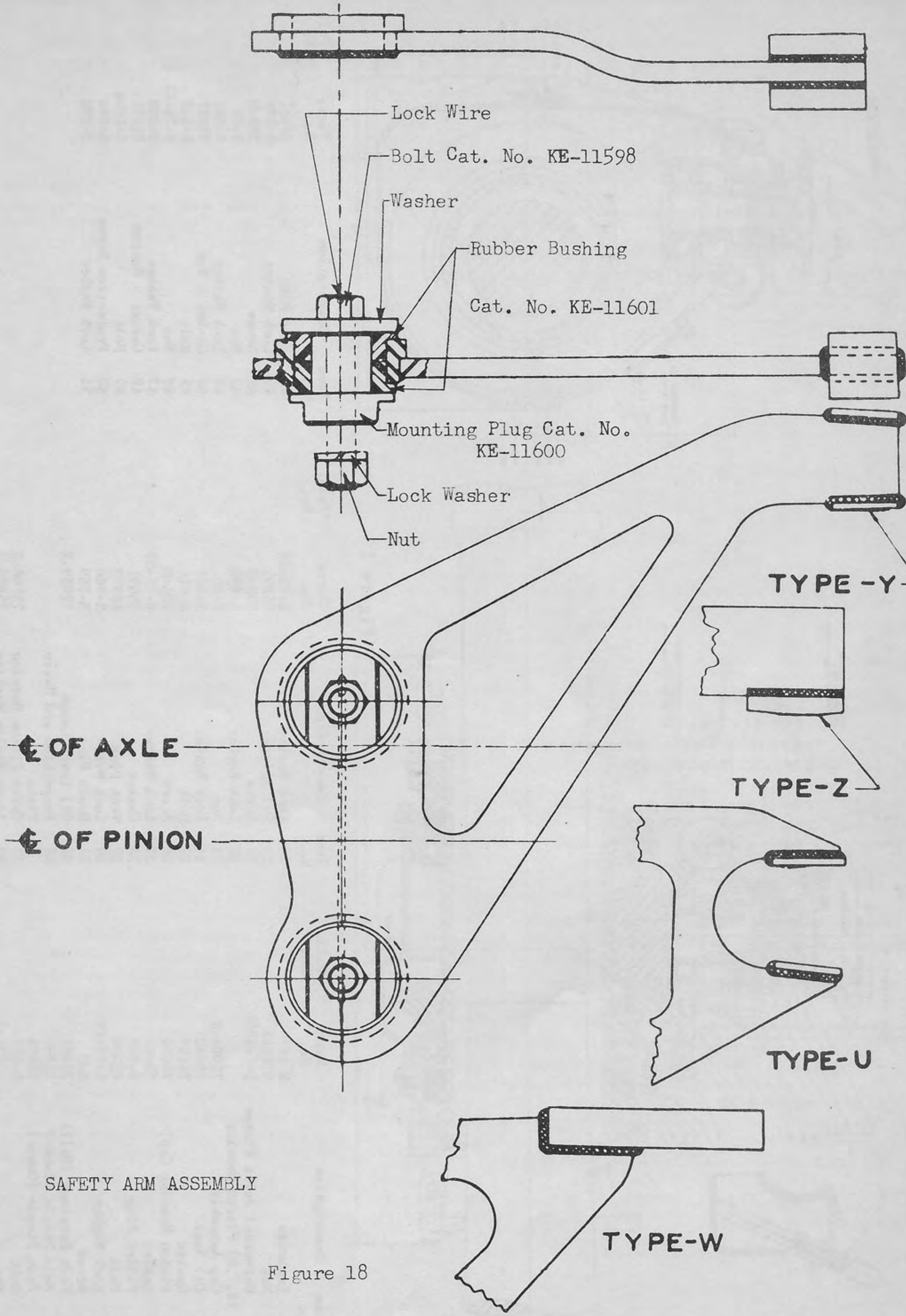
The assembly consists of the outside washers and rubber bushings and mounting plugs, safety arm and the 3/4" x 4 1/2" bolts with nuts. The mounting plugs, rubber bushings and bolts are assembled to safety arm before bolts are fastened to gear unit housing. See Figure 18.

NOTE: See Figure 18 for parts list.

DRIVE SHAFT: The Standard Spicer shaft shown on Figure 20 is of tubular construction with plain bushings in the universal joints. A special feature is the double seating arrangement at the spline which prevents entrance of dirt, dust, water, etc. All shafts are dynamically balanced at the factory. Certain special shafts of the solid type, an example of which is shown in Figure 21, are designed for special duty and should not be interchanged as a unit with standard types. The journal assembly, bearing assembly and alemite fittings are interchangeable. The shafts are furnished in various lengths to suit the location of generator and truck parts.

Proper lubrication of the drive shaft is necessary and only Catalog No. K-618, S A E 140 oil is to be used. There is one alemite fitting provided at each universal joint and one for the spline. The universal joints will be lubricated until oil comes through the pressure relief valve at center of journal. Spline will be lubricated until oil comes out the vent at end of shaft. A high pressure type gun should be used.

Major repairs to drive shaft should not be made except in yard shop. A new shaft should be applied in cases where shafts are found to have defective bearings, journals or seals.



SAFETY ARM ASSEMBLY

Figure 18

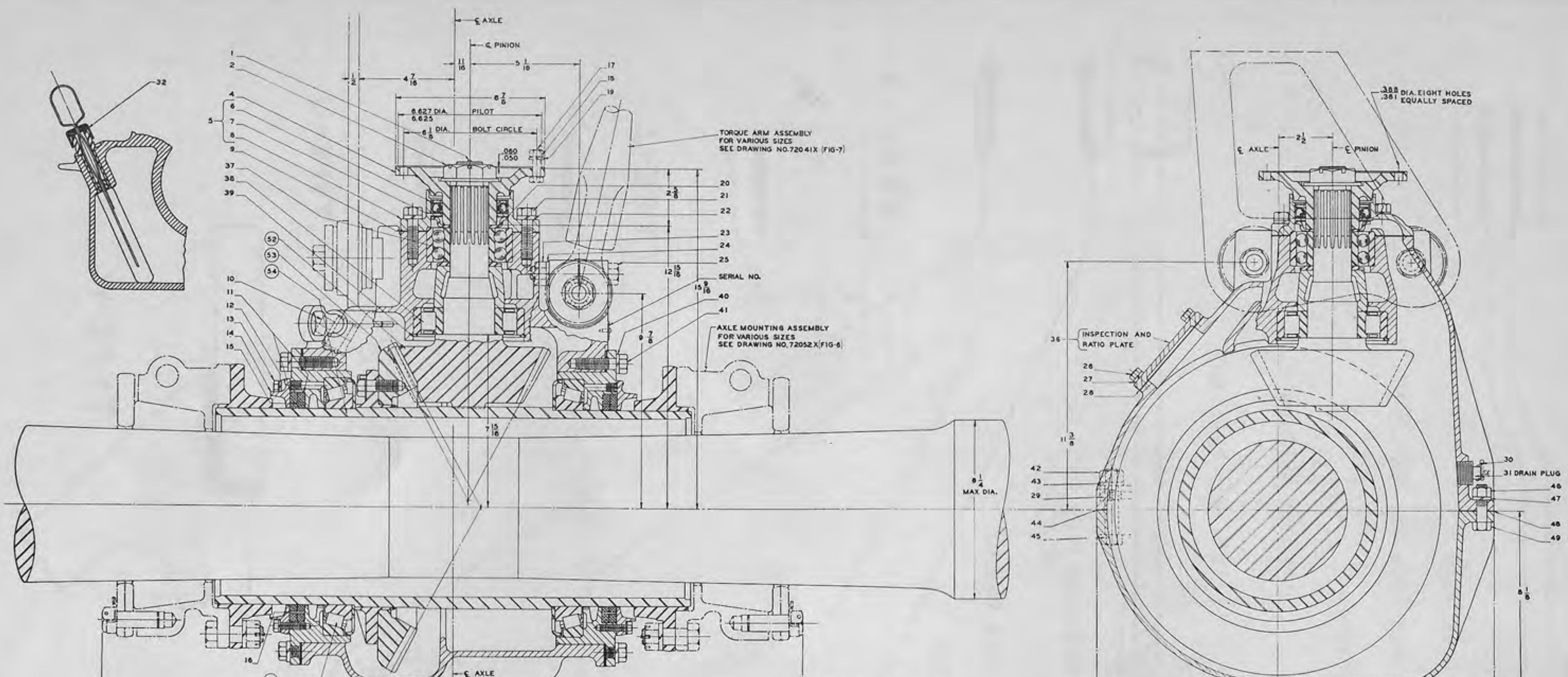


Figure 19

Item No.	Description	Parts No.	Pull. No.
1	Lockwire	S 1630	
2	Nut	S 1613	
4	Universal Joint Flange	5-1-1001	
5	(6,7,8) Pinion Bearing Cap Assembly	72006-X	
6	Oil Seal	75040	
7	Gasket	75129	
8	Pinion Bearing Cap	75050	
9	Gasket	75041	
10	Filler Plug	S-963	
11	Felt	75060	
12	Lock Washer	5-75-19	
13	Screw	8-D	
14	Felt Retainer (Half)	75061	
15	Felt Staple (Inner)	75093	
16	Felt Staple (Outer)	75094	
17	Bolt	S-617	
18	Nut	294-J	

Item No.	Description	Parts No.	Pull. No.
19	Lock Washer	6-75-29	
20	Oil Slinger	75095	
21	Screw	392-D	
22	Lock Washer	S-898	
23	Nut	S-26	
24	Lock Washer	S-881	
25	Bolt	S-616	
26	Screw	104-D	
27	Lock Washer	6-75-29	
28	Gasket	75091	
29	Vent Plug	16979	
30	Lock Wire	S-960	
31	Drain Plug	S-959	
32	Oil Level Gauge	72059-X	
36	Inspection and Ratio Plate		
37	Outer Pinion Bearing	75106-2	
38	Inner Pinion Bearing	75036-3	

Item No.	Description	Parts No.	Pull. No.
39	Snap Ring	75037	
40	Lock Washer	S-898	
41	Screw	392-D	
42	Nut	S-26	
43	Lock Washer	S-881	
44	Gasket - Top	75031	
45	Bolt	S-612	
46	Nut	8-74-11	
47	Lock Washer	S-898	
48	Gasket - Bottom	75032	
49	Bolt	S-1504	
50	Protection Screw	S-990	
51	Lock Washer	S-898	

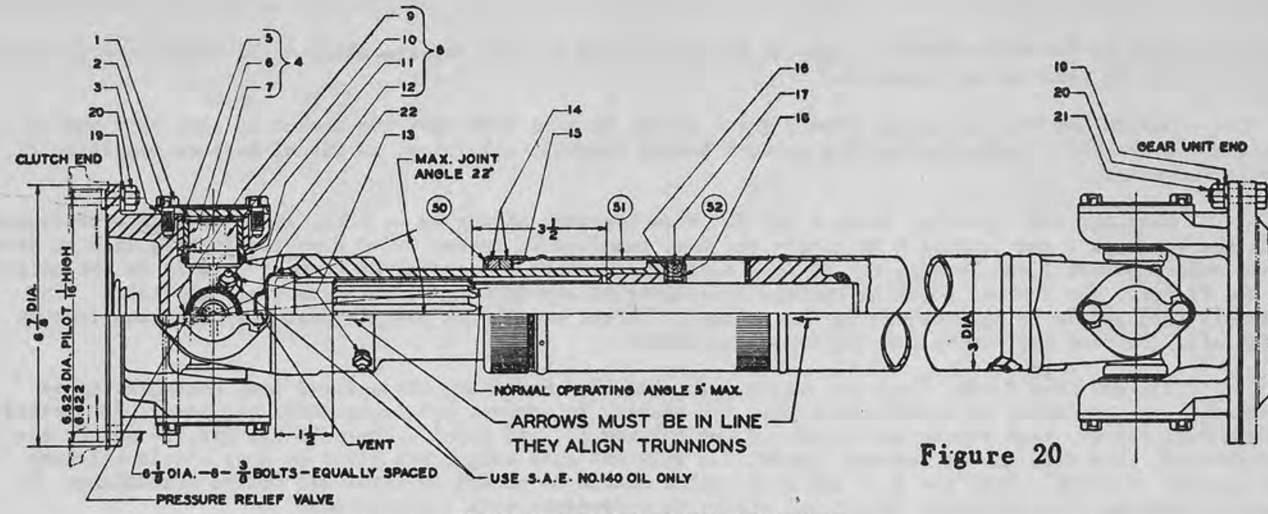


Figure 20

DRIVE SHAFT TUBULAR TYPE

ITEM NO.	DESCRIPTION	PART NO.	PULLMAN NO.	ITEM NO.	DESCRIPTION	PART NO.	PULLMAN NO.
1	Screw	5-73-109		16	Steel Washer	6-15-13	
2	Lock Strap	98-741		17	Cork Washer	6-16-73	
3	Bearing Cap	5-70-49		18	Steel Washer	6-15-29	
4(5,6,7)	Bearing Assembly	5-6-108X		19	Lock Washer	6-75-29	
8(9,10,11,12)	Journal Assy.	5-5-108X		20	Nut	294-J	
11	Bearing Seal Retainer	5-76-17		21	Bolt	S-617	
12	Bearing Seal Cork	5-86-79		22	Cup Assembly (Tackweld after assembling)	5-68-18X	
13	Alemite Fitting	99-29					
14	Felt Washer	4-16-103					
15	Steel Washer	4-15-93		50	Dust Cap	4-14-49	
				51	Dust Shield Tube	98-991	
				52	Dust Cap	6-14-29	

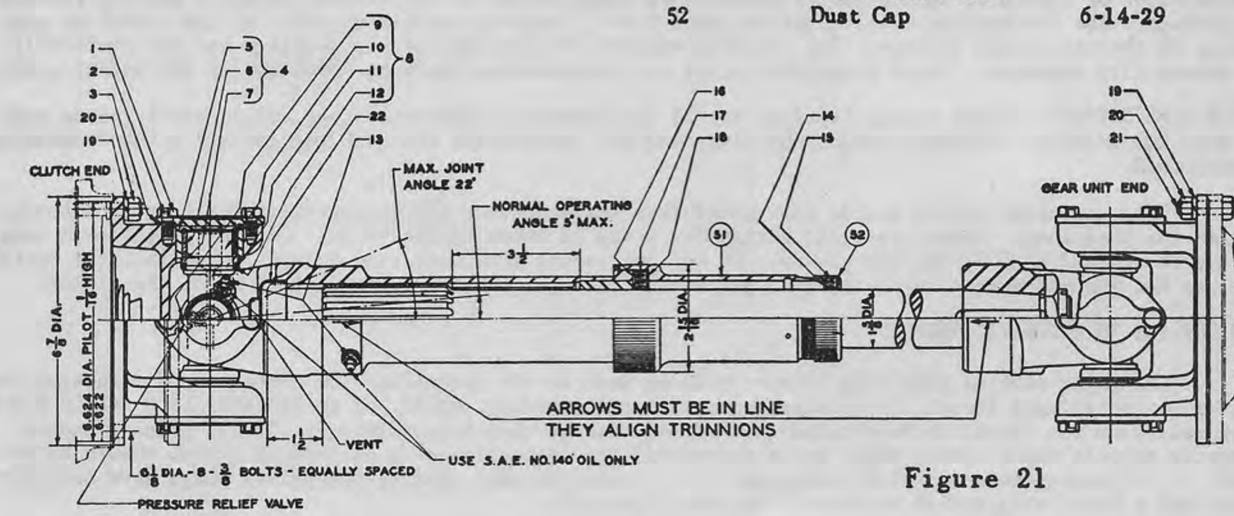


Figure 21

DRIVE SHAFT SOLID TYPE

ITEM NO.	DESCRIPTION	PART NO.	PULLMAN NO.	ITEM NO.	DESCRIPTION	PART NO.	PULLMAN NO.
1	Screw	5-73-109		16	Steel Washer	6-15-13	
2	Lock Strap	98-741		17	Cork Washer	6-16-73	
3	Bearing Cap	5-70-49		18	Steel Washer	6-15-53	
4(5,6,7)	Bearing Assembly	5-6-108X		19	Lock Washer	6-75-29	
8(9,10,11)	Journal Assy	5-5-108X		20	Nut	294-J	
11	Bearing Seal Retainer	5-76-17		21	Bolt	S-617	
12	Bearing Seal Cork	5-86-79		22	Cup Assembly (Tackweld after assembling)	5-68-18X	
13	Alemite Fitting	99-29					
14	Steel Washer	5-15-23					
15	Felt Washer	5-16-43		51	Dust Shield	98-1016	
				52	Dust Cap	4-14-19	

YARD SHOP REPAIRS TO DRIVE SHAFTS: Refer to Figures 20 and 21. No repairs which might effect the balance of shaft will be made in the Districts.

Before removing any parts from a drive shaft, be sure that they are marked so that they may be replaced in the *EXACT* relationship that existed before removal; otherwise, an out-of-balance condition is likely to occur.

Bearings and Journals; Items 4 and 8. When bearings appear to be worn, it is advisable to replace both the bearings 4 and journal 8 to obtain the best results. To remove, bend down the locking lugs on strap 2 and remove screws 1 and bearing cap 3. The bearing 4 can now be removed by tapping lightly on the outside of the flange. The journal 8 can be removed by sliding to one side and tipping to clear the yoke. Cup assembly (22) should be tack welded to the journal. Before assembling the new parts, dip the bearings in light oil. Be sure all screws are tightened and locked.

Oil and Dust Seals; Items 14, 15, 16, 17, and 18. Parts for the oil and dust seals are split to provide an easy means of assembling around the shaft. To remove, pry loose locks and remove dust shield 51 and dust cap 52, then remove oil seals, 14 (or 15) and 17. If steel washers 15 (or 14), 16 and 18 are not damaged, they need not be removed. Insert new felt and cork washer and screw on dust shield and dust cap locking in place. Both the felt and cork washer should be soaked in light oil before assembling. Be sure to lubricate the universal joints and spline in accordance with instructions.

CLUTCH: There are two types of Spicer clutches; Safety and Automatic. Figure 22 shows the Safety type Figure 23 shows the Automatic type. These clutches are interchangeable and are used to transfer the torque from drive shaft to the generator. They have tapered bore with keyway and are mounted on end of generator shaft. The safety clutch is a single plate friction clutch with the capacity controlled by spring pressure. The torque load is transferred from the drive shaft and through the clutch cover, housing, pressure plate and safety plate to driven disc, then through the hub to generator shaft. Release wedges are provided to release pressure plate when it is necessary to motor the generator. A safety overload feature is built in the clutch so that when clutch starts slipping at the friction surfaces, heat is generated in a safety plate. This heat transfers to soft metal safety plugs which melt and allow safety plate to move out of engagement. This clutch runs free on its bearings and no damage results. Figure 23 shows the details.

The Automatic clutch is similar to Safety Clutch and has the same safety overload feature. In addition, this clutch engages and releases automatically at 280 R.P.M. or car speed of 8 to 12 M.P.H., depending on ratio of drive. This feature eliminates starting load on the locomotive, permits quick motoring of generator in the yards; and in case of emergency, stops, the high inertia load of the generator armature is not placed on the gear unit. Shock loads caused by coupling cars are also avoided. The engagement and disengagement of clutch is controlled by centrifugal force acting on fly weights balanced against retracting springs. The fly weights are limited in their travel, and the maximum capacity of the clutch is controlled by the retracting springs. The clutches operate the same for either rotation and are statically and dynamically balanced. Three inspection plugs are provided for checking position of the safety plate.

CLUTCH LUBRICATION: Safety clutch bearings are of the prepacked lubricated type and no provision is made for yard lubrication. Automatic clutch bearings require lubrication when the regular six month inspection is performed.

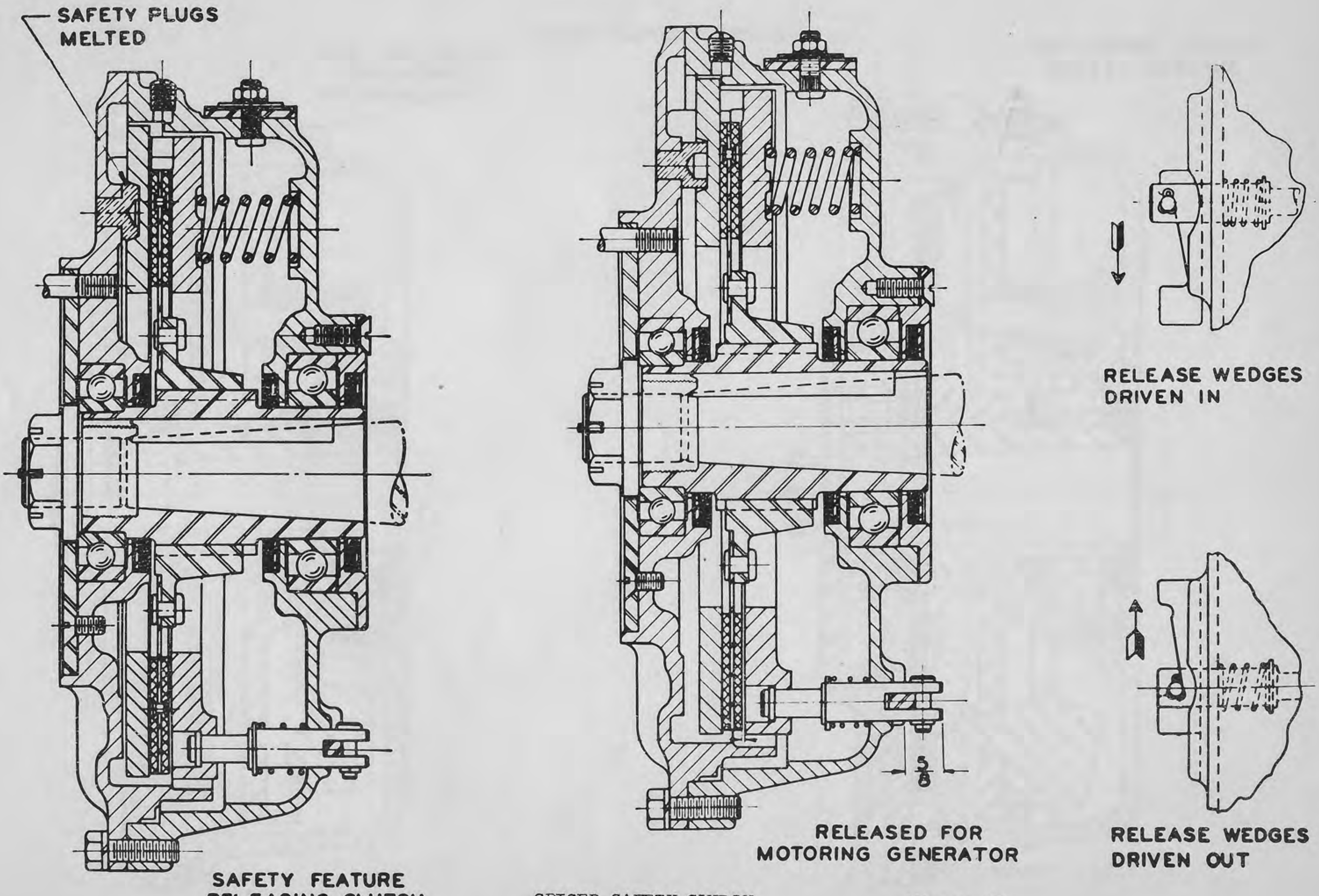
The automatic clutch should be removed from the generator and disassembled for bearing lubrication in the yard shop. Remove retainer plates No. 5 and 25 shown in Figure 24. Carefully pack each bearing one-third full of U.S. No. 508 grease. Do not put in any more than this amount; Otherwise, the bearings will run hot and the excess lubricant will get on the facings, resulting in the failure of the clutch.

YARD REPAIRS TO AUTOMATIC CLUTCH:

No major repairs affecting balance will be made in the districts. The clutch is of disc type controlled by centrifugal force. It is disengaged with car standing still and up to speed of 8 to 12 M.P.H. Motor generator can therefore be motored in the yard without clutch interference. In all cases of motor generator trouble where clutch might be in-operative, the inspection plug on side of clutch should be removed. If clearance between safety plate and disc is greater than 1/16", the safety plugs have probably melted and a new clutch should be installed. See Figure 23.

REMOVING THE AUTOMATIC CLUTCH:

1. Disconnect drive shaft.
2. Remove cotter pin and shaft nut.
3. Attach special puller and remove clutch. See Figure 25.



SPICER SAFETY CLUTCH

Figure 22

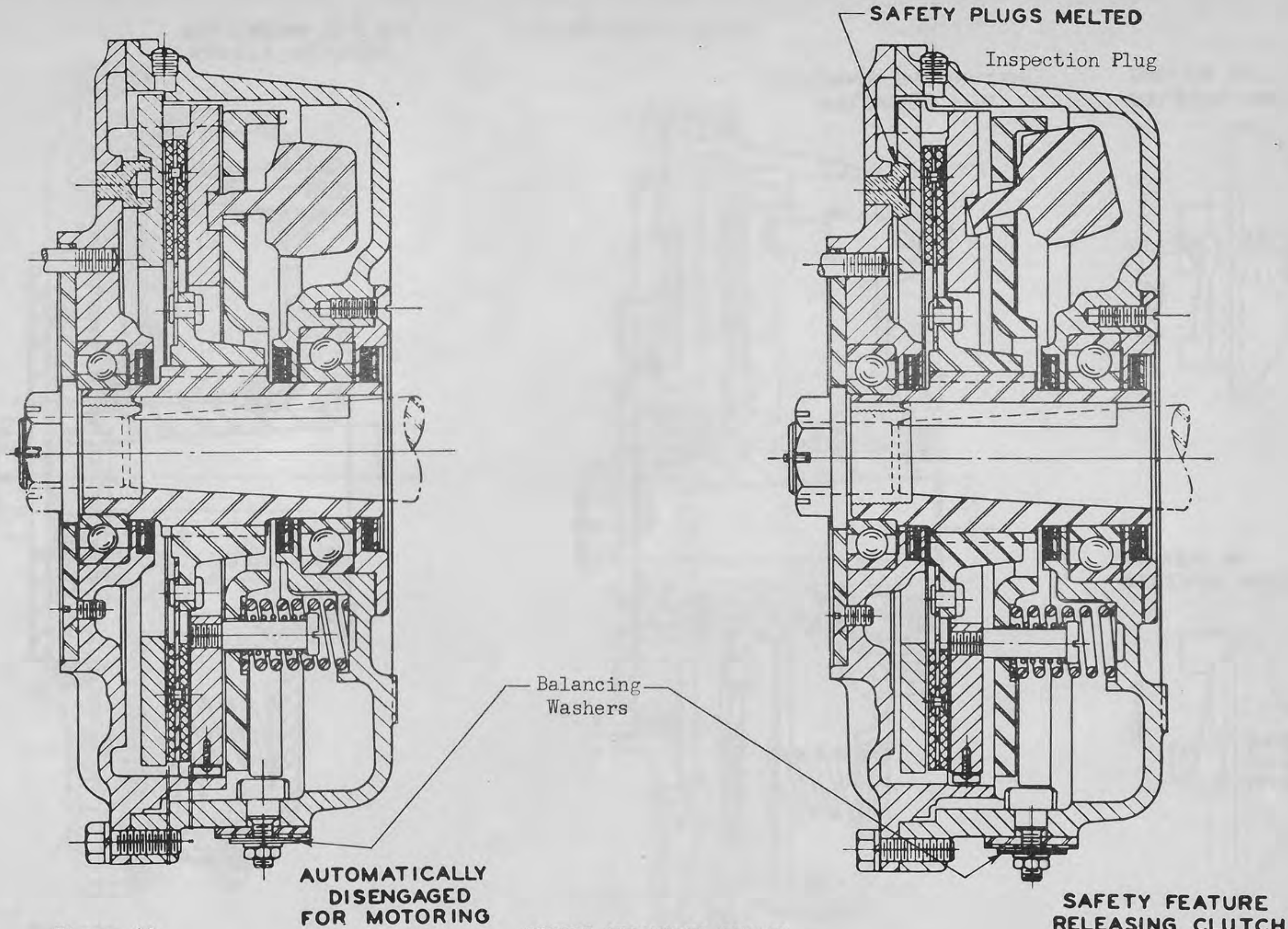


Figure 23

SPICER AUTOMATIC CLUTCH

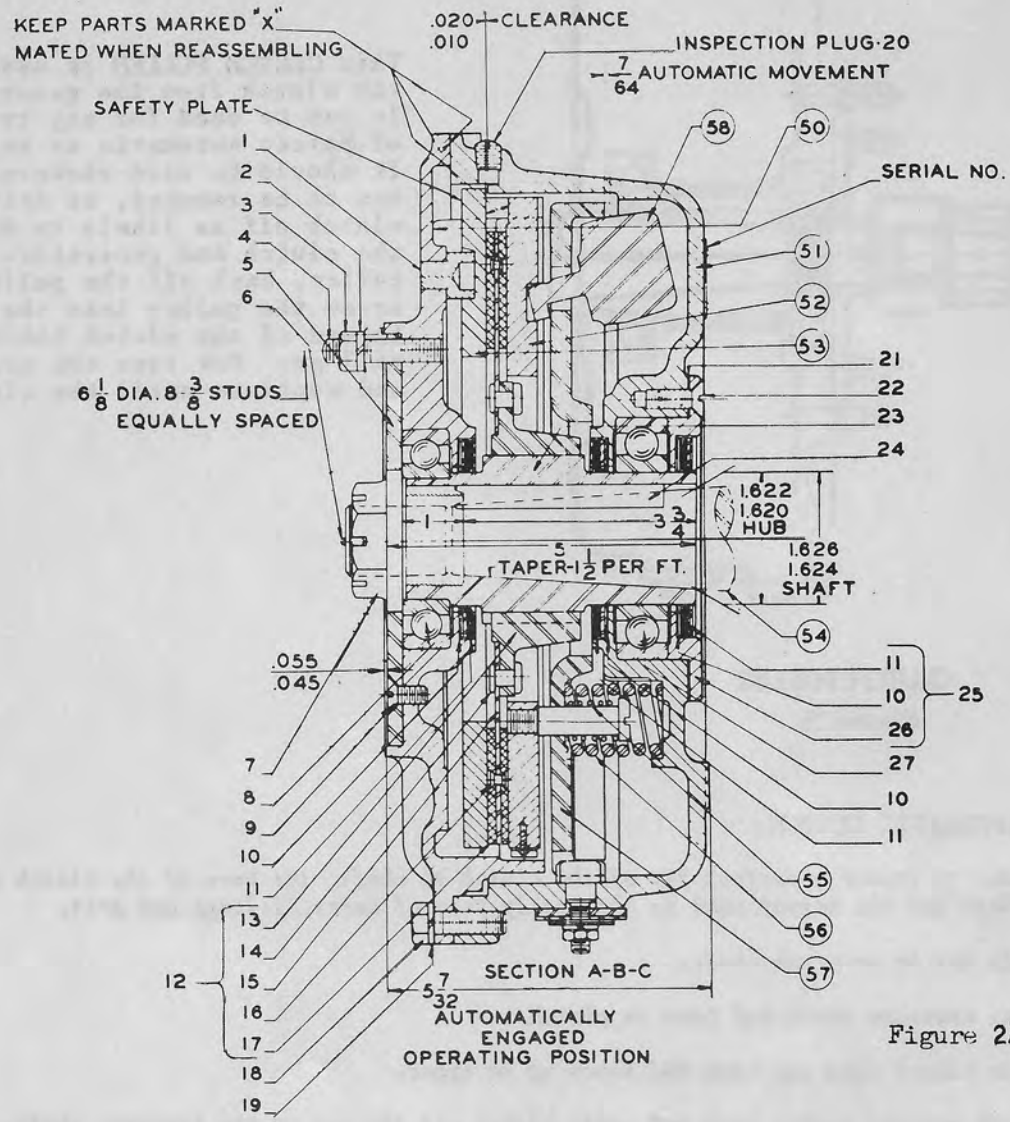
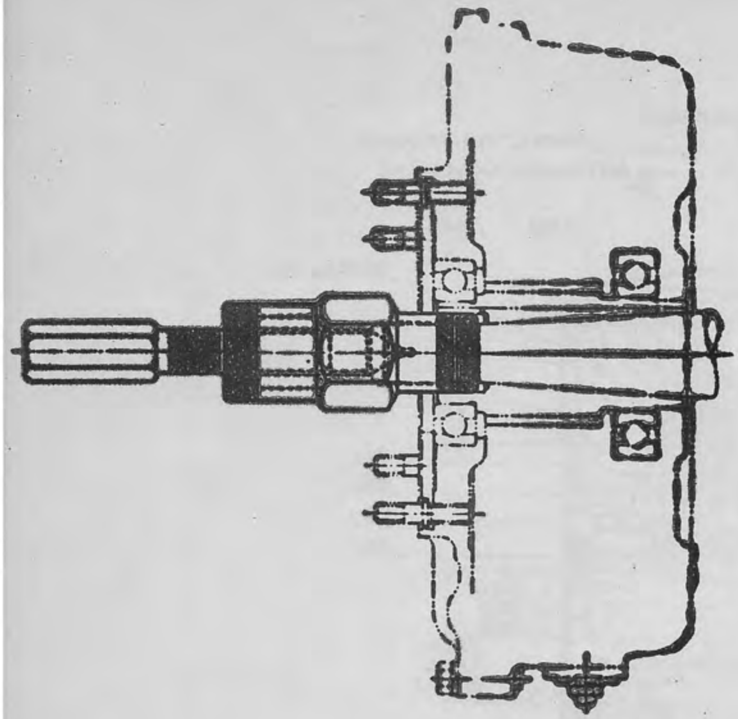


Figure 24

REPAIR PARTS

Item No.	Description	Part No.	Pullman No.	Item No.	Description	Part No.	Pullman No.
1	Safety Plug	55153-3		14	Hub Rivet	110-R	
2	Lockwasher	6-75-29		15	Driven Disc	55123	
3	Nut	294-J		16	Facing Rivet	224-R	
4	Stud	S-970		17	Facing	55103-6	
5	Bearing Retainer	55196		18	Screw	3-D	
6	Cotter Pin	8-72-19		19	Lock Washer	6-75-29	
7	Nut 1 1/8" x 12 Thds.	S-884		20	Inspection Plug	98-78-5	
7	Nut 1 1/8" x 7 Thds.	S-887		21	Gasket	55200	
8	Bearing in Cover	55201		22	Screw	S-1141	
9	Screw	S-971		23	Driving Hub	55207	
10	Gasket	55195		24	Key	S-945	
11	Oil Seal	55194		25	Bearing Retainer Assy.	55208-X	
12	(13,14,15,16			26	Bearing Retainer	55213	
17	Driven Disc Assembly	52009-X		27	Bearing in Housing	55202	
13	Driven Disc Hub	55205					



This **CLUTCH PULLER** is used to remove the clutch from the generator shaft. It can be used for any type or model of Spicer automatic or safety clutches. It should be used whenever a clutch has to be removed, as driving the clutch off is likely to damage both the clutch and generator. To use the puller, back off the puller screw and screw the puller into the internal thread of the clutch hub as far as it will go. Now turn the screw clockwise and continue until the clutch is free.

CLUTCH PULLER
Figure 25

APPLYING NEW AUTOMATIC CLUTCH:

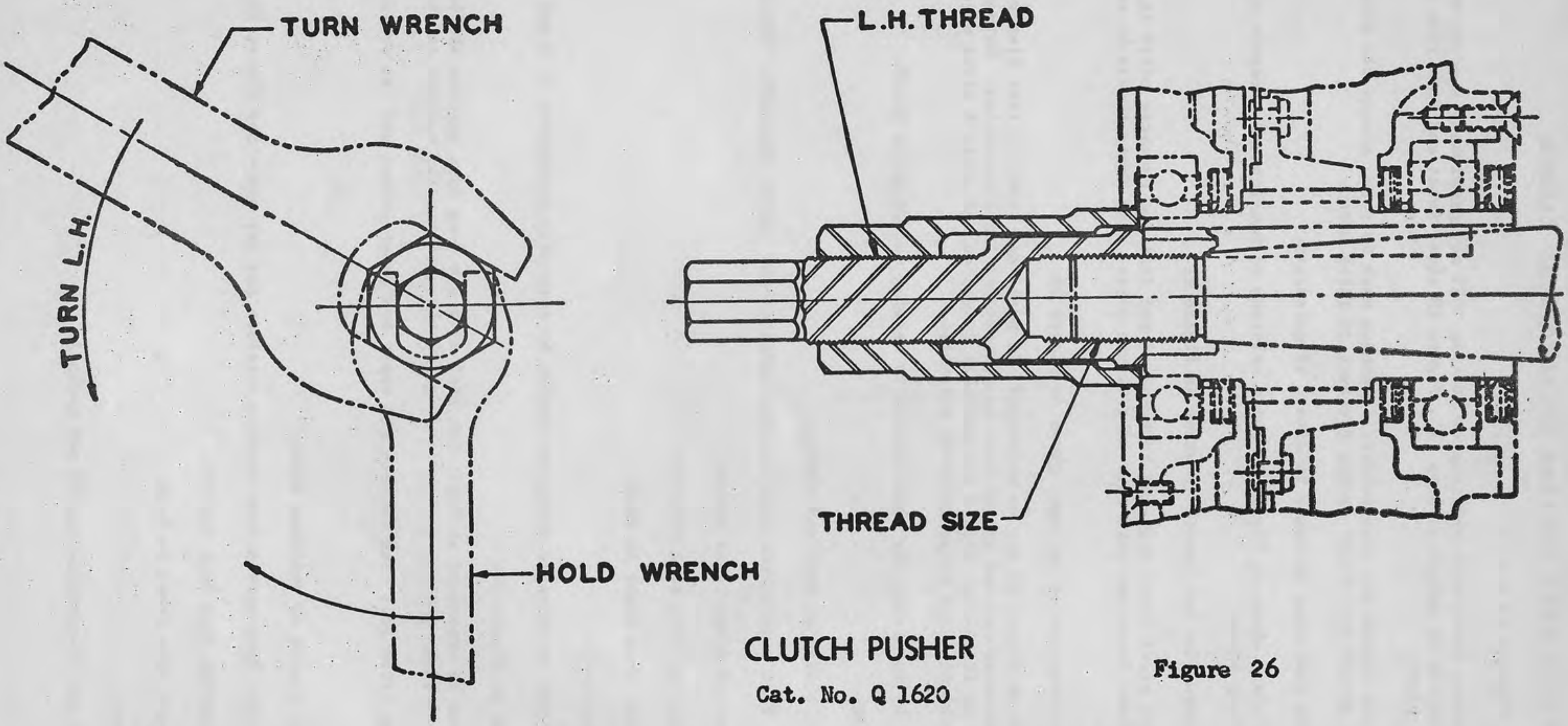
CAUTION: In order to insure a perfect fit of the clutch to shaft, the bore of the clutch and the surface of the shaft and the keyway must be absolutely free of burrs, filings and grit.

1. Apply key in armature shaft.
2. Clean armature shaft and bore in clutch.
3. Slide clutch into position and force up on taper.
4. Attach special pusher tool and press clutch *all the way* on the armature shaft. See Figure 26.
5. Apply nut and cotter key to armature shaft.
6. Re-Connect drive shaft.

NOTE: Too much emphasis cannot be placed on the necessity of making sure that the clutch is completely seated on the shaft.

REPLACING SAFETY PLUGS:

1. Mark parts in order to re-assemble in same position.
2. Remove cap screws in front cover.
3. Pry off front cover.
4. Lift out safety plate to expose safety plugs in front cover.
5. Drive out old safety plugs and clean out the melted material.
6. Drive in new set of safety plugs. (Use special driving tool and do not drive against face of plugs). See Figure 29.
7. Re-assemble safety plate and front cover.



CLUTCH PUSHER

Cat. No. Q 1620

Figure 26

This CLUTCH PUSHER is a combination tool to hold the armature shaft and push the clutch securely on the taper. It can be used for both the safety and automatic clutches, but not the 50003 Safety Clutch. It is particularly adapted for the automatic clutches as these cannot be held by other means. To use the pusher, first push the clutch on the taper then screw the small nut on to the threaded end of the shaft as far as it will go. Hold this nut from turning and turn the large nut in a counter-clockwise direction (Left Hand) forcing the clutch securely on the taper. Now remove the pusher and apply the regular nut and cotter.

MECHANIC'S SHOP REPAIRS TO AUTOMATIC CLUTCH

GENERAL DISASSEMBLY: See Figures 27 and 28.

1. Mark front cover plate with relation to housing. (If not previously factory marked). Both parts should be marked with an 'X'. Figure 29 shows front and back view of the front cover plate.

2. Remove six cap screws and lockwashers, loosening each in turn, around the circumference. This method will allow spring pressure to raise cover.

3. Pry cover the remaining distance to clear, if necessary.

4. Mark safety plate shown in Figure 30 (with relation to housing and pressure plate). Lift out safety plate.

5. Lift out driven disc hub assembly, shown in Figure 31.

6. Mark pressure plate (with relation to housing) and lift out pressure plate assembly. Figure 32 shows front and rear view of pressure plate. Both parts should be marked with an 'X'.

7. Lift out six compression springs, shown in Figure 33.

NOTE: Repair parts listed on Figure 24 may be exchanged. If parts not shown on this list require renewal, clutch must be re-assembled and turned over to storekeeper for disposition. Driven discs should be fastened to hub by 16 rivets. Should dis-assembly reveal an old style 8 rivet disc assembly it should be replaced with new style 16 rivet assembly.

8. Re-assemble by reversing the above procedure keeping marked parts mated.

RENEW - FRONT COVER BEARING:

1. Dis-assemble clutch as outlined above.

2. Remove four flat head screws from bearing retainer and remove retainer. See Figure 29.

3. Force hub out of front cover plate.

4. Force bearing out from back to front.

5. Force seal out from front to back.

6. Remove gasket.

7. Clean parts and re-assemble using new gasket by reversing procedures 3, 4 and 5.

NOTE: Apply seal as shown in Figure 34.

CAUTION: Extreme care must be exercised to apply the seal with the long edge against the bearing. This can be quickly determined by putting the rolled edge of the seal housing against the bearing.

8. Pack bearing 1/3rd full with K-13666 and apply new paper gasket and the retainer.

RENEW - HOUSING BEARING:

1. Dis-assemble clutch as outlined above.

2. Remove six flat head screws from bearing retainer and pry out. See Figure 33.

3. Force out bearing from back to front.

4. Force out seal from front to back.

5. Remove gasket.

6. Clean parts and re-assemble (using new gasket).

7. Repack bearing 1/3rd full with K-13666.

8. Renew seal in retainer.

9. Apply new gasket and retainer.

NOTE: Apply seal as shown in Figure **34**.

CAUTION: Extreme care must be exercised to apply the seal with the long edge against the bearing. This can be quickly determined by putting the rolled edge of the seal housing against the bearing.

RENEW DRIVEN DISC HUB OR FACINGS: No repairs are to be made to the driven disc hub or facings. The assembly should be renewed as a unit.

BALANCING: The housing and the front cover plate must be dynamically balanced individually before assembling. The pressure plate, driven disc and hub assembly and the safety plate are to be statically balanced individually.

After assembly the clutch must be dynamically balanced at full speed range of the balancing machine.

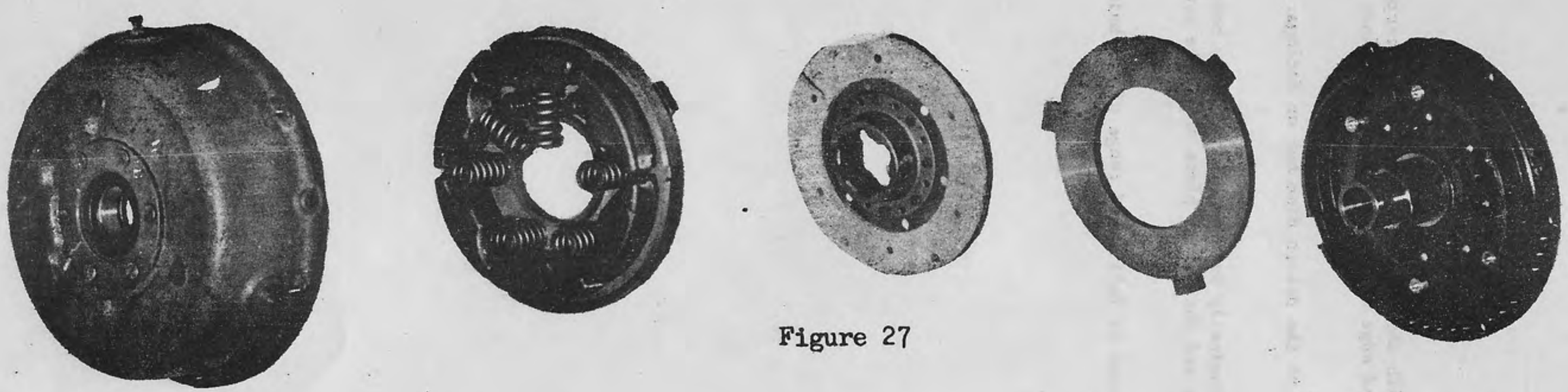


Figure 27

Housing | Pressure Plate | Driven Disc | Safety Plate | Cover Plate

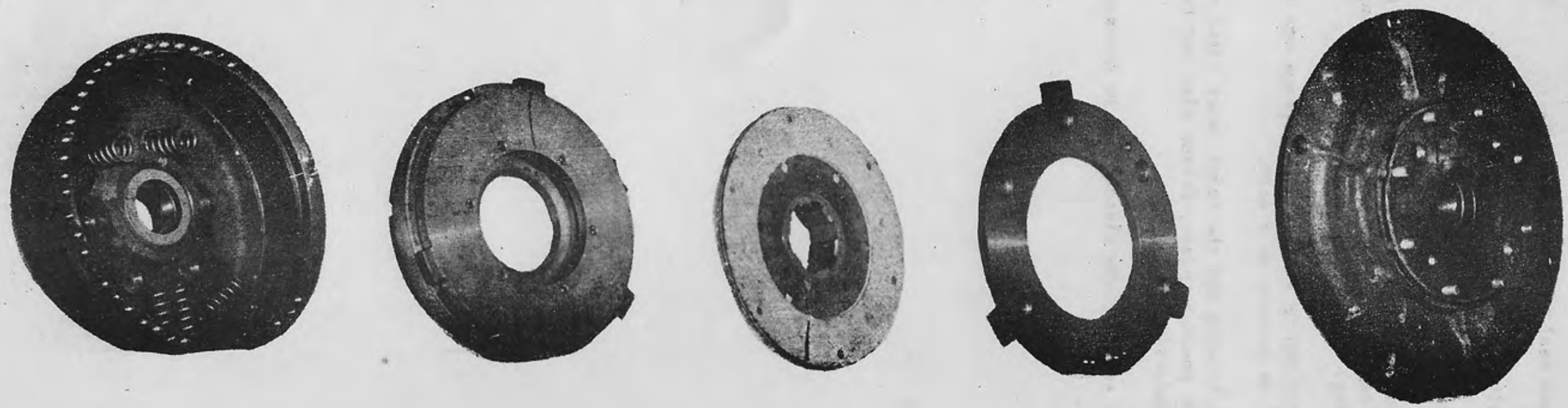
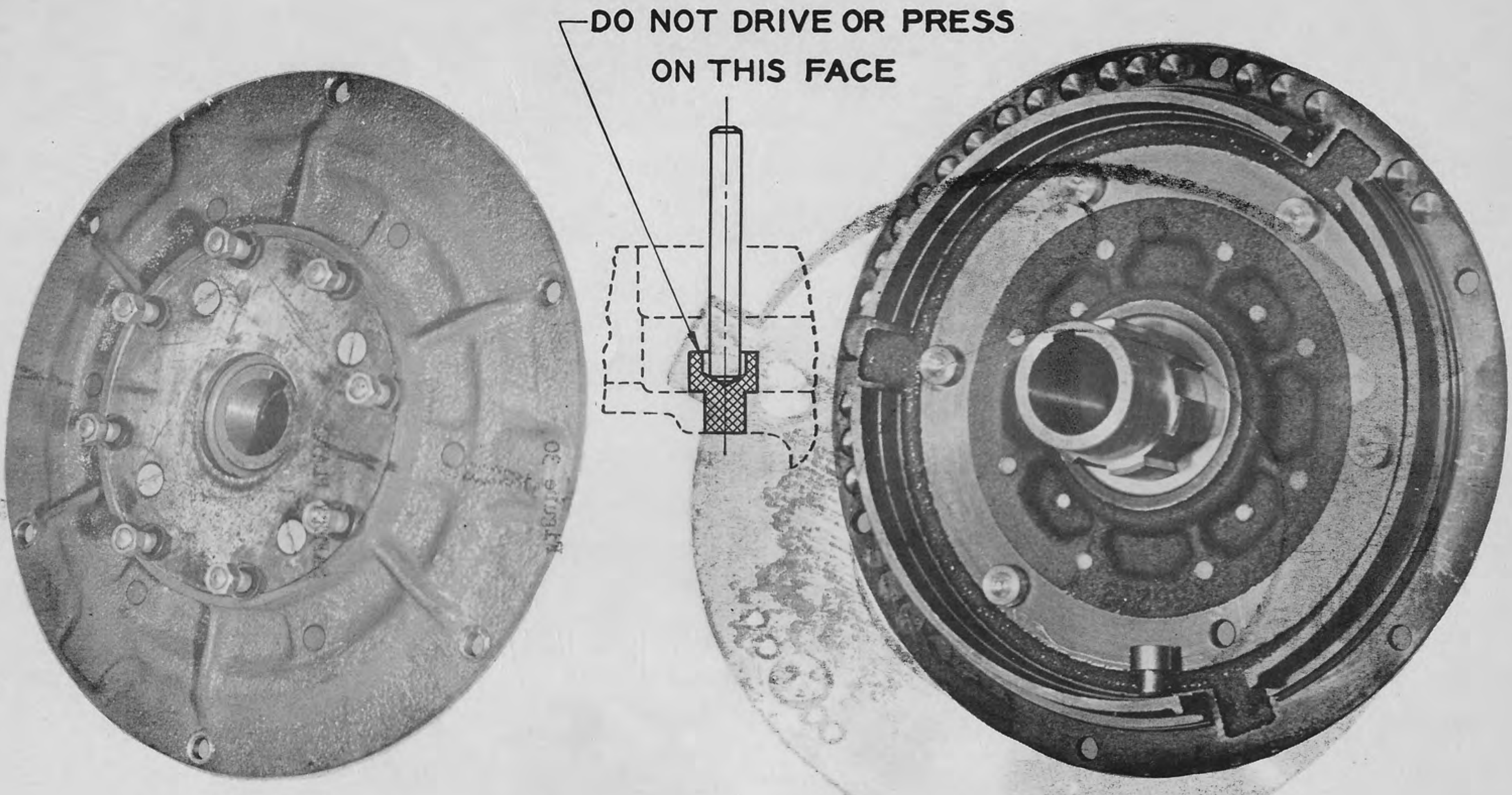


Figure 28

Exploded view of automatic clutch showing parts in assembly order.



(Back View)

(Front View

FRONT COVER PLATE

Figure 29

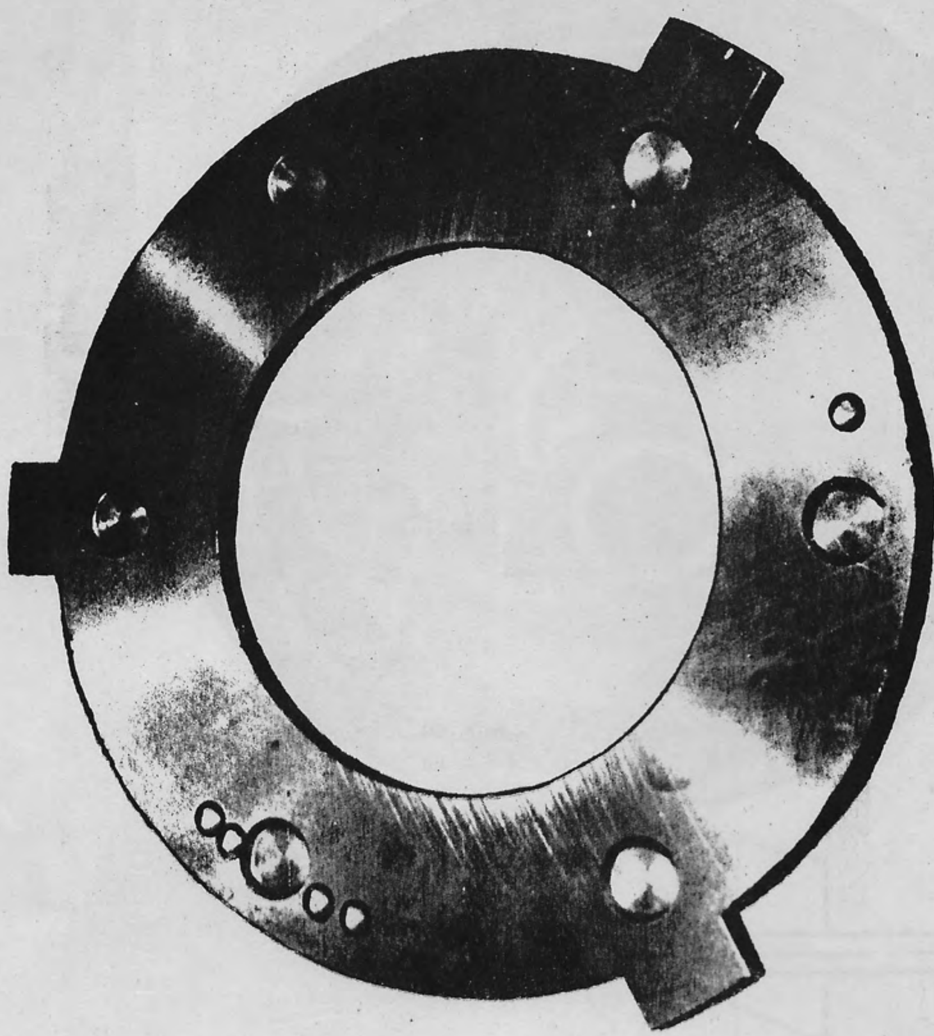


Figure 30

SAFETY PLATE

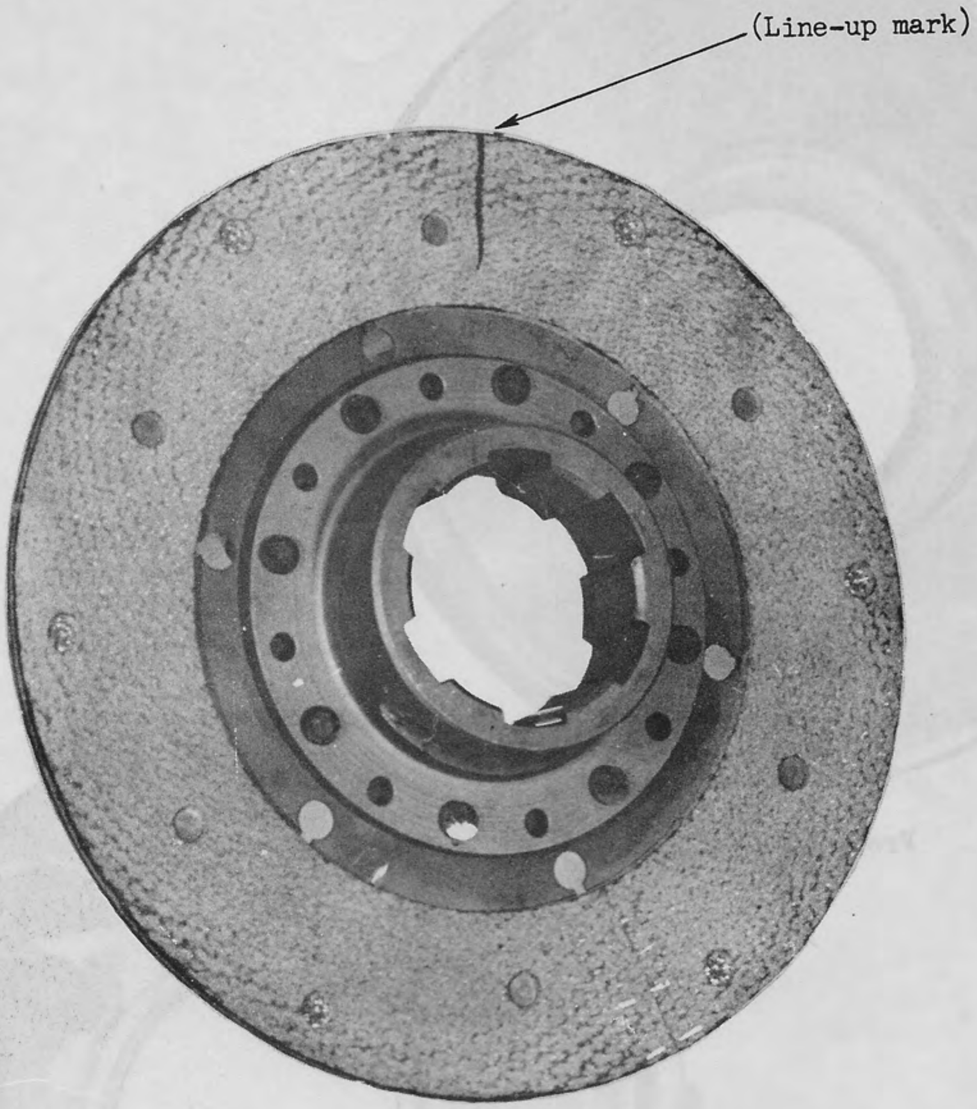
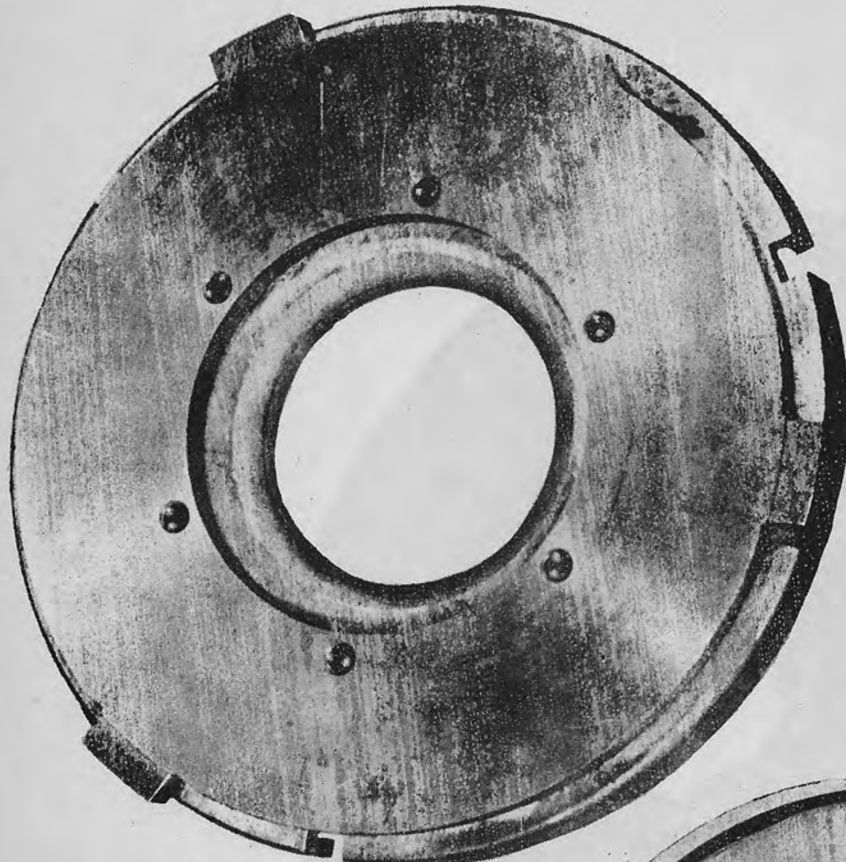
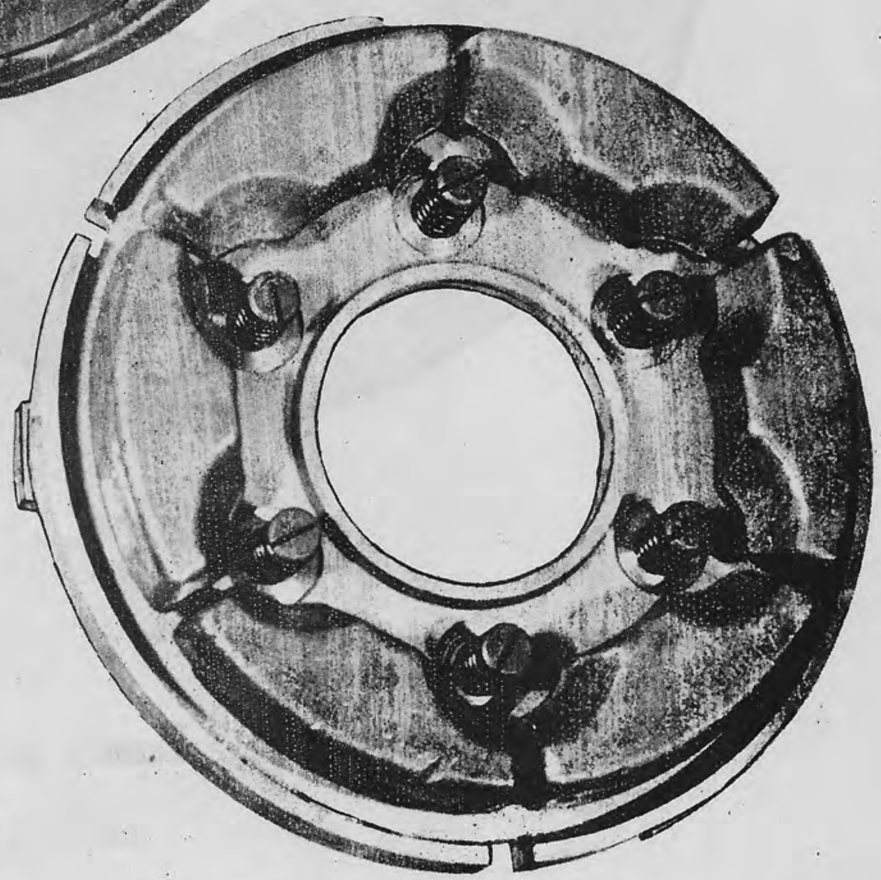


Figure 31

DRIVEN DISC HUB ASSEMBLY



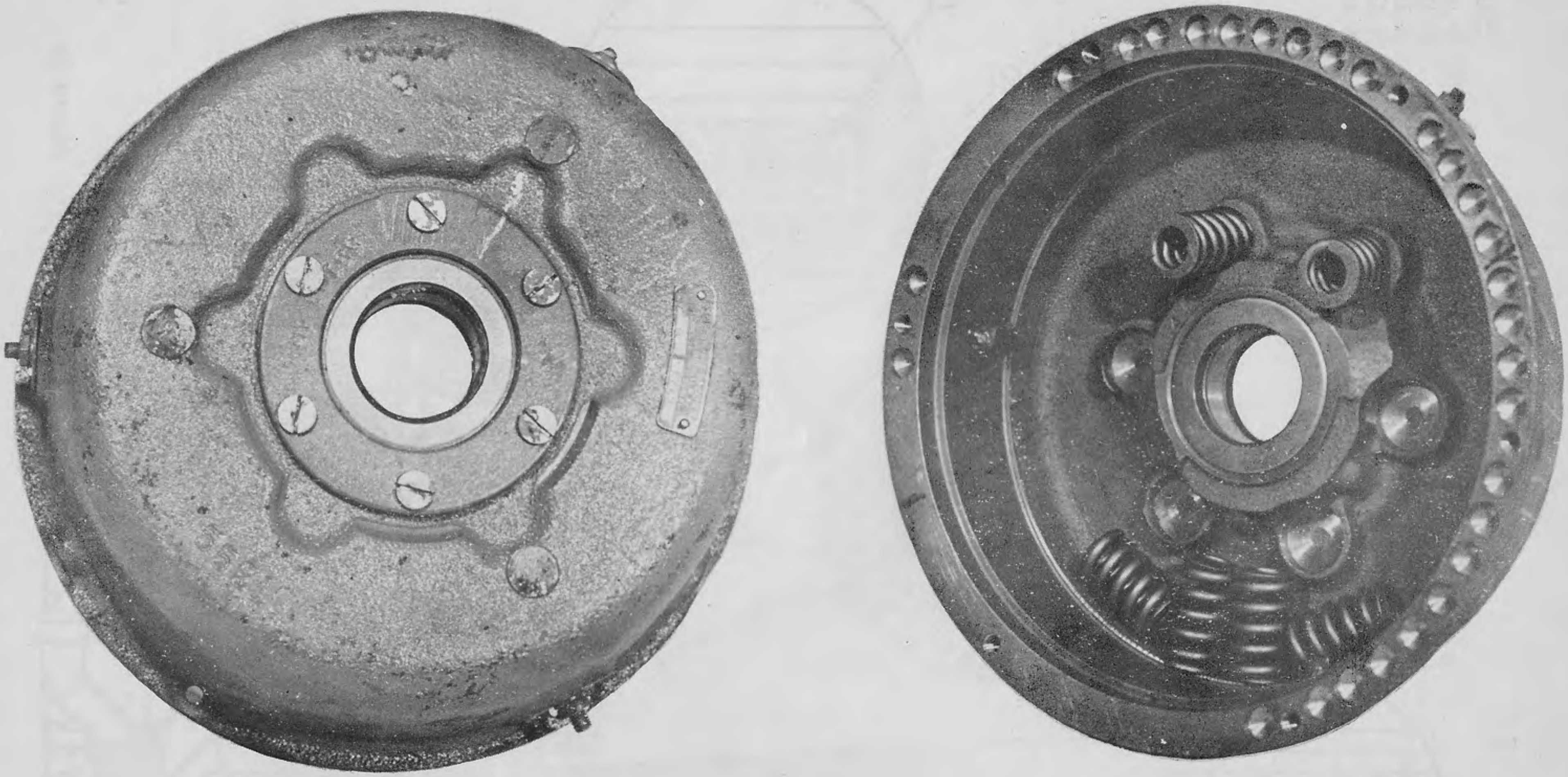
Front View



PRESSURE PLATE

Figure 32

Rear View



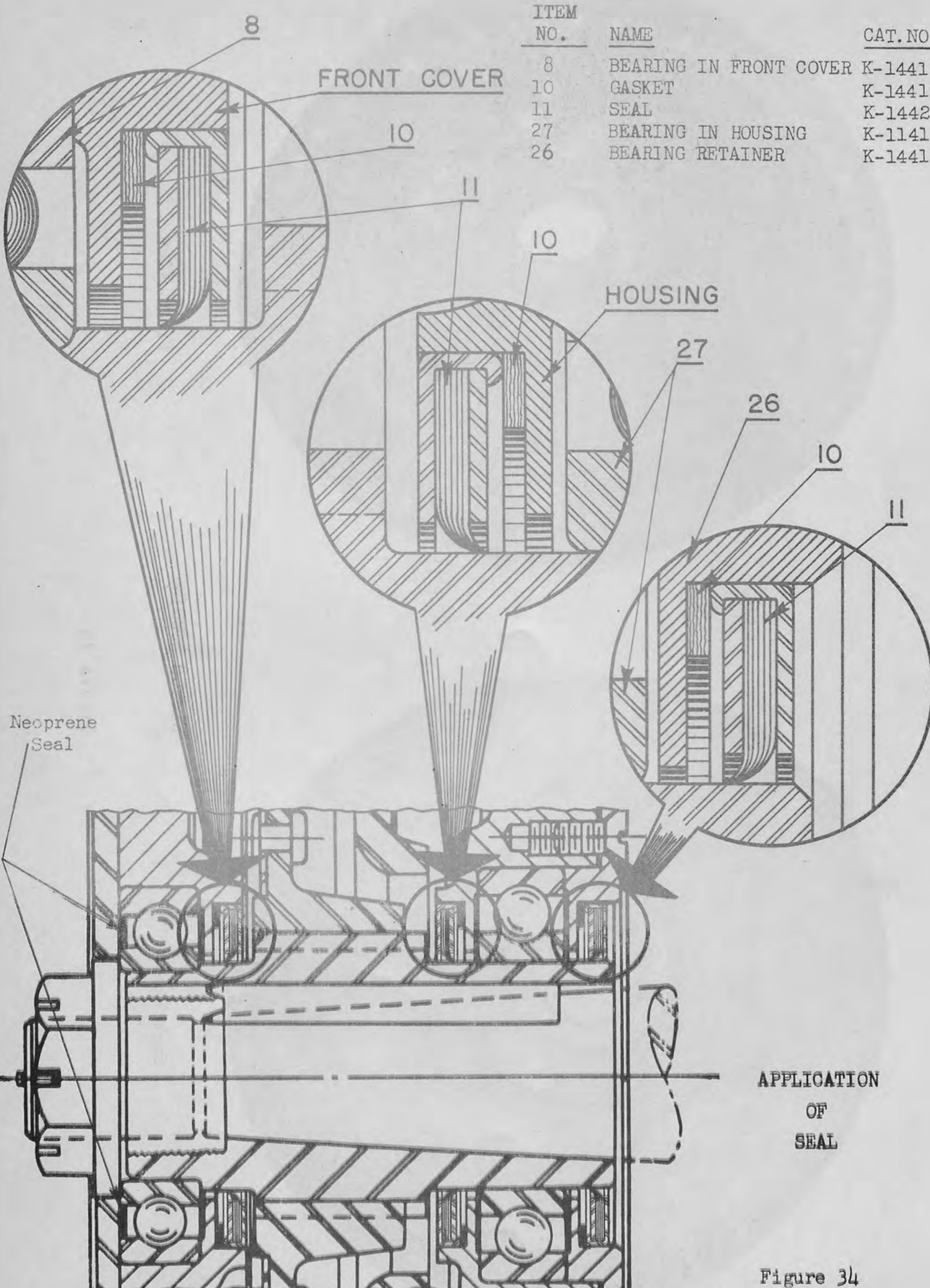
Back View

CLUTCH HOUSING

Front View

Figure 33

ITEM NO.	NAME	CAT. NO.
8	BEARING IN FRONT COVER	K-14417
10	GASKET	K-14419
11	SEAL	K-14420
27	BEARING IN HOUSING	K-11418
26	BEARING RETAINER	K-14415



APPLICATION OF SEAL

Figure 34

GENERATING EQUIPMENT

Two systems are used to provide power for battery charging, air conditioning and light load: namely, an axle driven genemotor or an under car mounted diesel driven generator. The plan for the "Empire Builder" is to run one car equipped with an axle driven genemotor next to and trainlined to a car equipped with a diesel driven generator. Trainlines are double to provide capacity to carry full air conditioning and light load from car to car.

AXLE DRIVEN GENERATING EQUIPMENT

Twenty-four cars are equipped with an axle driven system consisting of a Model 6-1 Spicer Gear Drive (Ratio 2.54 to 1) driving a Safety Company's Genemotor Type GN-25825 Cat. KE-13359. The genemotor is a generator rated 25 K.W. at 40 volts D.C. and a 25 H.P., 220 volts, 3 phase, 60 cycle stand-by motor in a common housing. A Safety Company's reverse current relay, Type S-31-EADRT is applied with a Safety Company's generator regulator, Type SM-150-EAE. This regulator is equipped with a bias coil and a manual toggle switch arrangement to reduce generator output on stand-by to the capacity of the stand-by lines.

WAUKESHA DIESEL DRIVEN GENERATING EQUIPMENT

Seventeen cars are equipped with a Waukesha Motor Company's diesel driven generator unit, Type R.D.-1008 that consists of a 6 cylinder, 4 cycle, 60 H.P. liquid cooled, vertical type diesel engine that drives a 25 K.W., 40 volt, D.C. generator at 1200 or 1800 RPM, depending on current demand at the generator. A Safety generator regulator, Type S M-350-E A and reverse current relay, Type S-31-EADR is connected in conjunction with the Waukesha timer controls and load sensing relays.

THERMOSTATIC KLIXON SWITCH

All cars are equipped with a thermostatic (Klixon) switch, Type C-4910 installed on the inside of one of the battery boxes at the top. The wires are run into the electric locker inside of cars through the nearest available conduit. The pin in the posts on the generator regulator panel for Edison battery charging voltage is removed and the thermostatic switch wires are connected in its place, one wire to each post. The generator operation is as follows:

When a temperature of 80 degrees or higher occurs at the top of the battery box, caused by atmospheric temperature, internal battery heat, or both, the thermostatic switch contacts close. This removes a portion of the resistance in the voltage regulating coil circuit thereby increasing the current through the voltage coil. This causes the voltage regulating arm to rise slightly and reduce the compression on the field carbon stack, which in turn lowers the operating voltage of the generator two volts.

When the temperature at the top of battery box is less than 70 degrees, the thermostatic switch is open and the regulator operates at set voltage.

SAFETY COMPANY'S GENEMOTOR

Listed below are the 24 cars that are equipped with Safety Company's Genemotor:

LOT 6877 - PLAN 4180 (2 COMPT., 5 DBR, 6 RMT)

1370 - ROGERS PASS - GN
1371 - PITAMAKAN PASS - GN
1372 - AKAMINA PASS - GN
1373 - SANTIAM PASS - GN
701 - WAPINITIA PASS - SP & S
1380 - SUIATTLE PASS - GN
1381 - HAINES PASS - GN
1382 - BLEWETT PASS - GN
1383 - INUYA PASS - GN
1384 - LEWIS & CLARK PASS

LOT 6878 - PLAN 4109-A, (2 BD RM, 1 DR, BUFFET OBS, LOUNGE)

1197 - PRIEST RIVER - GN

LOT 6889 - PLAN 4181 - (1 COMPT. 3 BDRM, 8 DX.RMT. - 1 for Porter)

4 OPEN SECTIONS

1270 - TOBACCO RIVER - GN
1271 - FRASER RIVER - GN
1272 - SPOKANE RIVER - GN
1273 - PEND O'REILLE RIVER - GN
1274 - BOIS DE SIOUX RIVER - GN

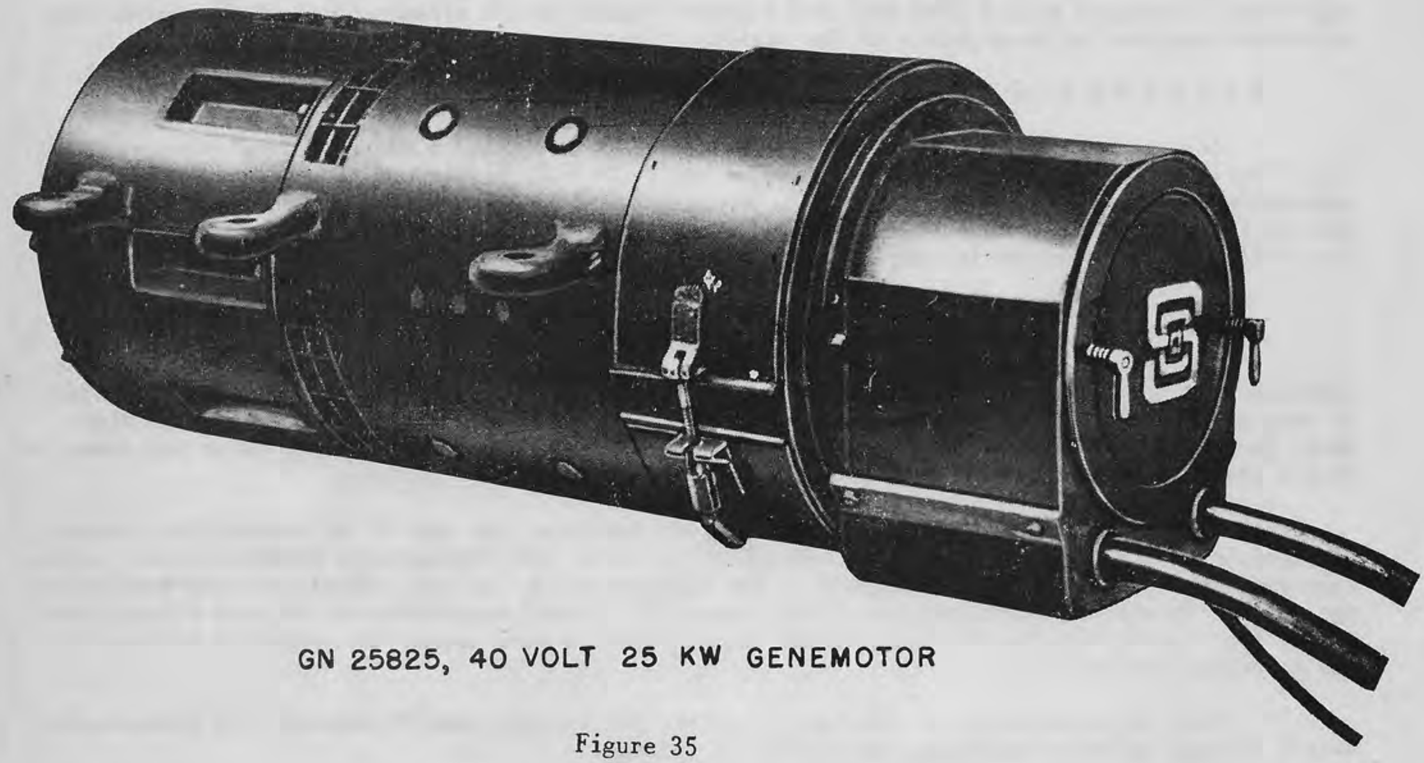
LOT 6890 - PLAN 4108-A (4BD RM, 16 DX RMT.)

1181 - KINTLA GLACIER - GN
1182 - AGLASSIZ GLACIER - GN
1183 - HUDSON GLACIER - GN
1184 - CHANEY GLACIER - GN
1185 - PARADISE GLACIER - GN
1186 - PUMPELLY GLACIER - GN
1187 - TAHOMA GLACIER - GN
1188 - TWO OCEAN GLACIER - GN

SAFETY GENEMOTOR

Safety Co. type G.N. 25825 genemotor is used to provide battery charging for both road and yard operation. The genemotor is a 40 volt, 25 KW, D.C. generator and a 25 h.p., 3 phase, 60 cycle, 220 volt A.C. motor in a common housing. Antifriction bearings are used, ball bearing at commutator end and roller bearing at drive end. The bearings are removable without removing the armature.

Safety genemotors are built in various types and sizes to fit the application where they are used. All units have name plates giving the model and Mfgs. number. Figure 35 shows a typical Safety Genemotor, and Figure 36 shows a cut of the G.N. type.



GN 25825, 40 VOLT 25 KW GENEMOTOR

Figure 35

ARMATURES: The complete armature for a genemotor consists of a D.C. armature, A.C. rotor, ventilation fan, and a common shaft. These parts are all removable from the shaft so that defective parts can be renewed.

The D. C. armature is built on a sleeve forming an assembly which is wholly independent of the shaft. Commutator and laminated core of silicon steel are keyed to the sleeve, which is then pressed on the shaft. Commutator has mica insulation and is undercut. The A.C. rotor has steel laminations with centrifugally cast integral copper bars and end rings. A double fan is mounted between a A.C. rotor and D.C. armature for ventilation purposes. Air is drawn through the motor and generator independently. Figure 37 shows a typical Safety Genemotor Armature.

FRAME: The generator frame is rolled steel while the A.C. motor frame is cast steel. The A.C. frame is bolted to generator frame to form the common housing. Six lugs for supporting the genemotor, three on each side, are welded to the frames and designed to fit special resilient mountings shown in Figure 37 Large inspection openings are provided in frame at commutator end and ventila tion openings at fan end. Four shunt field coils and two interpole coils with their pole shoes are mounted in D.C. frame while A.C. frame carries the 3 phase stator winding.

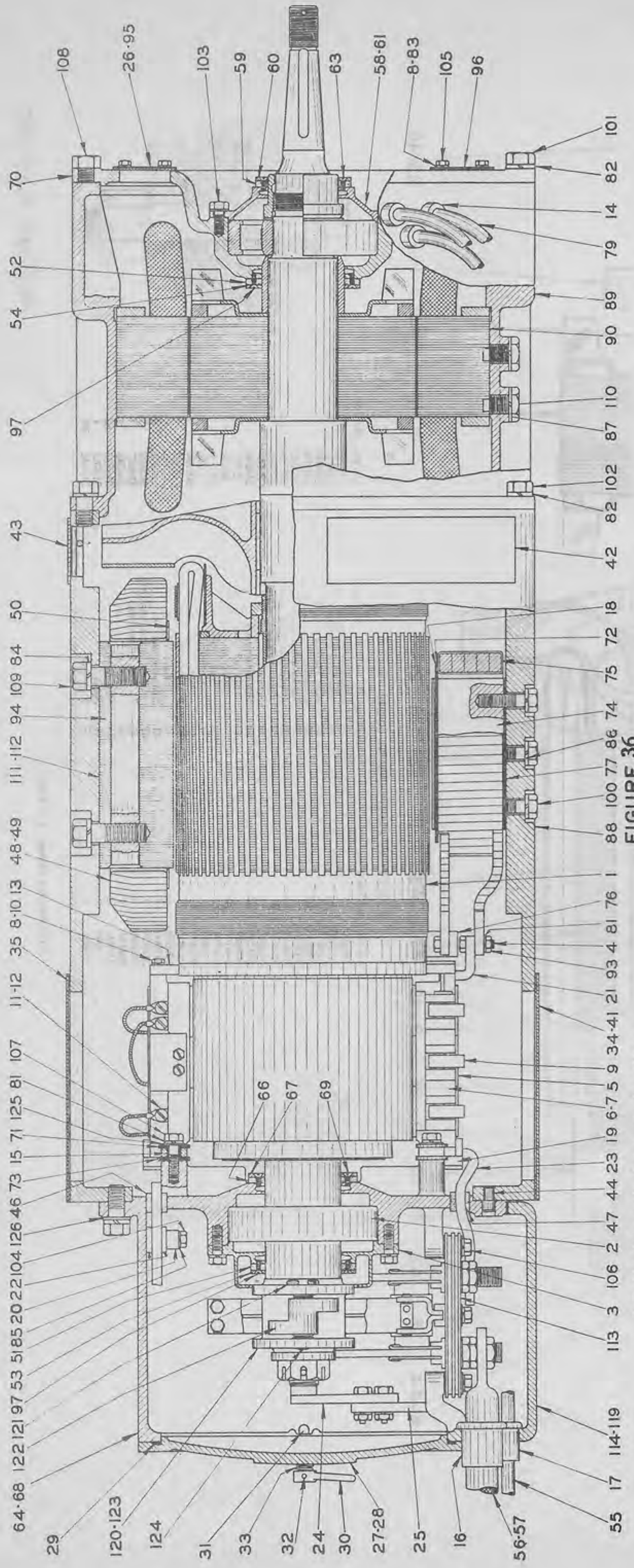


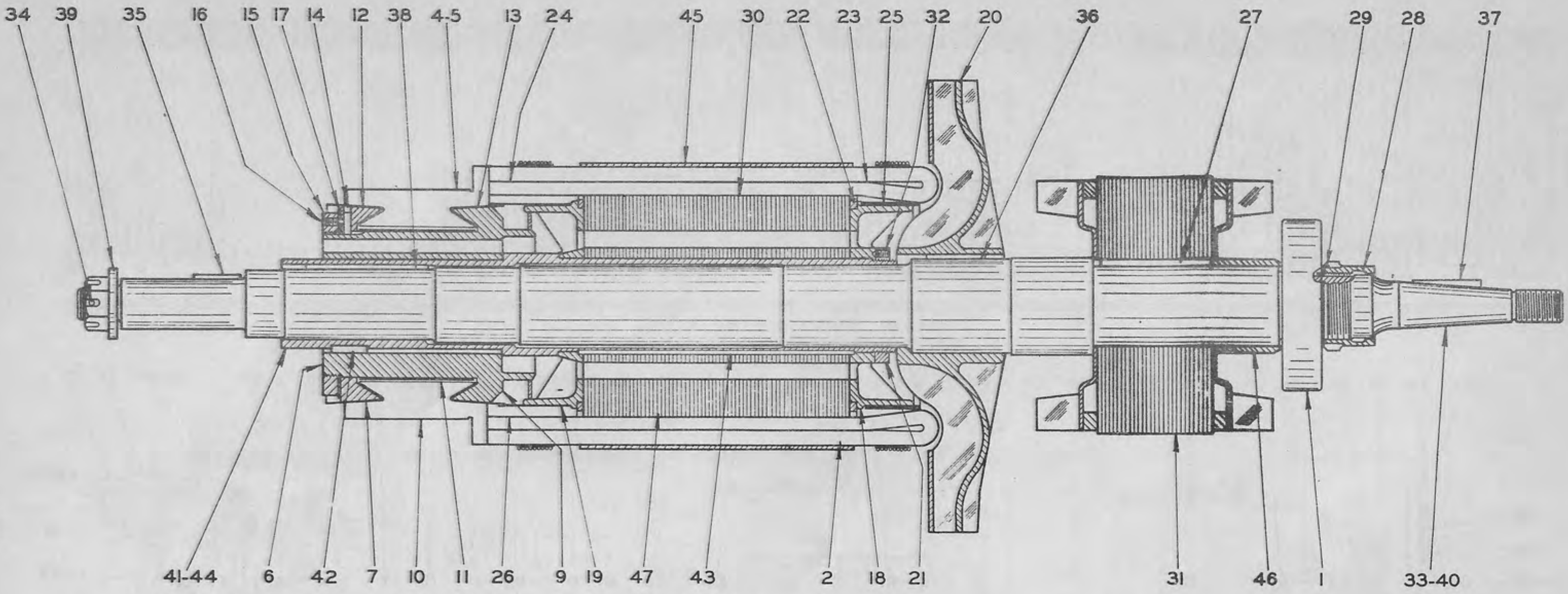
FIGURE 36

SAFETY TYPE GN-2825 GENEMOTOR, No. 314235

25 K.W. — 40 Volt D.C. — 25 H.P. — 220 Volt A.C.

* Indicates not shown on drawing.

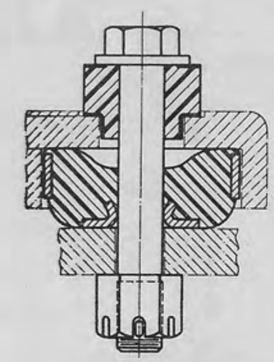
Item No.	Description	Cat. No.
1	Armature complete	314236
2	Ball bearing	20400
3	Bearing cap and shield	308086
4	Bolt	50049
5	Brush	302580
6	Brush box complete	314561
7	Brush box	314484
8	Lockwasher	22261
9	Pressure yoke	302024
10	Screw	21404
11	Screw	58807
12	Washer	56659
13	Brush box connector	314260
14	Bushing	20051
15	Bushing	58869
16	Bushing	314748
17	Bushing	314749
18	Coil support	303452
19	Conn. brush box	314258
20	Connector clamp	301584
21	Conn. I. P. to brush box	314256
22	Conn. support	301583
23	Conn. switch to brush box	314259
24	Conn. switch to interpole	314925
25	Conn. switch to interpole	314836
26	Cover	313765
27	Cover complete	314248
28	Cover	314211
29	Gasket	900590
30	Handle	301780
31	Latch	314249
32	Pin	59164
33	Spring	301781
34	Cover complete bottom	309523
35	Cover complete top	304304
36	*Adjusting bolt	20066
37	*Cotter pin	21102
38	*Hinge pin	20096
39	*Locking lever	20095
40	*Locking nut	301603
41	Cover — winter	304305
42	Cover — winter bottom	313436
43	Cover — winter top	313435
44	Dowel	313509
45	*Drive screw — name plate	52906
46	Dust stop	302099
47	Dust stop	302100
48	Field coil	62191
49	Field coil	62274
50	Field coil retainer	308870
51	Gasket	20526
52	Gasket	20578
53	Gasket plate	20527
54	Gasket plate	20577
55	Gen. lead (field)	62748
56	Gen. lead (neg.)	64760
57	Gen. lead (pos.)	64761
58	Grease cap complete	26179
59	Felt gasket	20524
60	Gasket plate	20525
61	Grease cap	26177
62	*Plug	52577
63	Screw	4356
64	Head complete	314247
65	*Dowel	58774
66	Gasket	20526
67	Gasket plate	20527
68	Head	314210
69	Screw	4356
70	Head pulley end	313759
71	Insulating washer	58870
72	Insulator	62771
73	Insulator	307414
74	Interpole	64916
75	Interpole coil	314560
76	Interpole conn.	314869
77	Interpole shim	63844
78	*Lead clip	21396
79	Lead motor	306584
80	*Lockwasher	3924
81	Lockwasher	4411
82	Lockwasher	7258
83	Lockwasher	22261
84	Lockwasher	53567
85	Lockwasher	58661
86	Lockwasher	58884
87	Lockwasher	59329
88	Magnet frame	314246
89	Motor frame	313761
90	Motor stator	313755
91	*Name plate	313482
92	*Nut	4763
93	Nut	4871
94	Pole complete	300553
95	Screen	313764
96	Screen clip	305549
97	Screw	4356
98	*Screw	12174
99	*Screw	50187
100	Screw	51398
101	Screw	51440
102	Screw	52625
103	Screw	53008
104	Screw	56557
105	Screw	57588
106	Screw	58166
107	Screw	58188
108	Screw	58494
109	Screw	59421
110	Screw	59766
111	Shim	308975
112	Shim	308976
113	Switch complete	302806
114	Terminal cover complete	314250
115	*Gasket	314251
116	*Gasket	314252
117	*Gasket	314253
118	*Gasket	314254
119	Terminal cover	314212
120	Trip carrier complete	302777
121	Cotter pin	21923
122	Trip carrier	304129
123	Trip gear body	302778
124	Trip pivot	302780
125	Washer	21781
126	Washer	58945



ARMATURE COMPLETE No. 314236

Item No.	Description	Cat. No.	No. Req'd.
1	Bearing (Roller)	59499	1
2	Coil (Armature)	315530	62
4	Commutator complete	314237	1
5	Commutator bar	314238	62
6	Commutator Hub	300626	1
7	Commutator "V" ring	310687	1
8	*Equalizer wire	301072	31
9	Insulator (flange)	313217	1
10	Insulator — bar	314239	62
11	Insulator — hub	300629	1
12	Insulator ("V" ring)	302170	1
13	Insulator ("V" ring)	300394	1
14	Pin — "V" ring	7845	1
15	Ring nut	300398	1
16	Screw	25604	1
17	Washer	309520	1
18	Core flange hub	313906	1
19	Core flange hub	314035	1
20	Fan	313899	1
21	Flange nut	314134	1
22	Flange ring	315343	2
23	Insulator (coil)	64944	1
24	Insulator (end connection)	64853	1
25	Insulator (flange)	26148	1
26	Insulator (flange)	315157	1
27	Key (motor rotor)	300899	1
28	Locknut	310598	1
29	Lockwasher	64213	1
30	Protection strip	315564	62
31	Rotor complete (motor)	313756	1
32	Screw	25604	1
33	Shaft complete	314240	1
34	Cotter pin	21602	1
35	Key	63894	1
36	Key (fan)	307546	1
37	Key (pulley)	7959	1
38	Key (sleeve)	300893	1
39	Locknut	21567	1
40	Shaft (only)	314241	1
41	Sleeve complete	314242	1
42	Key (commutator)	303599	1
43	Key (stamping)	314027	1
44	Sleeve	314243	1
45	Slot Wedge	315533	62
46	Spacer	313763	1
47	Stamping	315342	581

Indicates not shown on drawing



RESILIENT MOUNTING

Figure 37

POLARITY: Polarity is maintained through use of a double throw, double pole switch on most generators. This switch uses a self-clearing hardened cam to throw switch. These switches and trips are generally the same as those used on 15 K.W. Safety Generators shown in Diagram C, Page 375, A.C. Manual.

BRUSH BOXES: The brush boxes, connectors and brushes are standard Safety design, and there are four brush boxes and twelve brushes per generator.

VENTILATION: The drive end head is fitted with special opening for ventilation purposes during the cooling season. The opening is covered by a six-section screen held in place by small holding plates and cap screws. During non-cooling period, the screen sections are covered by six metal plates inserted under the screen holding plates.

The inspection openings in generator frame are covered by a two-piece hand hole cover similar to those now in use on 15 K.W. generators. The top half of cover is used all year round, but the solid lower half of cover is used only during non-cooling service. A screen type lower half is used during cooling period for ventilation.

The ventilation openings in frame over double fan are covered during non-cooling period by applying snap-on type metal plates. These covers are removed during cooling period for ventilating purposes.

GENERATOR REGULATOR: Safety Co. Type SM-150-EAB, Mfg. No. 313757, 40 volt, D.C. Generator regulator controls generator output, and has a bias coil cut in for 220 A.C. stand-by operation, by a set of interlock contacts on the A.C. starter switch. See wiring diagram Figure 38. The bias coil reduces generator output to approximately 20 K.W. on a stand-by operation. A 30 OHM resistor is used in series with the bias coil. No external shunt is provided on regulator as current coil carries the full load.

GENERATOR RELAY: Safety Co. Type S-31-EADRT, Figure 39 consists of a pilot relay, Figure 40, and load contactor Figure 41, which connects the generator to the battery. The inside contacts or interlock at right hand side of the load contactor are used to shunt out part of the compressor motor resistor when the generator is not operating. The other or outside contacts are used to automatically reset low voltage relay when generator is operating. A time delay relay, Safety Co. No. 314536 is used to allow the stand-by motor to come up to speed before the generator load is applied.

FUSES: Generator fuse is a 725 ampere superlag cartridge type. Generator field is protected by a 15 amp cartridge fuse.

ADJUSTMENT OF SAFETY CO.'S. TYPE S-31-EADRT GENERATOR REVERSE CURRENT RELAY

The S-31-EADRT reverse current relay panel consists of an Edison Time Delay Relay, pilot relay and load contactor.

No adjustments are made to the load contactor except armature spring tension which should allow contactor to close at 26 volts or below. Operation of this contactor is dependent on the pilot relay.

Reverse current pilot relay should close 1-2 volts above the battery voltage. The closing voltage can be adjusted by changing the position of the adjusting screw in the counterweight of the armature of the pilot relay. Turning the adjustment screw clockwise brings the pilot contacts closer together and will result in the pilot relay closing at a lower generator voltage. Turning the adjustment screw counter-clockwise widens the gap between the pilot contacts and will result in the pilot relay closing at a higher generator voltage.

The pilot relay contacts consisting of one adjustable stationary contact, and one moveable contact, energize the load contactor. The stationary contact has an adjustment screw and should be adjusted so that there is just sufficient tension on moveable contact leaf to drop out the relay when the generator is motoring after operating on the A.C. motor from stand-by.

The main contacts of the load contactor require no adjustment and it is only necessary to be certain that proper contact is made on the silver inserts. There are 3 interlock contacts on the load contactor, one normally closed, and two normally open. The normally open contacts should be adjusted so that the gap is approximately 1/16" when the contactor is in the open position. The normally closed contact is used to shunt out part of compressor motor field resistor when generator is not operating. The normally open contact on the left puts a resistor in parallel with the lifting coil of the pilot relay when the load contactor is closed. This resistor weakens the lifting coil and allows the relay to drop out at a low value of reverse current.

The normally open contact on the right acts as a reset button to close the low voltage relay on the compressor motor starter panel.

Following is the procedure to be used in adjusting the reverse current relays.

1. Turn off genemotor control switch and apply 220 A.C. stand-by cable into car receptacle.

2. Shut off all lights and devices by opening main light switch.

3. Read battery voltage by touching voltmeter leads to Terminals No. 1 and 4 at bottom of reverse current relay panel.

4. Connect voltmeter to Terminal No. 1 and 5 on bottom of reverse current relay panel to obtain generator voltage.

5. Raise voltage regulator arm, turn on genemotor control switch, slowly lower regulator voltage arm and watch voltage rise on voltmeter. Reverse current load contactor should close 1 to 2 volts above the battery voltage. Adjust pilot relay accordingly.

NOTE: Do not insulate the main contacts of the load contactor when making the above check.

VOLTAGE SETTING

1. Place car on stand-by with genemotor control switch in "OFF" position.

2. Block open the load contactor on the reverse current relay panel.

3. Disconnect thermostatic (Klixon) switch at Edison battery terminal posts.

4. Connect (50 volt scale) voltmeter, negative lead to No. 2 on regulator panel and positive lead to generator fuse clips.

5. Apply jumper across resistor in series with voltage coil and increase generator to 46 volts for two minutes to allow solenoid to come up to operating temperature.

6. Remove jumper from across resistor, vibrate panel lightly and adjust spring tension on voltage arm to obtain voltmeter reading of 37 volts.

7. Short out Edison battery terminals post with jumper. A 2 volt drop should occur in the operating voltage.

8. Remove block from load contactor on reverse current relay panel and remove voltmeter. Reconnect thermostatic (Klixon) switch wires and make sure switch is working properly. (Closed at 80° and above, open at 70° and below)

CURRENT SETTING

1. Place car on stand-by with genemotor control switch in "OFF" position.

2. Insert 750 amp. shunt in place of main fuse.

3. Connect ammeter to proper terminals on shunt.

4. Close genemotor control switch and allow regulator arms to assume their position.

5. The ammeter reading may be high or low depending on the demand from the batteries. In any case, grasp the voltage arm lightly between two fingers and gently pull downwards until the current arm begins to rise. The current arm should start to rise when the generator current output reaches 540 amperes; adjust spring accordingly.

6. Remove shunt and apply proper fuse to main fuse clips.

   Current setting may be obtained by using wgt. No. 303543 removing screw plug marked, "Remove for reg. of 125 amp and under."

WIRING DIAGRAM OF GENEMOTOR EQUIP. USING SM-150-EAB REGULATOR AND S-31-EADRT RELAY.

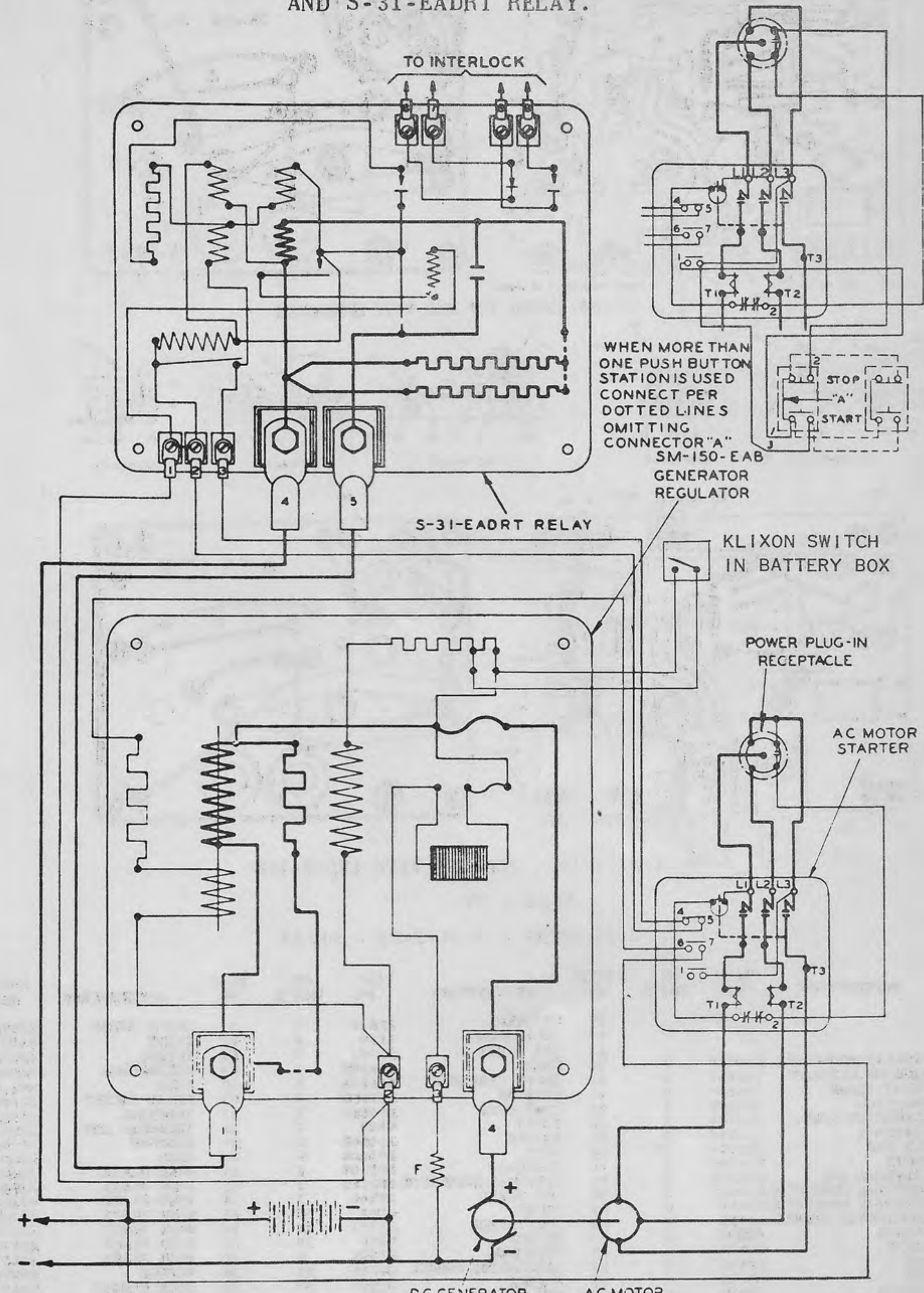
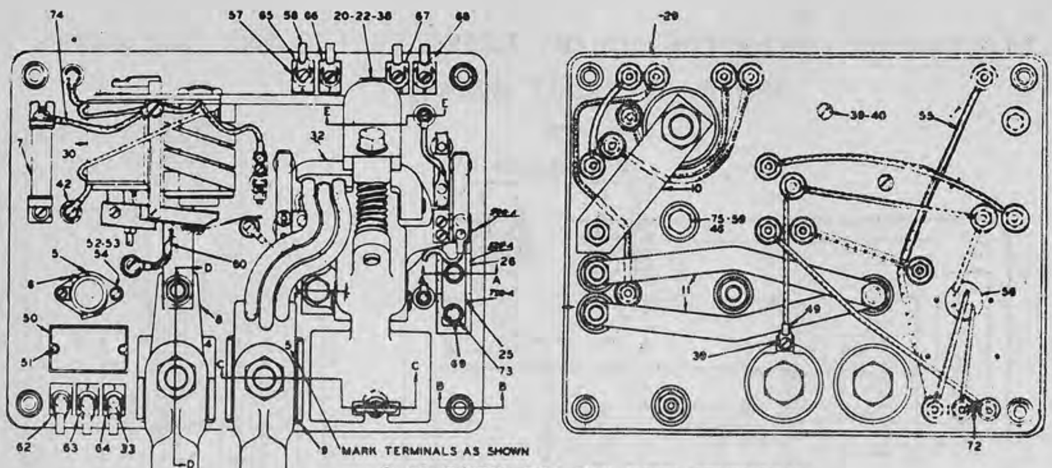
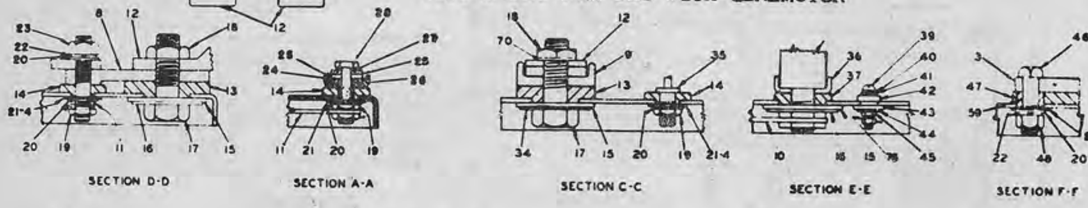
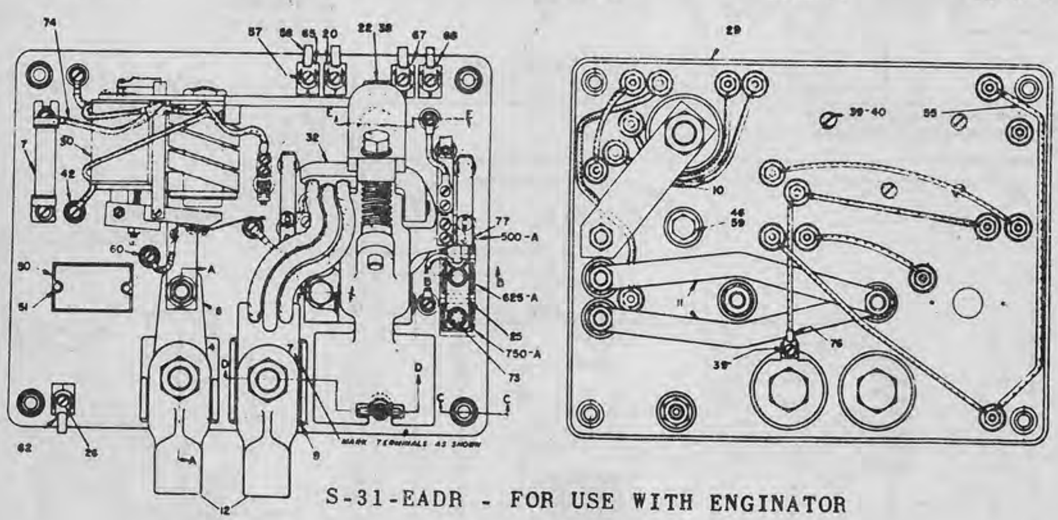


Figure 38



S-31-EADRT FOR USE WITH GENEMOTOR



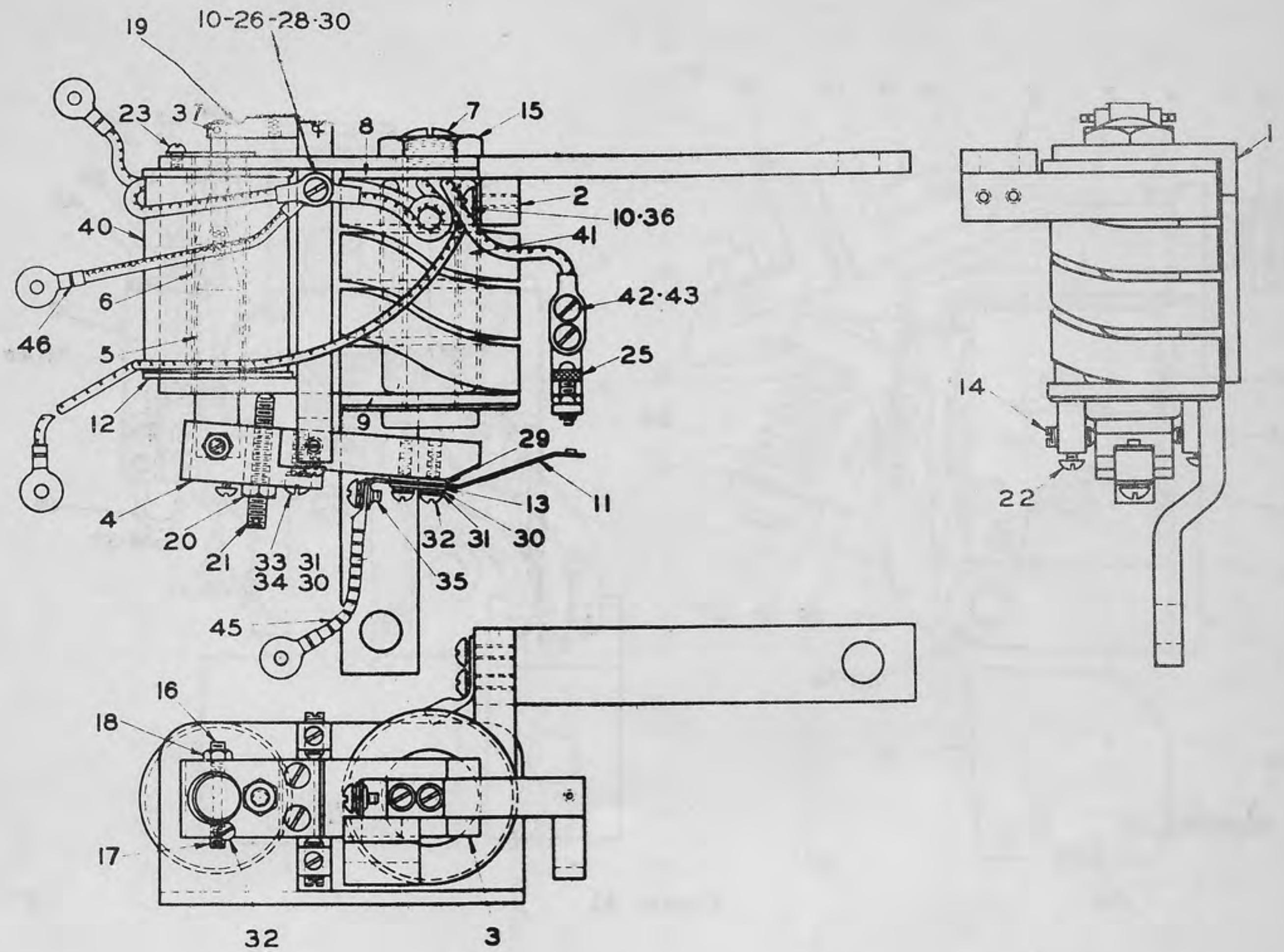


S-31-EADR - FOR USE WITH ENGINATOR

Figure 39

S-31-EADRT - S-31-EADR - RELAY

ITEM NO.	DESCRIPTION	CAT. NO.	NO. REQ'D	ITEM NO.	DESCRIPTION	CAT. NO.	NO. REQ'D	ITEM NO.	DESCRIPTION	CAT. NO.	NO. REQ'D
1				26	TERMINAL	27875	3	51	DRIVE SCREW	52905	2
2				27	LOCKWASHER	4319	3	52	SCREW	4403	2
3				28	CAP SCREW	57971	3	53	WASHER	58822	2
4	INSULATING WASHER	500095	7	29	PANEL	316585	1	54	LOCKWASHER	59583	2
5	TIME DELAY RELAY	314536	1	30	RELAY COMPLETE	316586	1	55	WIRE	900152	4
6	RELAY CLAMP	314537	1	31	BUSHING	316500	4	56	RELAY SOCKET	314881	1
7	RESISTOR	302338	1	32	CONTACTOR	316587	1	57	TERMINAL	301232	9
8	CONNECTOR COMP.	314549	1	33	SCREW	5480	7	58	TERMINAL LUG	20082	5
9	TERMINAL	314539	1	34	WASHER	314545	1	59	BUSHING	301460	2
10	BUS BAR	900024	6"	35	STUD	301604	1	60	LEAD	315071	1
11	SHUNT	314540	2	36	TERMINAL	300100	1	62	NAME PLATE	62801	1
12	TERMINAL LUG	314541	2	37	TERMINAL INSULATOR	300101	1	63	NAME PLATE	62802	1
13	TERMINAL INSULATOR	314517	2	38	CAP SCREW	58046	1	64	NAME PLATE	62803	1
14	TERMINAL INSULATOR	27877	5	39	SCREW	4759	18	65	NAME PLATE	315072	1
15	INSULATING WASHER	58926	3	40	LOCKWASHER	22262	22	66	NAME PLATE	315073	1
16	WASHER	58929	2	41	WASHER	7277	19	67	NAME PLATE	315074	1
17	SCREW	500395	2	42	TERMINAL	27885	9	68	NAME PLATE	315075	1
18	NUT	59524	2	43	INSULATING WASHER	58745	18	69	WASHER	53760	1
19	NUT	27879	11	44	WASHER	20163	20	70	LOCK WASHER	53567	2
20	WASHER	27883	10	45	NUT	21836	40	71	RESILIENT MOUNT.	312002	4
21	INSULATING WASHER	27881	7	46	CAP SCREW	51398	2	72	WIRE	900352	3
22	LOCKWASHER	4214	4	47	INSULATING PLATE	301238	1	73	WASHER	21187	2
23	NUT	58446	1	48	NUT	53839	1	74	LEAD COMPLETE	315079	1
24	TERMINAL POST	64952	3	49	TERMINAL LUG	500281	1	77	TERMINAL	27875	3
25	CUT OUT STRAP	29996	2	50	NAME PLATE	28326	1				



PILOT RELAY COMPLETE CAT. NO. 316586

ITEM NO.	DESCRIPTION	CAT.NO.	NO.RQD.	ITEM NO.	DESCRIPTION	CAT.NO.	NO.RQD.
1	Frame	301056	1	23	Screw	2758	1
2	Series Coil	314478	1	25	Connector	301928	1
3	Armature	301087	1	26	Screw	420	1
4	Counterweight	301088	1	28	Insulating Bushing	312544	1
5	Plunger Rod Comp.	301085	1	29	Insulator	17379	1
6	Plunger Stop Comp.	301091	1	30	Washer	4348	6
7	Core Complete	301113	1	31	Lockwasher	54444	3
8	Top Coil Head	301106	1	32	Screw	2672	3
9	Bottom Coil Head	314810	1	33	Screw	52278	2
10	Lockwasher	53884	3	34	Lockwasher	52909	2
11	Contact	301930	1	35	Screw	3877	1
12	Washer	101104	2	36	Screw	156	2
13	Insulator	302387	1	37	Pin	301134	1
14	Pilot Screw	301092	2	38	Pin	301135	1
15	Nut	301115	1	39	Cotter Pin	20463	4
16	Swivel Screw	25839	1	40	Holdout Coil	301136	1
17	Screw	25837	1	41	Lifting Coil	301137	1
18	Nut	4763	1	42	Screw	151	2
19	Guide Lever	301059	1	43	Lockwasher	58571	2
20	Nut	4551	1	45	Lead	315071	1
21	Adjusting Screw	25838	1	46	Lead	315079	1
22	Screw	2920	2				

Figure 40

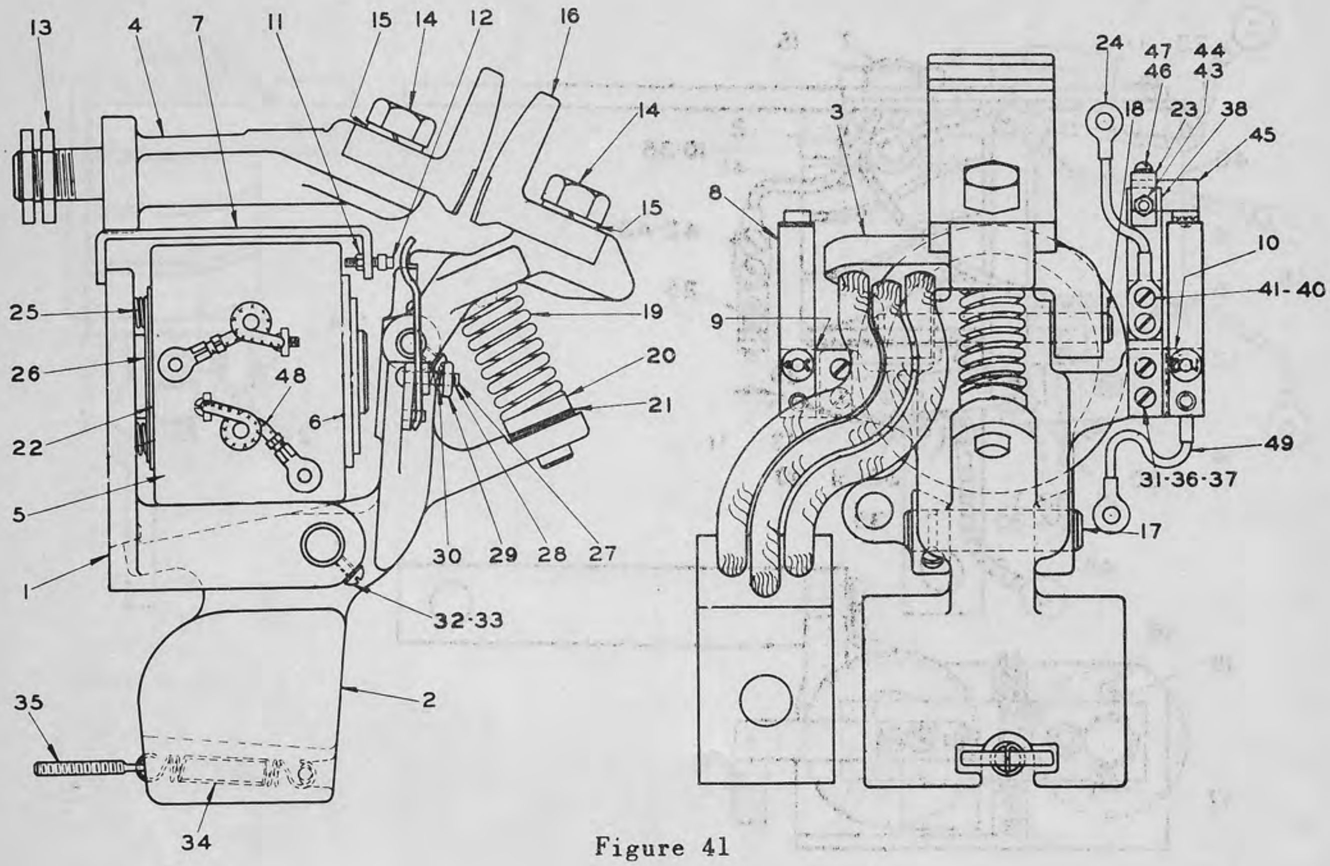


Figure 41

LOAD CONTACTOR CAT. NO. 316587

ITEM NO.	DESCRIPTION	CAT.NO.	NO.RQD.	ITEM NO.	DESCRIPTION	CAT.NO.	NO.RQD.
1	Magnet Frame	303044	1	25	Spring	303050	2
2	Armature Complete	314761	1	26	Spring Plate	314766	1
3	Contact Lever Comp.	314609	1	27	Pin	302346	2
4	Bracket Complete	314535	1	28	Cotter Pin	4696	2
5	Magnet Coil	303042	1	29	Collar	302347	4
6	Magnet Core	303043	1	30	Spring	302345	2
7	Contact Holder	302332	2	31	Screw	420	4
8	Contact	302333	2	32	Screw	314767	2
9	Interlock Cont. Plate	302334	1	33	Lockwasher	52909	2
10	Insulating Blk. Comp.	317926	1	34	Spring	303048	1
11	Nut	51648	2	35	Spring Adjusting Stud	303137	1
12	Contact	28135	2	36	Lockwasher	58571	6
13	Nut	314546	2	37	Washer	4348	4
14	Screw	50064	2	38	Contact	316406	1
15	Lockwasher	4214	2	40	Nut	52285	2
16	Contact Shoe	314613	2	41	Screw	4145	2
17	Shaft	303046	1	43	Contact Screw	61615	1
18	Shaft	303047	1	44	Nut	23427	1
19	Spring	303049	1	45	Support	316674	1
20	Spring Guide Pin	314762	1	46	Screw	2672	4
21	Shim	314763		47	Lockwasher	155131	4
22	Insulating Washer	314764	1	48	Lead	301350	2
23	Contact Holder	316410	1	49	Lead	313377	1
24	Lead	64770	1				

The following 17 cars of this group are equipped with Waukesha Diesel Enginators:

Lot 6877 - Plan 4180 - (2Compartment - 5 Double Bedrooms - 6 Roomettes)

BIG HORN PASS	HART PASS	PARK CREEK PASS
FIREBRAND PASS	JEFFERSON PASS	STATE PASS

Lot 6889 - Plan 4181 (4 Section, 1 Compartment, 3 Double Bedrooms - 7 Duplex Rmts.)

BAD AXE RIVER	POPLAR RIVER	SNAKE RIVER
CHUMSTICK RIVER	SHEYENNE RIVER	SNOHOMISH RIVER
MILK RIVER	SKAGIT RIVER	SUN RIVER
MOUSE RIVER	SKYKOMISH RIVER	

The Waukesha Diesel Enginator is a 25 K W - 40 Volt D.C. generator driven through a fluid coupling by a 60 H.P., six cylinder, four cycle, liquid cooled, vertical type diesel engine. The engine and generator are mounted in a common frame which mounts on roll-out tracks under side of car as shown in Figure 42, page 48. The assembled generator and engine are shown in Figure 46 page 50.

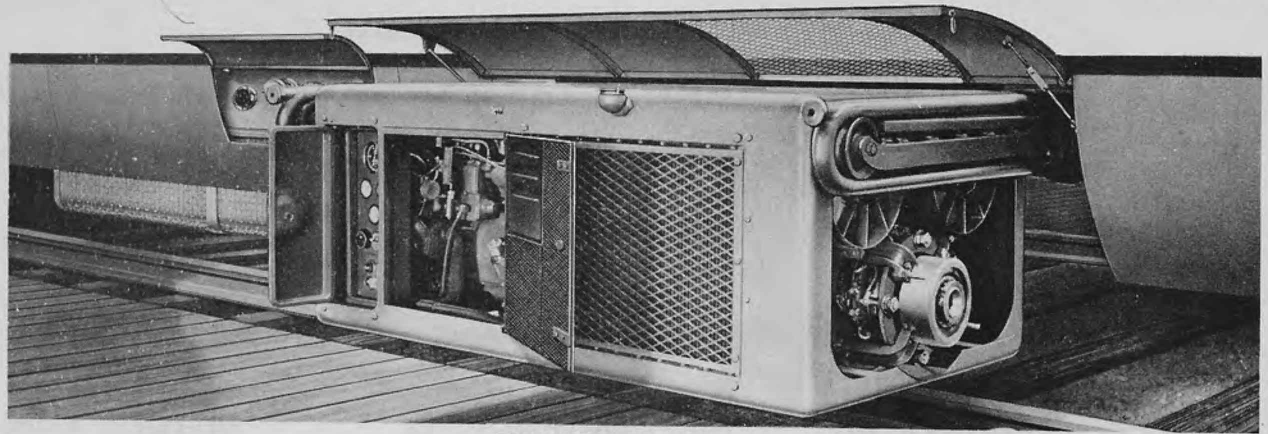
The unit roll-out mounting is shown in Figure 43 page 48 and consists of a deep grooved roller bearing wheel at the ends of a shear rubber dolly mount which rolls in tubular steel tracks. Track extensions are carried along side the mounting under the car. Roller stops or locks are automatic. Flexible lines are provided for fuel, steam and power and the exhaust is equipped with a push fitting so that the unit may be operated in the rolled out position. Quick disconnects are provided in lines to permit exchange of entire unit. A 200 gallon diesel fuel tank (Waukesha Design) is mounted under car on angle iron supports. See Figure 44 page 48.

G E N E R A T O R: The Waukesha generator is rated 25 K.W., 40 Volts D.C., at 1800 R.P.M. It is a four pole, (with four interpoles) shunt generator having a closed system of air cooling. Figure 45 page 49 shows a dis-assembled view of the generator with the Waukesha parts list. The generator shaft is supported by a ball bearing in the fluid coupling and a ball bearing at the commutator end. A fan mounted on the armature shaft circulates the air over the brush rig, commutator and field coils, through hollow armature shaft and the six spiral corrugated copper cooling ducts. The heat that is picked up inside the generator is dissipated through the cooling ducts which are externally mounted on each side of generator. The heat radiated by the cooling ducts is picked up by two electric fans and transferred to the outside of the generator compartment.

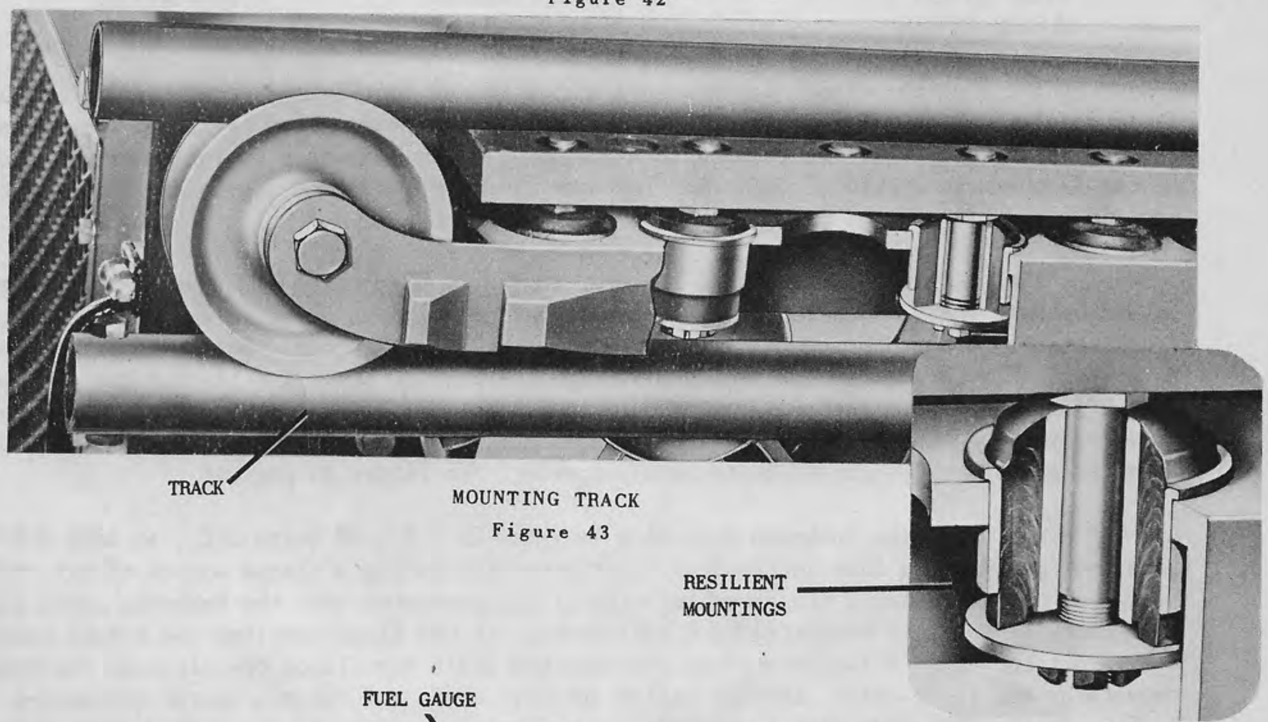
An air breather is applied at the top of the generator housing (Commutator end) to relieve air pressure that builds up inside the generator. Figure 61 page 78 shows the fans and air breather from a top view.

Sixteen (16) brushes are used on the commutator, four per box. The pressure per new brush is 2-1/4 lbs. Brush springs are of the constant pressure coil type.

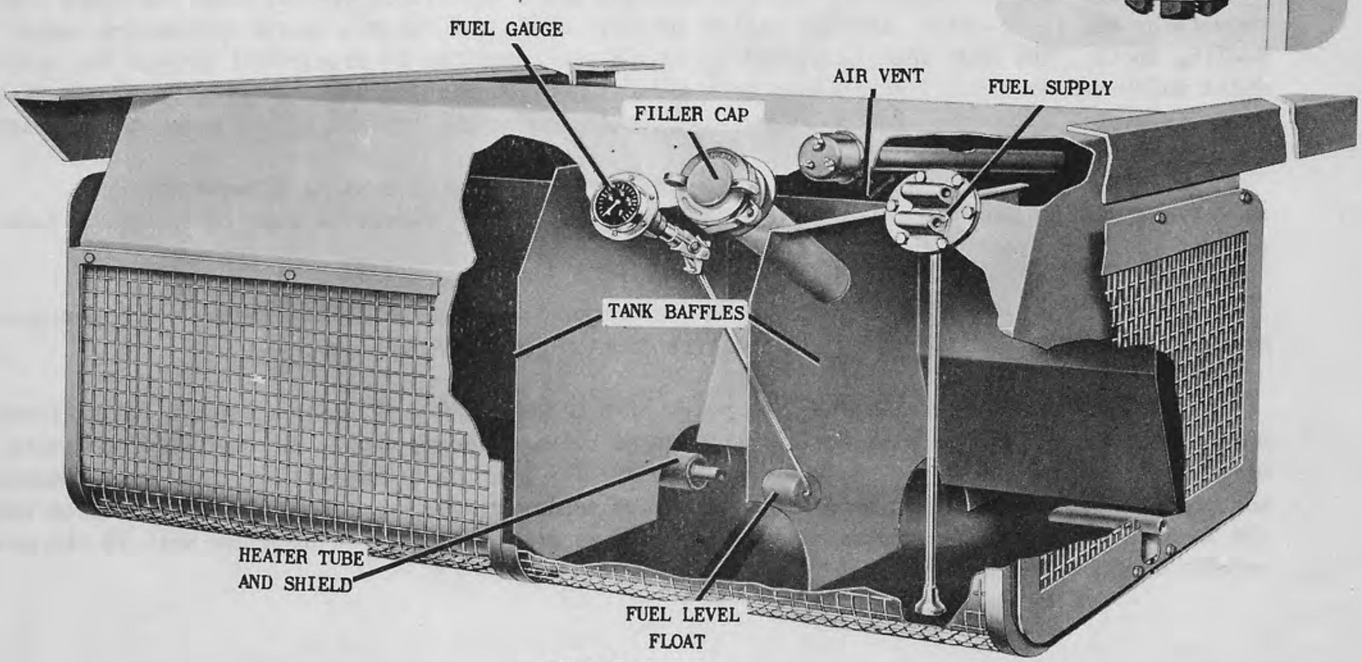
The armature, fields and interpoles have Class " B " insulation of glass and silicone material. The commutator bars are of hard forged silver-bearing copper and are insulated with mica. Bearing uses a No. D C 44 silicone grease. The bearing is accessible along with commutator and brushes by removing the dome cover. When replaced, the cover must seal properly to retain the inner air circulating system. (A generator heat switch is used to stop the unit if the generator becomes overheated.)



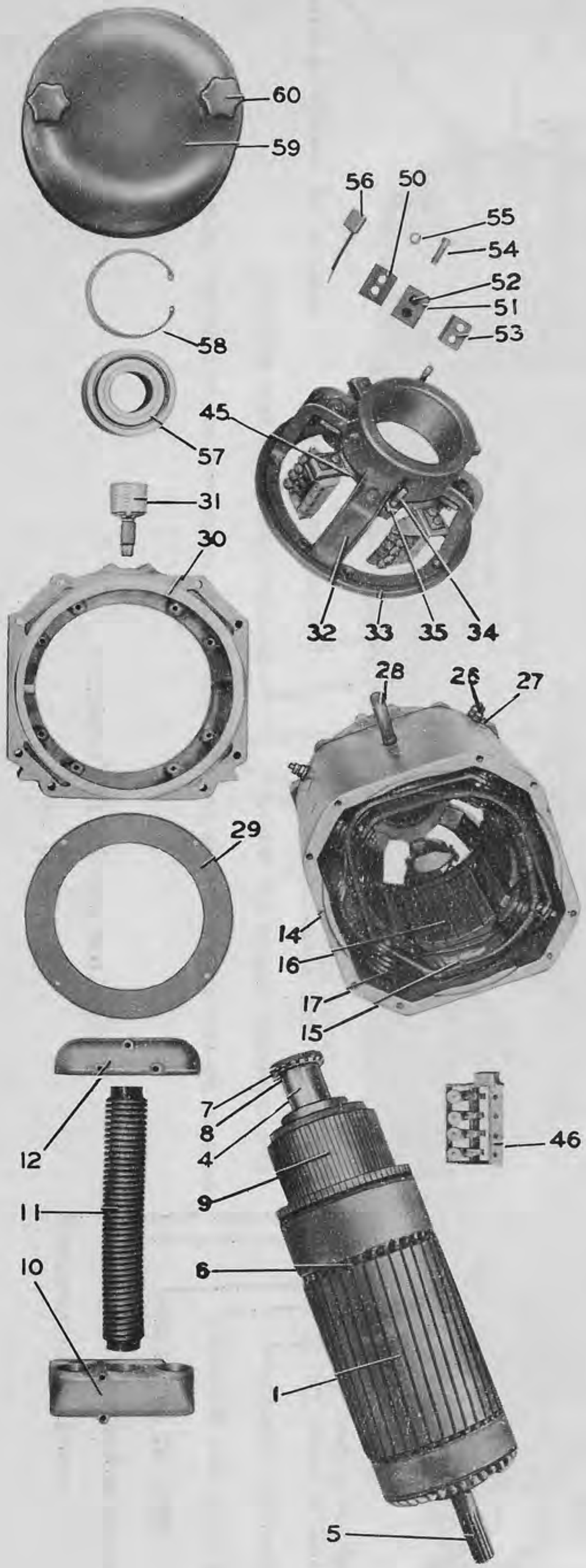
ENGINATOR ON CAR
Figure 42



MOUNTING TRACK
Figure 43



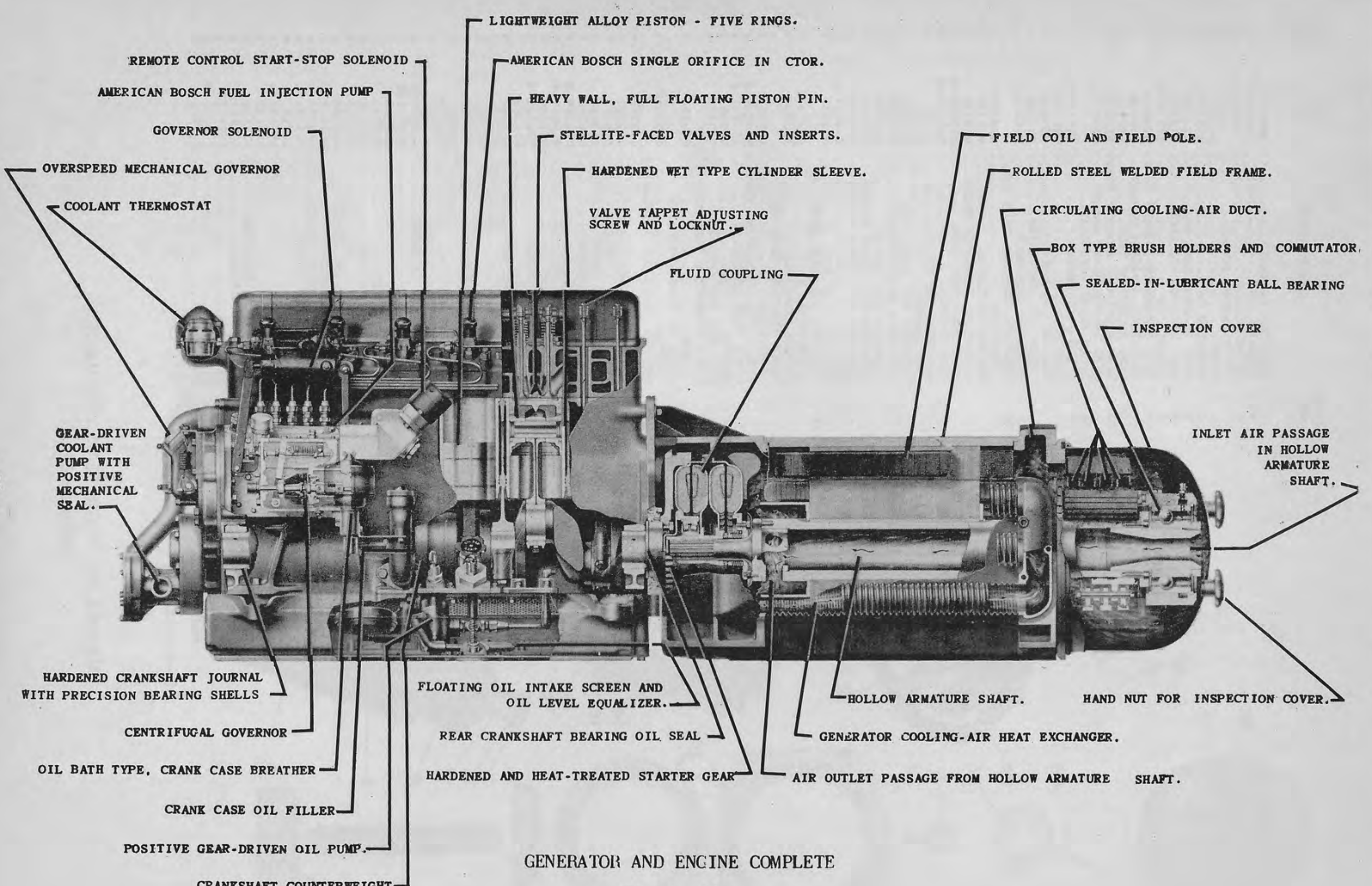
FUEL TANK
Figure 44



ITEM NO.	DESCRIPTION	PART NO.	QUAN. PER UNIT
1	ARMATURE ASSEMBLY..........	A951775	1
4	BEARING HUB................	950821	1
5	DRIVE FLANGE...............	950434-C	1
	DRIVE FLANGE SCREW.........	21981	6
	DOWEL......................	B-9824	3
6	ARMATURE COIL..............	0951775	36
7	BALL BEARING LOCK NUT......	951621	1
8	BALL BEARING NUT LOCK......	951622	1
9	COMMUTATOR.................	0951975	1
10	HEAT EXCHANGER BRACKET REAR.	950816	2
	HEAT EXCH. BRACKET GASKET...	950826	2
11	HEAT EXCHANGER TUBE.........	950247	6
12	HEAT EXCHANGER BRACKET FRONT	950815	2
	HEAT EXCH.BRACKET GASKET...	950437-A	2
14	FIELD FRAME ASSEMBLY........		1
15	FIELD COIL ASSEMBLY.........	0951752	4
16	POLE SHOE..................	0951753	
	WINDING INSULATION..........	951639	4
	FIELD COIL INSULATOR........	951640	4
17	INTERPOLE ASSEMBLY..........	0951754	4
26	NEGATIVE TERMINAL STUD AND CONDUCTOR..................	A952107	1
	BOTTOM INSULATOR............	952118	1
	CONDUCTOR INSULATOR BLOCK...	952119	1
	STUD INSULATOR TUBE.........	952120-A	1
	STUD SPACER.................	952121-A	1
	HEX HEAD JAM NUT............	26471	2
	LOCK WASHER.................	21539	1
	TERMINAL BOX INSULATOR......	952122	1
	INSULATOR BLOCK BRACKET.....	952123	2
	TERMINAL BOX (REAR).........	952124	1
	TERMINAL BOX COVER GASKET...	951699	1
	TERMINAL BOX COVER GASKET...	951700	1
	STUD........................	B-6314-A	4
	PLASTIC STOP NUT............	B-6849	4
27	POSITIVE TERMINAL STUD AND CONDUCTOR..................	A952125	1
	BOTTOM INSULATOR............	952126	1
	FIELD TERMINAL STUD AND CONDUCTOR..................	A952127	1
	FIELD STUD INSULATING TUBE..	952120-B	1
	FIELD STUD SPACER...........	952121-B	1
	WASHER......................	26088	2
	TERMINAL BOX INSULATOR......	952122	1
	FIELD CONDUCTOR INSULATOR BLOCK......................	952130	1
	TERMINAL STUD INSULATOR TUBING.....................	952120C	1
	CURRENT CONDUCTOR INSULATING BLOCK......................	952119	1
	INSULATOR BLOCK BRACKET.....	952131	2
	TERMINAL BOX (FRONT)	952132	1
	TERMINAL BOX COVER GASKET...	951699	1
	TERMINAL BOX COVER..........	951700	1
	STUD........................	B-6314-A	4
	ELASTIC STOP NUT............	B-6849-A	4
29	AIR INLET RING..............	950439	1
30	AIR INLET HOUSING...........	950131-A	1
31	BREATHER....................	951290	1
32	COMMUTATOR END BRACKET......	950818	1
	PIPE PLUG...................	26416	2
33	RUBBER GASKET...............	951625	1
34	STUD-COVER SUPPORT..........	951634	2
35	HEX JAM NUT.................	21208	2
45	BRUSH HOLDER RING...........	951777	1
	RING LOCATING BLOCK.........	951601	4
46	BRUSH HOLDER ASSEMBLY.......	A-951778	4
	BRUSH HOLDER................	0-951778	1
	BRUSH SPRING................	951782	4
	SPRING SUPPORT..............	951786	4
	SPRING SUPPORT PIN..........	951734	1
50	WASHER PLATE................	951785	4
51	INNER INSULATING BLOCK......	951783	4
52	INSULATING BUSHING..........	951627	8
53	OUTER INSULATING BLOCK......	951784	4
54	HEX HEAD CAP SCREW..........	21353.	8
55	LOCK WASHER.................	21729	8
56	BRUSH.......................	951979-A	16
57	BEARING.....................	951635	1
58	BALL BEARING RETAINER.......	951636	2
59	END COVER ASSEMBLY..........	A950819	1
	END COVER...................	0950819	1
60	KNOB........................	Y-6161-A	2
	SNAP RING...................	B-9578	2

WAUKESHA ENGINATOR GENERATOR PARTS.

Figure 45



GENERATOR AND ENGINE COMPLETE

Figure 46

The diesel engine is similar to the propane or gasoline engine in general design except that certain parts are of a heavier construction to withstand the higher pressures encountered in diesel operation. The counter-balanced crankshaft has hardened journals and crank pins. The cylinder sleeves are heat-treated for extra hardness and are precision honed. Heat of compression ignites the fuel and air mixture to produce the power stroke of the piston. The fuel injection pump and fuel injectors take the place of the magneto and spark plugs. In a diesel engine, air alone is taken through the intake manifold and compressed in the cylinders. At the proper time of compression, fuel is metered, injected under high pressure and burned in the combustion chambers. Throttling or engine speed is controlled by fuel quantity alone and air is taken in according to volumetric capacity of the engine.

CYLINDER HEAD, AND INSERTS: This engine is of the overhead valve type. It confines to the cylinder head the valves, the guides and valve seats, also the combustion chambers and injectors. This simplifies maintenance as the entire cylinder head can be removed for bench work. The intake and exhaust valves are Stellite faced and operate in removable valve guides. Both intake and exhaust valve inserts are solid Stellite.

Accepted valve grinding practice should be followed. Special grinding wheels are required to reface the valves and seats. The intake valve stem is 3/8", and the head diameter is 1-17/32" with a 45° face. The exhaust valve stem is 3/8" and the head diameter is 1-9/32" with a 44° 30' face.

Whenever the cylinder head is reassembled to the block, it is important to use a new head gasket, coating each side of the gasket with heavy cup grease. Use recommended torque wrench settings of 90-1000 foot pounds for drawing down the cylinder head cap screws.

CYLINDER SLEEVES: The wet type cylinder sleeves are cast from iron, and hardened. Each sleeve has a shoulder and flange at the upper end to locate it in the crankcase upper deck and prevent shifting and leakage when cylinder head and gasket are secured above it. The lower end of the sleeve is slightly tapered and immediately above the taper are two grooves with synthetic rubber seal rings. The cylinder sleeves are replaceable without special tools and are exposed to the engine coolant for practically their entire length.

REMOVING CYLINDER SLEEVES: After the cylinder head, pistons and rods have been removed, the sleeves can be driven out toward the top of the block with a hard wood block about 2" square and 18" long.

When replacing the sleeves, be sure to use two new bottom synthetic rubber seal rings. Lubricate the seal rings and seal ring grooves in sleeve with a synthetic rubber lubricant (Potash Soap) before applying the rings and again when the rings are in place on the sleeve. Sleeves should slip into position easily and should not be forced, as forcing may shear the rubber seal rings.

PISTONS, CONNECTING RODS AND CRANKSHAFT: The pistons are aluminum with full-floating piston pin. The four-ring piston combination consists of a top chrome plated ring, two type 70 scraper rings and a 3/16" Strut-Flex oil ring.

The crankshaft is fully counterbalanced and has four main bearings. The rod bearings and main bearings are heavy-duty, steel-backed, copper-lead Babbit precision bushings.

OIL PUMP AND CONTROLLED LUBRICATION: The oil pan proper is cast aluminum. Bottom plate can be removed for cleaning the pan and inspection of internal engine parts. The oil pump is a two-section gear type pump. The lower section pumps oil under pressure (25-30 lbs) to the moving parts of the engine, the governor and to the sump of the fuel injection pump. The oil pump is driven from a spiral gear on the camshaft. The top section of the dual oil pump circulates the oil through two cartridge type oil filters and then through an oil cooler and back to crankcase and governor. The oil cooler coil is located ahead of the back engine radiator.

The oil cooler assures normal lubricating oil temperature during extreme high ambient operating conditions. The top section of the pump, therefore, acts as a circulating pump, circulating the lubricating oil through the two oil filters and the oil cooler. Each pump section has a separate pressure relief valve and also separate intake oil screens. The lower pressure section has a "Float-O" type oil screen intake. This type screen intake floats on top of the oil and draws oil from the surface rather than from the bottom of the oil pan.

The lubrication of the engine is maintained by full pressure feed, a system which controls oil delivery to vital parts. The engine governor and fuel injection pump are lubricated from the main engine lubricating system.

The two cartridge-type lubricating oil filters are located on the manifold side of the engine to the left of the fuel oil filter. It is important that a premium grade of heavy-duty detergent type lubricating oil manufactured for use in diesel engines be used. Since a steam heat exchanger is used in the cooling system during cold weather operation, S.A.E. 30 oil can be used both winter and summer.

ENGINE COOLING SYSTEM: The engine cooling system consists of two radiators connected in parallel, with removable four-row thick, heavy-duty cores attached by bolts to cast aluminum top and bottom tanks. Radiators are mounted on either side of the generator. Air for cooling is drawn in through the radiator cores over the generator heat exchangers and is discharged out the generator end of the unit by means of two direct-connected axial flow fans driven independently by two 1/2 H.P. electric motors.

The fan motors operate at two speeds in relation to the engine coolant temperature. Up to a coolant temperature of approximately 180° F. the two fans operate at approximately 2700 R.P.M. and above this temperature they operate at approximately 3400 R.P.M. An adjustable type temperature switch with normally closed contacts is located in one radiator cast header. This switch opens its contacts on rising coolant temperature. This automatically increases the resistance in series with the shunt fields of the fan motors, thereby increasing their speed. One motor normally operates about 200 R.P.M. lower than the other motor at both low and high speeds. A resistor is used to lower the speed of the one motor to minimize resonant fan noise. See wiring diagram Figure 47, page 53.

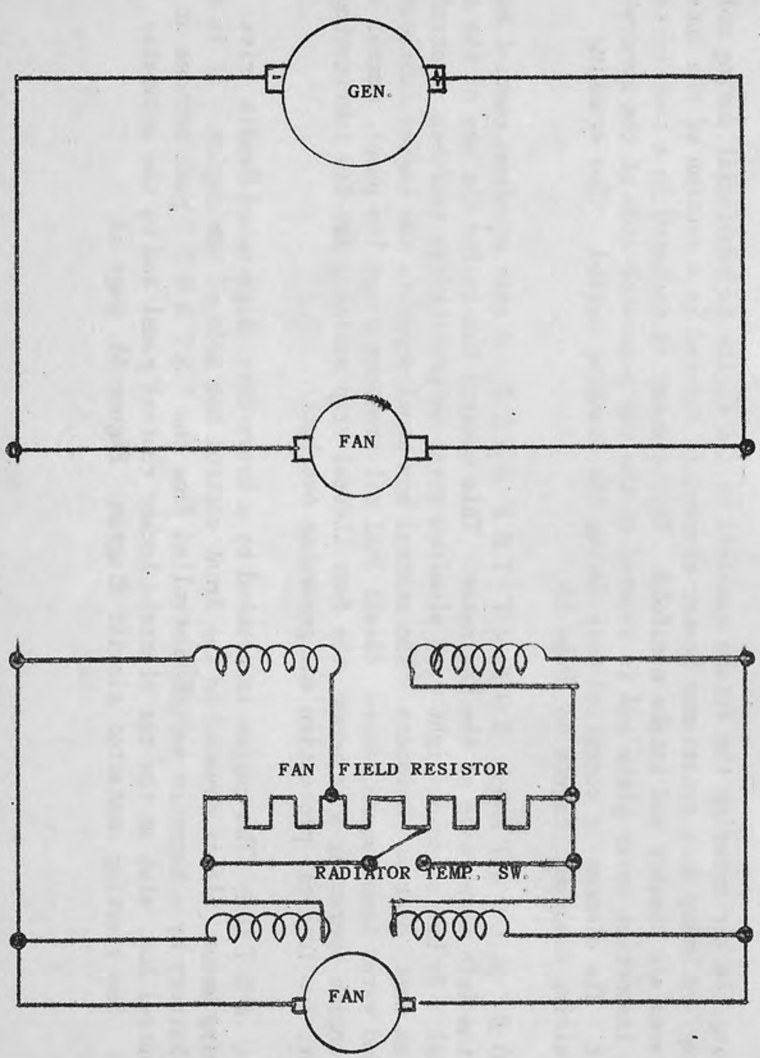
The cooling system is a closed system operating at four lbs. pressure. The pressure relief valve is located in the engine compartment. The test pet cock is used to check the level of the engine coolant and it also acts as an air bleed when filling the system. The coolant level should be checked when the engine is warm and the car or unit is level. Do not overfill - especially in winter when Anti Freeze is used. Add coolant only until it starts to drip out of the pet cock. Be sure to close test pet cock and replace rediator cap.

Coolant is circulated through the cooling system by a circulating pump which is gear-driven from the front end of the crankshaft. This pump is lubricated from the engine. It has a ball bearing impeller shaft and a mechanical or packless type seal. After the coolant leaves the water pump, it enters the engine and is directed about the cylinder sleeves in an even manner. It then passes upward into the cored passages in the cylinder head. These passages are designed to allow coolant access to all areas around the valves and the combustion chambers. The coolant then passes through the radiators and back to the pump inlet.

The engine thermostat is located at the discharge from the engine head and maintains approximately 170° to 180° coolant temperature in the engine block.

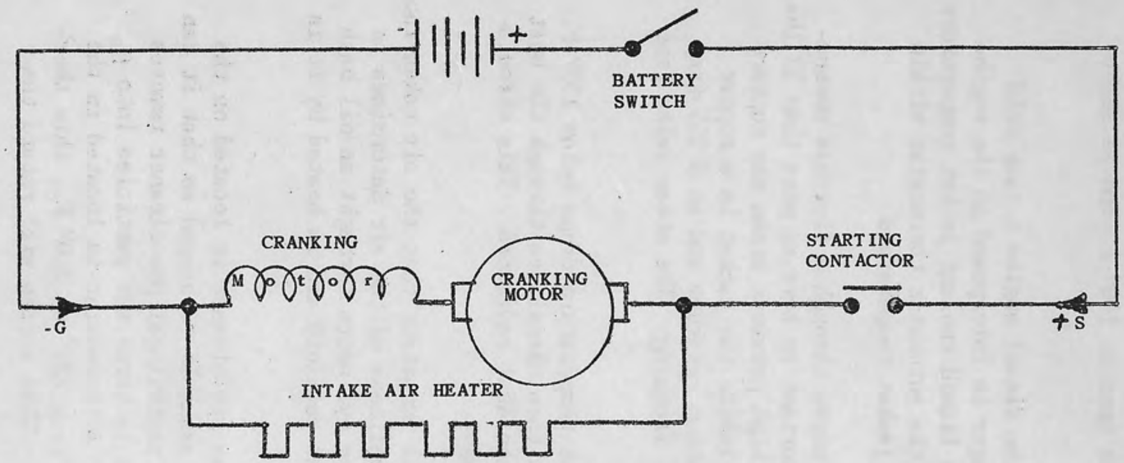
The cooling system should be protected with an Anti Freeze during the months when freezing temperatures are encountered. Refer to Tabulated Data Sheet, Page 94 for capacity of the system.

CLEANING THE ENGINE RADIATOR COOLING SYSTEM: It is important to maintain a clean cooling system. The complete system should be reverse-flushed with approved cleaning solvents to remove grease, sludge, rust and lime deposits. It is important to check and

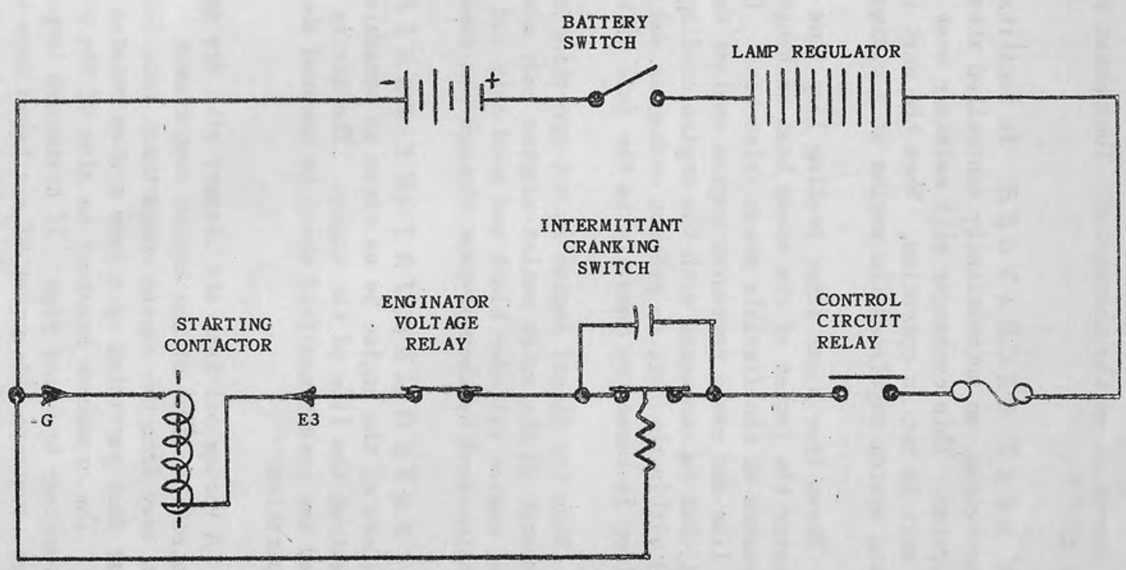


ENGINATOR FANS CIRCUIT.

Figure 47



CRANKING MOTOR CIRCUIT



ENGINE STARTING CONTACTOR CIRCUIT

Figure 48

test the operation of the thermostat. Thermostat should start to open at 170° F. and be fully opened at 195° F.

S T E A M H E A T E X C H A N G E R: To facilitate starting the diesel engine during cold weather operation, an automatically controlled steam heat exchanger is interposed in the engine cooling system. This exchanger will maintain near normal engine liquid coolant jacket temperature when the unit is not in operation. When the unit is operating, the automatic thermostat within the cooling system regulates the engine at a minimum of 170° F. jacket temperature.

Steam from a car floor heating loop (low pressure) is piped through a flexible connection to enter the jacket of the steam heat exchanger. It is important to have no more than 12 lbs. steam pressure at the flexible steam inlet hose. Train line or high pressure steam may rupture flexible line and cause excessive engine coolant temperatures. Inside the jacket is a copper tube coil that is connected with the engine cooling system. A steam retarder and an S 155 trap are piped within the unit to protect exchanger and lines against freezing. The steam inlet from the car loop is turned on manually in the fall of the year.

When the diesel engine is not operating and the coolant temperature drops below 170° F., the thermostat in the water outlet adapter body closes. Coolant then circulates through the heat exchanger, engine cylinder block and head only and not through the dual radiators. This circulation is maintained by thermosyphon through the steam heat exchanger.

A I R C L E A N E R A N D I N T A K E M A N I F O L D: It is important that the air taken into the cylinders of the engine be as clean as possible, as the cleanliness of the air determines to a large extent the life of the engine. The air is drawn into the cylinders throught an oil bath filter and the intake manifold which is mounted above the exhaust manifold and is heated by it in normal operation.

A Vortox oil bath air cleaner with dry centrifugal type pre-cleaner is located on the front control box side of the engine compartment. The complete assembly is hinged so that it can swing out away from the engine compartment into full view. The centrifugal pre-cleaner removes the larger dust particles as a vane system rotates with air flow to throw the particles into a side cup. The crankcase breather is also of the oil bath type. A thermostat is located in the engine crankcase breather pipe. If crankcase temperature rises from 225° to 250° F., this thermostat will restrict the amount of air taken into the crankcase. This action will retard the oxidation of the lubricating oil at high ambient temperature.

Heating the air entering the intake manifold to the engine is beneficial during cold weather starting. A heavy duty resistance heater element is located in a section of the intake air piping between air cleaner and intake manifold. This element is enclosed in a cast section with removable inspection cover plate and is secured to the top generator side of the generator partition sheet. The element is energized only during the cranking period. (See cranking motor circuit wiring diagram, Figure 48, Page 53.

I N S P E C T O R ' S C O N T R O L B O X A T T H E U N I T: A cast aluminum control box is located at the left front side of the Enginator. This control box is for the use of the servicing personnel. It has a gasket-tight cast aluminum cover to protect the switches, controls and instruments from dust, dirt and moisture. The control box panel supports the engine lubricating oil pressure and water temperature gauges, diesel fuel oil pressure gauge (to pump), manual start stop buttons, engine operating hour meter, the four thermal trip switches for low lubricating oil, engine overheat, low fuel oil prptection and generator overheat.

C R A N K I N G M O T O R: The engine is cranked by a heavy-duty, high-speed Bendix drive electric cranking motor. It is mounted on the front control box side of the engine. It is connected to the battery by a magnetic switch controlled from the "S T A R T" push buttons at the inspector's control box, also at the car electric locker control panel and by the automatic starting timer. See starting contactor circuit diagram, Figure 48, page 53.

ENGINATOR PROTECTIVE DEVICES: The Enginator is protected against overheating, loss of lubricating oil, impending depletion of fuel oil and excessive cranking by means of thermal stop switches which must be manually reset if tripped. The generator is also protected against overheating by means of similar thermal stop switches. See control circuit diagram Figure 49, page 56.

The engine heat switch is attached to an adapter on the exhaust manifold. A small quantity of the engine coolant circulates through the switch adapter. If this circulation stops due to loss of coolant, the switch temperature rises, closes its contacts and energizes the thermal trip switch in the inspector's control box. In approximately 30 seconds, the latter switch opens its contacts and de-energizes the solenoid on the fuel pump control rod, through the control circuit relay, stopping the engine.

The engine Low Lubricating Oil Switch is located inside the inspector's control box and is connected to the engine lubricating system. If the engine oil pressure should drop to approximately three lbs., the switch contacts will close, energizing the thermal trip switch in the inspector's control box. In 30 seconds, the thermal switch contacts open and de-energize the solenoid on the fuel pump control rod, stopping the engine.

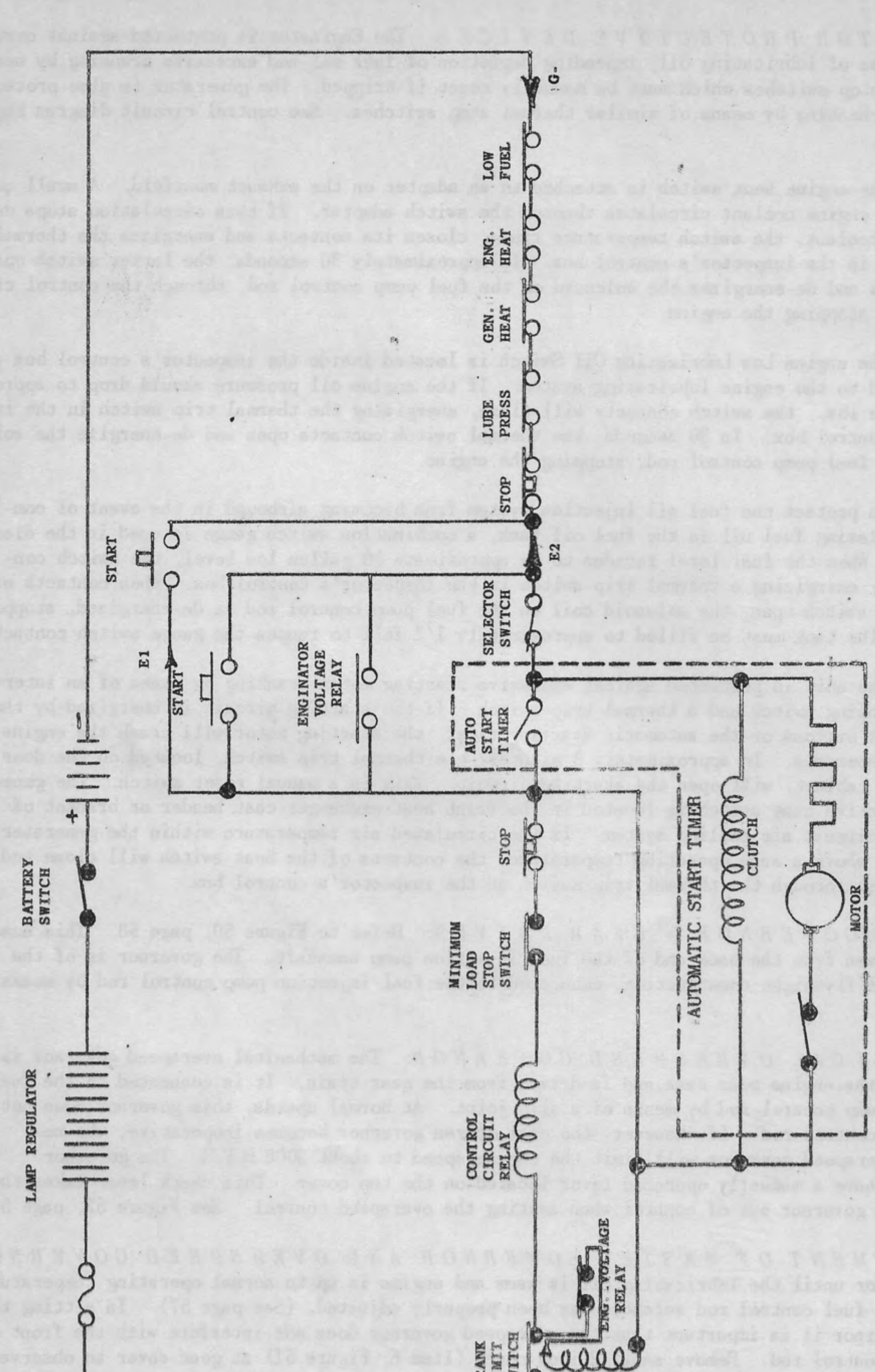
To protect the fuel oil injection system from becoming airbound in the event of completely depleting fuel oil in the fuel oil tank, a combination switch gauge is used in the diesel fuel tank. When the fuel level recedes to an approximate 10 gallon low level, the switch contacts close, energizing a thermal trip switch in the inspector's control box. When contacts of the thermal switch open, the solenoid coil on the fuel pump control rod is de-energized, stopping the unit. The tank must be filled to approximately 1/2 full to reopen the gauge switch contacts.

The unit is protected against excessive starting motor cranking by means of an intermittent cranking switch and a thermal trip switch. If the starting circuit is energized by the manual start buttons or the automatic starting timer, the starting motor will crank the engine for 15 second intervals. In approximately 3 minutes, the thermal trip switch, located on the door of the control cabinet, will open the starting circuit. This is a manual reset switch. The generator protective heat switch is located in the front heat exchanger cast header or bracket of the closed circuit air cooling system. If the circulated air temperature within the generator should rise above a safe operating temperature, the contacts of the heat switch will close and stop the unit through the thermal trip switch at the inspector's control box.

MASTER GOVERNOR - GEAR DRIVEN: Refer to Figure 50, page 58. This assembly is gear-driven from the back end of the fuel injection pump camshaft. The governor is of the conventional flyweight construction, connected to the fuel injection pump control rod by means of a lever.

MECHANICAL OVERSPEED GOVERNOR: The mechanical overspeed governor is located in the engine gear case and is driven from the gear train. It is connected to the fuel injection pump control rod by means of a slip-joint. At normal speeds, this governor does not act on the control rod. If, however, the gear driven governor becomes inoperative, the mechanical overspeed governor will limit the engine speed to about 2000 R.P.M. The governor assemblies have a manually operated lever located on the top cover. This check lever takes the gear-driven governor out of control when setting the overspeed control. See Figure 52, page 59.

ADJUSTMENT OF MASTER GOVERNOR AND OVERSPEED GOVERNOR: Run Enginator until the lubricating oil is warm and engine is up to normal operating temperature. Be sure the fuel control rod solenoid has been properly adjusted. (See page 57) In setting the master governor it is important that the overspeed governor does not interfere with the front end fuel pump control rod. Remove small 2 inch cover (Item E, Figure 51) at gear cover to observe action or location of the overspeed control arm in relation to fuel pump control rod. It should not be touching the fuel pump rod.



ENGINATOR CONTROL CIRCUIT
Figure 49

Adjust master governor spring (Item D, Figure 51) so that engine will run the generator at 1800 R.P.M. full load.

When adjusting the overspeed governor at adjusting screw (Item C, Figure 51) it is important not to have interference from the master governor. Hold the governor check lever located on top cover of master governor to the extreme left to manually take the gear driven master governor out of control. Adjust the overspeed governor spring (Item G Figure 51) tension until the control arm or pin just clears the out notch of the fuel pump control rod at full load.

After the master and overspeed governor adjustment is completed, adjust the dashpot screw (Item F, Figure 51) so that the governor will respond to a change in load and not be sluggish.

FUEL PUMP CONTROL ROD SOLENOID: A solenoid control assembly is used to open the fuel injection pump control rod on starting. It is adjacent to the gear-driven governor assemblies. When the solenoid coil is de-energized to stop the unit, a spring returns fuel pump control rod to a closed position. (Item A, Figure 51).

ADJUSTMENT OF FUEL PUMP CONTROL ROD SOLENOID: The fuel pump rack is held open, when the unit is running, by a solenoid. An opposing spring closes the rack when the solenoid is de-energized on stopping the unit.

The solenoid has a pull-in and hold-in coil. When replacing a solenoid, it is important that the solenoid switch contacts open, de-energizing pull-in coil when plunger is in the running position (rack open). To make adjustment, remove solenoid cover and observe the contacts when solenoid is energized. Contacts should be open. Adjustment can be made at the yolk end of plunger shaft.

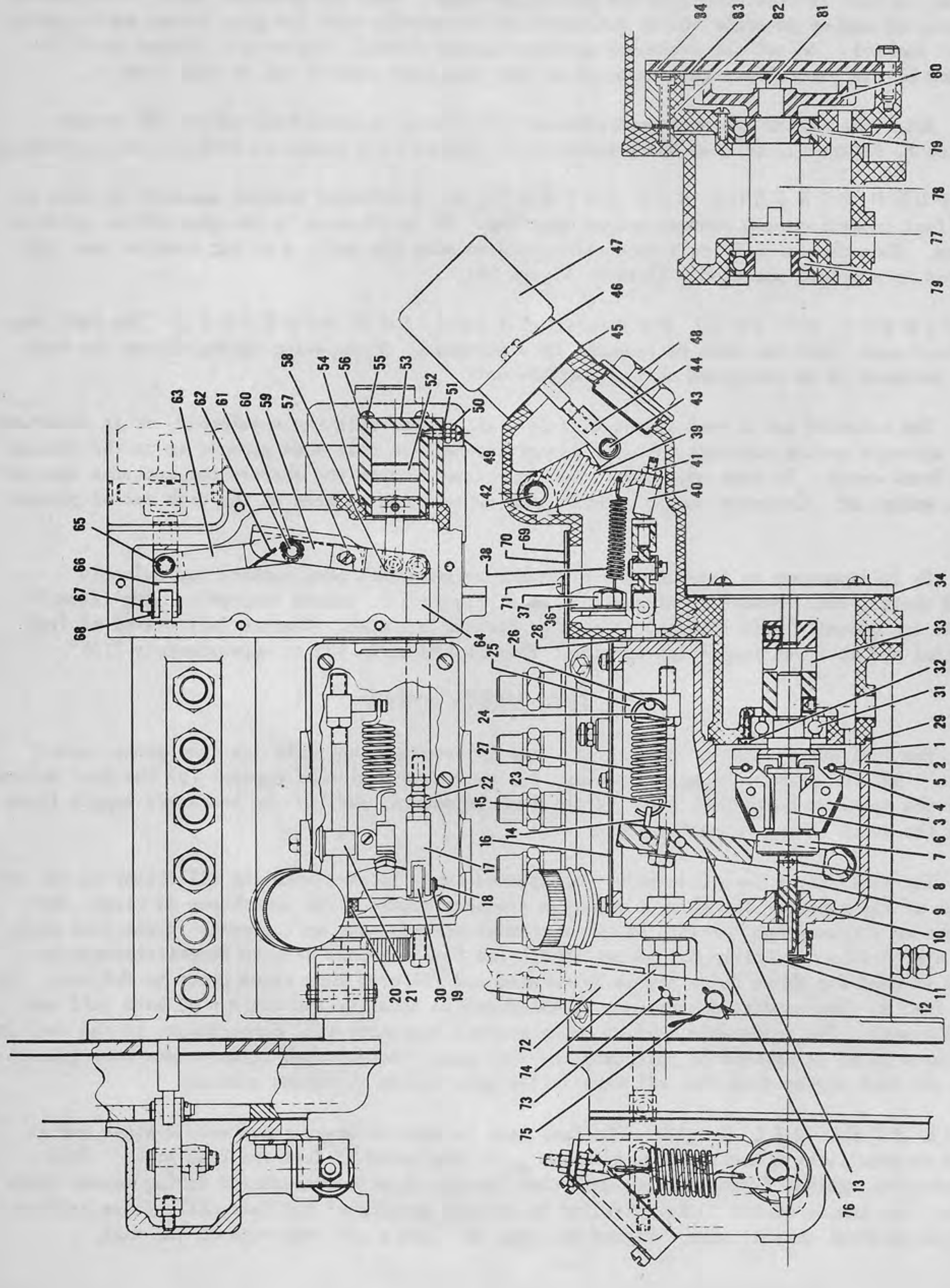
It is important to have correct clearance between fuel pump control rod solenoid lever and control rod. Remove front cover (Item E, Figure 51), remove inspection plug (Item H, Figure 51) and manually hold solenoid to open or running position. Measure full travel of fuel pump control rod at front inspection opening. This should be a .435 or approximately 7/16".

FUEL SUPPLY SYSTEM

The fuel supply system consists of the (1) storage tank with its fuel gauge, vent lines, etc. (2) The primary or transfer pump, (on the inboard side of engine) (3) the fuel sediment bowl, (4) the American Bosch fuel pump (5) the fuel injectors, and (6) the necessary supply lines including the steel tubing to each injector.

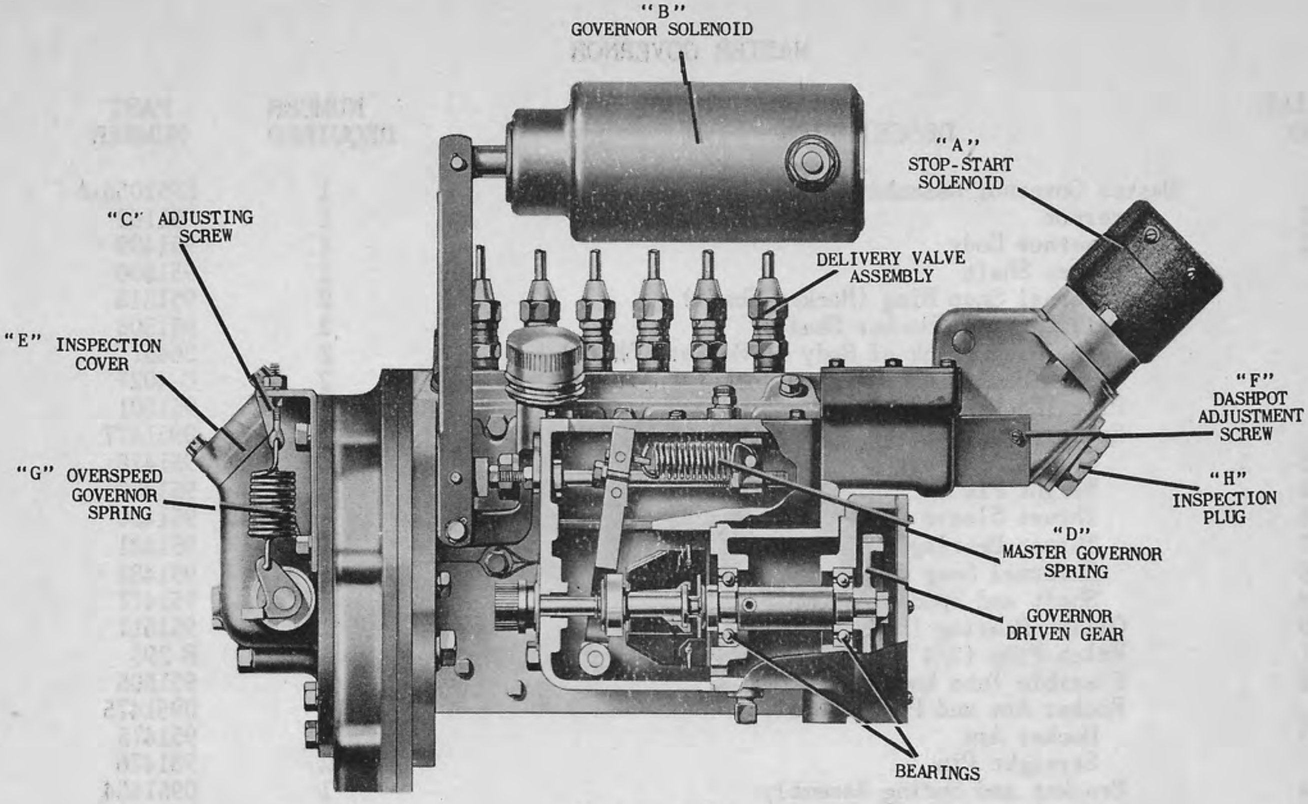
The fuel filter is a renewable, wast packed type, located with the oil filter on the inboard side of the engine. The element requires frequent change. The importance of clean, dry fuel cannot be stressed too forcibly since tolerances between some moving parts in the fuel pump and the injectors is two millionths of one inch. The fuel commonly used in Diesel-electric locomotives is used for these units and is dehydrated and filtered many times prior to delivery. To keep the fuel in this condition care must be exercised in handling and storage of both full and empty containers. The condensate from an empty storage container will cause damage to the fuel injector system if it is allowed to pass into the fuel pump. Screens and filters have been incorporated in the fuel system from fuel oil tank filler body to the injection nozzles.

DIESEL FUEL OIL TANK: The fuel tank is made of heavy gauge welded steel and is protected externally by a sectional wire screen guard supported 1" from the tank walls. This gives protection against flying ballast and other foreign objects encountered during normal train operation. The inside of the tank is baffled to prevent surging of the fuel oil. These baffles also act as internal support ribs. Figure 44, page 48 shows a cut-away view of the tank.



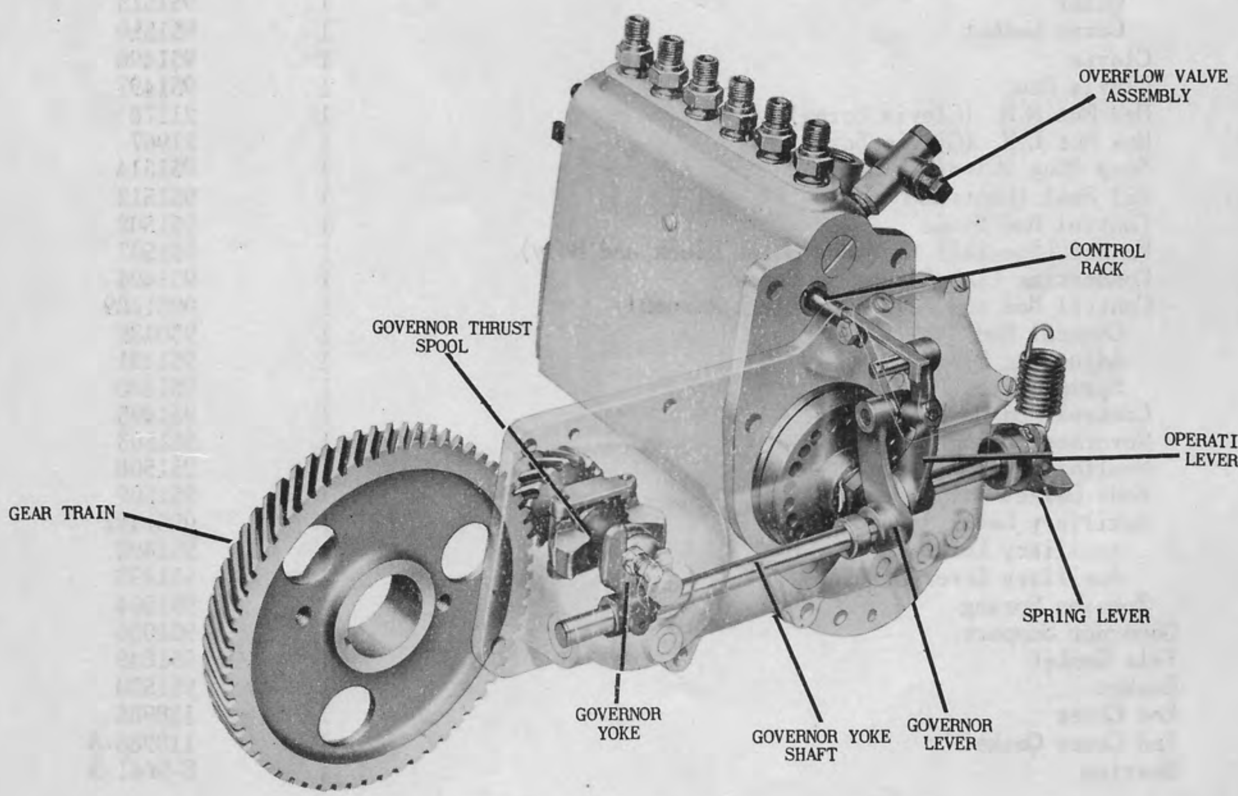
MASTER GOVERNOR, GEAR DRIVEN

Figure 50



MASTER GOVERNOR

Figure 51



OVERSPEED GOVERNOR

Figure 52

MASTER GOVERNOR

ILLUS. NO.	DESCRIPTION	NUMBER REQUIRED	PART NUMBER
	Master Governor Assembly	1	E951056-A
1	Governor	1	951162
2	Governor Body	1	951499
	Rocker Shaft	1	951500
	External Snap Ring (Rocker Shaft)	2	951513
	Ball Bearing (Rocker Shaft)	2	951506
	Welch Plug (Back of Body at Rocker (Shaft)	2	26457
	Groove Pin (Rocker Arm to Rocker Shaft)	2	B-4027
	Plug (Rocker Shaft)	2	951501
	Spider Shaft and Weight Assembly	1	0951477
3	Weight Assembly	4	951478
4	Weight Pin	4	951479
6	Thrust Sleeve	1	951480
7	Thrust Bearing	1	951481
8	External Snap Ring	1	951483
9	Shaft and Spider Assembly	1	951477
10	Oilite Bearing (Body at Drive Shaft)	1	951511
11	Welch Plug (3/4") (Lock Drive Nut)	1	B-295
12	Flexible Tube End Swivel Nut	1	951505
	Rocker Arm and Pin Assembly	1	0951475
13	Rocker Arm	1	951475
	Straight Pin	2	951476
14	Bracket and Spring Assembly	1	0951484
	Bracket	1	951484
	Spring Connector	1	951485
	Compression Spring	1	951486
	Washer (Special Lock)	1	951487
	Spring Bracket to Rocker Arm	1	21272
15	Top Cover Plate	1	951488
	Oiler	1	951515
16	Cover Gasket	1	951510
17	Clevis	1	951498
18	Clevis Pin	1	951497
	Hex Nut R.H. (Clevis Screw)	1	21178
	Hex Nut L.H. (Clevis Screw)	1	21967
19	Snap Ring (Clevis Pin)	1	951514
20	Oil Seal (Control Rod)	1	951512
21	Control Rod Guide	1	951502
	Washer (Special) (Between Guide Block and Body)	1	951507
22	Connecting Link Adjusting Screw	1	951494
	Control Rod and Adjusting Block Assembly	1	0951489
23	Control Rod	1	950489
25	Adjusting Block	1	951491
26	Spring Pivot Pin	1	951490
	Control Rod Bushing (Body)	1	951495
27	Governor Spring	1	951503
28	Sealing Ring "O" Type	1	951508
29	Body Gasket	1	951509
30	Auxiliary Lever Assembly	1	0951492
	Auxiliary Lever	1	951492
	Auxiliary Lever Bushing	1	951493
	Torsion Spring	1	951504
	Governor Support	1	951056
	Felt Gasket	1	951849
	Gasket	1	951520
	End Cover	1	118985
	End Cover Gasket	1	118986-A
31	Bearing	1	B-9641-A

MASTER GOVERNOR

ILLUS. NO.	DESCRIPTION	NUMBER REQUIRED	PART NUMBER
34	Motor Gasket	1	950909-A
36	Spring Support	1	951087
38	Extension Spring	1	951089
39	Shut-Off Lever Assembly	1	0951084
	Shut-Off Lever	1	951084
	Bearing	1	951095
40	Plunger	1	951083
41	Hex Nut	1	21264
42	Lever	1	951086
	Expansion Plug	1	B-536
43	Link Pin	1	41508
44	Solenoid Rod Adapter	1	951085
45	Solenoid Gasket	1	951107
47	Shut-Off Solenoid	1	951134
49	Dashpot Adjusting Screw	1	951431
52	Dashpot Piston	1	951430
	Dashpot Piston Link	1	951432
	Dashpot Piston Pin	1	951433
53	Dashpot Cylinder	1	951428
54	Dashpot Gasket	1	951429-A
57	Link Pin Clip	1	951435
58	Governor Beam Pin	1	951434
59	Governor Beam	1	951069-A
60	Beam Bushing	1	951308
61	Beam Center Pin	1	951071-A
62	Beam Center Pin Spring	1	951072
63	Fuel Pump Beam	1	951070-A
64	Governor Adapter Link	1	951092-A
65	Link Pin	1	41508
66	Pump Adapter Link	1	951082
	Button	1	44625
67	Link Pin	2	951706
68	Washer	2	B-141
	Cotter Pin	2	21058
69	Governor Support Cover	1	0951058
	Pipe Plug	1	Y-14179-A
70	Cover Gasket	1	951059
71	Round Head Machine Screw	6	21101
72	Governor Control Rod	1	951228
73	Control Block Pin	1	951231
74	Control Rod Block	1	951229
75	Control Lever Pin	1	951230
	Cotter Pin	2	21058
76	Governor Accelerator Bracket	1	951227
77	Governor Stud Shaft Spline	1	951348
78	Governor Shaft Spline	1	951853
	Groove Pin	1	B-5456
79	Bearing	2	B-9641
80	Governor Driven Gear	1	951356
	Driven Gear Key	1	951376
	Governor Drive Gear (Injection Pump)	1	951350
	Key	1	26482
82	Governor Gear Housing	1	951496
	Square Head Pipe Plug	1	78282-C
	Injection Pump Stud	4	39064
	Copper Washer	4	B-4188
	"O" Ring	1	951054-B
	Gasket	1	951520
	Injection Pump Gasket	2	118986-A
83	Governor Gear Cover Gasket	1	951704
84	Governor Gear Cover	1	951075

TANK ACCESSORIES AND FITTINGS: The 3" Protectoseal filler cap and body assembly and the tank vent are protecto ventline fittings, both are of the approved flame arrestor type, similar to those used on diesel locomotives. A special fuel supply line cap is located on top front side of the tank for connecting the oil line to the Enginator and also the return oil line from the Enginator. The top connection is the fuel supply outlet and the bottom connection the fuel return line. Both are marked. The outlet connection is piped to within a short distance from the bottom of the tank. The flared inlet end of this pipe is fitted with a bronze mesh strainer screen which can be removed for inspection and cleaning.

The fuel oil gauge serves two purposes. Besides indicating the fuel oil level in the tank, it is electrically connected to the enginator to stop the engine prior to depletion of the fuel oil. This prevents the admission of air into the fuel injection system.

A two-in one removable plug is located at the bottom of the fuel oil tank sump. This large 3" pipe plug can be removed for tank cleaning and flushing. In the center of the 3" plug is a small 3/4" pipe plug which can be used for oil draining.

STEAM HEAT FOR FUEL OIL TANK: It is necessary to provide auxiliary steam heat to the diesel fuel oil during cold weather operation to insure constant flow of the fuel oil to the Enginator. Low ambient temperature tends to congeal the fuel oil. Automatic control of the steam heat is provided through a 1668 admission valve. Excessive auxiliary heat and high ambient temperatures will tend to agitate the oil, causing air bound fuel lines.

All tanks have a built-in heat exchanger coil at tank bottom. Tanks are equipped with steam trap support bracket and the temperature control switch. The 1668 steam solenoid valve, retarder and S-155 steam trap are located near the tank.

It is important to provide no more than 12 lbs. maximum inlet steam pressure from car heating loop. The temperature switch at the top of the fuel tank controls the steam solenoid valve, opening and closing this valve according to temperature demand. The switch closes contacts at approximately 50°F. and opens contacts at approximately 60° F.

FUEL OIL TANK SERVICING: The operation of the fuel level gauge should be checked twice per year or as requirement demands. Connect electrician's test lamp across terminals (9 and 10) at the unit control receptacle. Drain oil from the tank and check the oil level switch for point of contact. Switch contacts should close when the oil level recedes to approximately 10 gallons of empty position of the gauge needle.

The protectoseal vent should be removed and cleaned in a solvent. The bronze mesh strainer or screen at the supply line intake should be inspected and cleaned. This can be done by removing the six cap screws holding the inlet and outlet oil line cap fitting. The cap, inlet pipe and screen assembly can now be removed.

THE PRIMARY OR TRANSFER PUMP is of the common plunger type, conventional driven from the engine cam shaft. This pump transfers the fuel from the storage tank, through the fuel filter and sediment bowl to the Bosch fuel pump. The sediment bowl must be removed and cleaned on each three week inspection. A manual handle is provided on the pump for purging air from the fuel system before starting the engine.

THE AMERICAN BOSCH FUEL PUMP is located on the front side of the engine. It is gear driven (in time) from the engine crankshaft and performs the following: (1) Delivers a measured amount of fuel to each injector, under high pressure, at the proper time. (2) Through a load sensing coil, additional fuel is delivered to maintain speed when heavy generator loads are applied. The master governor controls engine speed at 1200 R.P.M. for loads below 12 K.W. or at 1800 R.P.M. for loads from 12-1/2 to 25 K.W. A mechanical overspeed governor, prevents the engine from damage at overspeeds, (tearing off) when load is suddenly removed from the generator. A solenoid provides remote control of engine shut down. It is important that all fuel lines and fittings be tight.

Surplus fuel not used by the injection pump and surplus injector fuel is returned to the fuel tank by means of a 3/8" copper return line. Relief pressure from within the injection pump sump forces the return oil back to the fuel oil tank. The camshaft compartment of the injection pump is lubricated with motor oil taken directly from the outlet of the two lubricating oil filters. The return or discharge from the camshaft compartment is to the engine crankcase. It is very important that a flow of oil be maintained through this line to assure long injection pump life.

There are six fuel injectors of the inward-opening pintle type which are adjusted at the factory to open at approximately 1500 lbs. fuel pressure. Adjustments should not be attempted in the field unless a test stand is used. The injector spray pattern is checked in the field and the nozzles may be cleaned in a carbon solvent.

The American Bosch pump proper is shown in cross section on Figure 53, page 64. Figure 51, page 59 shows a side view of the pump with the governor, load sensing coil, remote control shut down, and overspeed governor mount.

The Bosch pump is gear driven through an adjustable drive coupling. This coupling provides for timing the pump to the engine. With the engine flywheel rotated to align the F.P. mark on the flywheel with the pointer on the inspection opening, the fuel pump drive coupling mark should be aligned with the mark on the front pump bearing cover. This will provide pump timing on the No. 1 cylinder at 22° before top dead center on the compression stroke. The cam shaft of the pump sets firing order at No. 1-5-3-6-2-4.

The Bosch pump is of the constant stroke cam actuated, lapped plunger type. That is, the plungers which force the fuel to the injectors, are "lapped in" with their individual barrel. The plunger makes the same movement or stroke regardless of the amount of fuel delivered on each stroke. A cam forces each plunger up on its stroke and a spring returns it for the next stroke. The cam shaft is ball bearing mounted in end plates. The cam shaft compartment of the pump is lubricated with engine lubricating oil directly from the oil filters and discharges oil to the engine crankcase. The felt wiping cushions in the closing plugs of the housing base assist in the lubrication of the cams and roller followers of the tappet assemblies.

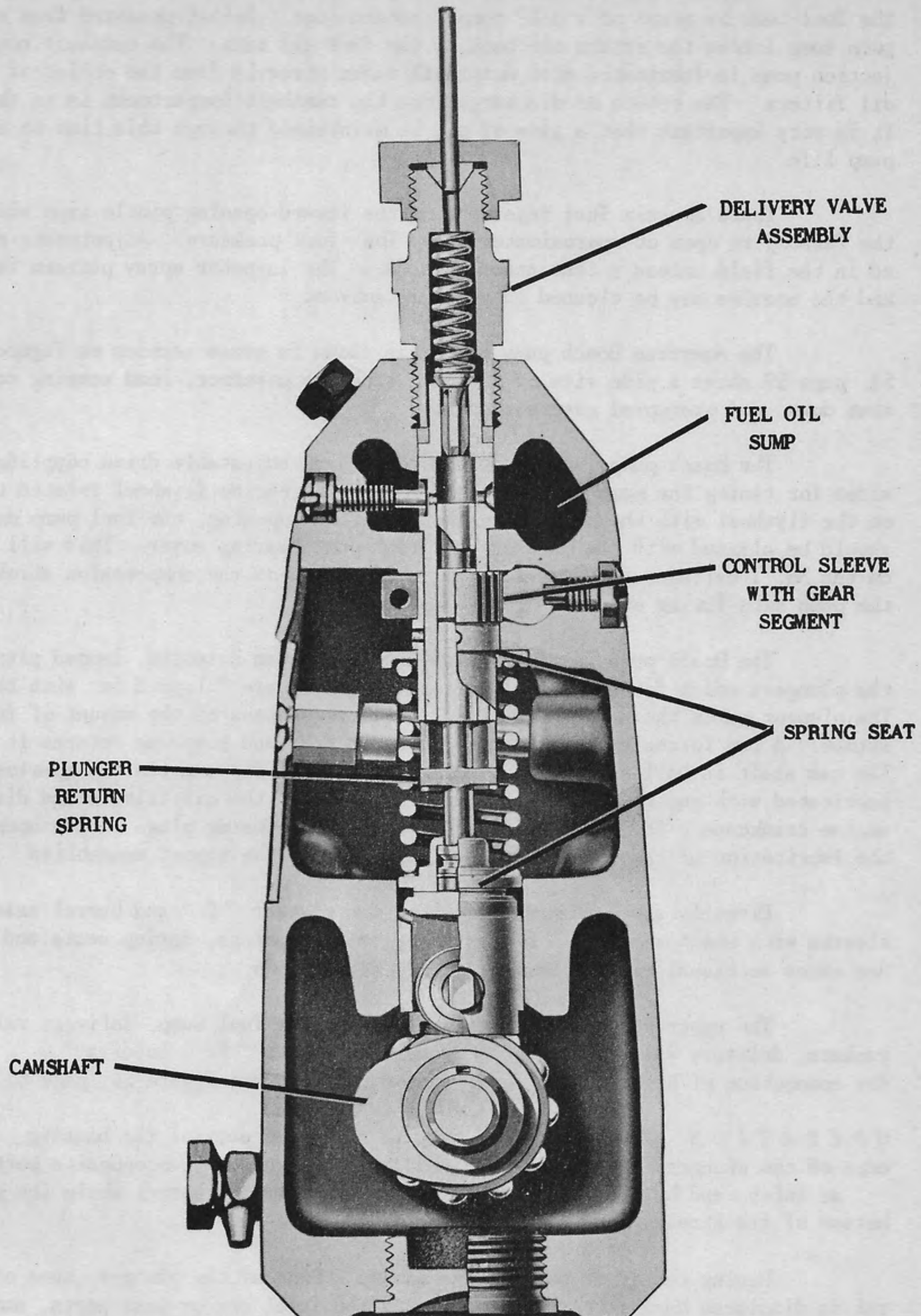
Directly above these are located the plunger "C" and barrel assemblies "A", control sleeves with tooth segments "B", plunger return springs, spring seats and the control rod "D". See cross sectional view of barrel, Figure 54, page 65.

The upper part of the housing contains the fuel sump, delivery valve assemblies with gaskets, delivery valve springs "E", delivery valve "F", holders "G", and nipple nuts "H" for connection of high pressure or injector tubing. See Figure 54, page 65.

OPERATION: Fuel enters the sump in the upper part of the housing. As soon as the upper edge of the plunger, during its downward stroke, opens the two opposite ports in the barrel, known as inlet and by-pass ports, the fuel rushes into the barrel while the plunger is at the bottom of its stroke. See Figure 54, page 65. (54-1)

During the first part of the upward stroke of the plunger, some of the fuel in the barrel is displaced back into the sump through the inlet and by-pass ports, until these two ports are completely closed. See Figure 54-2. Shortly afterwards, the fuel is placed under pressure, the spring-loaded delivery valve is lifted off its seat, and the fuel is delivered through the discharge tubing into the spray nozzle, whence it is discharged into the combustion chamber of the engine.

Delivery of fuel ceases as soon as the helix on the plunger passes the by-pass port in the barrel, for at this instant the pressure chamber communicates with the sump by way of vertical groove and helix on the plunger, allowing the fuel not yet delivered in the discharge tubing to by-pass back into the sump. See Figure 54-3.



AMERICAN BOSCH MULTI CYLINDER INJECTION PUMP

Figure 53

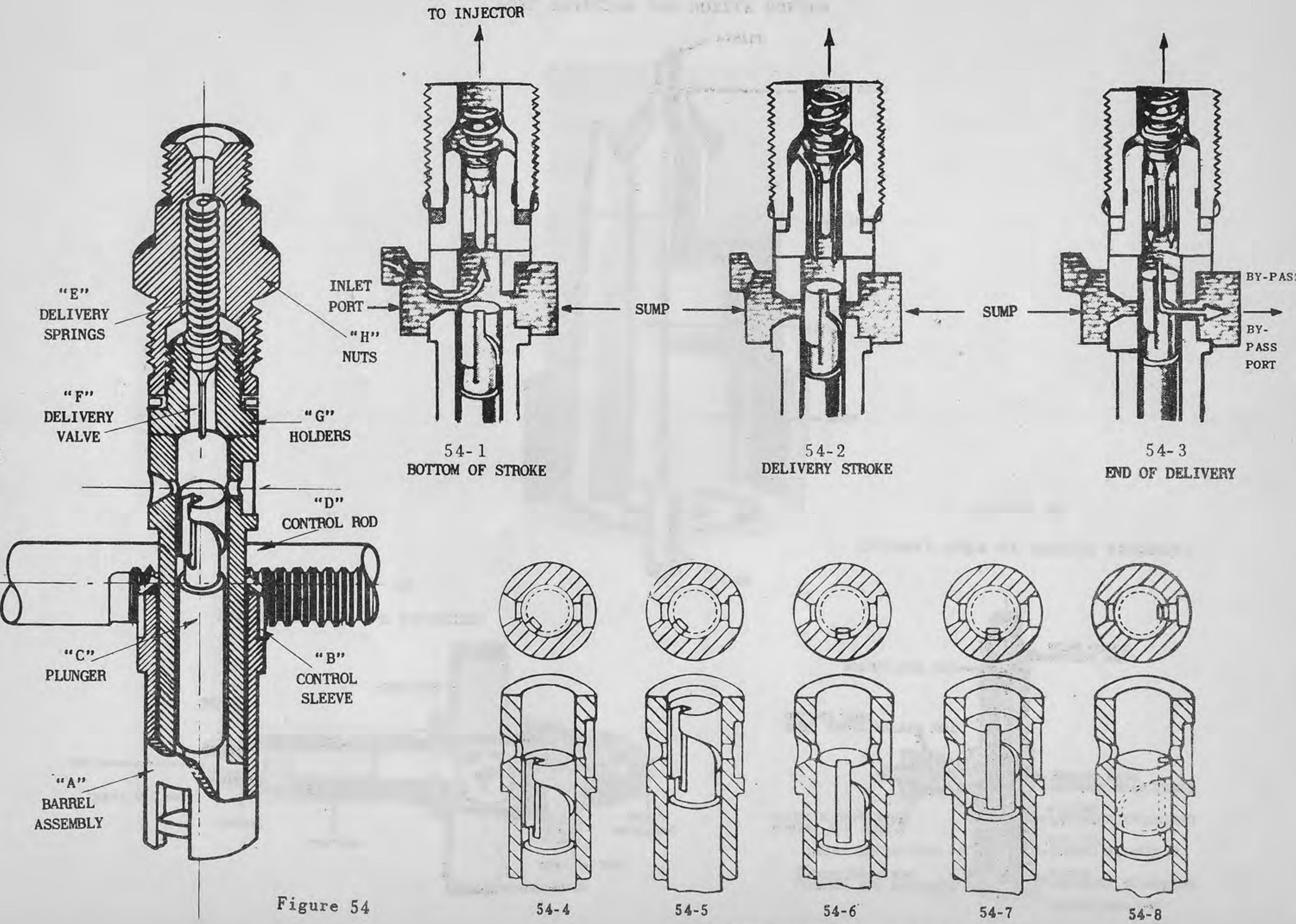
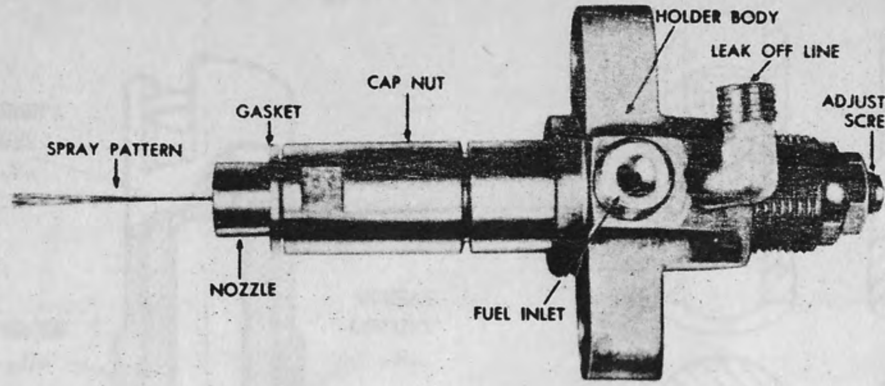


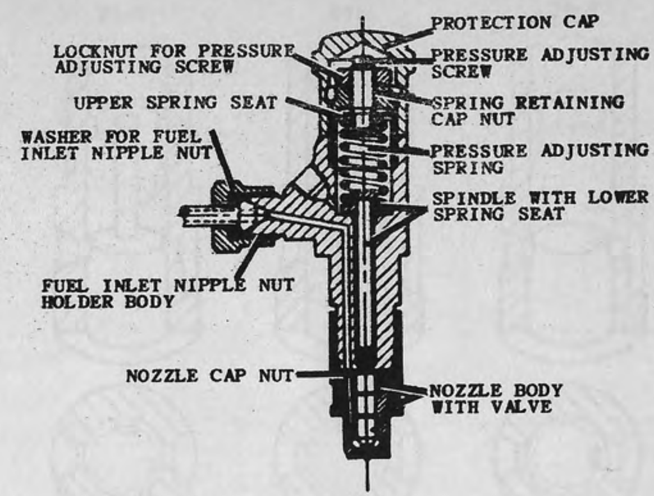
Figure 54

VARIOUS POSITIONS OF BARREL



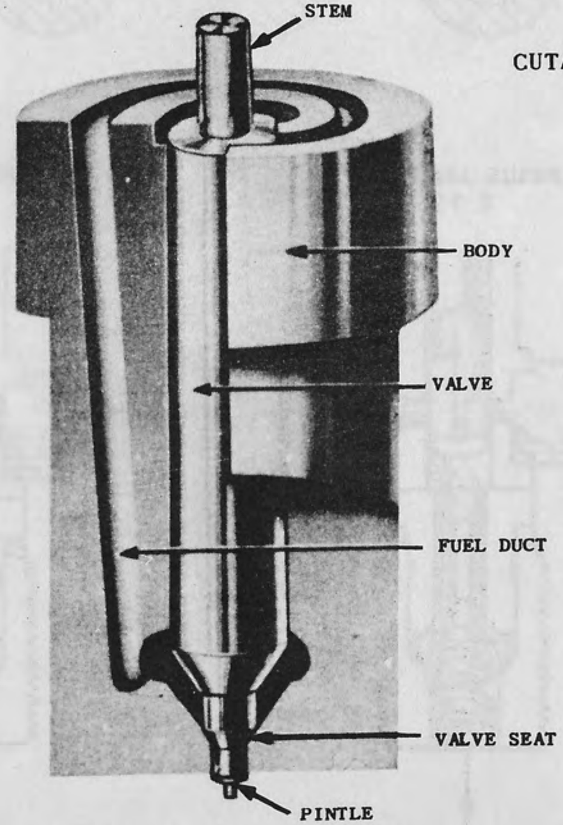
CROSS SECTION OF INJECTOR

Figure 55



CUTAWAY VIEW OF NOZZLE ASSEMBLY

Figure 56



FUEL INJECTOR AND NOZZLE HOLDER

Figure 57

The termination of the fuel delivery, which also controls the quantity of fuel delivered per stroke, is varied by turning the plunger in its barrel, i.e., by bringing the helix into various positions with relation to the by-pass port. To accomplish this, a control sleeve, " A ", Figure 54 is slipped over the barrel, the sleeve being provided with a toothed segment " B ", at its upper end and with two longitudinal, opposite slots at its lower end in which the cross flange of the plunger " C " is guided. The teeth of the gear segment engage corresponding teeth on the control rod " D ", and by shifting the latter, by means of the governor, the plunger is rotated in its barrel in either direction.

The less the control is moved away from its " stop " position and the less the plunger is thereby turned in its barrel, the sooner the helix opens the by-pass port, and the smaller the fuel delivery per stroke will be. See Figure 54-4,5,6,7,8. The farther the control rod is moved away from its " stop " position and the farther the plunger is turned in its barrel, the later the helix opens the by-pass port and the larger the fuel delivery per stroke will be. Figure 54-4 and 5. For maximum fuel delivery, the plunger, by moving the control rod farthest away from its " stop " position, is turned farthest in its barrel, resulting in very late opening of the by-pass port by helix, i.e., in the maximum effective plunger lift. For zero delivery, with the control rod in the " stop " position, the plunger is turned in its barrel until its vertical groove registers with the by-pass port. See Figure 54-8. In this position, the pressure chamber in the barrel is in constant communication with the sump during the entire mechanical stroke of the plunger; therefore, no fuel is delivered by the latter.

When the helix of the plunger uncovers the by-pass port in the barrel, Figure 54-7, during the latter part of the upward stroke, the pressure in the barrel is immediately released and the delivery valve " F " is quickly returned to its seat by the combined action of its spring " E " and the great difference in pressure which then exists between the barrel and the discharge tubing. This closes off communication between the pressure chamber in the barrel and the nozzle until the next delivery stroke takes place. In returning to its seat, the delivery valve performs a double function; first, it prevents excessive draining of fuel from the discharge tubing during by-passing, as well as during the suction stroke of the plunger; second, it relieves the pressure in the discharge tubing. This pressure relief is accomplished by means of the accurately lapped relief or displacement piston provided on the delivery valve proper below its conical seat and above its flutes.

Before the delivery valve actually reseats after the helix of the plunger has uncovered the by-pass port in the barrel, it reduces the pressure in the discharge tubing by increasing the volume therein by a quantity equal to the volume of the relief piston, for the latter slides down into the delivery valve seat with a plunger-like action. As a result of this rapid reduction in pressure, the nozzle valve at the other end of the discharge tubing " snaps" to its seat, thus instantaneously terminating the fuel injection from the spray nozzle and thereby eliminating " dripping".

The external control of the fuel delivery per stroke is accomplished by means of the control rod " D " Figure 54, one end of which is connected to the governor of the engine. There is a certain amount of dead movement of the control rod in its " stop " position, i.e., the rod must be moved by about 3/16" from its full stop position before delivery of fuel commences. From that point on, however, the quantity of fuel delivery is directly proportional to the movement of the control rod.

Speed and power output are controlled solely by a variation of the amount of fuel injected into the combustion chamber. This variation of the amount of fuel delivered by the injection pump to the nozzle is regulated by the simple action of the helix on the plungers.

The external control of this action is by means of the control rod attached to the governor.

F U E L I N J E C T O R S: Description - The function of the injectors is to direct the metered quantity of fuel received from the injection pump into the engine combustion chamber in a definite spray pattern and in such a manner as to produce the most efficient engine performance. See Figures 55 and 56, page 66.

The injectors use a spring-loaded valve with a seat near the spray orifice to close the orifice after each injection of fuel into the engine combustion chamber. The valve is operated hydraulically by the pressure of the fuel oil being delivered by the injection pump.

Injectors consist of three main parts: The nozzle holder, nozzle spring, and nozzle valve, see Figures 55 and 56. The nozzle valve and body are lapped to form a mated assembly. This lapped fit is so close that measurement of it is impracticable except by a specially designed hydraulic instrument. The body and valve cannot be exchanged singly but must be kept together at all times as a unit after cleaning or servicing. Body and nozzle valve are shown in Figure 57, page 56.

The nozzle holder is used to hold the nozzle in its correct position in the cylinder head and to provide a means of conducting fuel oil to the nozzle. The holder also contains the necessary spring and means of pressure adjustment, which is a slotted screw held in place by a locknut.

At its upper end, the nozzle valve has an extension of reduced diameter, referred to as the "stem", which contacts the lower end of the spring loaded spindle. Adjustment of nozzle valve opening pressure, which is 1500 lbs. sq. in., is accomplished by means of the spring adjusting screw. Turning it clockwise increases the spring tension and consequently the injection pressure. Turning it counterclockwise reduces the spring tension and the injection pressure.

Operation of the nozzle valve and holder assembly is as follows. The metered quantity of fuel from the injection pump enters the holder through the inlet connection and passes through connecting ducts to the pressure chamber just above the nozzle valve. At the instant the pressure of the fuel exceeds the pressure with which the nozzle valve is held at its seat by the spring, the valve is lifted from its seat and fuel flows from the nozzle until delivery from the pump ceases. Then, a positive, instantaneous cut-off of fuel occurs as the valve is snapped to its seat by the spring force which eliminates after dripping.

A certain amount of seepage of fuel between the lapped guide surfaces of the nozzle valve and its body is necessary for lubrication. This leakage oil accumulates around the spindle and in the spring compartment, from which it drains through the leakoff connections and lines provided for this purpose.

Service: The injectors and nozzles are manufactured to precision accuracy. If it is necessary to inspect and clean the nozzles, the following instructions should be used as a guide. In outlining the procedure for inspection and cleaning, the necessity of cleanliness cannot be overemphasized. A clean workbench, clean washing fluid containers, clean tools, and clean hands are all necessary to produce satisfactory results.

Causes of Nozzle Trouble: Dirt, water and heat cause most injector troubles. Dirt, consisting of minute abrasive particles, damages the valve seats, the fit of the stem, and erodes or clogs the nozzle orifices and causes sticking of the needle in its guide. Water in the fuel causes corrosion which results in enlarged nozzle orifices and sticking needle valves. It is very important, therefore, that only clean fuel gets into the nozzle. The filters should be drained regularly and absolute cleanliness observed. The effect of heat on the nozzle is usually due to "cracking" of the fuel resulting in hard carbon deposits and varnish. If the engine is overloaded, troubles of this type occur. Therefore, it is obvious that operating the engine at high temperatures must be avoided.

USING HYDRAULIC NOZZLE TESTER: The Diesel Nozzle Tester, shown in Figure 58, page 70 is a precision instrument capable of producing 7,500 pounds of pressure per square inch, to prevent damage to the gauge of the nozzle tester, *DO NOT EXCEED 3,000 POUNDS PRESSURE.* The injectors or nozzles are tested for leakage, valve opening pressure, and spray pattern. *CAUTION: WHEN TESTING NOZZLE DO NOT OBSTRUCT THE OIL SPRAY AS IT LEAVES THE NOZZLE OR TRY TO RETAIN THE USED OIL. KEEP HANDS AWAY FROM SPRAY AT ALL TIMES.* Use only clean Diesel fuel oil or flushing oil in the tester tank.

TESTING FOR LEAKAGE: While the absence of dribble is generally required for the throttling, pintle-type nozzle, it is recommended a tester stroking speed of not less than 100 strokes per minute be employed. If the speed is lower, the throttling action of these nozzles will cause them to dribble and eject "flags", making the nozzle appear to function improperly. However, if the nozzle does not leak or dribble within 300 pounds of the specified opening pressure (1,500 pounds), the valve seat may be considered tight. If drops, dribbles or a jet appears, the valve is not seating properly. Thorough cleaning usually corrects the trouble.

OPERATING THE NOZZLE TESTER:

1. Remove the cork from the end of the coupling and operate the lever socket until the oil flows.

2. Attach the nozzle and holder assembly, as shown in Figure 58.

3. Close the valve and apply a few quick strokes to lever. If lever operates extraordinarily hard, it indicates plugged nozzle. Note the spray pattern as shown in Figure 58, page 70 and look for leakages as indicated above. If plugged or if there is leakage, the nozzle should be removed, cleaned and lapped according to the instruction on the following pages. If the injection pressure is not 1500 pounds, the nozzle must be adjusted as given below.

ADJUSTING INJECTION PRESSURE: Remove the nozzle protecting cap, exposing the pressure adjusting screw and locknut. Pressure is adjusted by turning adjusting screw shown in Figure 55, page 66.
Repeat the adjustments and test until the proper pressure is obtained.

DISASSEMBLE AND CLEAN NOZZLE AND NOZZLE HOLDER:

1. Wipe all dirt and loose carbon from the assembly with a clean cloth free of lint.

2. Clamp the holder assembly in a vise to remove the nozzle holder nut and spray nozzle.

3. Normally the nozzle valve can be easily withdrawn from the nozzle body. However, in some cases, it may be necessary to soak the nozzle in fuel oil, acetone carbon tetrachloride, or a similar carbon solvent before removal is possible. Do not permit the polished surfaces of the nozzle to come in contact with any hard or abrasive substances.

4. The nozzle valve can be cleaned with mutton tallow used on a soft cloth or a soft pad. The valve may be held by its stem in a revolving chuck during this operation. A piece of soft wood well soaked in oil will be helpful in removing the carbon from the valve

   NOTE: Hard or sharp tools, emery cloth, crocus cloth, grinding compound, or abrasives of any kind should never be used in cleaning the nozzles.

5. The inside of the nozzle body may be cleaned by forming a piece of soft wood, well soaked in oil, the point of which will correspond to the angle of the nozzle valve seat. The orifice of the pintle may be cleaned with a wood splinter.

   The outer surfaces of the nozzle body may be cleaned with a soft cloth soaked in the carbon solvent. Do not attempt to scrape carbon from the surfaces around the orifice as serious damage might result; use a soft brass wire brush but nothing harder than this.

6. Thoroughly rinse both the valve and nozzle body in clean fuel oil before assembly.

LAPPING VALVE SEAT TO NOZZLE: Wash the pintle valve and the pintle valve body in clean fuel oil by swashing and brushing with a soft wood stick. Cloth or paper might leave lint on the pintle and should not be used. *NOTE:* Hold the valve at the stem end only. Using oil for a lubricant, lap the valve seat by rotating the valve back and forth in the body. Time and patience are often required in removing the particles of dirt from the pintle valve. *NOTE: ABRASIVE MATERIALS SHOULD NOT BE USED* in lapping the pintle in the body because of the extremely close tolerance between them, which is measured in millionth of an inch.

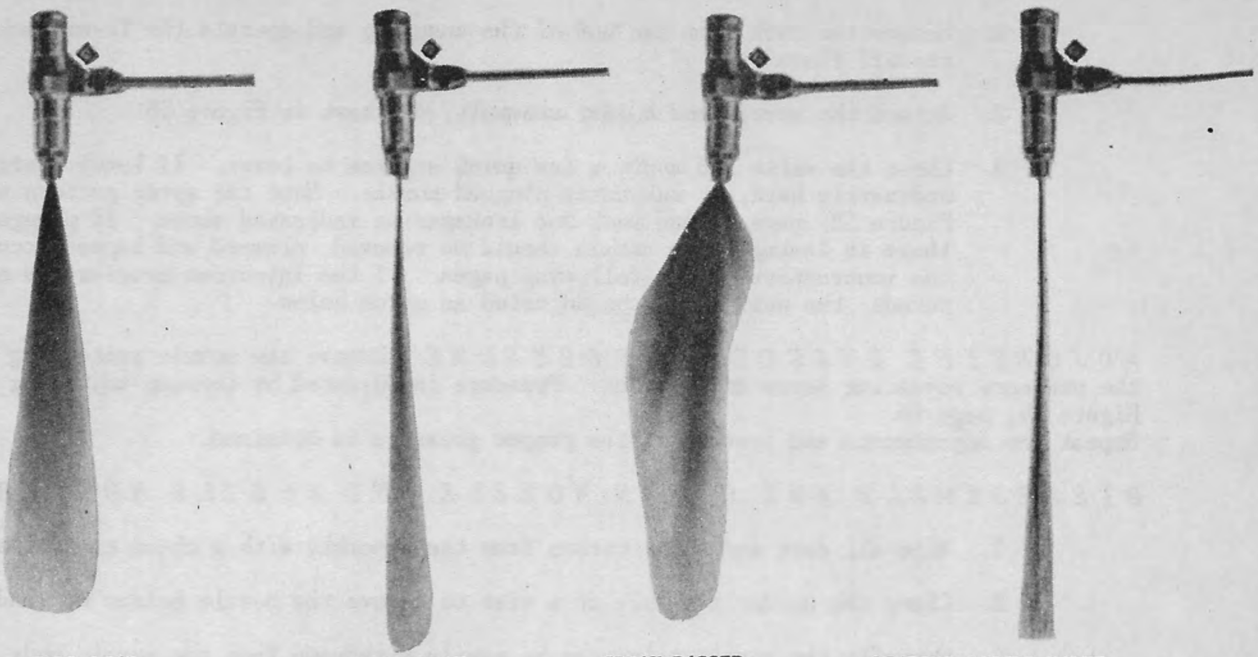
DISASSEMBLY, CLEANING AND REASSEMBLY OF NOZZLE HOLDER:

1. Remove cap nut and gasket.

2. Loosen jam nut and spring tension adjusting screw.

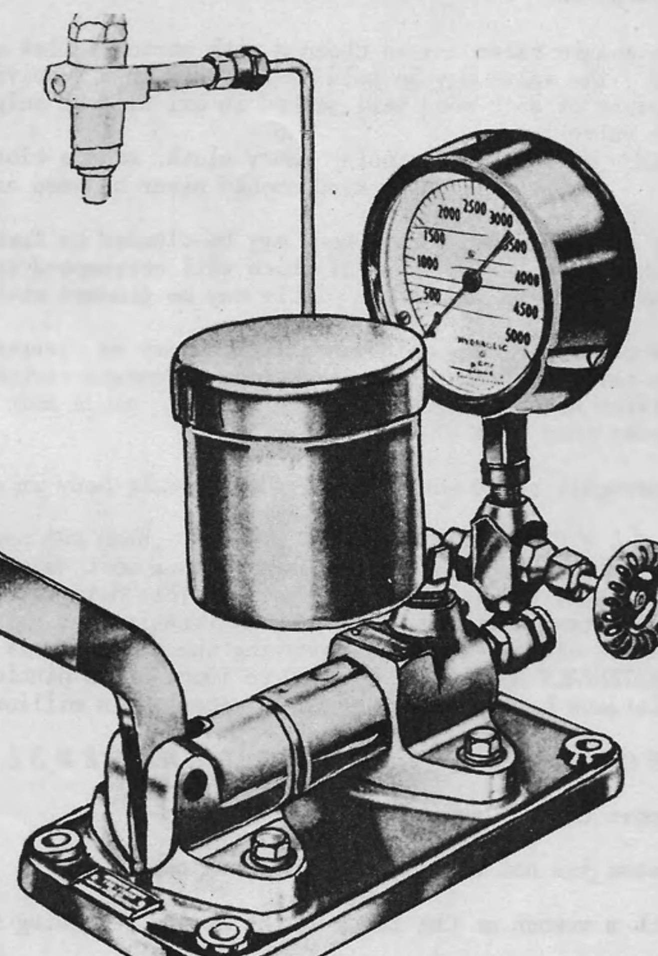
3. With a wrench on the flats of the spring retaining nut, remove retaining nut.

4. Remove spring and spindle. Wash the parts thoroughly in fuel oil or gasoline. Examine the small end of the spindle for any irregularities when it contacts the nozzle stem. If the contact surface is pitted or rough, replace the spindle. Check the spring seat for tightness to spindle and cracks or worn spots. Replace if necessary. To reassemble, reverse the above procedure, leaving the spring adjusting



FULL LOAD SPRAY PATTERN | IDLE SPRAY PATTERN | SPRAY RAGGED UNSATISFACTORY | LEAKING NOZZLE VALVE UNSATISFACTORY

FUEL INJECTOR SPRAY PATTERN



NOZZLE TESTER

Figure 58

nut loose.

REASSEMBLY OF NOZZLE TO HOLDER.

1. Thoroughly rinse the lapped end of the nozzle holder shank and the corresponding surface of the nozzle to assure a clean seat between the surfaces.

2. Remove all carbon from the nozzle cap before reassembly.

3. It is essential that the nozzle be perfectly centered in the cap nut, and for this purpose, an assembling sleeve should be used with the nozzle. If no centering sleeve is at hand, insert a feeler gauge between the nozzle body and cap nut.

4. Reinstall injector in nozzle tester and reset injection pressure.

ASSEMBLE INJECTOR TO ENGINE:

1. Thoroughly clean the nozzle recess in the cylinder head before reinserting the nozzle holder assembly. Particular attention should be paid to the seating surfaces in order that no small particles or carbon will cause the assembly to be cocked or permit blowby of the combustion gases. No hard or sharp tools should be used for this cleaning operation. A round piece of wood or brass properly shaped is very effective.

2. Always install new injector gaskets. It is essential that there be no carbon flakes on the surfaces which the gasket seals.

3. The assembly should be carefully inserted so that the nozzle tip does not strike against the recess wall.

4. The assembly securing nuts should be tightened evenly so that there is no sticking of the injector in the cylinder recess. This would result in the nozzle valve being bound in the body, making it inoperative.

5. Connect the high pressure tubing and the leak-off lines. Make sure they are securely tightened.

TIMING FUEL INJECTION PUMP TO ENGINE. Timing the fuel injection pump to the engine is relatively simple. Remove the top inspection cover in the flywheel housing located in the generator compartment. The flywheel is stamped for the opening position of engine valves No. 1 cylinder and also fire position. By means of a screw driver in flywheel ring gear, turn the engine over in the direction of normal rotation until the No. 1 cylinder is on compression stroke or firing point. This is 22^{o} before top center. The firing point can be accurately established by means of the flywheel marking F.P. and the pointer being centered in the inspection opening on the flywheel housing.

Now rotate the fuel pump drive coupling on the pump until the mark on the rotating member and the mark on the front pump bearing cover are in alignment. Assemble the drive gear to the coupling. The drive gear and coupling hub have multiple attaching holes. Rotate the gear until two opposite holes are in line. Fasten gear to pump coupling. Fasten pump to the support bracket. Do not exchange pump drive couplings, as couplings are marked in relation to the pump timing at the factory.

Connect the high pressure fuel oil lines to the injectors. The outlet closest to the gear cover goes to the No. 1 cylinder, pump end of the engine. Connect remaining 5 lines in the same sequence. The internal timing of pump plungers takes into consideration the firing order 1,5,3,6,2 and 4.

NOZZLE TROUBLES AND REMEDIES: For the operator's guidance a list of the most common nozzle troubles, their causes and remedies, is given in the following.
If, after exhausting the list of remedies given, the performance of the engine still indicates difficulties with the nozzles, install new or service injectors in the engine.

NOZZLE TROUBLES AND REMEDIES

Trouble	Causes	Remedy
1. Nozzle Opening Pressure Too High	a. Pressure adjusting screw set incorrectly.	a. Adjust pressure adjusting screw correctly and secure setting with its locknut.
	b. Nozzle valve seized in nozzle body.	b. Try to free valve by clamping stem tip in a vise. OR replace nozzle. *WARNING:* Place sheets of brass between jaws to avoid injury to part. Twist nozzle body very carefully with a circular motion to free valve.
	c. Nozzle valve stuck in body due to cocking.	c. See Note "A."
	d. Spray hole clogged.	d. Clean hole, then clean nozzle with gasoline and compressed air.
2. Nozzle Opening Pressure Too Low.	a. Pressure adjusting screw incorrectly set.	a. Adjust pressure setting screw as above.
	b. Pressure adjusting screw broken or nozzle valve stuck in body due to cocking.	b. Replace pressure adjusting screw. Also see Note "A".
3. Dripping of Nozzle.	a. Nozzle valve leaking due to damaged seat or stuck valve on account of cocking.	a. If valve seats are damaged replace complete nozzle. Otherwise, see Note "A".
4. Fuel Spray Distorted (Shows Flags).	a. Nozzle tip cocked or nozzle valve damaged.	a. If nozzle valve is damaged, replace complete nozzle. Otherwise see Note "A".
5. Excessive Overflow from Leak-Off Connection on Nozzle Holder.	a. Too much play in Nozzle Valve.	a. Replace complete nozzle.
	b. Cap Nut insufficiently tightened.	b. Tighten cap nut.
	c. Dust, grit or scale from tubing between the lapped surfaces of nozzle body and holder shank.	c. Remove nozzle and thoroughly clean the lapped surfaced with gasoline and compressed air.
	d. Marred or scored lapped surfaces of nozzle body and holder shank.	d. This may sometimes be corrected by lapping both surfaces singly on a smooth flat surface such as plate glass, etc. by using a mixture of talcum powder and fuel oil or rouge and fuel oil. This requires several hours of such lapping. Hold the part to be lapped low or near the lapping surface to avoid cocking the part and hence uneven grinding.

NOTE "A".

Soak nozzle in carbon tetrachloride, acetone, Bendix cleaner, Karbonoff or a similar non-corrosive cleaner and then remove lossened carbon with a soft dry cloth or brass wire brush.

W A R N I N G

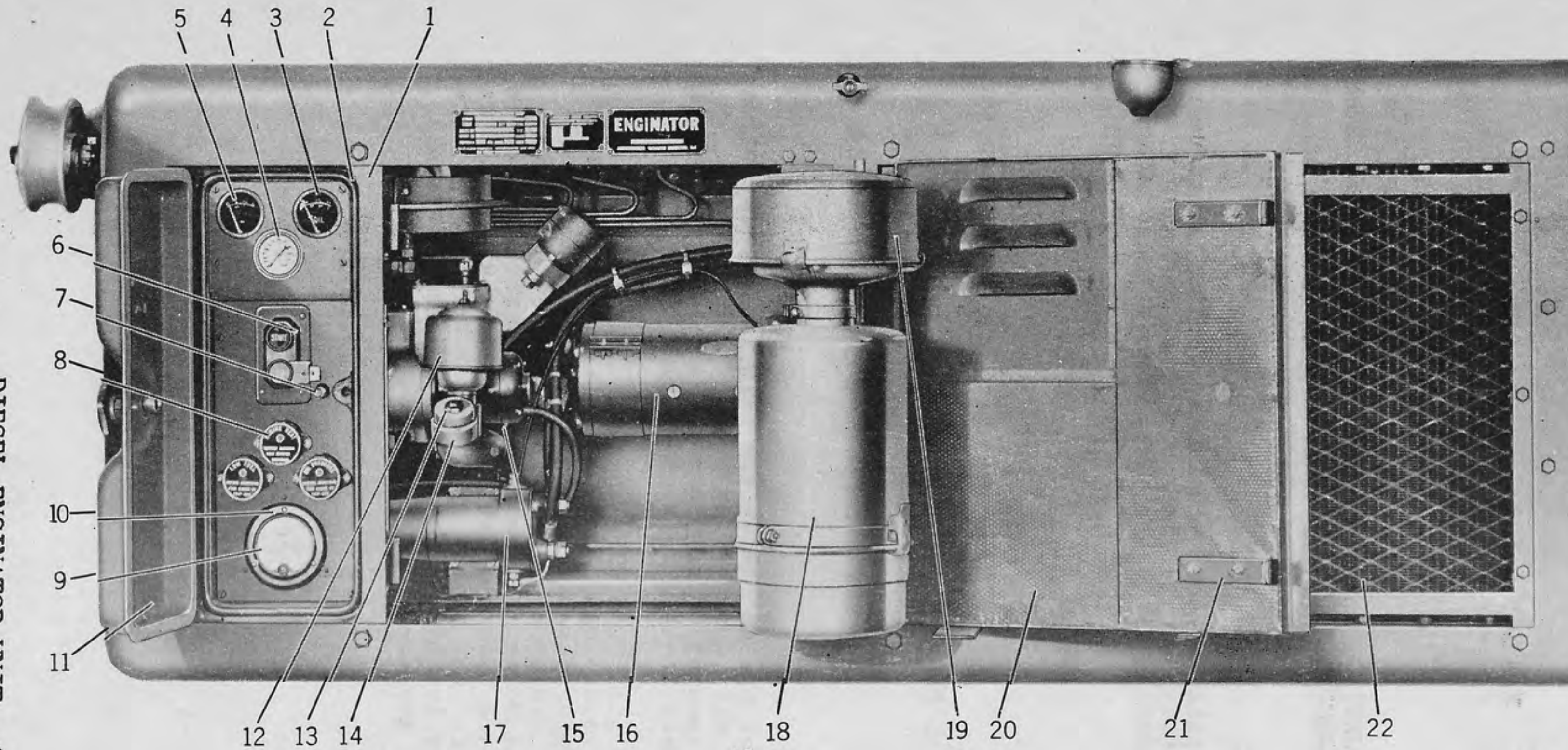
SUBJECT: *DANGER OF INJURY TO HANDS AND FINGERS WHEN TESTING SPRAY NOZZLES AND ADJUSTING NOZZLE HOLDERS.*

The fuel spray of a nozzle in operation has sufficient penetrating power to puncture the flesh of the fingers or hand and destroy the tissues. The fuel entering the blood stream may cause blood poisoning.

Therefore: *H A N D S O F F A S P R A Y I N G N O Z Z L E*

Generally, when the fuel oil punctures the skin, no harmful effect will result. When the oil, however, enters the blood stream, it may result in blood poisoning in some cases, particularly when the injury is not immediately treated by a physician.

It is, therefore, of utmost importance and absolutely essential that in the event of injury resulting from the discharge of a spraying nozzle, first aid should be resorted to by washing the injured part with a 3% Boric Acid solution and supporting the injured finger or hand by a splint so that the injured part will remain absolutely at rest. The injury should then be examined by a physician, particularly in those cases where inflammation and festering of the wound are observed.



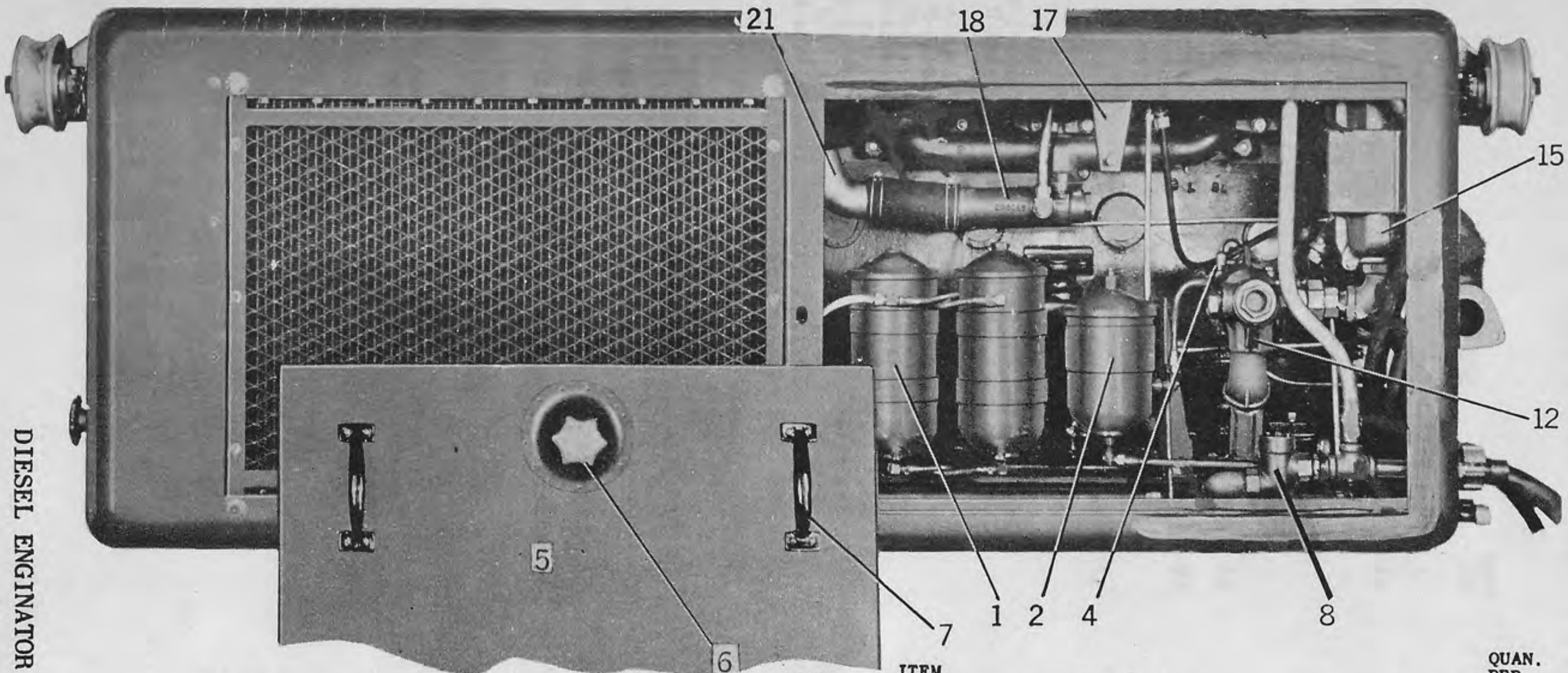
ITEM NO.	DESCRIPTION	PART NO.	QUAN. PER UNIT
1	Control Box	A950377	1
2	Control Box Gasket	Y-6287-K	1
3	Fuel-Oil Pressure Gauge	50003-H	1
4	Temperature Gauge	Y-18592	1
5	Oil Gauge	50003-C	1
	Gasket	951392	1
	Pressure Switch	950036	1
	Wire Assembly (D.C. Control)	OY-19246-V	2
	Aircraft Wire	Y-19246-P	1
	Solderless Lug	Y-18984-A	1
	Solderless Lug	Y-18984-D	1
	Terminal Sleeve	Y-19154	2
6	Push Button Switch Assembly	OY-18149-C	1
	Push Button Switch Cover	Y-18150-C	1
	Push Button Switch	Y-18149	1
7	Control Box Stud	950401	1
8	Cut-Out Switch (Low Fuel Oil)	Y-6146-A	1
	Half Minute Element	Y-6311-B	1
	Resistor	950739	1
	Cut-Out Switch (Engine Heat)	Y-6146-A	1
	Half Minute Element	Y-6311-B	1
	Resistor	950739	1
	Cut-Out Switch (Oil Pressure)	Y-6146-A	1
	Half Minute Element	Y-6311	1
	Resistor	950739	1

DIESEL ENGINATOR UNIT - FRONT VIEW

Figure 59

DIESEL ENGINATOR UNIT - FRONT VIEW - Cont'd.

ITEM NO.	DESCRIPTION	PART NO.	QUAN. PER UNIT
9	Time Meter	951367	1
	Solderless Lug	Y-18984-D	2
	Terminal Sleeve	Y-19154	2
	Adapter Ring	951370	1
	Wire Cont. Box - Mag. Sw.	951372-A	1
	Solderless Lug	Y-18984-D	1
	Solderless Lug	Y-18984-B	1
	Terminal Sleeve	Y-19154	2
	Cord Grip	951049	1
	Wire Cont. Box - Resistor	951372-B	1
	Solderless Lug	Y-18984-C	1
	Cord Grip	951049-B	1
	Wire Cont. Box - Resistor	951372-B	1
	Solderless Lug	Y-18984-C	1
	Cord Grip	951049-B	1
10	Meter Mounting	Y-18920	1
	Two-Wire Tirex - Engine Heat	Y-6785-A	1
	Solderless Lug	Y-18984-D	2
	Solderless Lug	Y-18984-A	2
	Cord Grip	Y-6867-A	1
	Two-Wire Tirex Fuel Solenoid	Y-6785	1
	Solderless Lug	Y-18984-A	2
	Solderless Lug	Y-18984-D	2
	Cord Grip	Y-6867-A	1
	Three-Wire Tirex - Starter	Y-14908-B	1
	Solderless Lug	Y-18984-D	3
	Solderless Lug	Y-18984-B	1
	Terminal Lug	951336	2
	Cord Grip	Y-6867-A	1
	Wire Assembly - Gov. Motor	AY-19246-D	3
	Aircraft Wire	Y-19246-C	1
	Solderless Lug	Y-18984-D	1
	Terminal Sleeve	Y-19154	1
	Amphenol Receptacle	951195	1
	Three-Wire Tirex - Gen. Com.	Y-6778-F	1
	Solderless Lug	Y-18984-D	3
	Cord Grip	Y-6867-A	1
11	Control Box Cover Assembly	0950376	1
	Control Box Cover	950376-A	1
	Spring	Y-20181	2
	Hinge Pin	950402	2
	Pin	951172	2
	Control Box Knob	Y-6161-A	1
	Gasket	B-7695	1
	Snap Ring	B-9578	1
	Guide Pin	951182	1
12	Oil Bath Breather	78589-A	1
	Oil Bath Breather Stud	OY-7325	1
13	Oil Filler Cap	Y-7072	1
14	Oil Filler Elbow Assembly	0951063	1
	Oil Filler Elbow Gasket (Elbow to Case)	118986	2
	Oil Bath Breather Adapter	Y-7324-A	1
	Oil Filler Neck	Y-7074	1
	Oil Gauge Bushing	951197	1
15	Oil Level Gauge Assembly	0950945	1
16	Starting Motor	951131	1
	Starting Motor Spacer	950939	1
	Terminal Lug	951336	6
17	Magnetic Switch (Starter Solenoid)	951132	1
	Conduit Bushing	951301	2
	Conduit Bushing	Y-18277	4
	Cable Term. Box Motor	Y-18997-Q	1
	Cable Starter - Magnetic Switch	951445-D	1
	Cable Magnetic Switch - Term. Box	951445-A	1
	Cable Term. Box Resistor	951445-B	1
	Cable Resistor Starting Motor	951445-C	1
	Terminal Sleeve	Y-19154-K	8
	Solderless Lug	Y-19145	2
	Solderless Lug	Y-19145-B	6
	Wire	Y-6775-J	1
	Solderless Lug	Y-18984-B	1
	Terminal Lug	951336	1
18	Air Cleaner	950962	1
	Air Cleaner Gasket	B-4855	1
	Gasket	951074	2
	Air Cleaner Elbow Support	950414	1
	Air Cleaner Elbow	950415	1
	"O" Ring	951054-A	
19	Precleaner	950963	1
20	Service Door Assembly	A951167	1
21	Spring	950626	2
	Hinge Tube	0950785	1
	Spring	Y-20181	2
	Pin	951172	2
	Hinge Pin	950402	2
	Latch Stop (On Frame)	950627	2
22	Radiator Guard	950852	2

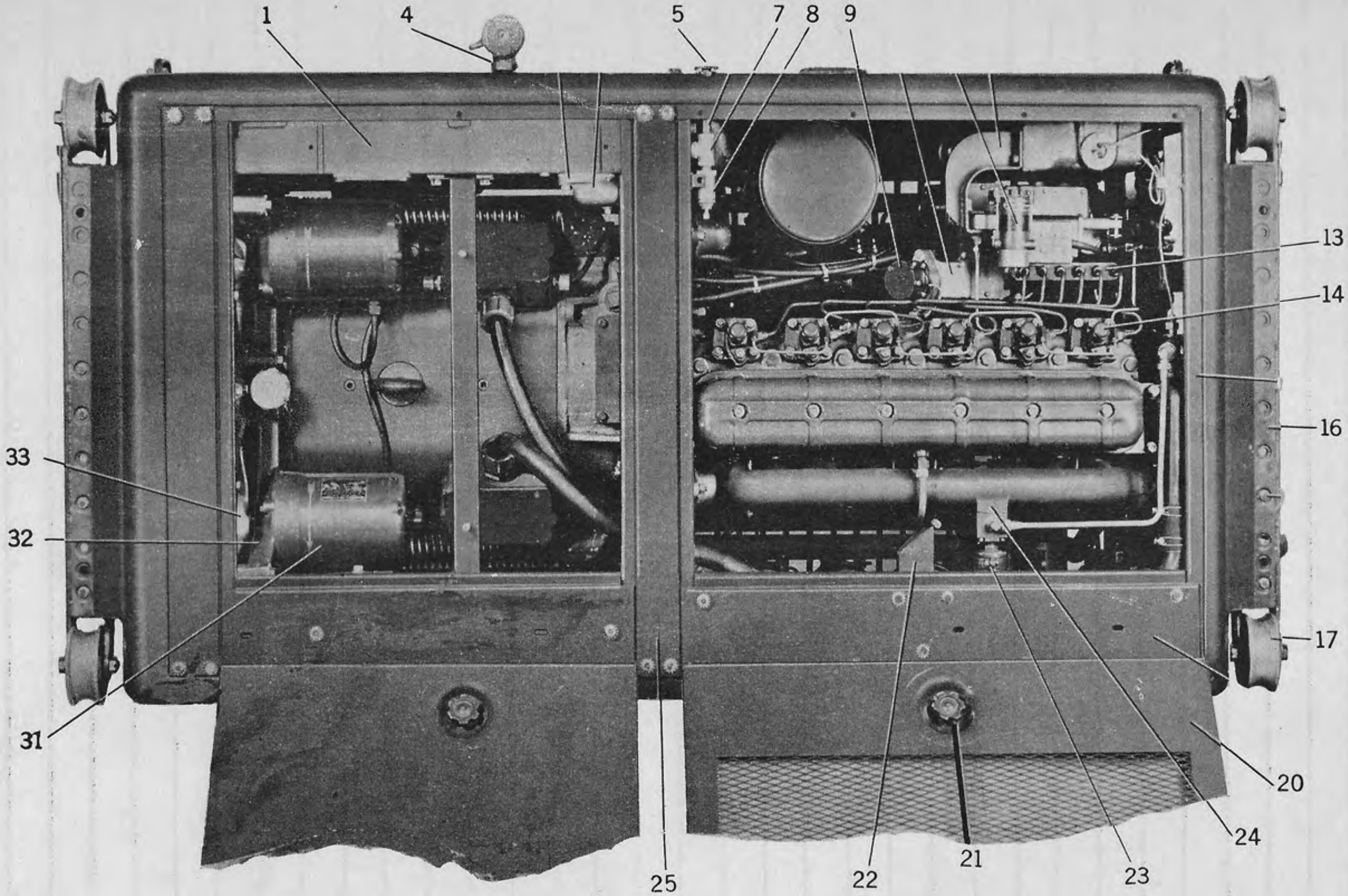


ITEM NO.	DESCRIPTION	NO.	QUAN. PER UNIT
1	LUBRICATING OIL FILTER	950964	2
	LUBRICATING OIL FILTER ELEMENT	60369	2
	COPPER GASKET	B-5149	1
2	FUEL OIL FILTER	950965	1
	FUEL OIL FILTER ELEMENT	951746	1
4	FUEL SUPPLY PUMP	60204-A	1
	FUEL SUPPLY PUMP GASKET	9519697	1
	PUMP ADAPTER PLATE	951868	1
	ADAPTER PLATE GASKET	951869	1
	PLUNGER ROD ASSEMBLY	951870-A	1
	SUPPLY PUMP ADAPTER	951854-A	1
	FUEL SUPPLY PUMP GASKET	951966	1
	ADAPTER SLEEVE	951867-B	1
	FUEL OIL STRAINER	951902-A	1
	FUEL OIL STRAINER BOWL GASKET	UAC-2-854259	1
	FUEL OIL STRAINER	UAC-1-854113	1
5	SERVICE DOOR ASSEMBLY L.H.	00950862	1
	SERVICE DOOR	0950862	1
6	DOOR KNOB	Y-6161-A	1
	DOOR SNAP RING	B-9578	1
7	DOOR HANDLE	Y-6071	2
8	RETARDER	951060	1
	PIPE	950020-B	1
	SUPPORT BUSHING	Y-6899	1
	LOCK NUT	106026	1
12	STEAM TRAP	950323	1
15	HEAT EXCHANGER	951061-A	1
17	SERVICE DOOR BRACKET	0951323	1
18	AIR INLET ELBOW	950935	1
	AIR INLET ELBOW GASKET	41525	1
	INVERTED MALE CONNECTOR	73017-L	1
	BREATHER TUBE	0951013	1
	INVERTED MALE ELBOW	73018-K	1
21	AIR CLEANER FLANGE TUBE	950917	1
	HEATER DUCT RESISTOR ASSEMBLY CONSISTS OF:	0951332-B	1
	AIR INLET HEAT DUCT COVER	951329-B	1
	RESISTOR GRID	951332	1
	RESISTOR GRID INSULATOR	952002	2
	INSULATING BUSHING	950120	4
	INSULATING WASHER	950119	4
	TERMINAL STUD	951989	1
	RESISTOR STUD BLOCK	951988	2
	TERMINAL STUD STOP	951990	4
	AIR INLET HEATER DUCT ASSEMBLY (With Side Insulator Strips)	A-951328	1
	HEATER DUCT GASKET	951330	1
	GASKET	951074	2

DIESEL ENGINATOR UNIT - REAR VIEW

Figure 60

NOTES



DIESEL ENGINATOR UNIT - TOP VIEW

Figure 61

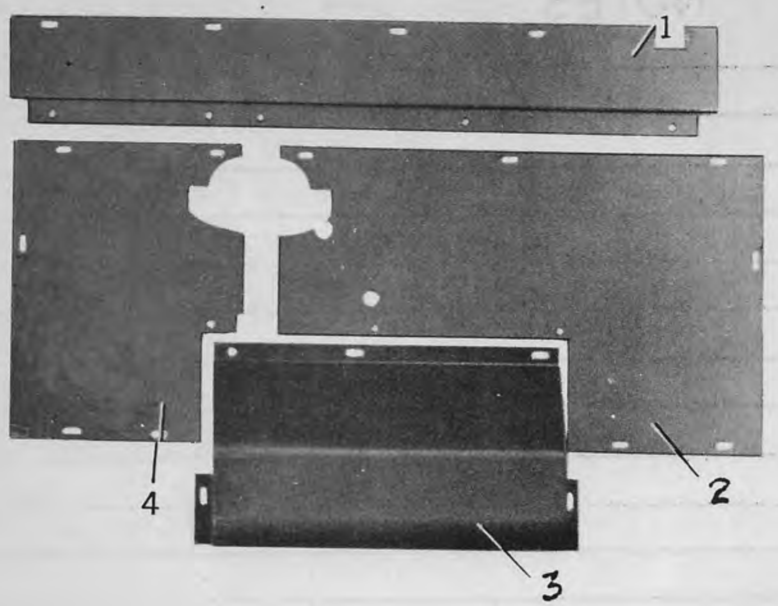
"PARTS LIST - DIESEL ENGINATOR UNIT - TOP VIEW"

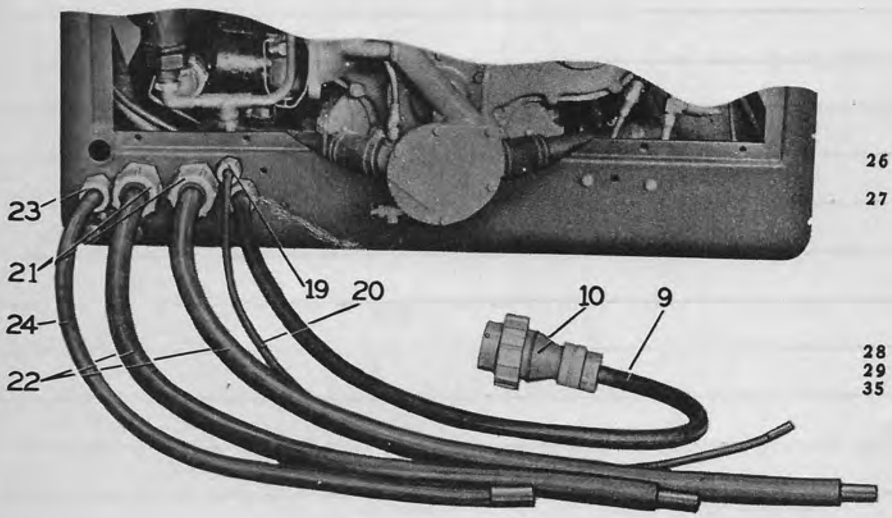
ITEM NO.	DESCRIPTION	PART NO.	QUAN. PER UNIT
	Lubricating Oil Cooler (Coil Assembly) Note: Used on units having dual type lubricating oil pump and oil cooler	952083	1
1	Radiator Assembly	0950970-B	2
	Radiator Core	950970	1
	Bottom Radiator Tank	950853	1
	Top Radiator Tank	950854-A	1
	Water Distributor	951871	1
	Water Distributor Spring	951881	1
	Radiator Tank Gasket	951138	2
	Radiator Bushing	48797-Q	1
	Pipe Plug	Y-7257	1
	Radiator Slide Plate	0951186	2
	Radiator Washer Plate	951187	4
	Hex Head Cap Screw	21310	52
	Shakeproof Lock Washer	21631	52
4	Radiator Filler Body Assembly	OY-6079-D	1
5	Pet Cock	B-5911	1
7	Pressure Relief Elbow Assembly	0951940	1
	Radiator Equalizer Vent	0951961	1
8	Relief Valve	951173	1
	Valve Housing Gasket	951127	1
9	Solenoid Fuel Shut-Off	951134	1
13	Fuel Injection Pump Assembly	A-60239-J	1
	Fuel Pump Gasket	118515	1
	Fuel Pump Gear	41433	1
	Fuel Pump Gear Hub Cap Screw	B10509	2
	Fuel Injection Pump Gasket	118986	1
14	Fuel Injector	C-60268	6
	Ermetto Nut	41260-B	12
	Ermetto Sleeve	44005-B	12
	Set Injector Tubing	0118683-G	1
	Injector Tubing No. 1	118683-G	1
	Injector Tubing No. 2	118683-H	1
	Injector Tubing No. 3	118683-J	1
	Injector Tubing No. 4	118683-K	1
	Injector Tubing No. 5	118683-L	1
	Injector Tubing No. 6	118683-M	1
	Injector Tubing Clamp	119244	2
	Injector Tubing Clamp	119245	2

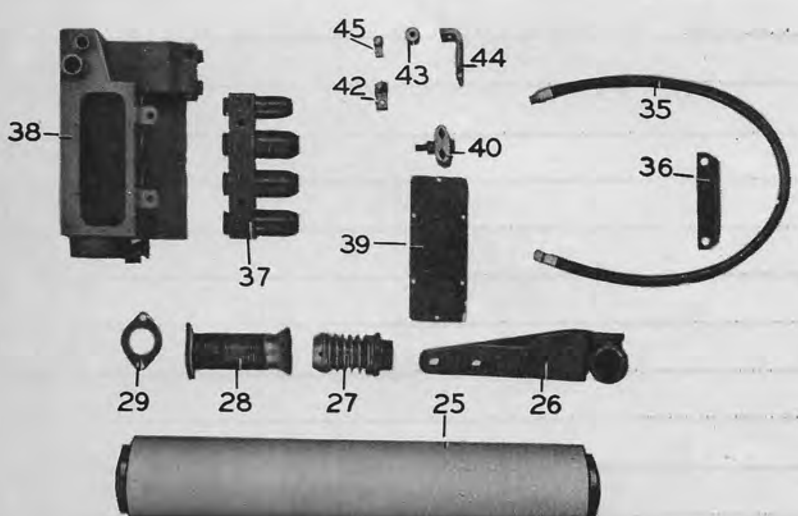
"PARTS LIST - DIESEL ENGINATOR UNIT - TOP VIEW" (cont'd.)

ITEM NO.	DESCRIPTION	PART NO.	QUAN. PER UNIT
16	Trolley Wheel Assembly L.H.	OC-950257A	1
	Trolley Assembly L.H. (Less Cushion Mountings)	C-950257	
17	Mounting Wheel Assembly	0950149	2
	Mounting Wheel	950149	1
	Needle Bearing	950659	2
	Socket Head Pipe Plug	26416	1
	Axle Bushing	950258	2
	Washer	39074	4
	Cushion Mounting	950658	6
20	Engine Compartment Cover Assembly	AO-950843	1
21	Cover Clamping Knob	950950-A	2
	Snap Ring	117796-A	2
22	Top Cover Bracket	0951158	2
23	Elbow Adapter Consists of:	0950072	1
	Insulator Disc	951309	1
	Heat Switch Insulator	951311	1
	Ralco Cord Grip	Y-6784	1
	Heat Switch	950009-A	1
24	Heat Switch Block	951296	1
	Half Union Elbow (Heat Switch Manifold to Water Elbow)	B-1687	
	Amphenol Plug	950884	1
	Amphenol Clamp	950887	1
	Cord Grip	Y-6867-A	
31	Radiator Fan Motor	951377	2
	Brushes for Radiator Fan Motor	952018	8
32	Motor Fan Support (For 10.5 Inch Fan)	951443	2
	Fan Support - Front (12 Inch)	951832	2
	Fan Support - Rear (12 Inch)	951833	2
33	Radiator Fan (10.5 Inch)	950136	2
	Radiator Fan (12 Inch)	951981	2
	Key	44408	2
	Straightener Vane Ring (12 Inch Fan)	0951558	2
	Shakeproof Lock Washer	26110	6
	Cable, Motor-Motor	Y-9139-B	1
	Solderless Lug	Y-18994-A	4
	Terminal Sleeve	Y-19154-C	4
	Cable, Motor-Gen. Term.	951375-B	2
	Solderless Lug	950675	4
	Terminal Sleeve	Y-19154-D	4
	Solderless Lug - Motor Term.	Y-18984-A	4
	Terminal Sleeve	Y-19154	4
	Starting Motor Magnetic Switch Cable	951455-D	1
	Resistor Starting Motor Cable	951455-H	1
	Terminal Block Support	0951725	1
	Terminal Block	951701	1
	Adjustable Bracket	951711	1
	Lug - Starter	951727	1
	Spacer	951820	1
	Lug - Field	951728	1
	Terminal Support Cover	951732	1
	Terminal Lug	951336	6
	Cord Grip	Y-6867-A	1
	Countersunk Pipe Plug (Gen. Term.)	78283-J	2
	Fan Shroud	951442	1
	Straightener Vane Ring	0951440	1
	Ext. Int. Shakeproof Lock Washer	21650	5

NOTES







ITEM NO.	DESCRIPTION	NO.	QUAN. PER UNIT
1	FRONT COVER ADAPTER PANEL	0951354	1
2	FRONT COVER R.H.	0951177	1
3	FRONT COVER BOTTOM ...	951179	1
4	FRONT COVER L.H.	0951178-A	1
9	TEN-WIRE TIREX D.C....	Y-7410-B	1
10	CONTROL PLUG ASSEMBLY D.C. CONSISTS OF:....	0951065	1
	CONTROL PLUG	951065	1
	CONTACT UNIT	951067	1
19	CORD GRIP	Y-6867-A	1
	LOCK NUT	Y-6250	1
20	POWER CABLE FIELD	951375-A	1
	SOLDERLESS LUG	951289	1
	SOLDERING SLEEVE	951772	1
21	CORD GRIP	Y-18436-A	2
	LOCK NUT	Y-18610	2
22	POWER CABLE - GENERATOR	951373-A	2
	TERMINAL LUG	951748	2
	SOLDERING SLEEVE	951770	2
23	CORD GRIP	Y-6968-C	1
	LOCK NUT	Y-19108	1
24	POWER CABLE - STARTING MOTOR	951374	1
	SOLDERLESS LUG	Y-19145-B	1
	SOLDERING SLEEVE	951771	1
25	EXHAUST MUFFLER ASSY. CONSISTS OF: ..	A951041	1
	EXHAUST MUFFLER ...	951041	
	EXHAUST MUFFLER FLANGE	951057	2
	EXHAUST MUFFLER GASKET	951166	2
	SHAKEPROOF LOCK WASHER	26166	8
	HEX HEAD CAP SCREW.	26397	8
26	EXHAUST SUPPORT BRACKET ASSEMBLY	0950772	1
27	FLEX. EXH. NIPPLE ASSY. CONSISTS OF:...	0950774	1
	SEAL RING	950774	1
	EXHAUST NIPPLE SPRING	950768	1
	EXHAUST TUBE	950769	1
	EXHAUST TUBE ADAPTER	950773	1
28	EXHAUST CONNECTION ...	0950772	1
29	EXHAUST FLANGE GASKET.	73593	1
35	FLEXIBLE HOSE FUEL ...	951253	2
	PIPE UNION	80339-M	2
	PIPE COUPLING	78209-X	2
	PIPE NIPPLE	65098-M	2
	FLEXIBLE HOSE STEAM ..	951254	1
	PIPE UNION	80339-K	1
	PIPE COUPLING	78209-U	1
	PIPE NIPPLE	Y-6818	1
36	ADJUSTABLE BRACKET ...	951711	1
37	TERMINAL BLOCK	951701	1
	HEX HEAD CAP SCREW ...	26484	2
	PLAIN WASHER	Y-18814-K	2
	HEX NUT	21206	2
	SHAKEPROOF LOCK WASHER	26110	2
	HEX HEAD CAP SCREW ...	21424	2
	HEX NUT	21206	2
	SHAKEPROOF LOCK WASHER	26187	2
38	TERMINAL BLOCK SUPPORT	0951725	1
39	TERMINAL BLOCK SUPPORT COVER	951732	1
	HEX HEAD CAP SCREW ...	21272	6
	SHAKEPROOF LOCK WASHER	21629	6
	STREET ELBOW	78282-E	1
40	CABLE CLAMP	951731	2
42	LUG STARTER	951727	1
43	SPACER	951820	1
44	CABLE CLAMP SUPPORT ..	951723	2
	HEX HEAD CAP SCREW ...	26168	2
	LOCK WASHER	Y-19390-D	2
45	LUG - FIELD	951728	1
	HEX HEAD CAP SCREW ...	26491	1
	LOCK WASHER	Y-19390-B	1
	HEX HEAD CAP SCREW ...	26115	1
	LOCK WASHER	Y-19390	1

WATER PUMP - END VIEW

CABLES, ATTACHMENTS AND DETACHED PARTS.

Figure 62

T H E   F L U I D   C O U P L I N G: The diesel engine is connected to the generator by means of a fluid coupling. This coupling consists of an impeller or outer shell which is attached to the engine flywheel. The inner rotor is ball bearing supported and is mated with the splined end of the armature shaft. A spring loaded rotary type seal, similar to ice engine compressor seals, retains the hydraulic fluid in the shell. See Figure 63, page 84. A full charge of hydraulic fluid is 11 lbs. 13 oz. of Texaco U.S.R.A. P-10 oil. This oil is used the year around. In an emergency a good grade of heavy duty S.A.E-20 oil may be used. A hex head drain plug is located in the shell and opposite it is an Allen head vent screw. Both are accessible after removing the cover on the top of the flywheel housing and by rotating the engine.

When the engine rotates the impeller a circulation of oil is set up between the radial compartments of the impeller and the inner rotor. Power is thereby transmitted from the impeller (engine) to the rotor (generator).

The fluid coupling provides for proper alignment of the engine and generator and arrests the transmission of any undesirable impact or stresses between the engine and generator.

T W O-S P E E D   O P E R A T I O N: The generator is regulated for constant voltage. The engine speed can, therefore, be increased or decreased, depending on the current demand at the generator. For example, to get electrical loads up to 12 K.W., the diesel engine operates at approximately 1200 R.P.M. From 12 K.W. to 25 K.W. the engine operates at 1800 R.P.M. This feature of increasing or decreasing the engine speed according to electric power demand is accomplished by the speed changing pilot relay (part of load-sensing relay, dual) speed-changing control relay and the governor solenoid. The speed-changing pilot relay (Item V, Figure 64, page 85) has a normally open contact. When the current demand at the generator exceeds approximately 300 amperes, this contact closes. This energizes the coil of the speed-changing control relay (Item U, Figure 64) closing its contacts to the governor solenoid (Item B, Figure 51, page 59). When the governor solenoid is energized, the governor spring (Item D, Figure 51) tension is increased, stepping up the engine speed to 1800 R.P.M. This sequence of operation is reversed as the load decreases below approximately one-half the rated generator capacity.

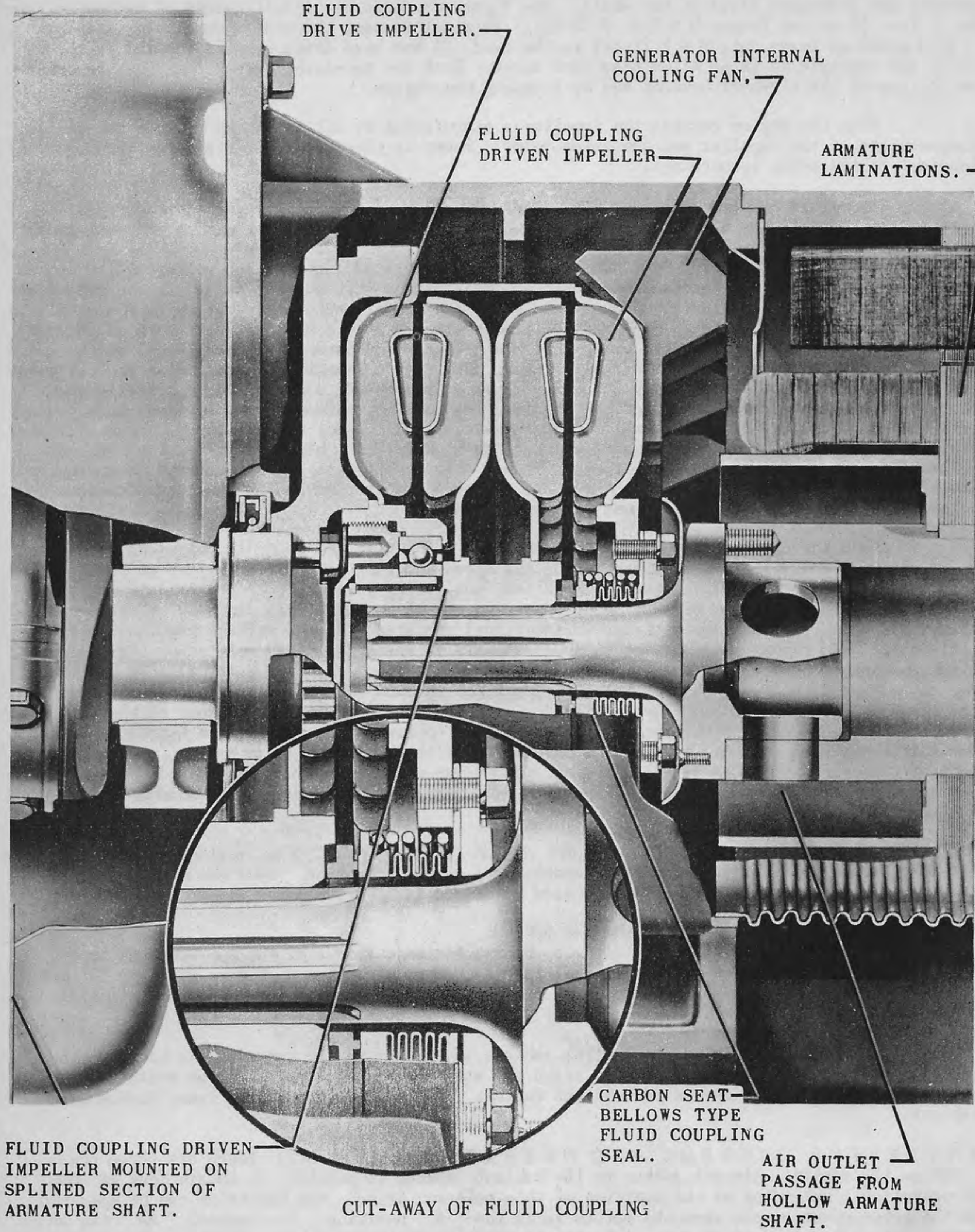
When the Enginator cycles from low to high speed, the generator is unloaded. When the speed-changing control relay is energized by the speed-changing pilot relay, a set of normally open contacts close, energizing two delay relays, one having a 7.5 second mercury tube and the other having an 11.5 second mercury tube. A second set of normally open contacts on the speed changing control relay close, cutting in additional resistance to the voltage regulator potential coil. This reduces the voltage to approximately 30 volts on the 40 volt generator. Almost simultaneously, the governor solenoid is energized by the speed-changing control relay and the engine increases to high speed. In approximately 7.5 seconds, the normally closed contact of the first delay relay opens. This is a series with the unloading resistance unit of the voltage regulator. The voltage at the generator then returns to normal setting and the Enginator assumes the additional load. In approximately 4 seconds after the first delay relay contact opens, the contact of the second delay relay (11.5) opens. This places the speed-changing pilot relay back in the speed-changing control circuit. Sequence of operation can be followed on the Line Wiring Diagram Figure 65, page 87.

VOLTAGE REGULATOR AND REVERSE CURRENT RELAY (D.C. UNIT): The voltage regulator, (Item T, Figure 64, page 85) is of the conventional carbon-pile type. It is mounted inside the Waukesha control cabinet. The generator load and field fuses are mounted on the back and side wall of the control cabinet.

The reverse current relay (Item S, Figure 64, page 85) is of the conventional type except that it is equipped with two sets of interlock contacts (Item 6, Figure 64, page 85) one normally open and one normally closed which are used for control circuits of Air Conditioning units and indicator lights.

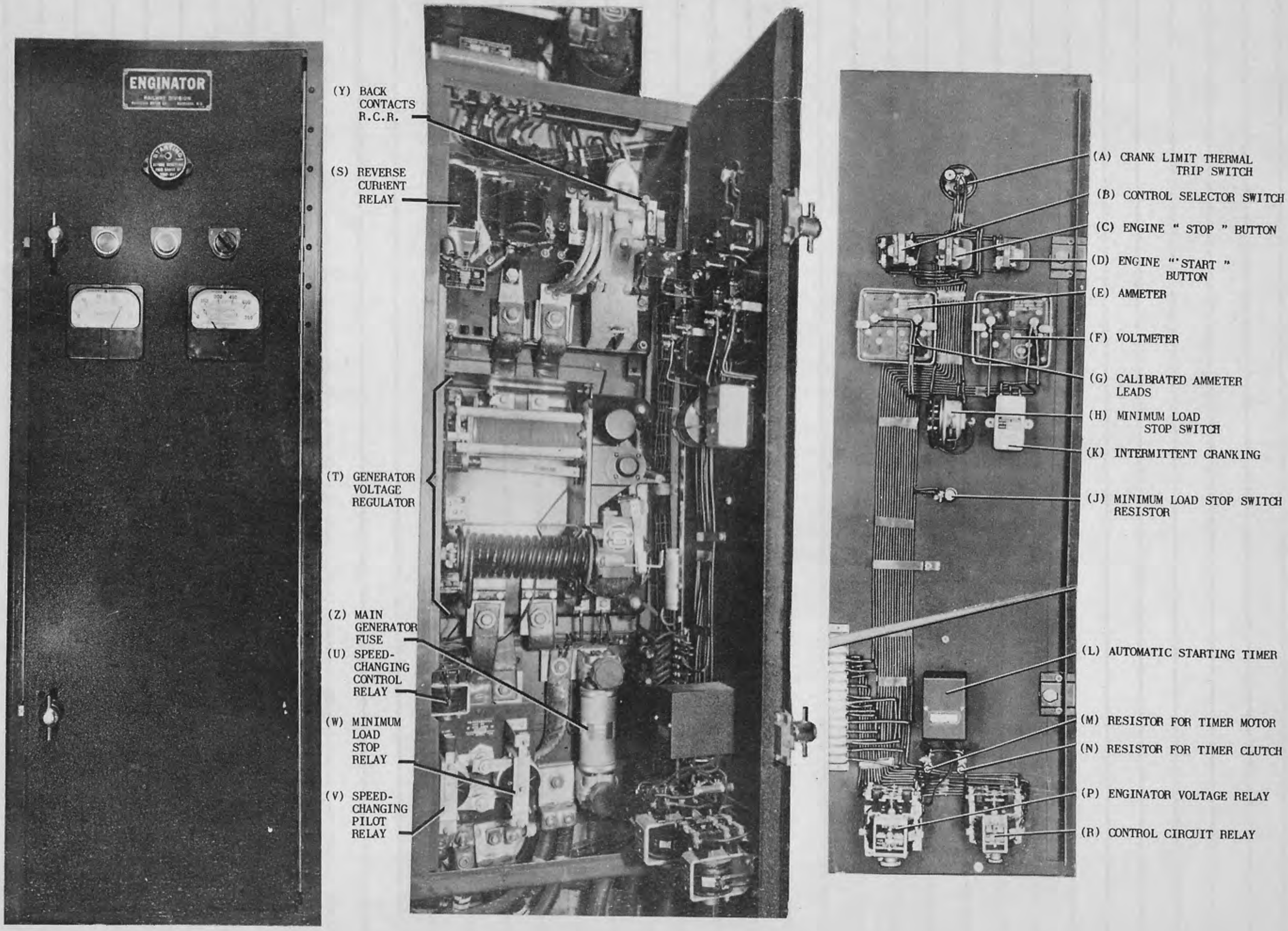
C O N T R O L   C A B I N E T: The control cabinet is located in the car electric locker. The crank limit thermal trip switch, manual start and stop buttons, control selector switch, voltmeter and ammeter are mounted on the door of the cabinet. The control circuit is fused in the control cabinet.

E N G I N A T O R   C O N T R O L   A N D   O P E R A T I O N   (D.C. UNIT) There are three positions on the control selector switch at the cabinet, making it possible to obtain four methods of operation. Depending on the position of this selector switch, the Enginator can be operated as the prime power source when the switch is in the "A" position. For control "AA" the selector switch is also set at the "A" position and the Enginator voltage regulator is readjusted. This control is used when Enginator parallels axle generator, starting, running and stopping automatically with load conditions.



CUT-AWAY OF FLUID COUPLING

Figure 63



ELECTRICAL CONTROL CABINET

Figure 64

NOTES

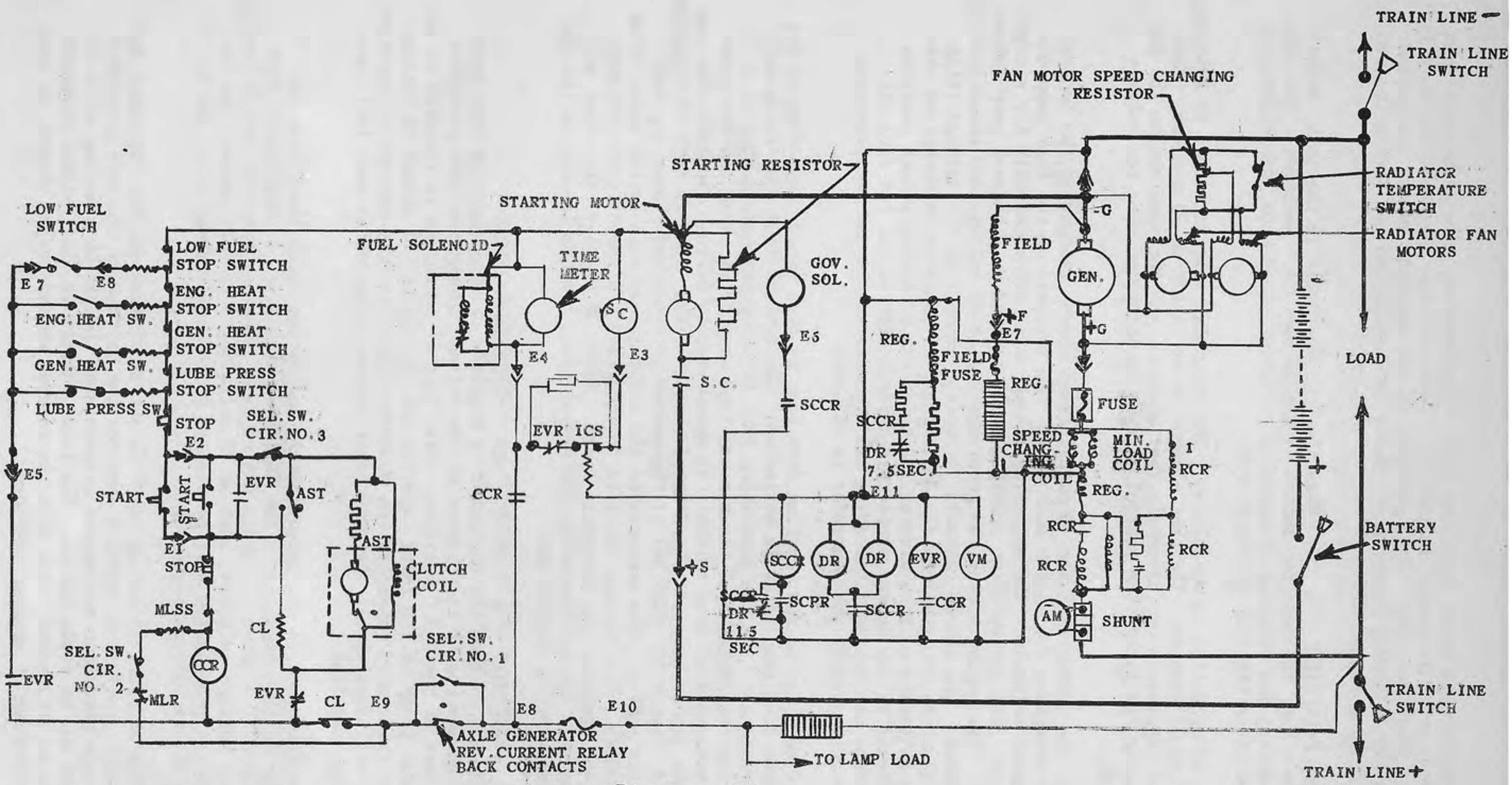


Figure 65

L E G E N D

CCR	CONTROL CIRCUIT RELAY	SCCR	SPEED CHANGING CONTROL RELAY
CL	CRANK LIMIT SWITCH	ICS	INTERMITTANT CRANKING SWITCH
MLR	MINIMUM LOAD RELAY	DR	DELAY RELAY
MLSS	MINIMUM LOAD STOP SWITCH	RCR	REVERSE CURRENT RELAY
EVR	ENGINATOR VOLTAGE RELAY	REG	GENERATOR REGULATOR (VOLTAGE & CURRENT)
AST	AUTOMATIC STARTING TIMER	VM	VOLT METER
SC	STARTING CONTACTOR	AM	AMMETER
SCPR	SPEED CHANGING PILOT RELAY	(arrow symbol)	PLUG & RECEPTACLE CONTACTS

LINE DIAGRAM FOR DIESEL ENGINATOR 25 KW - 32 VOLT D.C. SYSTEM.

In the "B" position, Enginator acts as an auxiliary unit, supplementing axle generators when axle generator reverse current relay is open. In the "C" position, the Enginator operates continuously having only manual start and stop. Each position of the selector switch and method of control are described in the following paragraphs. Refer to Control Cabinet Wiring Diagram, Figure 66, also Car Wiring Diagram Figure 67.

CONTROL SELECTOR SWITCH, POSITION "A". When the D.C. Enginator is the sole, prime source of electric energy on a car, the selector switch is set to the "A" position. This provides for full automatic starting and stopping, responding to battery condition, car electrical load demand and elapsed time since the last previous start.

A normal sequence of operation is as follows: The automatic starting timer is adjustable and has a timing range of 5 to 60 minutes. The time element is to be set at 30 minutes; Each graduation on the timer dial represents approximately four minutes; set the stop arm on the 8th graduation from the left facing the timer. The control circuit is energized when the battery and load switches are closed.

After 30 minutes, the contacts of the automatic timer close, energizing the control circuit relay which in turn energizes the engine hour meter, the solenoid on the fuel pump control rod and the starting motor solenoid. The engine will be cranked intermittently for a total elapsed time of three minutes. The intermittent cranking is controlled by a thermal warp switch, (Item K Figure 64, page 85). The engine starts the generator builds up voltage and immediately the voltage relay coil is energized. One set of contacts (normally closed) of the voltage relay opens and de-energizes the starting motor solenoid. Another set of contacts de-energizes the automatic starting timer so it resets to zero minutes. A third set of normally open contacts closes and completes the circuit to the engine protective devices such as the low fuel oil switch, the engine heat switch, the engine lubricating oil pressure switch and the generator heat switch. During this starting cycle the generator is unloaded.

The enginator will continue to run, cycling from low to high speed, depending on the load demand, until the minimum load stop relay is satisfied. The minimum load stop relay coil is in series with positive generator. As the generating rate of the generator reduces to a pre-determined current setting the contacts of the minimum load stop relay close and energize the thermal element of the minimum load stop switch. In approximately fifteen seconds, the contacts of the stop switch open and de-energize the control circuit relay. This in turn de-energizes the solenoid control (Item A, Figure 51, page 59) of the master governor and closes the fuel pump control rod, stopping the engine. The contacts of the minimum load stop switch again close in approximately fifteen seconds. The voltage relay is de-energized. A set of open contacts of the voltage relay close and energize the automatic timer. After 30 minutes, the timer will again start the unit, or the unit can be started by the manual start buttons located at the car control cabinet or at the Inspector's control box.

CONTROL SELECTOR SWITCH, POSITION "A" WITH "AA" TYPE OPERATION - ENGINATOR AND AXLE GENERATOR. When the Enginator is required to supplement an axle generator and start run or stop automatically in relation to the voltage ~~across~~ the axle generator, the selector switch is also set at the "A" position. This type of operation is referred to as "AA". If the axle generator is up to its rated capacity and the electrical demand to battery and car load is in excess of this rated capacity, the Waukesha Enginator will operate in parallel with the axle generator and will furnish all the additional current required to meet full capacity air conditioning and lighting load.

The voltage of the Enginator is set approximately one to two volts lower than the setting of the axle generator voltage regulator. The Enginator will start automatically from the starting timer as described above under the caption "Control Selector Switch Position "A"". If the axle generator voltage is normal such as 38 volts for a 32 volt system, the Enginator will operate for several minutes and will be stopped by its low current relay due to the lower (37 volt) setting of its voltage regulator.

If, for example, the automatic starting timer is set at 15 minutes, the Enginator will start every 15 minutes and will continue to operate whenever the voltage of the axle generator is 37 or lower. The lower axle generator voltage is evident when the car is standing still in the yards, station or enroute due to train delays. The lower voltage is also evident whenever the axle generator is not up to full speed, even with the reverse current relay closed, or when its voltage regulator is protecting it against overload.

CONTROL SELECTOR SWITCH, POSITION "B". On certain applications, the Enginator may be required to supplement an axle generator only when the axle generator reverse current relay main contacts are open. The control selector switch is set at the "B" position. The Enginator then acts as a standby power source when the train is standing still or when the axle generator fails to reach to cut in speed.

NOTES

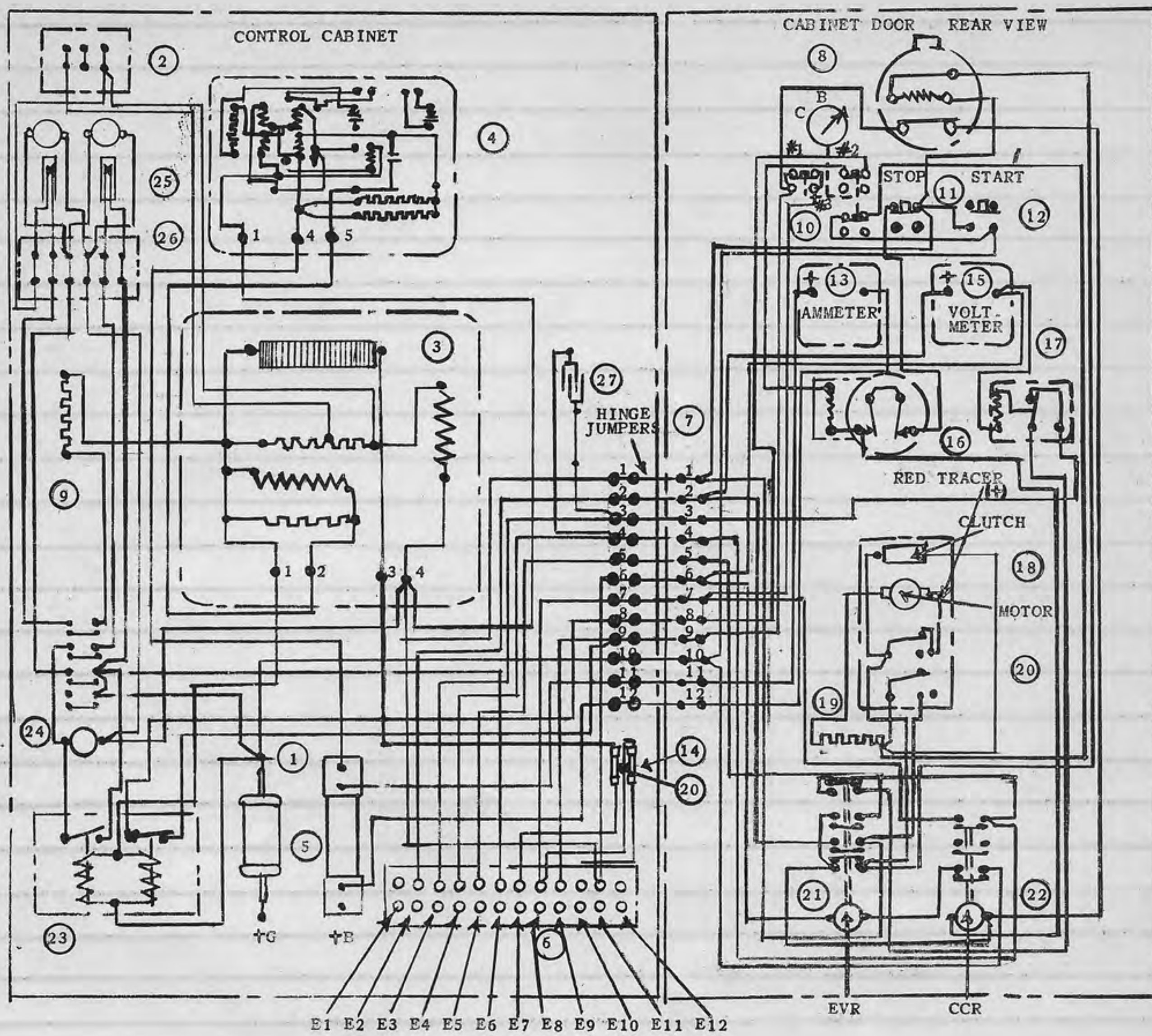
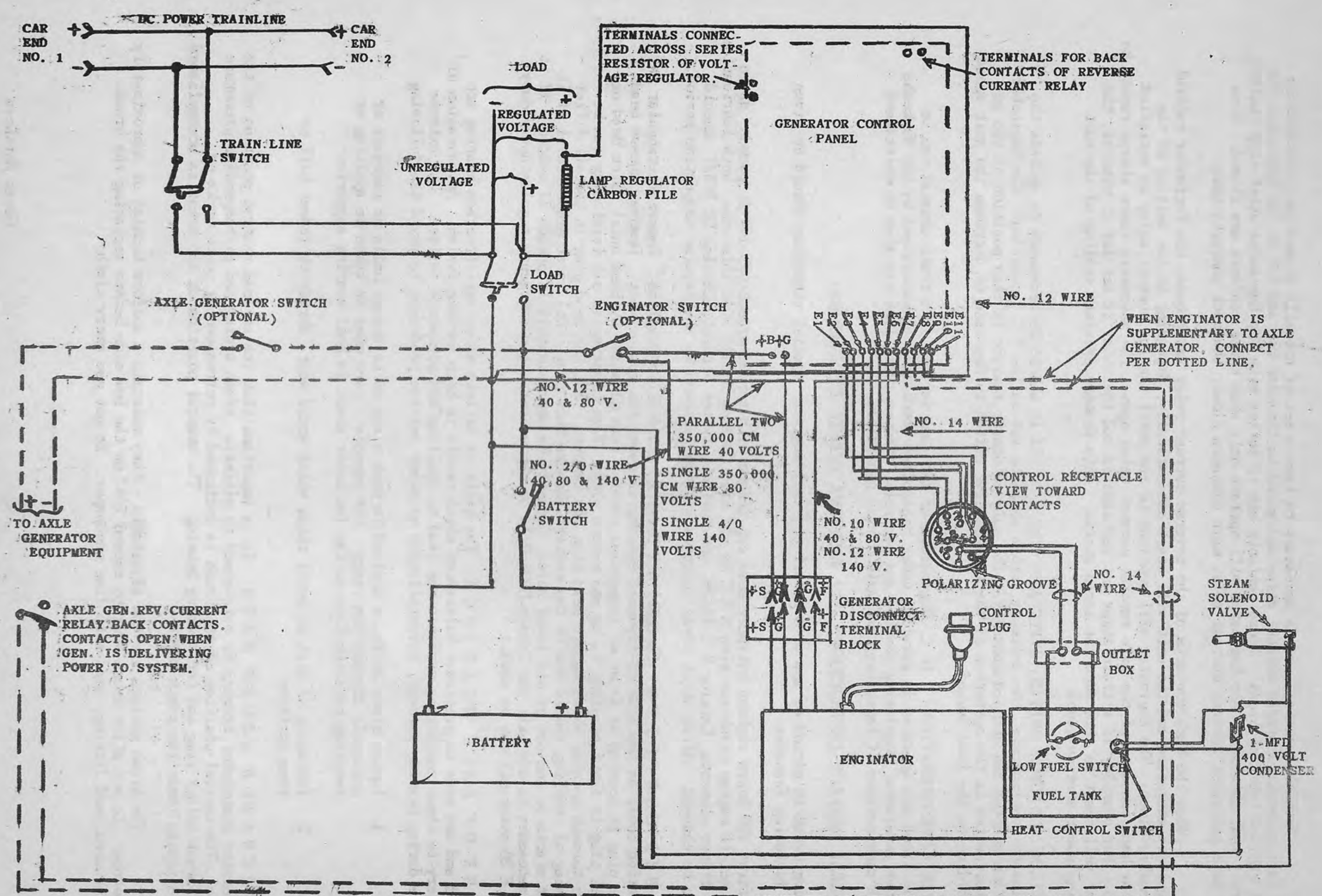


Figure 66

LEGEND

1	AMMETER SHUNT	15	VOLTMETER
2	REDUCED CHARGING TERMINAL STRIP	16	MINIMUM LOAD STOP SWITCH (MLSS)
3	GENERATOR REGULATOR	17	INTERMITTANT CRANKING SWITCH (ICS)
4	REVERSE CURRENT RELAY (RCR)	18	AUTOMATIC STARTING TIMER (AST)
5	GENERATOR FUSE	19	RESISTOR FOR TIMER MOTOR
6	CONTROL TERMINAL BLOCK	20	GENERATOR FIELD FUSE
7	HINGE JUMPER TERMINAL BLOCKS	21	ENGINATOR VOLTAGE RELAY (EVR)
8	CRANKING LIMIT SWITCH (CL)	22	CONTROL CIRCUIT RELAY (CCR)
9	UNLOADING RESISTOR	23	LOAD SENSING PANEL (DUAL)
10	SELECTOR SWITCH	24	SPEED CHANGING CONTROL RELAY (SCCR)
11	ENGINE "STOP" PUSH BUTTON	25	DELAY RELAY (DR)
12	ENGINE "START" PUSH BUTTON	26	DELAY RELAY TERMINAL STRIP
13	AMMETER	27	CONDENSER (INT. CRANK SWITCH)
14	CONTROL CIRCUIT FUSE		

D. C. ENGINATOR CAR WIRING DIAGRAM



ENGINATOR CONTROL CABINET WIRING DIAGRAM 40 VOLT D.C.

Figure 67

With this control, it is necessary to have a set of normally closed back contacts on the axle generator reverse current relay and wired to terminal E-8 and E-9 at the Enginator control cabinet terminal block. These contacts are in series with the Enginator start-stop control circuit and, therefore, the Enginator will operate only when these contacts are closed. When the axle generator reverse current relay main contacts close, the back contacts open.

When the back contacts of the reverse current relay are closed, the Enginator control circuit is energized and the unit will start automatically, depending on the setting of the automatic timer. The Enginator will continue to run until the low current relay is satisfied or the back contacts of the axle reverse current relay open. The automatic timer always resets to zero. For example, if a train stops for ten minutes and the timer is set for 15 minutes, the timer will reset to zero when the train starts. This feature prevents cycling of the unit during short station stops.

CONTROL SELECTOR SWITCH, POSITION " C ". If it should be necessary to operate the Enginator continuously, the selector switch would be set on the " C " position. The Enginator is then started and stopped manually. The only automatic feature in this position of the selector switch is the operation of the load-sensing switch to increase or decrease the unit speed according to the load demand.

TRAIN LINE OPERATION: D. C. Enginators of the same voltage in a train consist can be train-lined and operated in parallel under controlled conditions as maintained by the Waukesha master governors, regulating devices and controls. Common train line can also be maintained with combinations of Enginators and axle driven generators.

GENERAL SERVICE INSTRUCTIONS FOR WAUKESHA DIESEL ENGINATORS:

During break-in period of new or overhalled diesel engines, special attention should be given the following features:

At first 100 hours tighten cylinder head cap screws with torque wrench (95-100 ft pounds) drain and refill engine crankcase with S A E 30 S1 oil, Catalog M-2116. At this time, both lubrication oil filter elements, Catalog K E 16326, and fuel oil filter element, Catalog KE 16327, should also be changed. After which these features will be followed at the regular inspection period.

F L U I D *C O U P L I N G:* Checking oil level in fluid drive coupling. Remove rectangular inspection cover on top side of flywheel housing in generator compartment. Remove square head pipe plug in housing at front of inspection cover. Turn flywheel by hand until Allen Head oil level plug in fluid coupling is up and remove plug. Turn coupling so oil level plug can be seen through opening where square head plug was removed. The hex head plug in the oil filler opening of coupling should now be top center. Remove this plug. Oil is at proper level if it just starts to run out of oil level hole. Capacity is approximately 11 pounds 13 ounces. If it is necessary to add oil, use Texaco URSA P-10 or equivalent. (In emergency regular heavy duty S A E 20 motor oil can be used.)

C A R E O F B A L L B E A R I N G S: The balls or rollers of an anti-friction bearing are hard and are made to precision tolerances which result in high surface finish. Any abrasion or injury to these contacting surfaces may lead to spalling and premature failure. Use extreme care during bearing removal, reinstallation or other service procedure to avoid the following:

1. Impact blows or force applied in such a way as to damage balls or raceways or seriously distort the rings. For example - care must be taken in applying or removing radiator fans as the fan motor shaft is ball bearing supported.

2. Intrusion of dirt or metal chips which would wear, abrade or indent ball or race surfaces.

G E N E R A T O R B R U S H D A T A: It is important that the no-load neutral position of the generator commutator brushes be maintained to minimize brush arcing and corresponding premature wear. The neutral position of the brush is indicated by corresponding punch marks on the brush holder ring and the bearing housing. The neutral position of the brush is accomplished by aligning these two punch marks.

The brush springs are not adjustable - they maintain a uniform tension of approximately 2 pounds. Do not allow brush wear to exceed 7/8" on the low side before replacing the brush. If brushes need fitting, sand with fine sandpaper. Do not use emery cloth.

E N G I N A T O R S T O R A G E:

If Enginators are stored or are not used for approximately 30 days or more the following recommendations should be followed prior to the storage period. If Enginator is running prior to shutdown:

1. Run engine until it is warm.

2. With engine running squirt Houghtons rust preventative (light) oil No. 60 into air intake manifold. This will form a mild protective film on the cylinder walls, piston rings, piston and valves. About one minute is ordinarily adequate for the admission of the rust preventative oil.

3. Disconnect fuel line behind fuel oil filter and operate the engine using Shell Cornea No. 21 flushing oil or its equivalent for approximately 4 or 5 minutes. This will provide some protection to the internal parts of the fuel pump, fuel lines and injectors.

4. Reconnect fuel line.

If engine is not running prior to storage period:

1. Disconnect the fuel line just ahead of the fuel pump and immerse line into auxiliary container having Shell Cornea No. 21 flushing oil or its equivalent.

2. Remove front gear cover inspection plate. Manually open the fuel pump control rod by moving it in towards the pump.

3. Remove the six fuel injectors from the engine. Attach injectors to the high pressure fuel lines. Do not come in contact with spray from the injectors.

4. Temporarily connect starting motor solenoid directly across battery voltage and crank engine until the flushing oil comes through the 6 injectors.

5. Replace injectors into the cylinder head and reconnect fuel line.

TABULATED DATA

ENGINE (D.C. ENGINATORS)

Model	190 DLCR	
Cylinders	6	
Bore (Inches)	3-3/4	
Stroke (Inches)	4	
Compression Ratio	16 to 1	
Displacement (Cu. In.)	265	
Horsepower	60	
Lubrication Oil Capacity with Filters (Qts.)	22	
Lubricating Oil Pressure (Hot)	25 - 30	
Lubricating Oil Weight (Summer and Winter)	SAE 30	
Fuel Oil Pressure	6 to 8	
Firing Order	1, 5, 3, 6, 2, 4	
Valve Clearances (Cold)	Intake	Exhaust
Checking	.010	.020
Injection Pump Timing (B.T.D.C.)	22°	
Injection Pressure (lbs. per sq. in.)	1500	
Coolant Capacity (Qts.)	48	

GENERATOR

Voltage (D.C.)

40 Volt	32 Volt Systems

Capacity (Net kw)

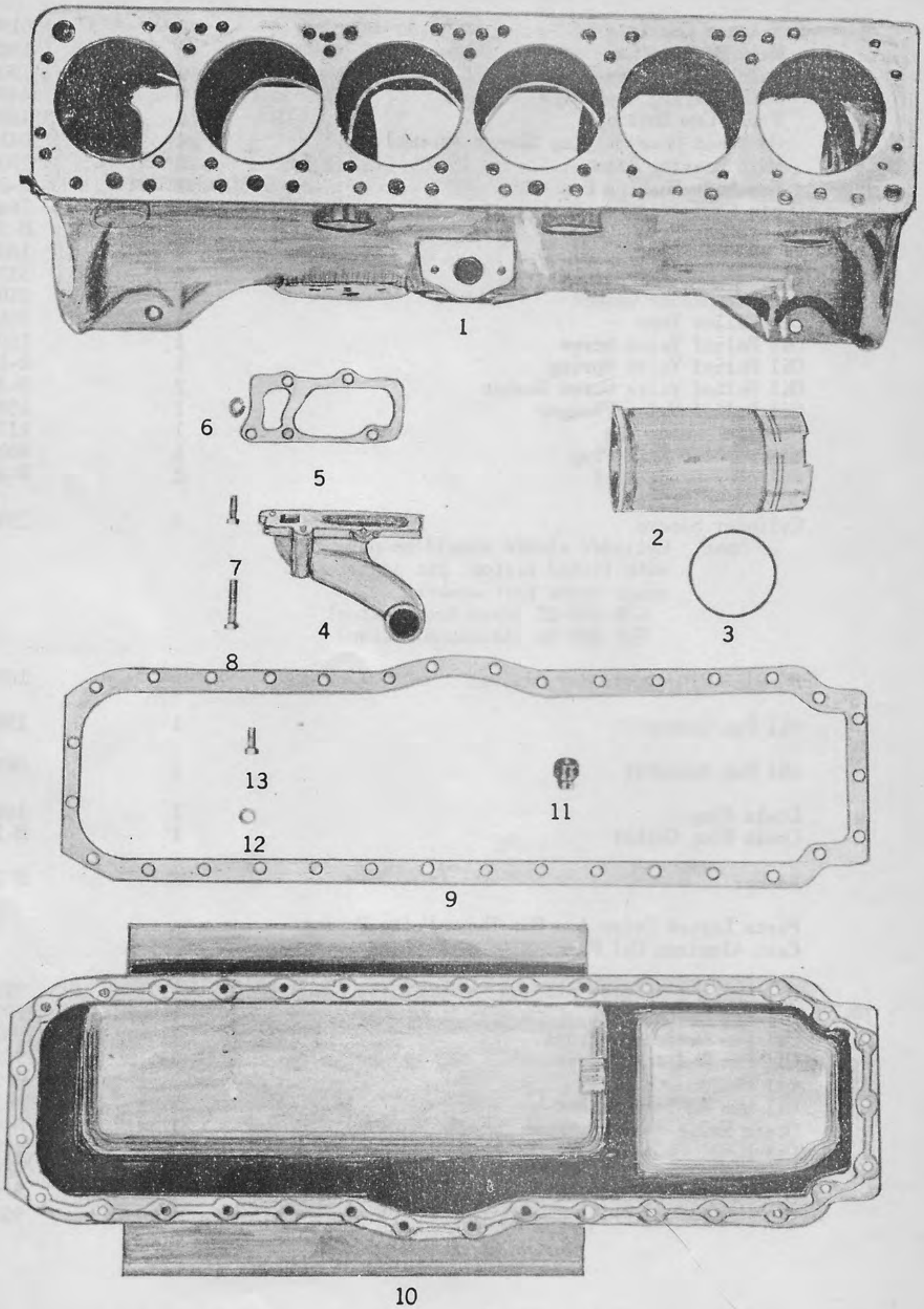
1200 R.P.M.	12
1800 R.P.M.	25

Note: Generator gross output is 27 kw as 2 kw are required for radiator fans and battery charging.

Brushes	16
Brush Spring Tension (lbs)	2-1/4

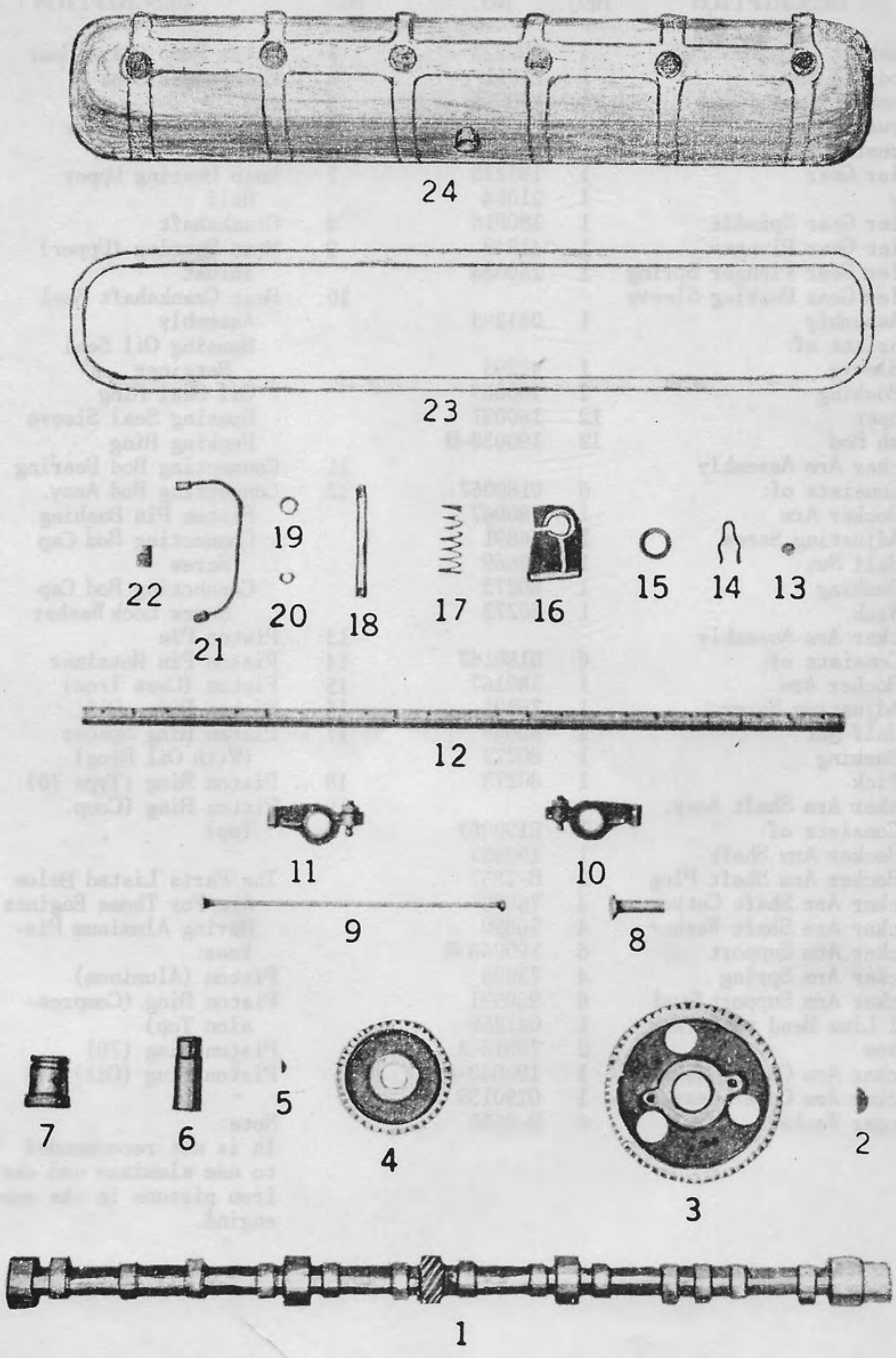
CRANKCASE AND OIL PAN ASSEMBLIES

ILLUS. NO.	DESCRIPTION	NUMBER REQUIRED	PART NUMBER
1	Crankcase Consists of:	1	0190320-B
	Main Bearing Cap	3	190046
	Main Bearing Cap - Thrust	1	190049
	Main Bearing Cap Screw	8	44929
	Front Cam Bushing	1	160027
	Governor Gear Bushing Sleeve Assembly	1	041080
	Main Bearing Shim	8	190017-A
	Camshaft Bushing Pin	1	B-356
	Drain Cock	1	76400
	Escutcheon Pin	4	B-557-A
	Timing Gear Oil Tube	1	160024
	Expansion Plug-Rear Cam	1	3337
	Rear Crankcase Gasket	1	950986
	Oil Filler Tube	1	951064
	Oil Relief Valve Screw	1	150134
	Oil Relief Valve Spring	1	B-1852
	Oil Relief Valve Screw Gasket	2	B-8230
	Oil Relief Valve Plunger	1	150116
	Governor Hole Plug	1	117500
	Distributor Hole Plug	1	80118
	Cylinder Head Dowel	2	B-3568
2	Cylinder Sleeve Note: Cylinder sleeve should be purchased with fitted piston, pin and piston rings under part numbers: GR-399-27 (Cast Iron Piston) GR-399-38 (Aluminum Piston)	6	192130-A
3	Packing Ring (Cylinder Sleeve)	2	160029
9	Oil Pan Gasket	1	190078-A
10	Oil Pan Assembly	1	0951349
11	Drain Plug	1	76909
	Drain Plug Gasket	1	B-175
12	Washer	33	B-221
	Parts Listed Below Are For Those Units Having Cast Aluminum Oil Pans		
	Oil Pan	1	952017
	Oil Pan Gasket	1	190078-B
	Oil Pan Deflector-Front	1	952055
	Oil Pan Deflector-Rear	1	952056
	Oil Pan Adapter	1	A-952027
	Oil Pan Adapter Gasket	1	952050
	Drain Valve Assembly	1	A-952057
	Oil Level Gauge	1	A-952052
	Thermostat (245° F.)	1	73903-A
	Oil Pan Bottom Cover	1	A-952061
	Oil Pan Bottom Cover Gasket	1	952047



CRANKCASE AND OIL PAN ASSEMBLIES.

Figure 68



CAMSHAFT, IDLER GEAR, ROCKER ARM AND COVER ASSEMBLIES.

Figure 69

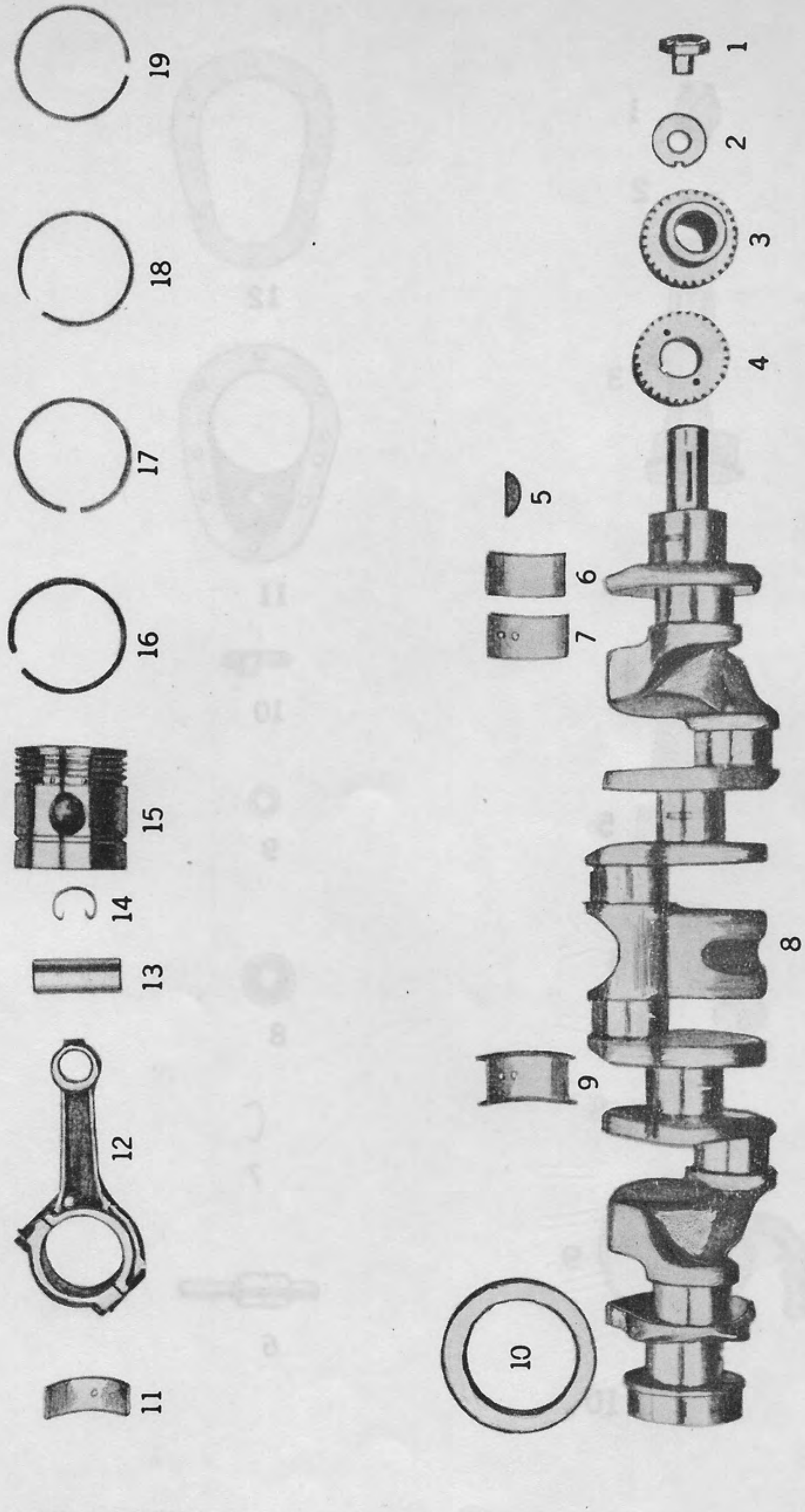
CAMSHAFT, IDLER GEAR, ROCKER ARM AND COVER ASSEMBLIES

ILLUS. NO.	DESCRIPTION	NO. REQ.	PART NO.
1	Camshaft	1	190223
2	Woodruff Key	1	21011
3	Camshaft Gear	1	190026
	Thrust Button	1	76420
	Thrust Button Spring	1	74993.
4	Idler Gear	1	191115
5	Key	1	21004
6	Idler Gear Spindle	1	180016
	Idler Gear Plunger	1	41349
	Idler Gear Plunger Spring	1	150033
7	Idler Gear Bushing Sleeve Assembly	1	041293
	Consists of:		
	Sleeve	1	41293
	Bushing	2	160069
8	Tappet	12	160037
9	Push Rod	12	190038-B
10	Rocker Arm Assembly		
	Consists of:	6	0180067
	Rocker Arm	1	180067
	Adjusting Screw	1	76891
	Half Nut	1	80669
	Bushing	1	80272
	Wick	1	80273
11	Rocker Arm Assembly		
	Consists of:	6	0180167
	Rocker Arm	1	180167
	Adjusting Screw	1	76891
	Half Nut	1	80669
	Bushing	1	80272
	Wick	1	80273
	Rocker Arm Shaft Assy.		
	Consists of:	1	0190053
12	Rocker Arm Shaft	1	190053
13	Rocker Arm Shaft Plug	2	B-2857
14	Rocker Arm Shaft Cotter	4	76898
15	Rocker Arm Shaft Washer	4	76899
16	Rocker Arm Support	6	190068-B
17	Rocker Arm Spring	4	73888
18	Rocker Arm Support Stud	6	950991
21	Oil Line Head to Rocker	1	041269
22	Elbow	2	73018-A
23	Rocker Arm Cover Gasket	1	190040-A
24	Rocker Arm Cover Assy.	1	0190139
	Copper Washer	6	B-8556

CRANKSHAFT AND PISTON ASSEMBLY

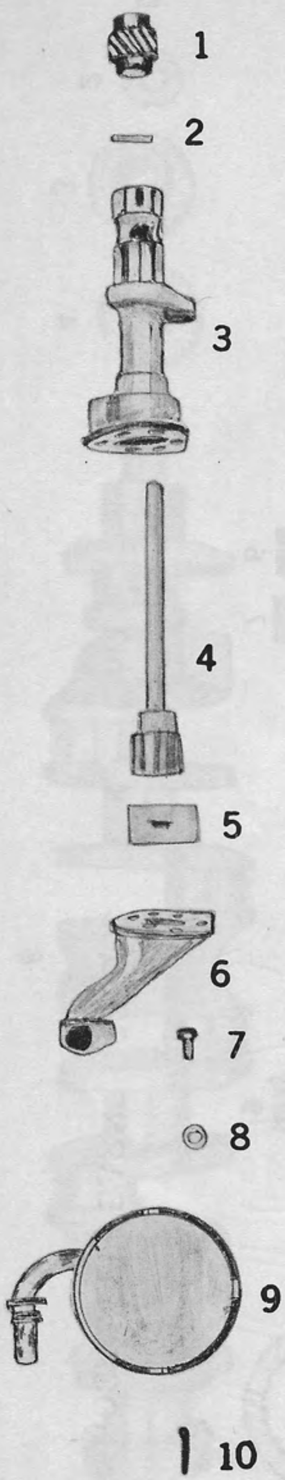
ILLUS. NO.	DESCRIPTION	NO. REQ.	PART NO.
3	Water Pump Drive Gear	1	117716
4	Crankshaft Gear	1	190012
5	Key	1	26105
6	Main Bearing Lower Half	4	190125
7	Main Bearing Upper Half	3	191322
8	Crankshaft	1	192211
9	Main Bearing (Upper) Thrust	1	191318
10	Rear Crankshaft Seal Assembly	1	A951933
	Housing Oil Seal Retainer	1	951933
	Oil Seal Ring	2	951939
	Housing Seal Sleeve	1	951932
	Packing Ring	1	74909
11	Connecting Rod Bearing	12	192010
12	Connecting Rod Assy.	6	0192107
	Piston Pin Bushing	12	190008-A
	Connecting Rod Cap Screw	12	B-10594-A
	Connecting Rod Cap Screw Lock Washer	12	44911
13	Piston Pin	6	190106-A
14	Piston Pin Retainer	12	41298-A
15	Piston (Cast Iron)	6	192204-A
16	Piston Ring, Oil	6	192305
17	Piston Ring Spacer (With Oil Ring)	12	119685
18	Piston Ring (Type 70)	12	192105
19	Piston Ring (Comp. Top)	6	192205
	The Parts Listed Below Are For Those Engines Having Aluminum Pistons:		
	Piston (Aluminum)	6	192204-C
	Piston Ring (Compression Top)	6	192205-A
	Piston Ring (70)	12	192105-A
	Piston Ring (Oil)	6	192305

Note:
It is not recommended to use aluminum and cast iron pistons in the same engine.



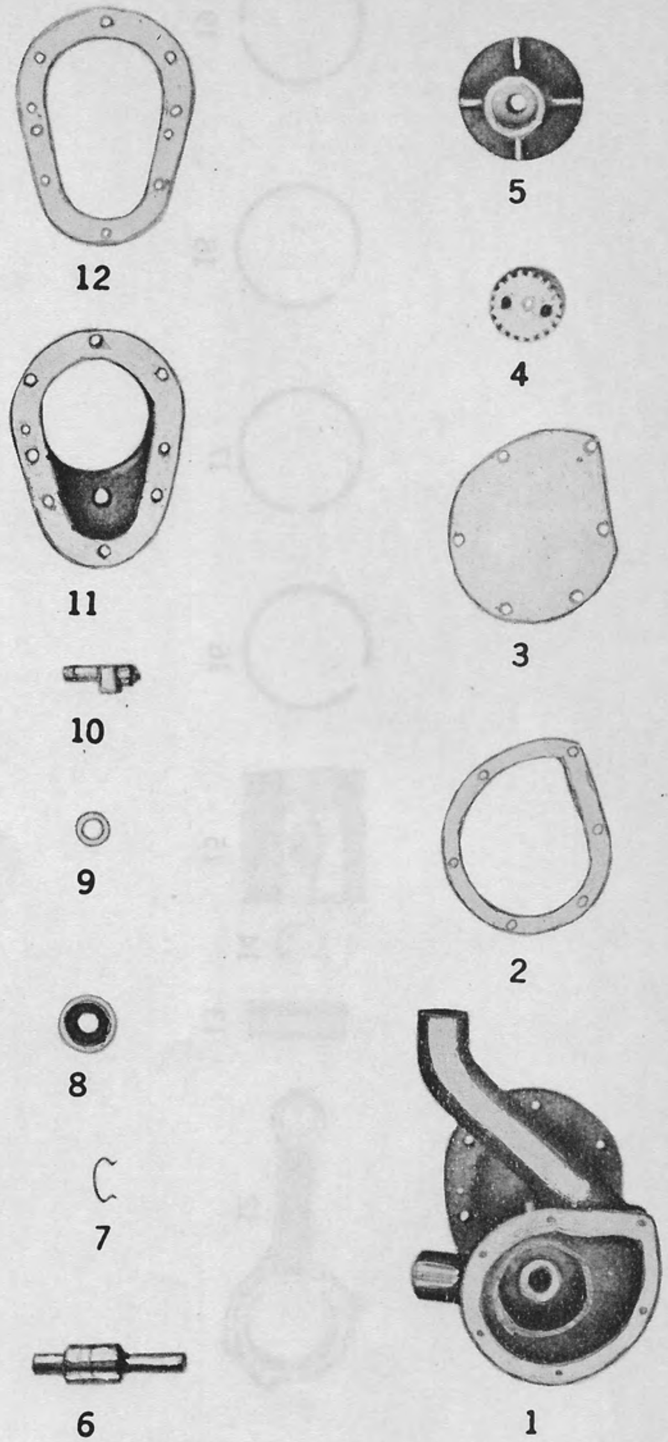
CRANKSHAFT AND PISTON ASSEMBLY.

Figure 70



LUBRICATING OIL PUMP ASSEMBLY.

Figure 71



WATER PUMP ASSEMBLY.

Figure 72

LUBRICATING OIL PUMP ASSEMBLY

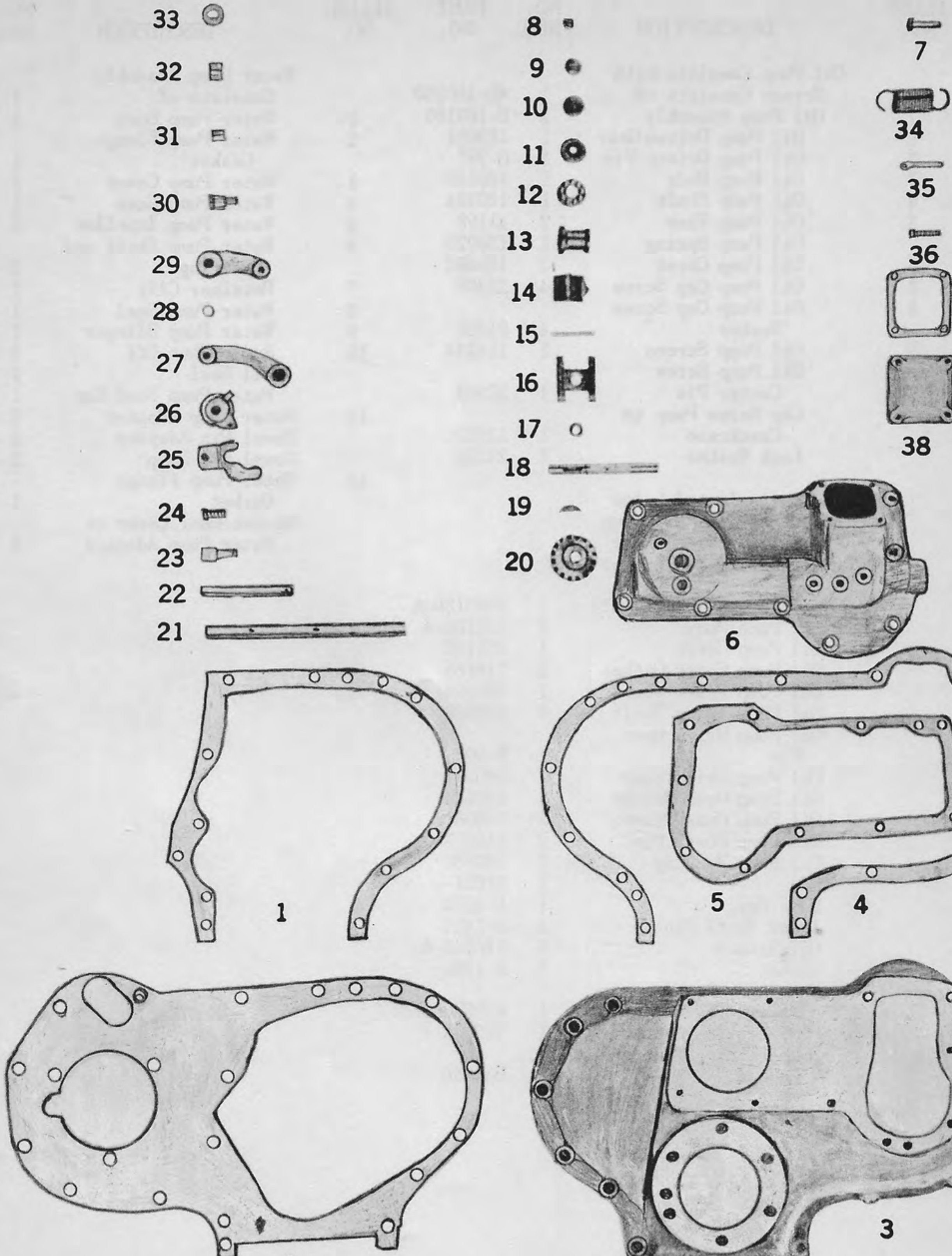
ILLUS. NO.	DESCRIPTION	NO. REQ.	PART NO.
	Oil Pump Complete with Screen Consists of:	1	AB-180180
	Oil Pump Assembly	1	B-180180
1	Oil Pump Driven Gear	1	180051
2	Oil Pump Driven Pin	1	B-997
3	Oil Pump Body	1	180180
4	Oil Pump Shaft	1	180184
5	Oil Pump Vane	2	41198
	Oil Pump Spring	1	150029
6	Oil Pump Cover	1	180482
7	Oil Pump Cap Screw	4	21309
8	Oil Pump Cap Screw Washer	4	21051
9	Oil Pump Screen	1	116244
10	Oil Pump Screw Cotter Pin	1	21503
	Cap Screw Pump to Crankcase	1	21352
	Lock Washer	1	21052

The parts listed below cover the dual oil pump assembly used on those units having oil cooler -

DESCRIPTION	NO. REQ.	PART NO.
Oil Pump Assembly (Dual)	1	0190180-A
Oil Pump Body	1	190180-A
Oil Pump Cover	1	190182
Oil Pump Cover Gasket	2	116166
Oil Pump Drive Shaft	1	190184
Oil Pump Idler Shaft	1	190083
Oil Pump Drive Gear Pin	1	B-997
Oil Pump Drive Gear	1	180051
Oil Pump Gear-Driven	2	190185
Oil Pump Gear-Driver	2	190081
Oil Pump Dowel Pin	2	116223
Oil Pump Housing	1	190088
Key	2	21001
Snap Ring	1	B-6274
Idler Shaft Pin	1	B-1425
Oil Screen	1	116244-A
Gasket	1	B-1256
Scavenger Suction Screen Assembly	1	A-952062
Pump Fitting Adapter	1	952045
Pump Fitting Adapter Gasket	2	B-1256

WATER PUMP ASSEMBLY

ILLUS. NO.	DESCRIPTION	NO. REQ.	PART NO.
	Water Pump Assembly Consists of:	1	0191160-D
1	Water Pump Body	1	191160-A
2	Water Pump Flange Gasket	1	117712
3	Water Pump Cover	1	117715
4	Water Pump Gear	1	118623
5	Water Pump Impeller	1	190063
6	Water Pump Shaft and Bearing	1	0190056
7	Retainer Clip	1	76939
8	Water Pump Seal	1	117681
9	Water Pump Slinger	1	78654
10	Angle Shut-Off	1	73059
	Oil Seal	1	951281-A
	Water Pump Seal Cup	1	951255
11	Water Pump Adapter	1	117714
	Dowel Pin-Adapter	2	B-1883
	Dowel Pin-Pump	2	B-3280
12	Water Pump Flange Gasket	1	117713
	Gasket-Gear Cover to Water Pump Adapter	1	41482

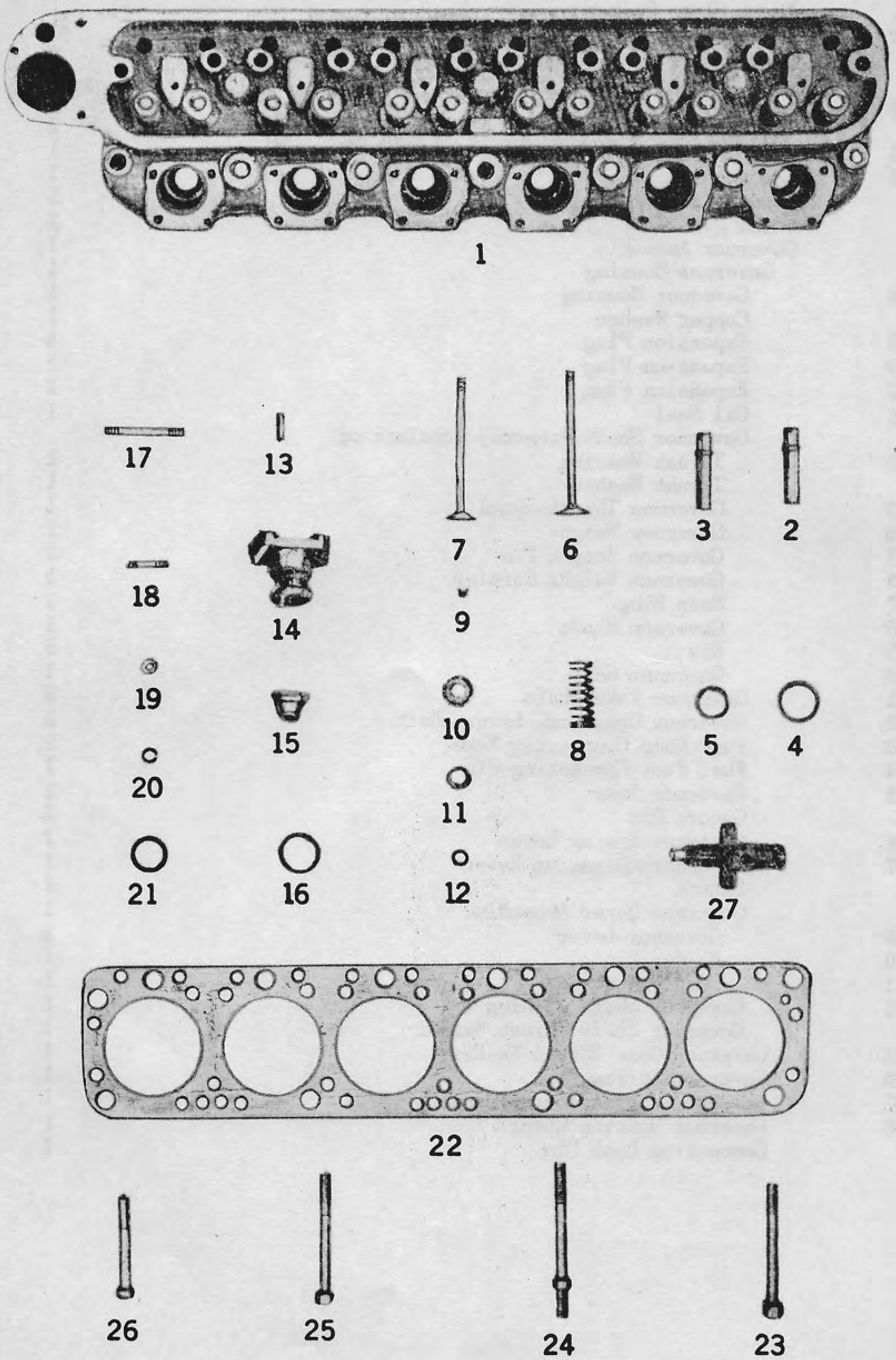


GEAR COVER AND OVERSPEED GOVERNOR.

Figure 73

GEAR COVER AND OVERSPEED GOVERNOR

ILLUS. NO.	DESCRIPTION	NO. REQ.	PART NO.
1	Front Plate Gasket	1	41479-A
2	Front Plate	1	191654
	Dowel Pin Plate & Cover	2	B-2315
	Gov. Spring Support	1	951055
3	Gear Cover Assembly	1	0191645
	Thrust Button	2	B-6016-C
4	Gear Cover Gasket	1	118171
5	Gov. Housing Gasket	1	118173
	Copper Washer	5	B-2135
	Dowel Pin	2	B-1883
	Governor Assembly	1	00191344
	Governor Housing	1	0191344
6	Governor Housing	1	191244
	Copper Washer	1	B-4188
8	Expansion Plug	4	76913
9	Expansion Plug	1	B-295
10	Expansion Plug	1	B-560
11	Oil Seal	1	73949
	Governor Shaft Assembly Consists of:		C-180173
12	Thrust Bearing	1	116252
	Thrust Washer	1	116253
13	Governor Thrust Spool	1	180075
14	Governor Weight	2	160059-C
15	Governor Weight Pin	2	76928
16	Governor Weight Carrier	1	180077
17	Snap Ring	1	116251
18	Governor Shaft	1	180173
19	Key	1	78877
20	Governor Gear	1	190228
21	Governor Yoke Shaft	1	181275
22	Governor Operating Lever Shaft	1	181074
23	Fuel Pump Connecting Yoke	1	950413
24	Fuel Pump Connecting Pin	1	951109
25	Governor Yoke	1	160076
	Groove Pin	5	B-6175
26	Governor Spring Lever	1	116160
27	Governor Operating Lever	1	181169
	Button	1	44625
	Governor Lever Assembly	1	044466
29	Governor Lever	1	44466
30	Roller Pin	1	181094
31	Needle Bearing	1	73596-L
32	Governor Shaft Bushing	1	116250
	Governor Shaft Thrust Washer	1	44459
33	Governor Gear Thrust Washer	1	41456-A
34	Governor Spring	1	B-10137
37	Governor Housing Cover Gasket	1	116159
38	Governor Housing Cover	1	116329
	Connecting Link Pin	1	116504



CYLINDER HEAD ASSEMBLY, GASKET AND CAP SCREWS.

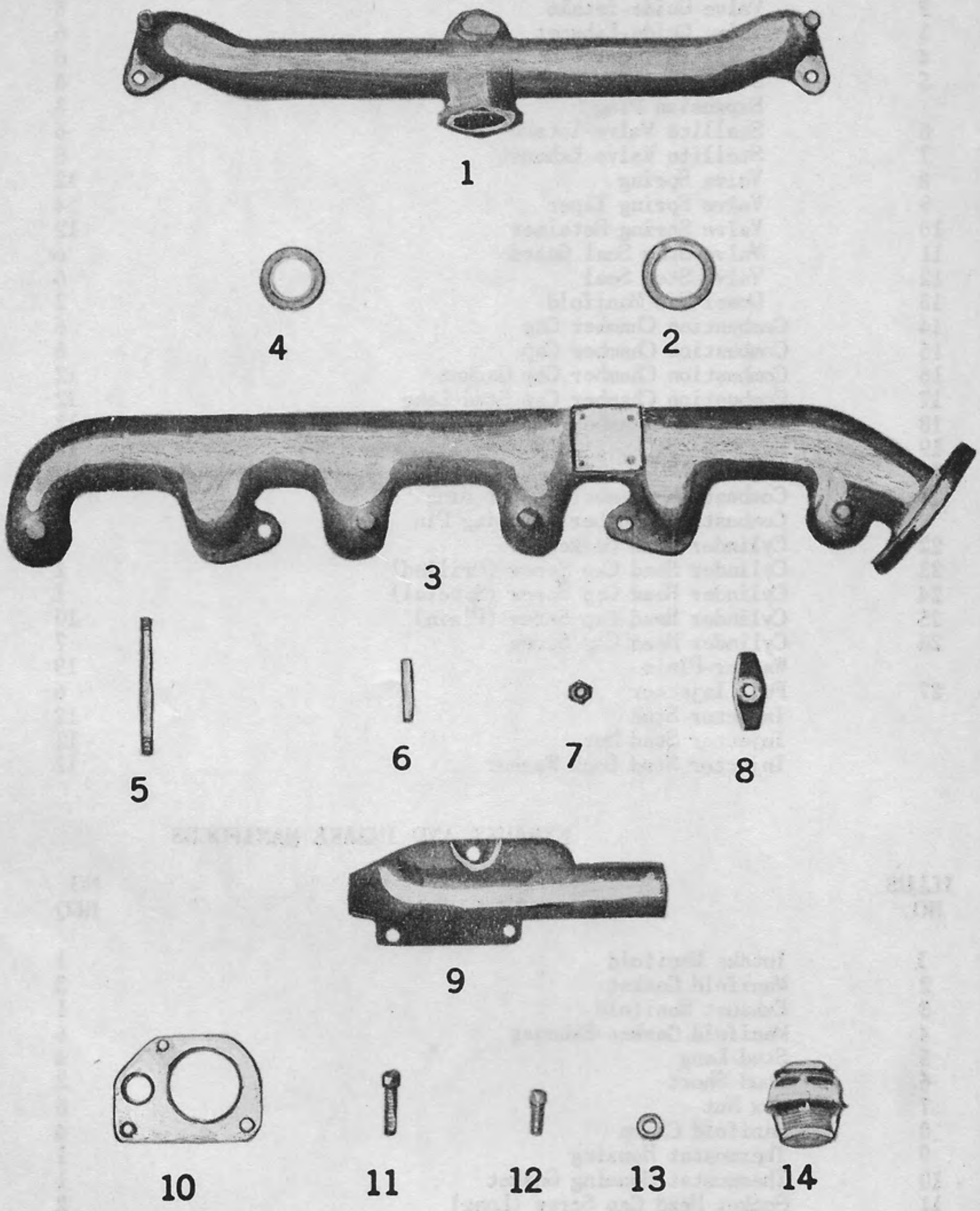
Figure 74

CYLINDER HEAD ASSEMBLY, GASKET AND CAP SCREWS

ILLUS. NO.	DESCRIPTION	NO. REQ.	PART NO.
1	Cylinder Head Consists of:	1	00191002-C
2	Valve Guide-Intake	6	181009-A
3	Valve Guide-Exhaust	6	181109-A
4	Stellite Insert-Intake	6	118664
5	Stellite Insert-Exhaust	6	118665
	Expansion Plug	3	B-4171
6	Stellite Valve-Intake	6	191036-A
7	Stellite Valve-Exhaust	6	191136-A
8	Valve Spring	12	190035
9	Valve Spring Taper	24	B-6466-A
10	Valve Spring Retainer	12	76771
11	Valve Stem Seal Guard	6	160016
12	Valve Stem Seal	6	160015
13	Dowel Pin Manifold	2	B-9824
14	Combustion Chamber Cup	6	44925
15	Combustion Chamber Cap	6	41292-G
16	Combustion Chamber Cap Gasket	12	48788-D
17	Combustion Chamber Cap Stud-Long	12	44736-C
18	Combustion Chamber Cap Stud	12	44736-A
19	Hex Nut	24	80107-B
20	Washer	24	B-6717-A
21	Combustion Chamber Rubber Ring	6	44727
	Combustion Chamber Locating Pin	6	44936
22	Cylinder Head Gasket	1	192100
23	Cylinder Head Cap Screw (Drilled)	1	116273
24	Cylinder Head Cap Screw (Special)	1	118790
25	Cylinder Head Cap Screw (Plain)	10	116312
26	Cylinder Head Cap Screw	7	41459
	Washer-Plain	19	B-363
27	Fuel Injector	6	C-60268-B
	Injector Stud	12	41484
	Injector Stud Nut	12	21193
	Injector Stud Lock Washer	12	21052

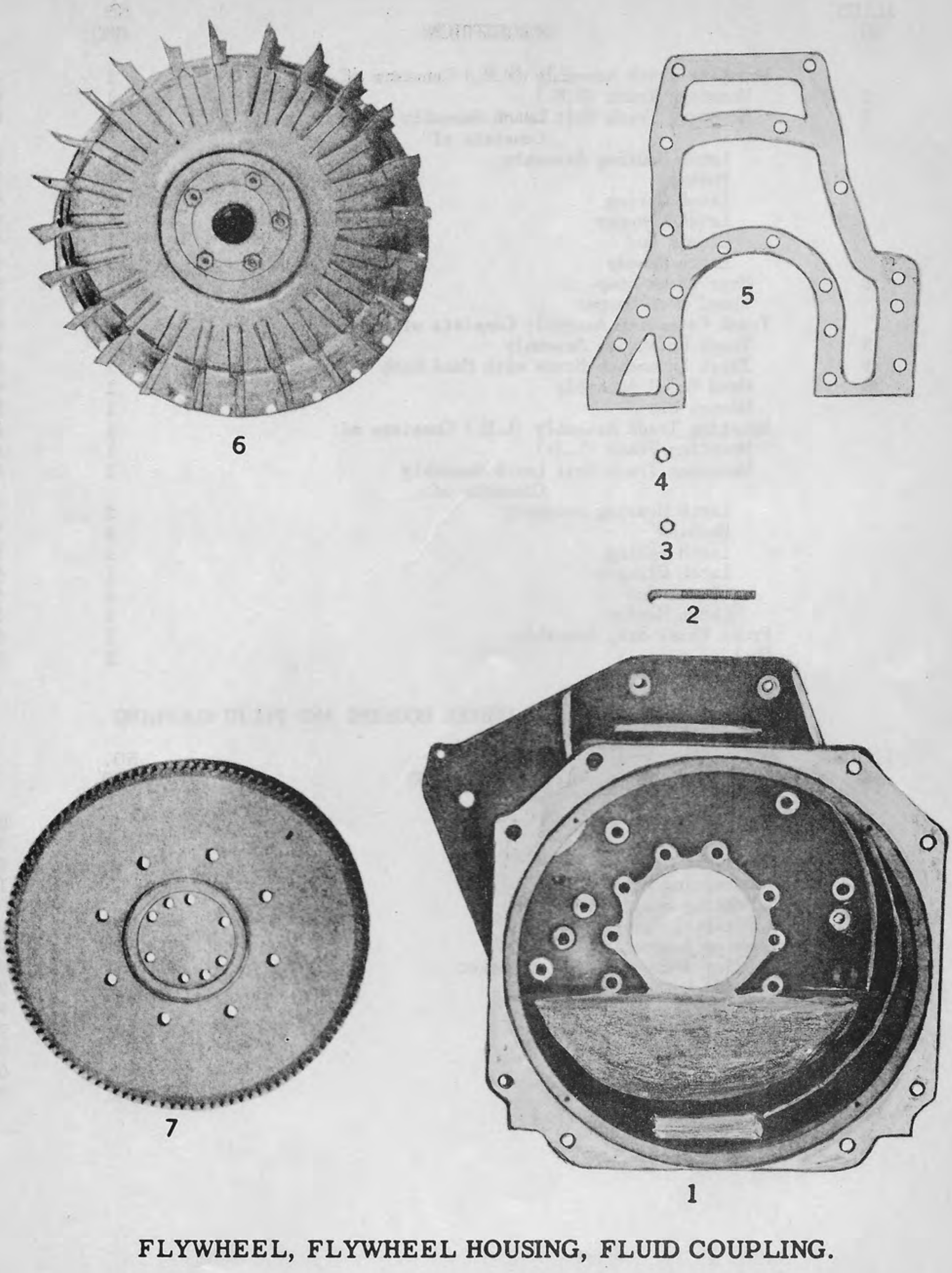
EXHAUST AND INTAKE MANIFOLDS

ILLUS. NO.	DESCRIPTION	NO. REQ.	PART NO
1	Intake Manifold	1	191041-A
2	Manifold Gasket	3	41426
3	Exhaust Manifold	1	191242-A
4	Manifold Gasket-Exhaust	6	44932
5	Stud-Long	4	74358
6	Stud-Short	2	B-2634
7	Hex Nut	6	21193
8	Manifold Clamp	4	41464
9	Thermostat Housing	1	116952-A
10	Thermostat Housing Gasket	1	117231
11	Socket Head Cap Screw (Long)	2	26342
12	Socket Head Cap Screw (Short)	1	21544
13	Lock Washer	3	21729
14	Thermostat (195° F. Full Open)	1	60223



EXHAUST AND INTAKE MANIFOLDS.

Figure 75



FLYWHEEL, FLYWHEEL HOUSING, FLUID COUPLING.

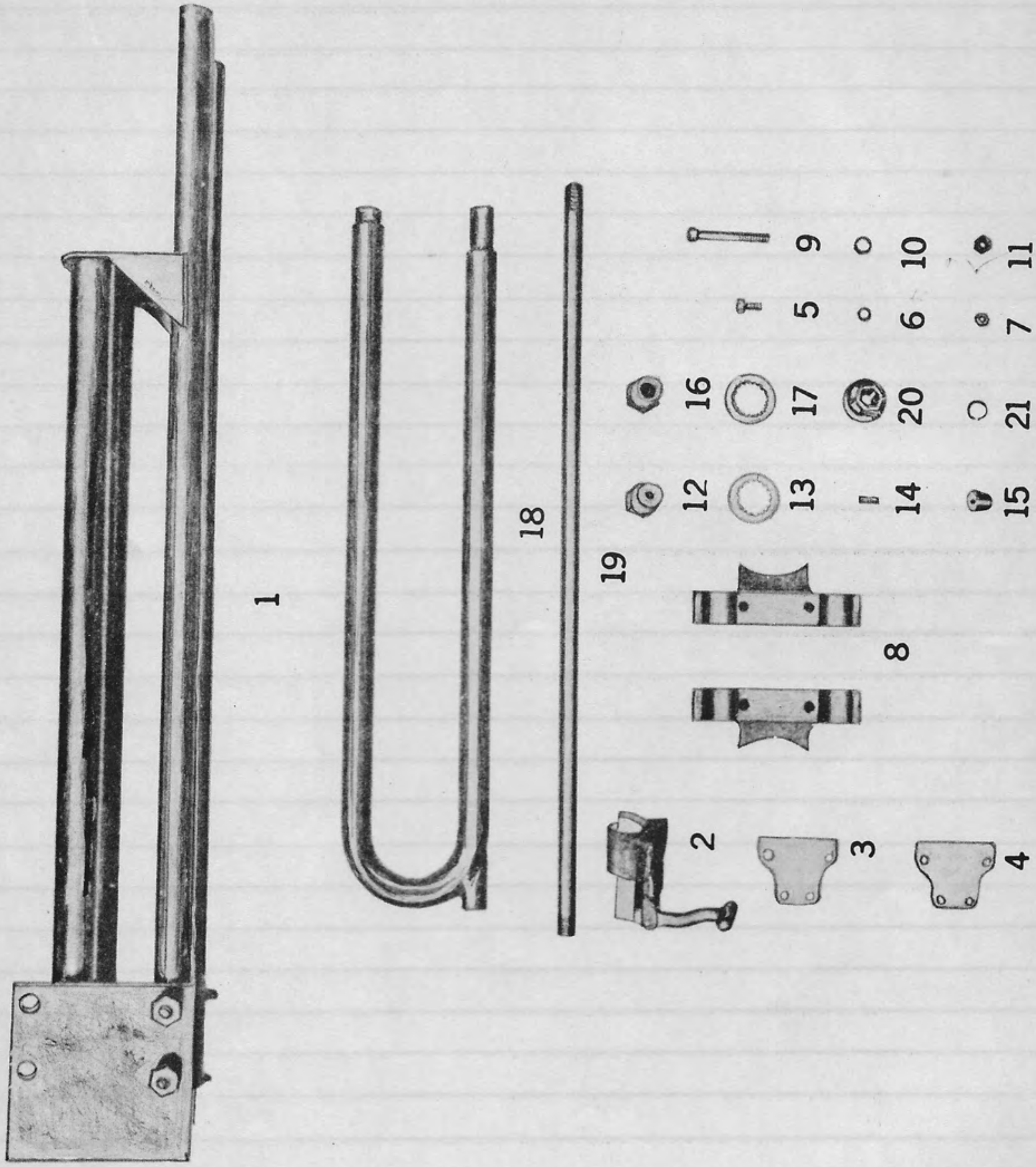
Figure 76

MOUNTING TRACK ASSEMBLY

ILLUS. NO.	DESCRIPTION	NO. REQ.	PART NO.
	Mounting Track Assembly (R.H.) Consists of:	1	A950629-A
1	Mounting Track (R.H.)	1	0950629-A
2	Mounting Track Unit Latch Assembly Consists of:	1	0950369-B
	Latch Housing Assembly	1	X950369-B
	Bushing	4	Y-18222
	Latch Spring	1	950371
	Latch Plunger	1	950363
	Clevis End	1	950362
	Latch Handle	1	950366
8	Rear Track Stop	2	950279-5
	Wheel Stop Bumper	2	951991
	Track Extension Assembly Consists of:	1	A950666-A
18	Track Extension Assembly	1	0950666-A
19	Track Extension Screw with Hand Knob	2	0950657
20	Hand Wheel Assembly	1	0950267
	Groove Pin	1	B-5544
	Mounting Track Assembly (L.H.) Consists of:	1	A-950630
	Mounting Track (L.H.)	1	0950630
	Mounting Track Unit Latch Assembly Consists of:	1	0950369-B
	Latch Housing Assembly	1	X950369-B
	Bushing	4	Y-18222
	Latch Spring	1	950371
	Latch Plunger	1	950363
	Clevis End	1	950362
	Latch Handle	1	950366
	Front Wheel Stop Assembly	2	A-952004
	Bushing	2	952003

FLYWHEEL, FLYWHEEL HOUSING AND FLUID COUPLING

ILLUS. NO.	DESCRIPTION	NO. REQ.	PART NO.
1	Flywheel Housing	1	0950427-A
	Flywheel Housing	1	950427-B
	Oil Pan Stud	2	951324
	Retaining Ring	2	117796-B
	Housing Seal Sleeve	1	951932
2	Flywheel Pointer Stud	1	950934
	Housing Inspection Plate	1	950431
	Housing Inspection Plate Gasket	1	950438
	Housing Bottom Plate	1	950430
	Bottom Plate Gasket	1	951108
5	Rear Crankcase Gasket	1	950986
6	Fluid Coupling	1	950767-C
7	Flywheel and Ring Gear	1	0950432-A
	Ring Gear	1	9240-A



MOUNTING TRACK ASSEMBLY

Figure 77

NOTES

FRIGIDAIRE-RAILWAY AIR CONDITIONING SYSTEM

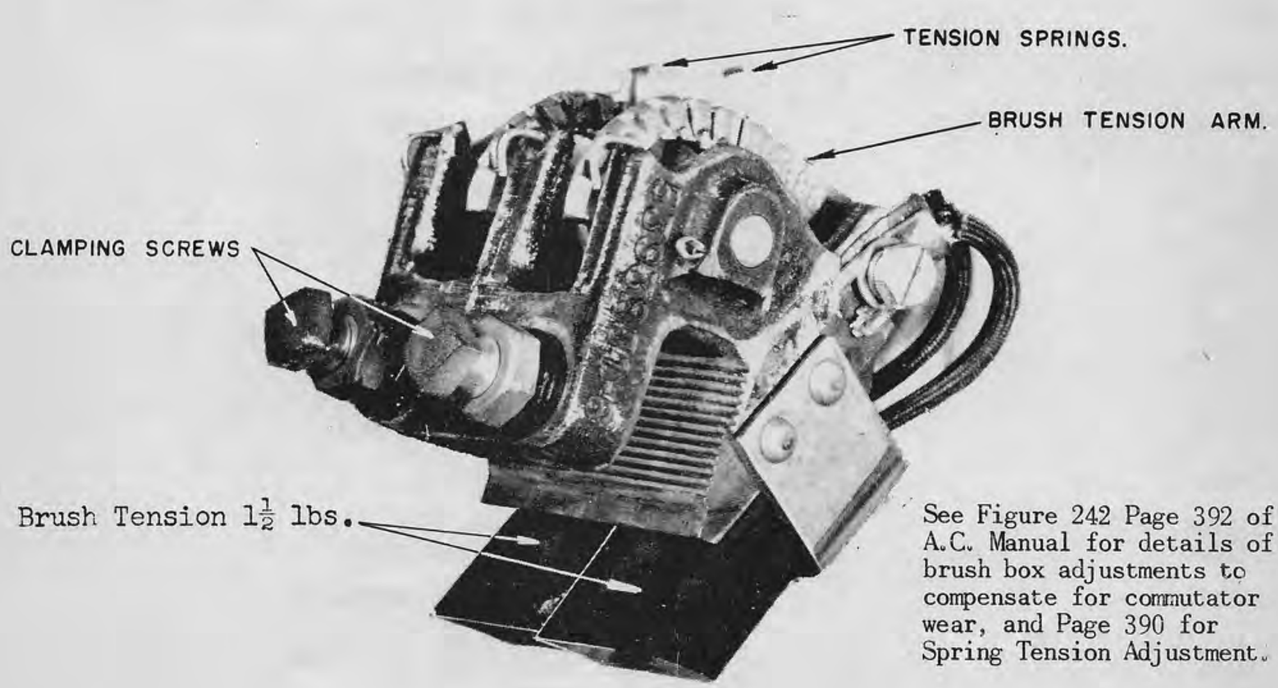
The Frigidaire-railway air-conditioning system used on these cars consists of three separate units; namely the compressor motor unit, the condenser unit, and the air-conditioning unit. A description of the various parts follows:

COMPRESSOR MOTOR UNIT

The compressor motor unit consists of the standard Frigidaire 4 cylinder compressor driven by a 12 H.P., 2 speed, D.C. motor. The compressor and motor are mounted to a suitable framework RY10. Special rubber mounts insulate the unit from the car members. Four safety bolts are used to prevent the unit from dropping, in the event of failure of the rubber mounts. There is no enclosure around the compressor motor unit, however, a belt guard prevents unauthorized persons or workmen from accidentally catching their fingers or clothing in the belts. Care should be exercised to stand free of the unit when operating, and it should never be run without this belt guard in place. The motor is suspended from the frame by a swivel mounting. Belt tension is maintained by means of a belt adjusting rod and bracket fastened to the side of the motor. This arrangement simplifies belt adjustments as it is no longer necessary to loosen the four motor base bolts. The commutator end head has a heavy aluminum plate that fits tightly against the machined end head itself, and it can be rotated to expose the four brush access ports. *CAUTION:* This movable plate should be turned so that it covers the brush access ports except during time of maintenance. They are not to be left open for ventilation as the motor is ventilated through a baffle chamber on the bottom. The brush box assembly is similar to Westinghouse type. See Figure 78.

The compressor supports have been arranged so that the compressor will slide out without interfering with the framework. Shut-off valves are on both the suction and compressor discharge manifold. In this way it will be possible to perform the necessary service operation on the compressor without pumping down the complete system. Flexible couplings in both the suction line and discharge line serve to prevent vibration being transmitted into the lines.

Six B-section endless Vee Belts 84" long are used. Typical unit is shown in Figure 79, Page 113.



See Figure 242 Page 392 of A.C. Manual for details of brush box adjustments to compensate for commutator wear, and Page 390 for Spring Tension Adjustment.

Figure 78

COMPRESSOR MOTOR BRUSH BOX ASSEMBLY

COMPRESSOR MOTOR UNIT EM-16307

PART NUMBER	QUANTITY	DESCRIPTION
1133707	1	Body Assembly - Compressor
ED-34518	1	Flywheel
640082	1	Washer - Flywheel Mtg. (Plain)
635941	1	Nut - Flywheel Mtg.
1136289	1	Valve Assembly - Suction (1133435 Alternate)
640052	1	Gasket - Valve Mtg.
640054	4	Screw - Valve Mtg. 5/8" - 18
EB-24542	1	Trap - Scale
640052	1	Gasket - Scale Trap Mtg.
1149161	1	Strainer Assembly (Mt. In Body)
EB-73909	1	Connection Assembly - Suction
EB-72260	1	Connection - Flexible
640052	1	Gasket - Suction Conn. Mtg.
1136289	1	Valve Assembly - Discharge (1133435 Alternate)
640052	1	Gasket - Discharge Valve Mtg.
EA-117473	2	Stud - Discharge Valve Mtg.
EA-118061	2	Screw - Discharge Valve Mtg. 5/8" - 18
EB-73897	1	Connection Assembly - Discharge
EB-72261	1	Connection Assembly - Flexible
640052	1	Gasket - Discharge Conn. Mtg.
ED-18263	1	Support and Rod Assembly - Compressor
642536	6	Spacer - Frame to Compressor Support Mtg.
642537	6	Nut Frame to Compressor Support Mtg. 7/8" - 14
A-7161	1	Motor, 12 H.P., 36 V, D.C., 1750/1100 RPM.
EB-72286	1	Screw - Spacer Assembly
EB-72324	1	Screw - Spacer Assembly
EC-28504	1	Bracket - Motor Hanger (Front)
EA-112254	1	Bearing - Motor Hanger Bracket
EC-28503	1	Bracket - Motor Hanger (Rear)
EA-112254	1	Bearing - Motor Hanger Bracket
EA-112265	2	Screw - Hanger Bracket Mtg. 1/2 - 13
EA-112240	4	Nut - Hanger Bracket Mtg.
EA-112255	2	Screw - Shaft to Motor (Set) 1/2" - 13
EA-112253	2	Washer (Mt. on Ends of Shaft)
EA-112245	2	Pin (Mt. on Ends of Shaft)
EA-112247	1	Nut (Mt. on End of ~~Shaft)~~ 1" - 14
EA-112243	1	Pin (Mt. on End of Shaft)
EB-70462	1	Rod - Belt Adjusting
EA-112248	3	Nut - Motor Adjusting
EA-112264	1	Washer (Assemble on Rod)
EB-25717	6	Belt 84" (Match in Sets of 6)
EC-24764	1	Pulley 4 5/8"
EA-78191	2	Screw - Pulley Set
EB-72318	1	Chain Assembly
EA-132640	4	Shackle Assembly - Chain
EB-73414	4	Mounting Assembly - Rubber
EA-79395	8	Screw - Mounting Assembly to Frame Mtg. 3/8" - 16
EA-79437	8	Nut - Mounting Assembly to Frame Mtg. 3/8" - 16
EC-46975	1	Guard Assembly - Belt

FRIGIDAIRE COMPRESSOR UNIT

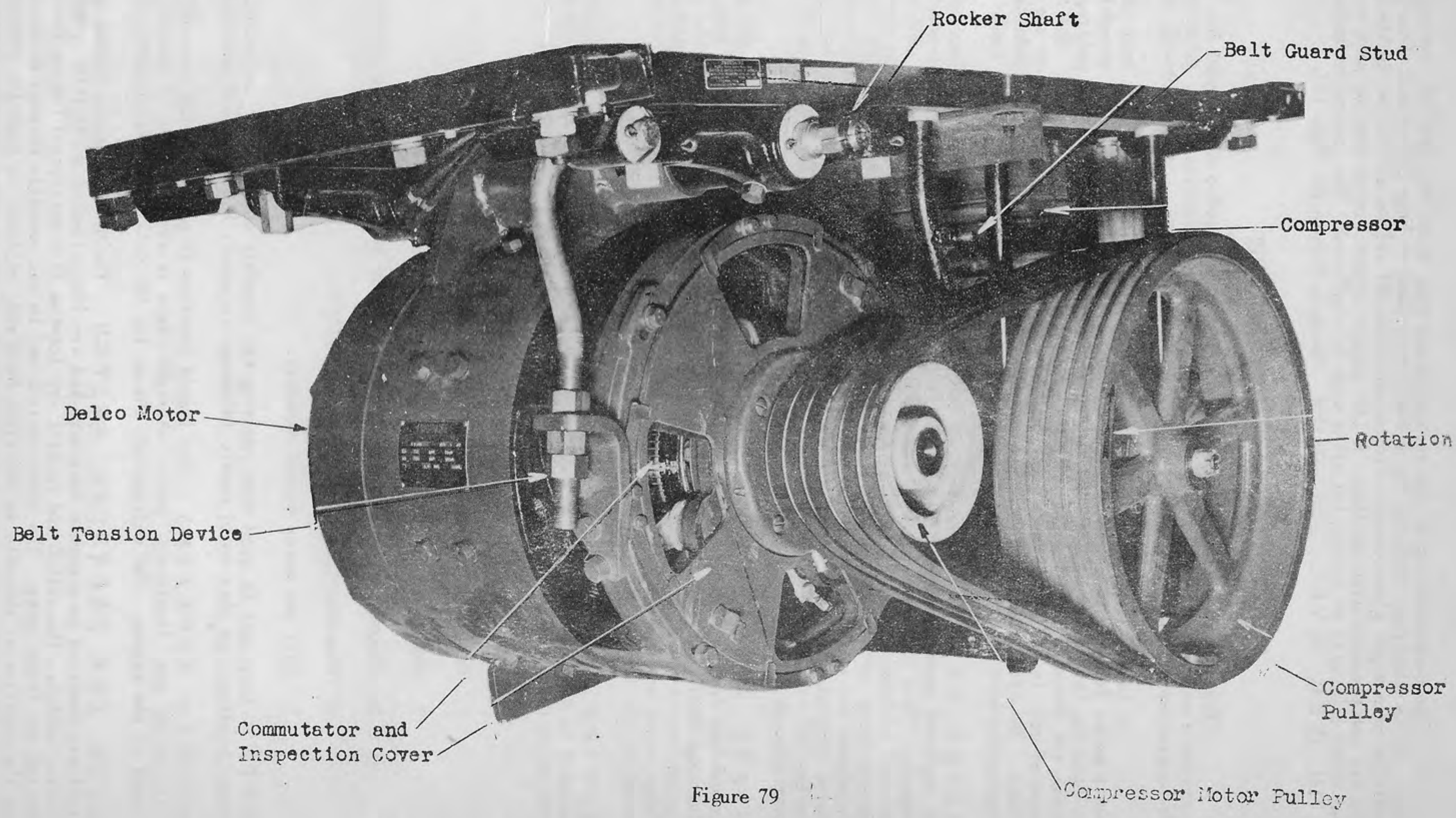


Figure 79

The compressor is of the reciprocating type Model No. 1133707, having four cylinders in line. It is identical to Model No. 1130221 described on Page 163 of A.C. Manual, except for the addition of a sight glass cover. Compressor shut-off valves are bolted to the compressor body and are not provided with handles. A 1/2" square socket wrench must be used to operate valves, and valve caps will be re-applied after work is completed. The compressor motor is a Delco No. A 7161, 12 H.P., 36 V.D.C., 1750/1100 RPM. Shown in Figure 80, Page 115.

CONDENSER UNIT

The condenser unit on these cars is the full flooded type, Model No. EM 16138. The unit contains a water spray system, air system and condenser, receiver tank, freon pressure gauges, Hi-Lo pressure switch, and high pressure modulating control. See Figures 81, 82, 83 and 84.

A baffle arrangement (eliminator assembly) is provided at the rear of the unit which prevents water from being carried out of the unit by the air stream. This assembly can be taken off by removing two screws at each end, pulling the bottom outward and then pulling downward to release the assembly from the three spring clips which hold it at the top. The condenser in this type of unit is cooled by the combination of air and water spray forced on the condenser fins and tubes. The efficiency of this unit is further increased by having the condenser coil mounted vertically with the bottom six inches submerged in the water of the sump tank.

WATER SYSTEM: The sump of the unit has a capacity of 80 gallons of water which must be replaced manually through the manual fill pipe each time the sump is drained for inspection or repairs. This fill pipe has been extended from the end of the condenser tank to both sides of the car to facilitate filling the sump. This water is supplemented during operation of the condenser spray system from the car water supply tank under the control of the float valve which maintains the water level. The water flows from the car water supply tank through a shut-off valve located inside the water tank casing to a second shut-off valve at the condenser unit, then to the "Y" type strainer, the float valve to the sump. Water from the sump is circulated by the pump through the spray system.

SPRAY ASSEMBLY: This consists of a common pipe fitted with ten orifice and nozzle assemblies from which water is sprayed on the condensers. Water is taken from the sump by the Ingersol Rand Pump, Model K R V S driven by a Delco Motor. On some units the operation of the sprays may be observed through an inspection port provided on each end of the condenser tank. Other units are not provided with this port. The sprays may be removed for cleaning after removal of the fan motor assembly from the unit.

CONDENSER FAN: The blower and motor assembly is removable as a separate unit. It is mounted on steel plate which in turn is engaged by opposed angles and held in place by means of two bolts that extend through and engage the tapped holes on the supports.

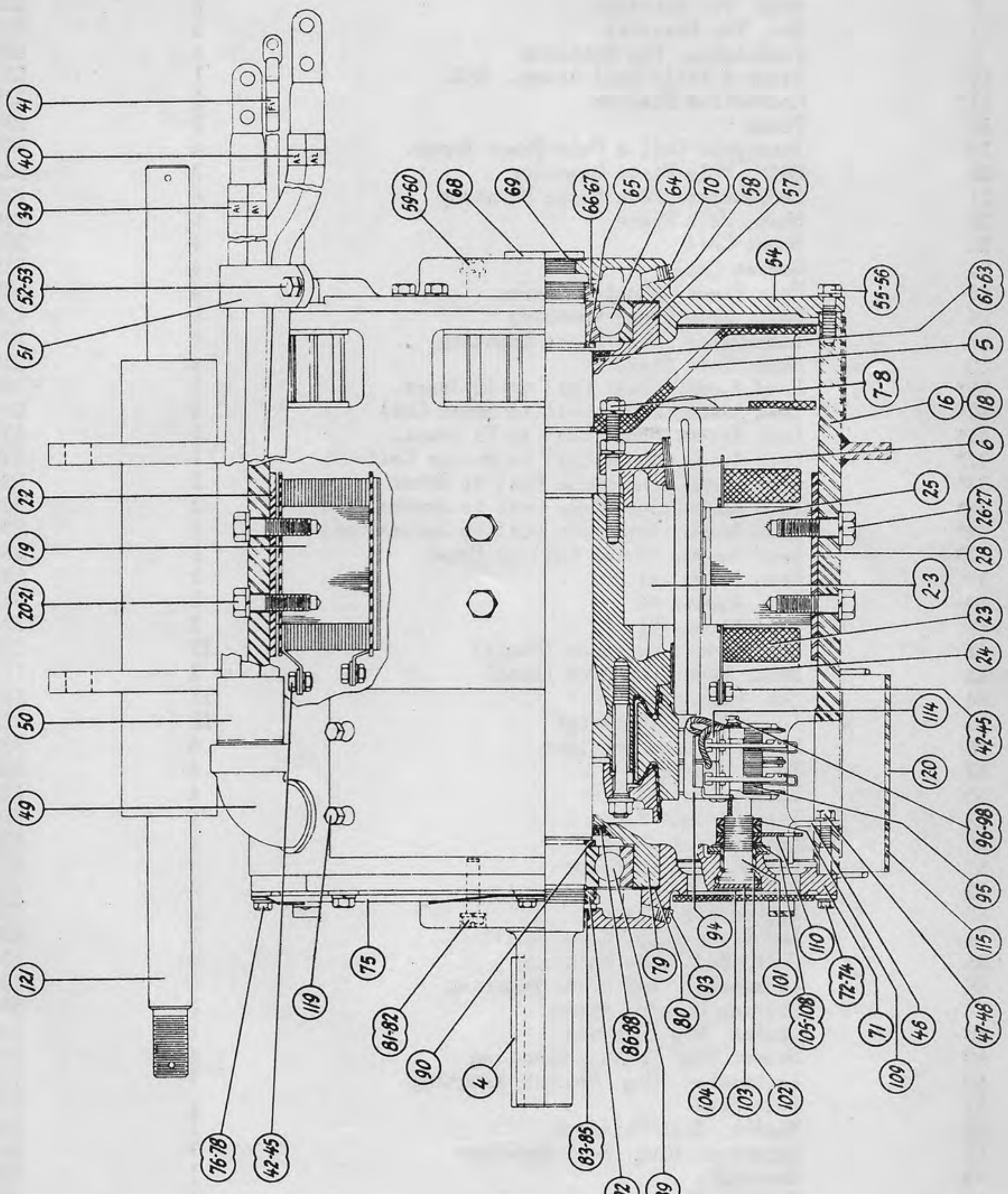
The assembly may be removed as follows:

1. Remove bolts holding removable portions of blower housings.
2. Remove blower housing sections from box. See Figure 81.
3. Remove two hex bolts that secure blower motor assembly to mounting angles.
4. Disconnect motor plug from receptacle.
5. Lift out motor blower assembly.

NOTE: Care must be used when removing the assembly so it is not subjected to jolting or rough handling, as this could result in damage to motor, blower wheels and shaft.

LIQUID RECEIVER: The liquid receiver is provided with shut-off valves on the "liquid-in" and "liquid-out" ports. A sight glass is also provided to observe operating liquid level of the system. The refrigerant charge for the entire system consists of 55 pounds F-12.

HIGH-LOW PRESSURE SWITCH: The Hi-Lo pressure switch and modulating control are combined in a common enclosure and are identified as a "YL-LOHH" pressure cut-out and safety switch. The switch and control are located in a waterproof box on the right-hand end just inside the front cover. The safety switch may be set manually through an access plate provided on the exterior of the unit at the right-hand end, adjacent to high-low pressure gauge box. The settings of the Hi-Lo pressure switch should be as shown under "Service Operations". The condenser unit is mounted to the car structure by means of rubber mounts. These rubber mounts are fairly solid and are used to absorb car coupling shocks and to prevent transmission of noise.


41
40
39
52-53
51
22
19
20-21
50
49
121
76-78
42-45
119
75
81-82
90
4
83-85
91-92
89
86-88
80
79
93
94
104
103
102
101
105-108
110
72-74
109
71
46
47-48
115
95
96-98
120
114
42-45
24
23
2-3
28
26-27
25
6
18
16
7-8
5
61-63
55-56
54
57
58
70
64
65
66-67
69
68
59-60

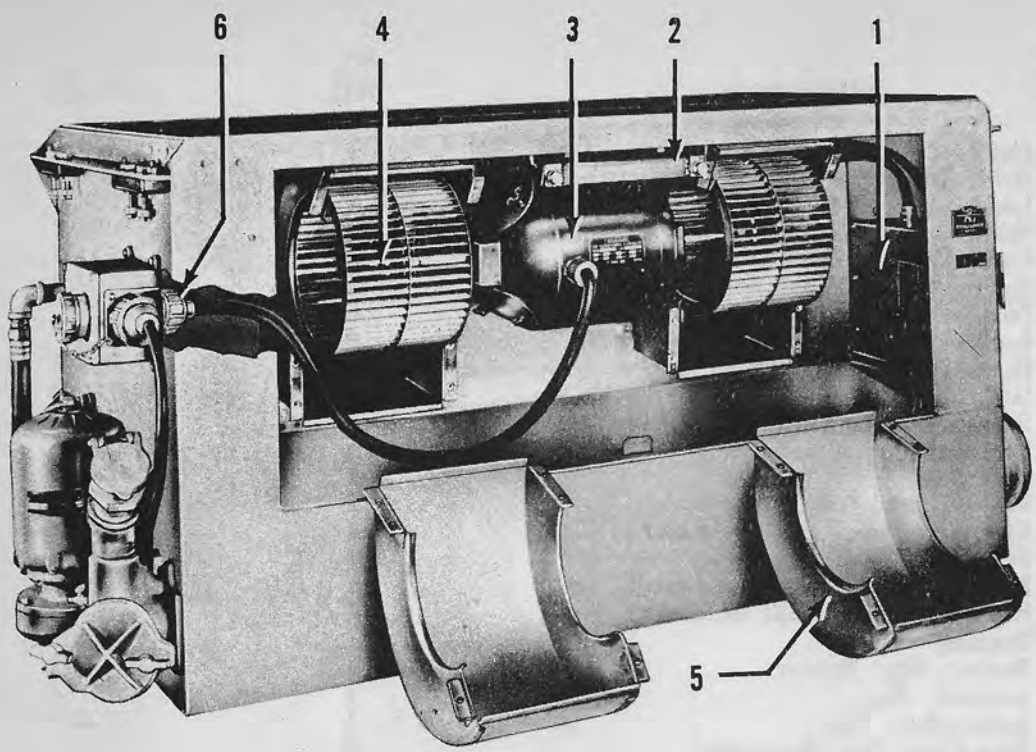
A 7161 Motor

SERVICE PARTS FOR DELCO-FRIGIDAIRE MOTORS

ILLUS. NO.	DESCRIPTION	NO. REQ.	A-7161
1	Armature, Fan, Rotor & Shaft Assem.	1	
2	Armature, Fan & Shaft Assem.	1	5393955
3*	Armature & Shaft Assem.	1	5388286
4	Key, Shaft Extension	1	1064311
5	Fan	1	5493733
6	Stud, Fan Retainer	6	5327775
7	Nut, Fan Retainer	6	5312255
8	Lockwasher, Fan Retainer	6	120382
16	Frame & Field Coil Assem., D.C.	1	5393953
17*	Connection Diagram	1	5393725
18	Frame	1	5393710
19	Interpole Coil & Pole Piece Assem.	4	5393744
20	Bolt, Pole Piece Mounting	8	122446
21	Lockwasher, Pole Piece Mounting	8	120384
22	Shim, Pole Piece	4	1069975
23	Shunt Coil	4	5393823
24	Series Coil	4	5393851
25	Pole Piece, Shunt & Series	4	5392820
26	Bolt, Pole Piece Mounting	8	122446
27	Lockwasher, Pole Piece Mounting	8	120384
28	Shim, Pole Piece	4	5393857
29*	Lead Assem. Shunt Coil to A2 Junct.	1	5393895
30*	Lead Assem. Shunt Coil to Shunt Coil	3	5393840
31*	Lead Assem. Shunt Coil to F1 Junct.	1	5393841
32*	Lead Assem. Shunt Coil to Series Coil	1	5393896
33*	Lead Assem. Interpole Coil to Brush	2	5387804
34*	Lead Assem. Interpole Coil to Series Coil	2	5387803
35*	Lead Assem. Interpole Coil to Series Coil	1	5387843
37*	Lead Assem. Series Coil to Brush	1	5387802
39	Lead Assem. A1	1	5388278
40	Lead Assem. A2	1	5388272
41	Lead Assem. F1	1	5392871
42	Bolt, Coil Connector (Short)	12	120834
43	Bolt, Lead Connector (Long)	2	120228
44	Nut, Connector	12	123437
45	Lockwasher, Connector	12	120214
46	Bracket, Lead Retainer	4	5393855
47	Bolt, Bracket	4	122007
48	Lockwasher, Bracket	4	120214
49	Lead Conduit Elbow	1	5395517
50	Lead Conduit Nipple	1	5388276
51	Clamp, Lead to Frame	1	5314584
52	Bolt, Clamp	2	120233
53	Lockwasher, Clamp	2	120382
54	End Frame (Opp. Comm. End)	1	5393830
55	Bolt, End Frame Mounting	6	186679
56	Lockwasher, End Frame Mounting	6	120382
57	Bearing Housing Assem.	1	5393742
58	Gasket, Brg. Housing	1	5312229
59	Screw, Brg. Housing Mounting	4	1057178
60	Lockwasher, Brg. Housing Mounting	4	120382
61	Felt Seal	1	1079145
62	Washer, Seat Retainer	1	5316993
63	Expansion Ring, Seal Retainer	1	1078259
64	Bearing	1	5364645
65	Washer, Brg. Spacer	1	5312203
66	Locknut, Bearing	1	5311754
67	Lockwasher, Bearing	1	1070039
68	Plug, End Frame Center	1	5381885
69	Gasket, Plug	1	043216
70	Pipe Plug, Brg. Reservoir	2	103883

ILLUS. NO.	DESCRIPTION	NO. REQ.	A-7161
71	End Frame & Brush Holder Assem. (Comm. End.)	1	5393826
72	Bolt, End Frame Mounting	4	186679
73	Lockwasher, End Frame Mounting	4	120382
74	Washer, End Frame Mounting	4	5309587
75	Cover Plate Assem.	1	5393962
76	Spring, Cover Plate Retainer	4	5392974
77	Bolt, Retainer Spring	8	121887
78	Lockwasher, Retainer Spring	8	120380
79	Bearing Housing Assem.	1	5393743
80	Gasket, Bearing Housing	1	5312229
81	Screw, Bearing Housing Mounting	4	1057178
82	Lockwasher, Bearing Housing Mounting	4	120382
83	Felt Seal	1	5323298
84	Washer, Seal Retainer - Outer	1	5327756
85	Expansion Ring, Seal Retainer	1	1078262
86	Felt Seal	1	1079145
87	Washer, Seal Retainer - Inner	1	5316993
88	Expansion Ring, Seal Retainer	1	1078259
89	Bearing	1	5364645
90	Washer, Brg. Spacer	1	5312203
91	Locknut, Brg.	1	5311754
92	Lockwasher, Brg.	1	1070039
93	Pipe Plug, Brg. Reservoir	2	103883
94	Brush Holder & Spring Assem.	4	5393836
95	Spring, Brush Tension	8	5310593
96	Screw, Brush Lead Terminal	4	5396361
97	Lockwasher, Brush Lead Terminal	4	120217
98	Washer, Brush Lead Terminal	4	042663
99	Screw, Brush Holder Clamp	8	5310598
100	Locknut, Brush Holder Clamp	8	123479
101	Brush Holder Stud & Insulating Sleeve Assy.	4	5385684
102	Insulating Sleeve	4	5312128
103	Insulating Disc, Stud End	4	5317124
104	Expansion Plug, Disc Retainer	4	1070969
105	Insulating Washer, Brush Holder Stud (1/16" Mica)	4	5313422
106	Insulating Washer, Brush Holder Stud (1/16" Mica)	4	5312127
107	Insulating Washer, Brush Holder Stud (5/32" Fibre)	4	5386534
108	Spring Washer, Brush Holder Stud	4	5327711
109	Locknut, Brush Holder Stud	12	5308407
110	Terminal Clip, Brush Holder Stud	4	5393832
111	Bolt, Terminal Clip	4	132315
112	Nut, Terminal Clip	4	123437
113	Lockwasher, Terminal Clip	4	120214
114	Brush	8	5388271
115	Cover Band & Baffle Assem.	1	5393862
116*	Gasket, Cover Band	1	5385746
117	Cover Band & Clamp Assem.	1	5393863
118	Gasket, Cover Band	1	5385747
119	Bolt, Cover Bands Mounting	4	1060327
120	Cover Band Assem., Fan	1	5393866
121	Shaft, Mounting Pivot	1	5323788
122*	Bracket, Belt Tension Mech.	1	5393739
123*	Bolt, Bracket Mounting	3	122433
124*	Lockwasher, Bracket Mounting	3	120384
126*	Name Plate, D.C.	1	5365449
127*	Drive Screw, Name Plate	6	1061405

* Not Illustrated

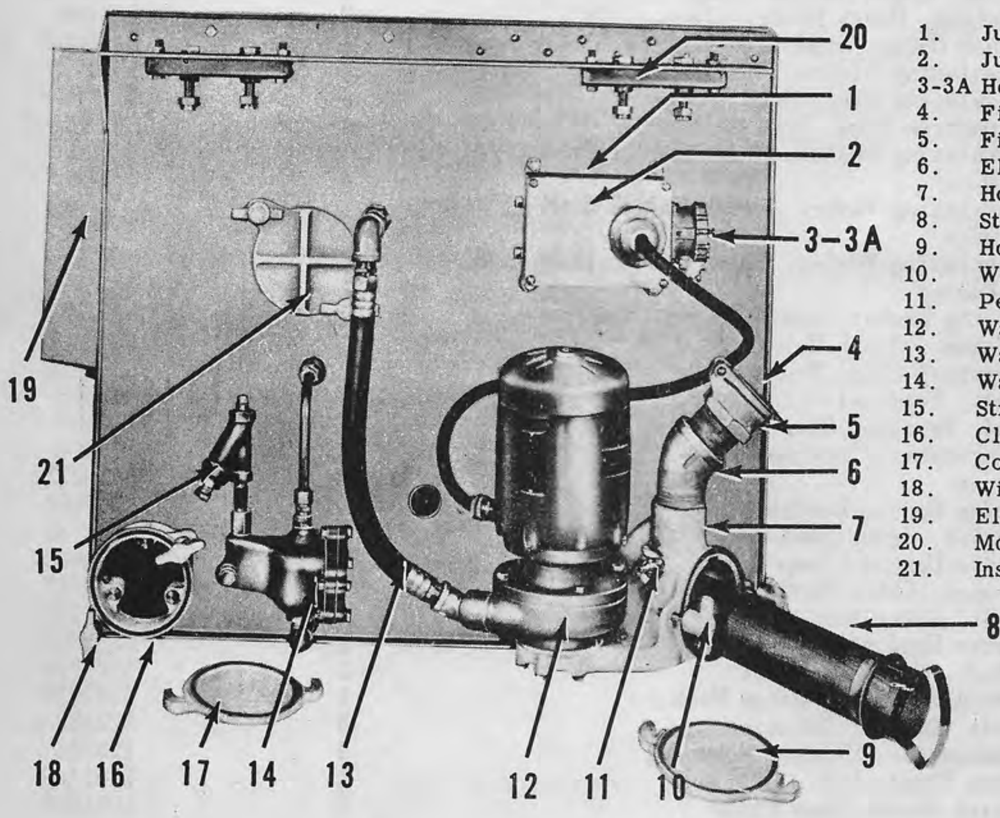


ILLUS. NO. DESCRIPTION

1. YL SWITCH AND PARTS
2. SLIDE PLATE AND PARTS.
3. BLOWER MOTOR
4. BLOWER WHEEL
5. BLOWER HOUSING, (REMOVABLE SECT.)
6. RECEPTACLE AND HOUSING.

EM 16138 CONDENSER - FRONT VIEW

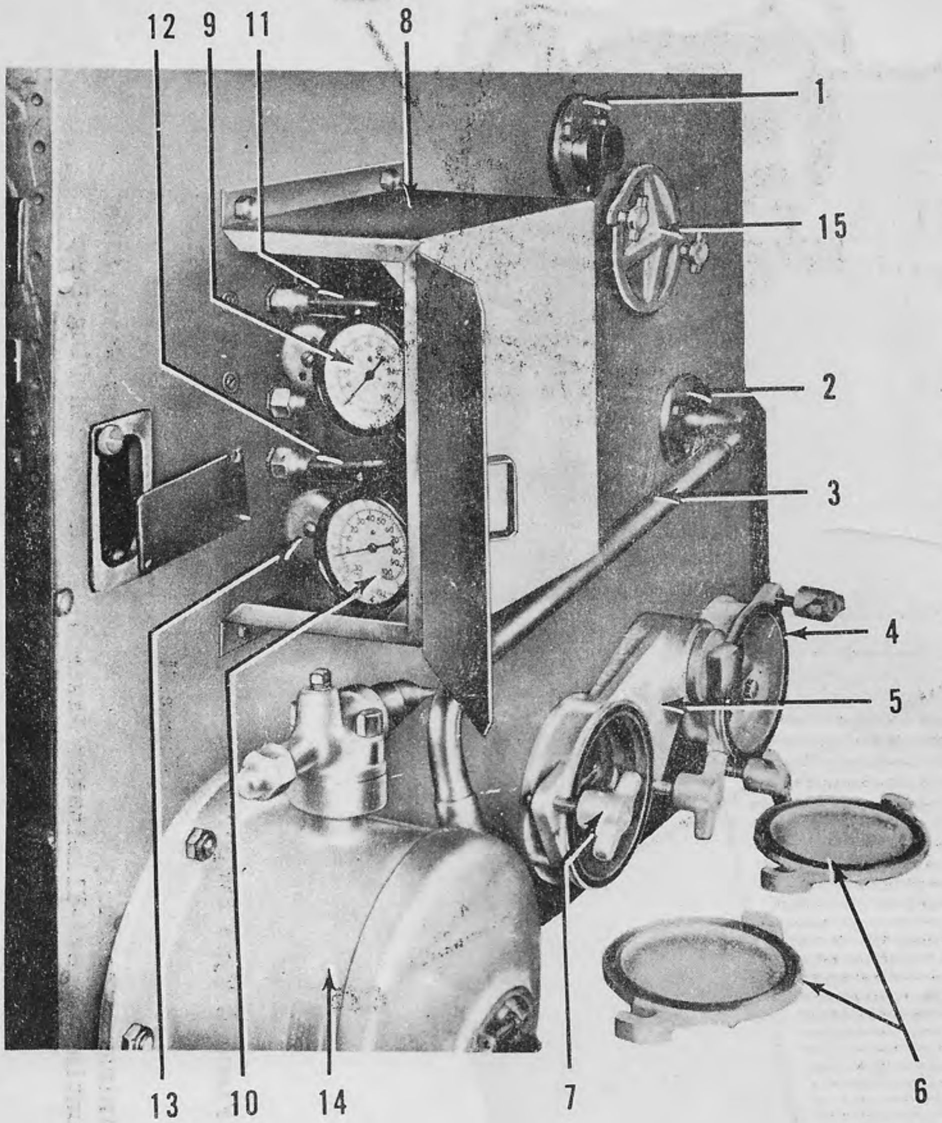
Figure 81



1. Junction Box and Parts
2. Junction Box Cover
3-3A Housing and Receptacle
4. Filler Cap
5. Filler Cap Body
6. Elbow
7. Housing
8. Strainer Assembly
9. Housing Cover
10. Wing Nut and Stud
11. Petcock
12. Water Pump and Parts
13. Water Hose
14. Water Level Controller
15. Strainer
16. Clean Out Housing
17. Cover
18. Wing Nut and Stud
19. Eliminator and Parts
20. Mounting Assembly and Parts
21. Inspection Port and Parts

EM - 16138 CONDENSER - LEFT HAND END

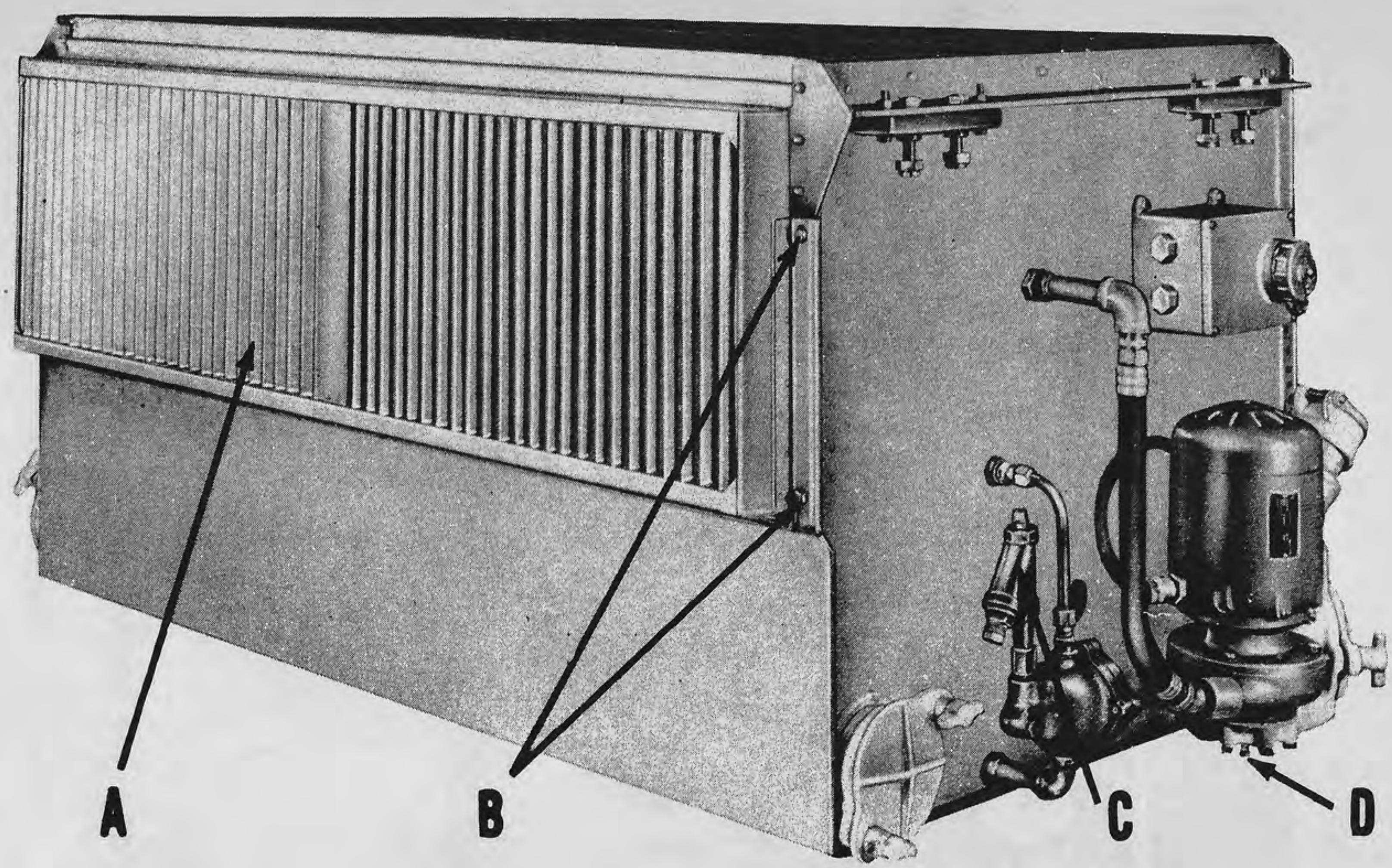
Figure 82



1. Retainer and Mtg. Parts
2. Retainer and Mtg. Parts
3. Tube
4. Housing and Parts
5. Housing and Parts
6. Cover
7. Wing Nut and Stud
8. Gauge Box and Parts
9. High Pressure Gauge
10. Low Pressure Gauge
11. High Pressure Control Tube
12. Low Pressure Control Tube
13. Packless Valve and Parts
14. Receiver and Parts
15. Inspection Port and Parts

EM 16138 CONDENSER - RIGHT HAND END

Figure 83



Flooded Type Evaporative Condenser EM-16138 - Rear

Figure 84

a. Eliminator Assembly
b. Mounting Screws-Eliminator Assembly
c. Filter-Water Line
d. Drain Plug-Pump

AIR CONDITIONING UNIT: The air conditioning unit is mounted in the ceiling accessible through access panels. See Figure 85. This unit consists of a combination cooling coil and blower fan. The steam coil has 4 tubes in parallel on the inlet side and manifolded to 4 parallel tubes on the outlet side. Baffles are placed in the inlet steam manifold to assure even steam distribution through all 4 tubes. The steam coil fins are formed in a zigzag "Z" shape; because of this shape they will eliminate the water that is usually carried over from the cooling coil in very humid weather. In this way they serve the dual purpose of fin surface and water eliminators. There is a separate drip pan under the steam coil to take care of the water which may be collected. This drip pan drains into the large, lower drain pan. The drain line is connected at each end of the drain pan and drain under the car on one side. The steam coil is attached to the evaporator or cooling unit by means of two cap screws at the top of the frame and a nut and screw at the bottom. In this way the removal of these six screws permits the steam coil to be removed from the assembly unit without lowering the entire air conditioning unit.

The evaporator, or cooling unit, is a straight counter-flow type. The coil is eight tubes high and seven tubes deep. Each tube is individually supplied with the required amount of liquid refrigerant, starting with the tubes on the discharge face of the coil and progressing through the staggered row of tubex to the air inlet side. In this way, the warm air entering the coil assures complete vaporization of the refrigerant entering the suction line. The expansion valve, which feeds the four top rows of tubes, is controlled by a solenoid valve in the liquid line. See Figure 86. The expansion valve for the lower four rows of tubes connects directly into the main liquid line. The reason for dividing the coil into two equal sections is to provide what is termed modulated control of the system.

The system operates as follows:

Both the upper and lower sections of the cooling unit are in use whenever the car temperature is above 76 degrees with the temperature selector switch set on the warner position. The compressor at this time is operating at approximately 560 RPM. As the car temperature goes below 76 degrees, the thermostat in place of stopping the compressor as it did previously now operates a pilot relay. This pilot relay opens the circuit to the valve controlling the top section of the coil and at the same time shorts out the external field resistor of the compressor motor, reducing the compressor speed to approximately 320 RPM. This is known as the modulated position. We now have the upper half of the coil inoperative and the lower half of the coil in operation, but the refrigerant is approximately 6 degrees to 8 degrees colder than when on full cooling. In this way additional de-humidification is accomplished on the air passed through the lower half of the coil; no cooling whatsoever is done on the top half. The reason for the lower half of the coil being cooler is because the compressor was not reduced to half speed but operates somewhat faster. Therefore, 50% of the coil and approximate 60% of the compressor capacity is in use and system will operate at lower temperature. This half-coil cooling will be provided until the car temperature is reduced to approximately 2 degrees below the temperature selector setting (or 74 degrees) at which time the compressor is stopped by the thermostat. Modulation can also occur through action of the modulating control when the head pressure reaches 210 pounds. This system should provide even temperature and humidity within the car, and eliminate the stuffy moist conditions usually encountered during mild and wet weather. There is also a distinct saving of the power drawn from the generator and battery because, when operating on modulated position, there is a direct reduction in current. The heavy surges of current usually encountered with frequent starting and stopping of the compressor are also eliminated.

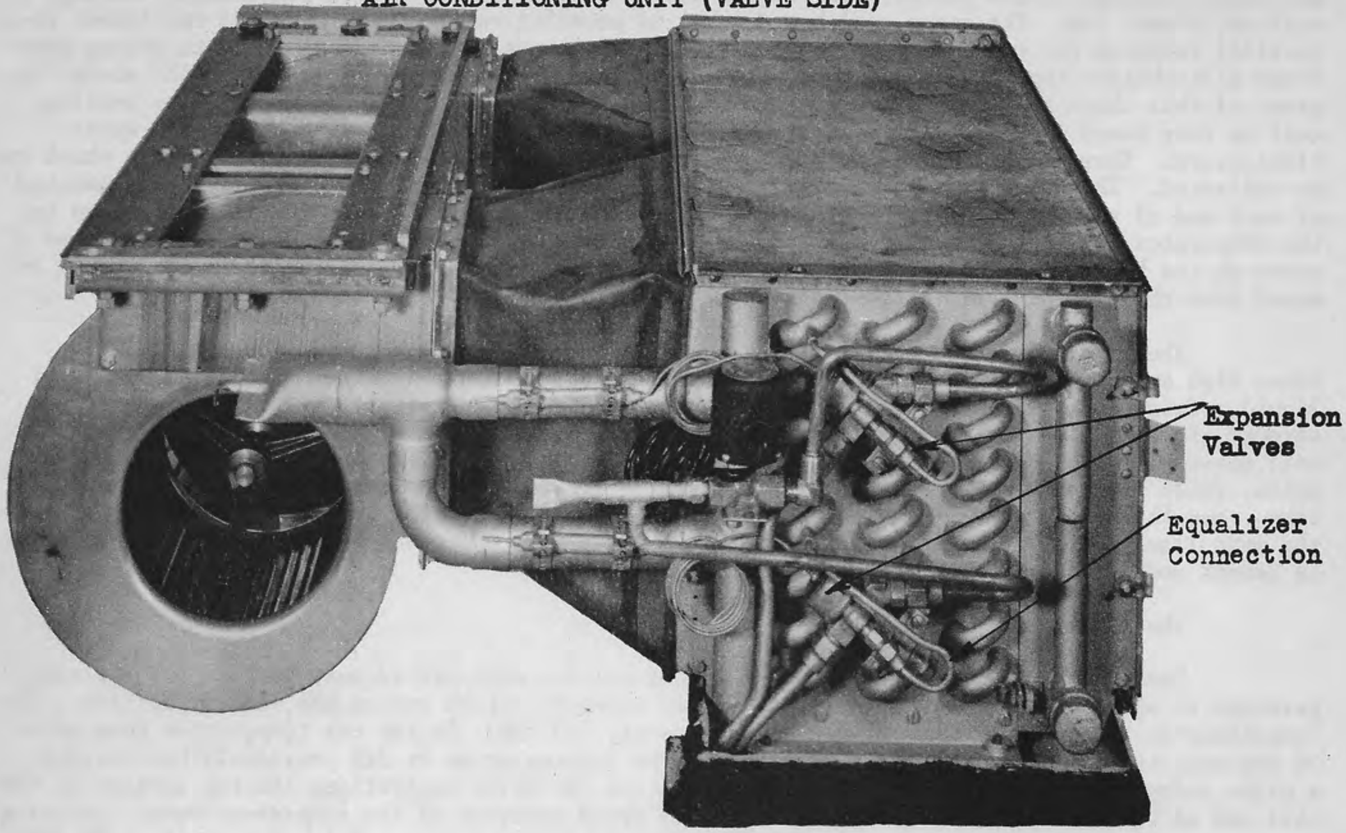
Another important change is to provide individual suction line outlets from each of the two coils. The expansion valve bulbs are fastened to their respective suction line outlet and not to a common point on the suction line.

The flexible duct between the blower and the evaporator has been designed to make it easier to remove. A groove is provided at the top of the coil into which the edge of the flexible duct is forced and held by a rod. The bottom edge of the flexible duct is held in place by several wing nuts and toggle action bolts. Clips with wing nuts are provided at the side of the coil to hold the flexible duct in place at this point. In order to remove the flexible duct, loosen the two wing nuts at the sides of the coil and those at the bottom. The toggle bolts at the bottom can be pushed down, releasing the flexible duct, which can now be pulled out of the groove at the top and provide free access to the face of the coil. The flexible duct can be put back into place by reversing the above procedure.

The blower fan motor is a Delco No. A 8321-1 H.P., 30 V.D.C., see Figure 87. Shaft extensions as shown in Figure 88 are used on this motor. The two blower housings are of aluminum and do not require painting. The blower and motor assembly are provided with rubber mounts to prevent transmission of noise to the car.

The evaporator is equipped with two Frigidaire MX49ECC "MODULEX" expansion valves which are fully explained later.

AIR CONDITIONING UNIT (VALVE SIDE)



AIR CONDITIONING UNIT (DISTRIBUTOR SIDE)

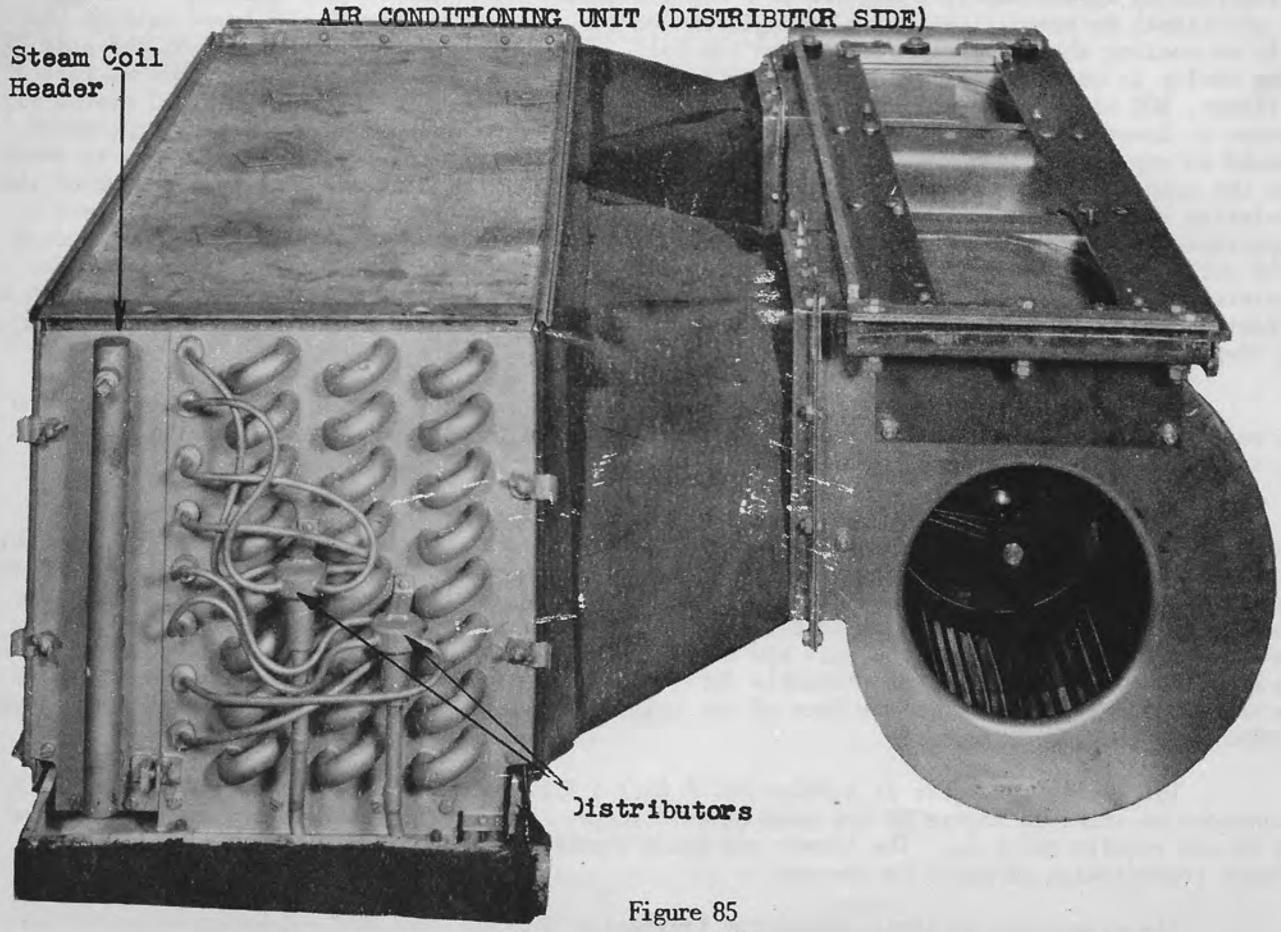


Figure 85

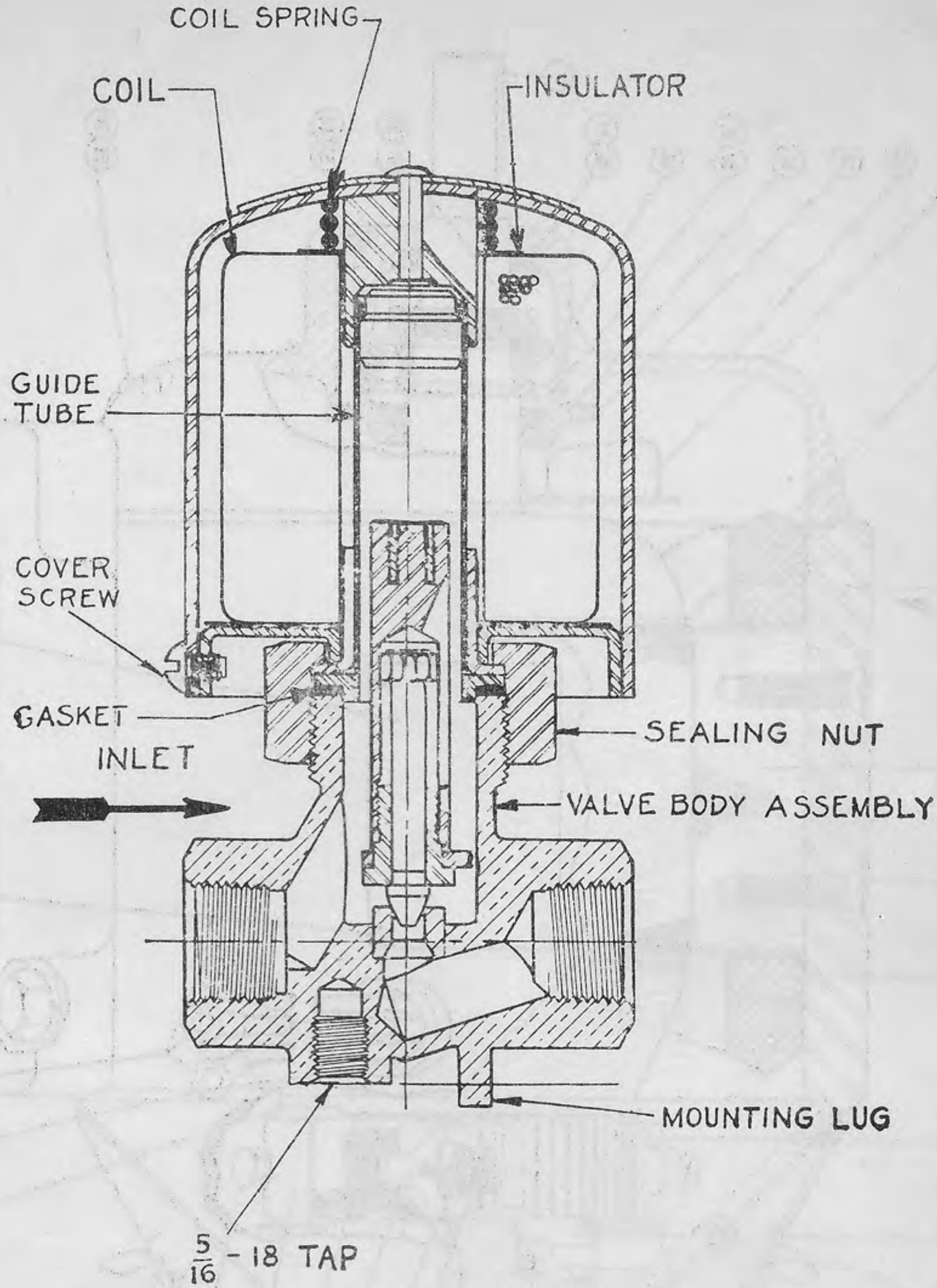


Figure 86

SOLENOID VALVE

A model 73 RJ solenoid valve is used to divide the evaporator and is shown in Figure 86 It is an electrically operated stop valve and is installed in the liquid line just ahead of the top expansion valve.

SERVICING THE 73 RJ VALVE: To remove the coil from the valve, remove 4 coil cover screws. The cover, coil retaining spring, and the coil can be lifted off. When replacing parts, be sure to replace in proper position.

To inspect the needle and seat, the coil and cover assembly is removed as a unit by loosening the hexagon body nut. This will expose the stem and plunger assembly, which can be lifted out for inspection of the stem and valve orifice. The orifice must be within 3/16" - 7/32".

When replacing valves be sure that arrow on valve body is pointing in the direction of refrigerant flow.

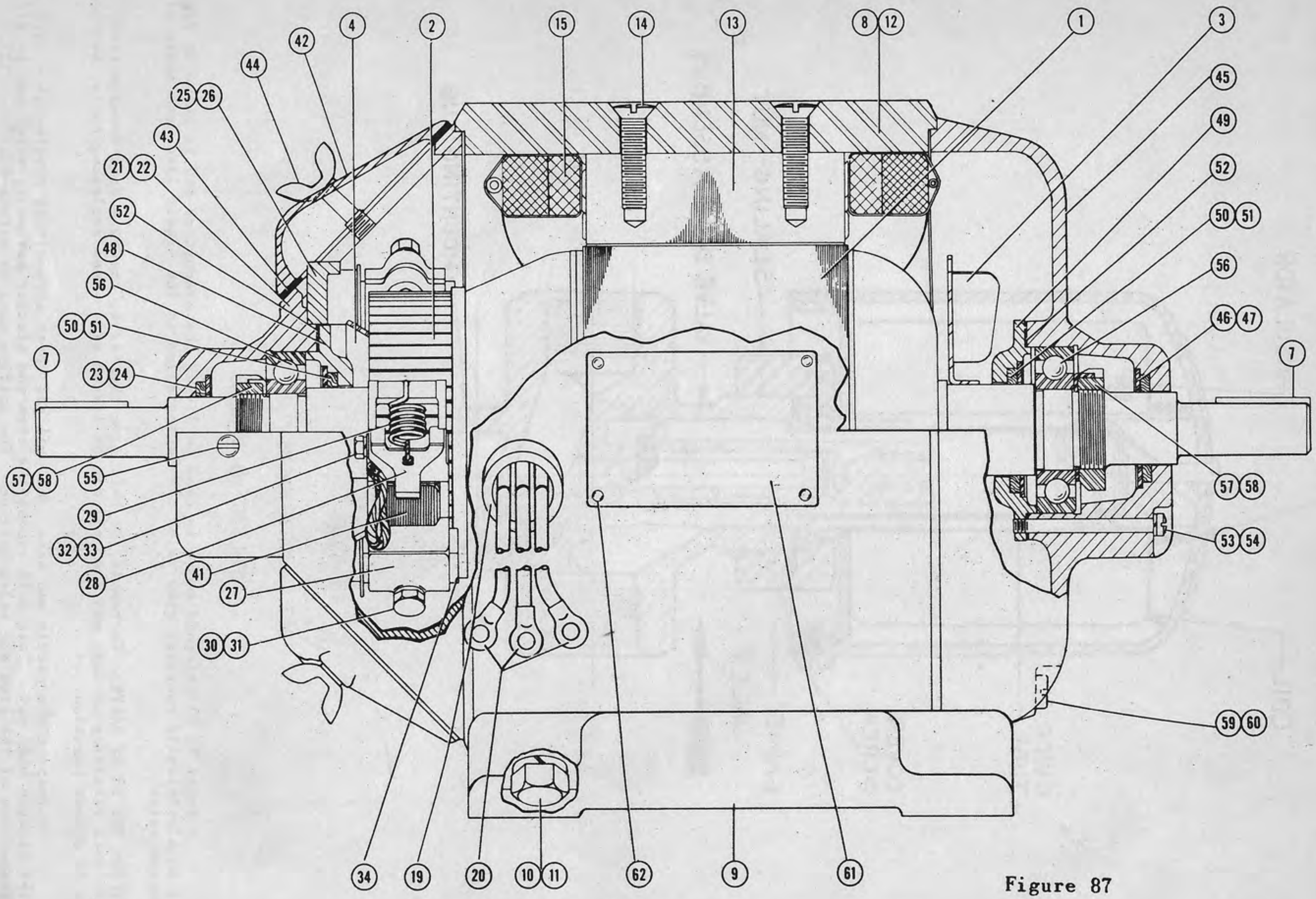
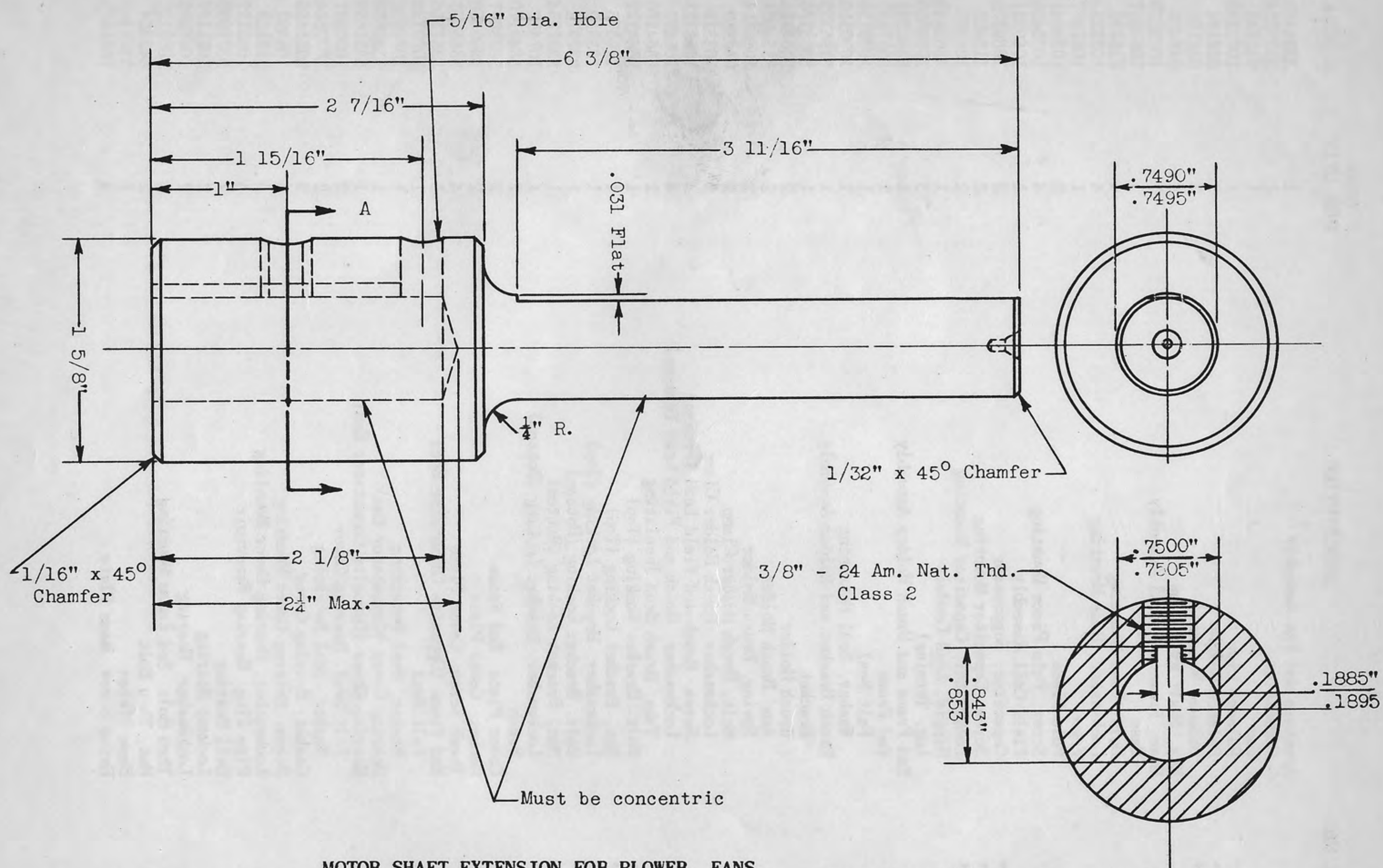


Figure 87

BLOWER FAN MOTOR

A 8321 Motor

ILLUS. NO.	DESCRIPTION	QUAN. PER UNIT	A-8321
1	Armature and Fan Assembly	1	5335465
2	Commutator	1	5319234
3	Fan	1	042243
4	Balance Disc	1	1072389
5*	Balance Weight	3	038194
6*	Balance Weight	3	038195
7	Key, Shaft Extension	2	048488
8	Base, Frame and Coil Assembly	1	1075219
9	Base	1	1064517
10	Bolt, Base Mounting	4	215735
11	Lockwasher, Base Mounting	4	103323
12	Frame	1	1067577
13	Pole Piece	2	1058641
14	Screw, Pole Piece Mounting	4	1070426
15	Field Coil Assembly	1	1069321
16*	Capacitor, Suppressor	2	1880376
17*	Screw, Capacitor Mounting	2	115402
18*	Lockwasher, Capacitor Mounting	2	106497
19	Nipple, Lead Conduit	1	5365448
20	Lug, Terminal	3	1054856
21	End Frame and Brush Holder Assembly	1	5340342
22	End Frame	1	5357155
23	Felt Seal	1	1079138
24	Washer, Seal Retaining	1	1070518
25	Brush Bracket and Holder Assembly	1	5396355
26	Bracket	1	5364174
27	Brush Holder	2	5364114
28	Arm, Brush Holder	2	5354004
29	Spring, Brush Holder	2	1066014
30	Bolt, Brush Holder Clamp	2	046369
31	Lockwasher, Brush Holder Clamp	2	103319
32	Screw, Brush and Field Lead Terminal	4	1065723
33	Lockwasher, Brush and Field Lead Terminal	4	106497
34	Tube, Brush Stud Insulating	2	5364170
35*	Bolt, Bracket Locking (Top)	1	5364172
36*	Nut, Bracket Locking (Top)	1	120375
37*	Lockwasher, Bracket Locking (Top)	1	103319
38*	Bolt, Bracket Locking (Bottom)	1	037972
39*	Nut, Bracket Locking (Bottom)	1	5337834
40*	Lockwasher, Bracket Locking (Bottom)	1	107497
41	Brush	2	5340170
42	Cover Plate, End Frame	2	5333077
43	Gasket, Cover Plate	2	5390450
44	Thumb Screw, Cover Plate	4	5306893
45	End Frame (Opposite Commutator End)	1	5357156
46	Felt Seal	1	1079138
47	Washer, Seal Retaining	1	1070518
48	Bearing Cover (Commutator End)	1	5351658
49	Bearing Cover (Opposite Commutator End)	1	5351659
50	Felt Seal, Bearing Cover	2	1070537
51	Washer, Seal Retaining	2	1070514
52	Gasket, Bearing Cover	2	5351655
53	Screw, Bearing Cover Mounting	6	106497
54	Lockwasher, Bearing Cover Mounting	6	132158
55	Pipe Plug, Bearing Reservoir	4	1062157
56	Ball Bearing	2	5379898
57	Locknut Bearing	2	1071139
58	Lockwasher, Bearing	2	1067505
59	Thru Bolt, End Frame Mounting	2	1069191
60	Nut, Thru Bolt	2	042454
61	Name Plate	1	5365449
62	Drive Screw, Name Plate	4	1061405



MOTOR SHAFT EXTENSION FOR BLOWER FANS

Figure 88

Section A-A

FRIGIDAIRE MODULEX REFRIGERANT CONTROL VALVE

The MX49ECC Modulex expansion valve, see Figure 89 is a gas-charged modulating liquid refrigerant control valve, rated at four tons. The inlet and outlet valve connections are of the 1/2" flare type. It is provided with an equalizer connection for use with distributor type evaporators, as shown in Figure 90.

The thermostatic expansion valve is a liquid metering device. Its only function is to control the amount of liquid refrigerant entering the evaporator or cooling coil. It is not a temperature control device, and no attempt should be made to use it as such. Control of the refrigerating unit is a function of the thermostat.

The Frigidaire Modulex refrigerant control is of all metal construction with removable needle, orifice, spring, etc.

The equalizer connection taps into the evaporator at the last return bend for the top row of tubes for each section. This arrangement vaporizes the small amount of liquid which ordinarily passes through the equalizer.

The inlet fitting is removable and the outlet fitting is machined as part of the valve body.

The evaporator pressure as read on the low pressure gauge, should be 35-40 pounds with a 70 degree car and a 40-45 pounds with an 80 degree car and full speed operation. The MX49ECC valve is factory adjusted for 7 degrees to 10 degrees superheat.

The operation of this valve should not be checked until the evaporator has pulled down within the operating temperature range. The evaporator should be effective over its entire surface and this is indicated when the return bends are covered with beads of water.

The operation of the Modulex thermostatic valve is as follows:

At the top of the valve is a power element connected to a bulb by a small diameter tube. The power element is charged with inert gas (CO_2). The bulb is filled with absorbent material (activated carbon), which releases the CO_2 gas as the bulb temperature rises and absorbs the CO_2 gas as the bulb temperature decreases. This action increases or decreases the pressure in the power element and bulb. The operating bellows of the valve is, therefore, subject to the refrigerant pressure in the cooling unit on the lower side via theequalizer line and to the pressure of power element on the upper side. There are three operating pins which extend from the lower side of the bellows to the upper side of the needle carriage. Below the needle carriage there is an adjustable spring. The spring tension, plus the cooling unit F-12 pressure, opposes the pressure in the power element.

The spring tension is adjusted through the use of an adjusting nut and screw. The lower end of the spring rests on the top of the nut. The screw remains stationary and when the screw is turned, the nut being free to move is raised or lowered, increasing or decreasing spring tension. The screw has a left hand thread so that when the screw is turned clockwise (viewed from adjustment end), the nut is raised, increasing the spring tension, which throttles the valve and increases the superheat of the vapor leaving the cooling unit. Turning the screw counter-clockwise, the adjusting nut is lowered, decreasing the spring tension, which opens the valve and decreases the superheat of the vapor leaving the cooling unit, and increasing the flow of liquid refrigerant.

The seal around the adjusting screw consists of a packing gland, packing, and packing nut. A valve cap and gasket are used to prevent moisture from condensing around the adjusting screw; also serves to prevent refrigerant leaks in cases where the packing is not tightened properly.

With the unit idle, we have the combined pressures of the refrigerant in cooling unit and the adjusting spring tension holding the valve closed. When the unit starts, the F-12 pressure in the cooling unit and the low side of the valve is reduced; when the pressure is reduced to the point where the pressure in the power element is greater than the combined pressures of the refrigerant and the spring, the bellows in the top of the valve is compressed and pushes down on the operating pins, forcing the needle off its seat, allowing liquid refrigerant to flow through the valve into the cooling unit. The amount of liquid permitted to flow is in exact proportion to the condensing unit's ability to pump out the vaporized refrigerant which has absorbed heat from the air stream. This action continues until the cooling unit is flooded sufficiently so that the temperature of the suction line at the point where the valve bulb is clamped is reduced. The cooling of the bulb causes the material in the bulb to absorb a portion or the vapor in the power element, thus reducing the pressure. This reduction of pressure in the power element permits the combined pressure of the refrigerant and the spring to force the needle towards its seat, reducing the flow of liquid refrigerant. With the reduced flow of liquid refrigerant the compressor is able to reduce this suction pressure, thereby lowering refrigerant temperature. This action continues and so long as we reduce bulb temperature while reducing suction pressure and refrigerant temperature, the valve continues to replenish the liquid, which is absorbing heat and vaporizing.

During the operating cycle, for all practical purposes superheating of the vapor in the cooling unit is held constant. This is accomplished by the valve maintaining the same degree of flooded condition in the cooling unit at all times regardless of the fact that the suction pressure and refrigerant temperature are being lowered.

The degree to which the cooling unit is being flooded with liquid refrigerant depends upon the adjustment of the expansion valve. The valve is factory adjusted to maintain from 7 degrees to 10 degrees superheat at the outlet of the evaporator.

When the desired car temperature is reached, the thermostat circuit should open, stopping the compressor. There is an immediate rise in the evaporator refrigerant pressure. The combined refrigerant pressure and spring tension overcomes the pressure in the power element and forces the valve closed.

During the "OFF" cycle of the system the pressures of the low side of the valve are always sufficiently higher than the pressure in the lower element, which holds the valve closed.

The Modulex control bulb is tightly clamped to the suction line, near the end of the evaporator. A heat exchanger is applied near the evaporator coil outlet to cool liquid freon and warm the freon vapor, insuring that no liquid freon that might be spilled over by the coil will reach the compressor inlet.

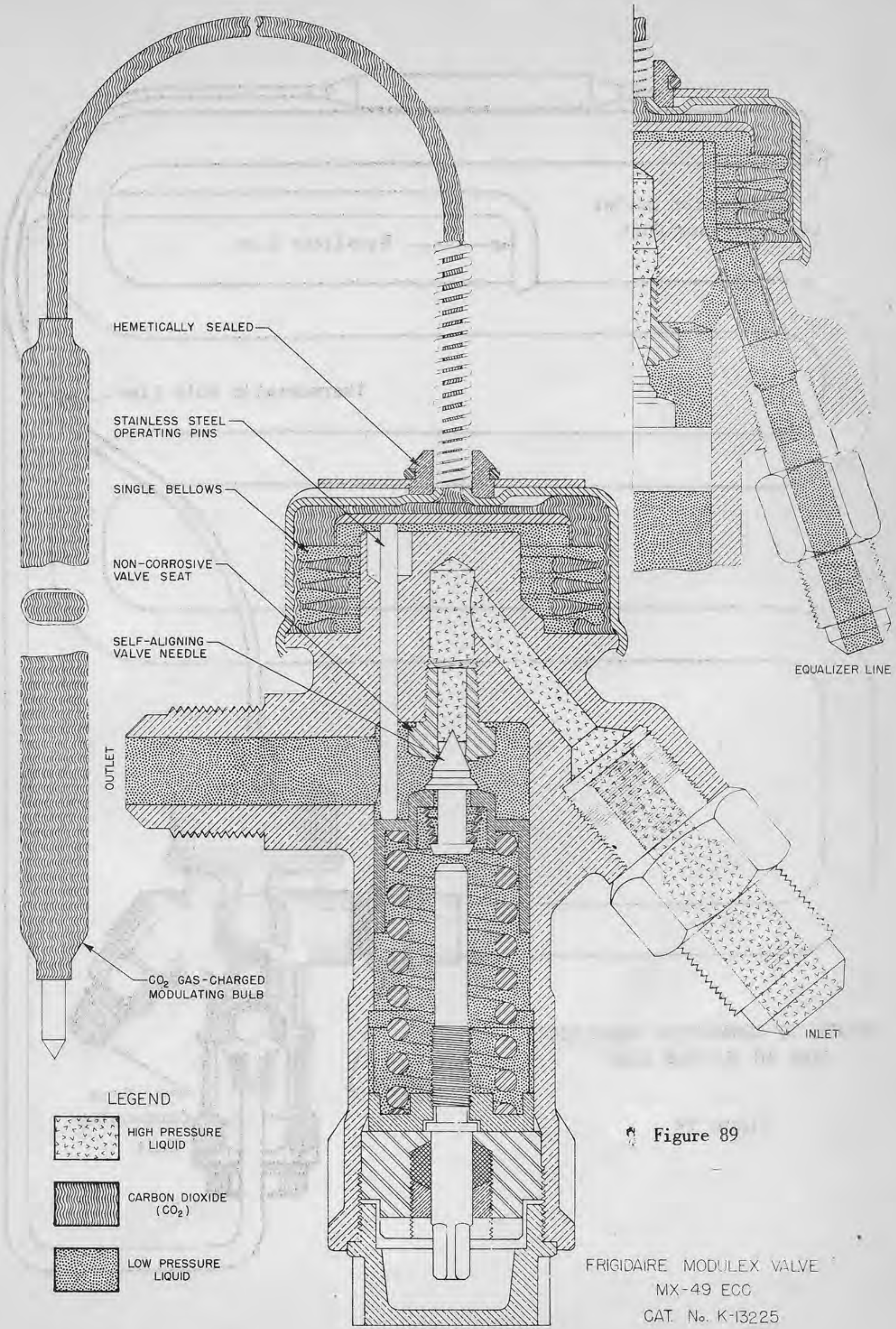
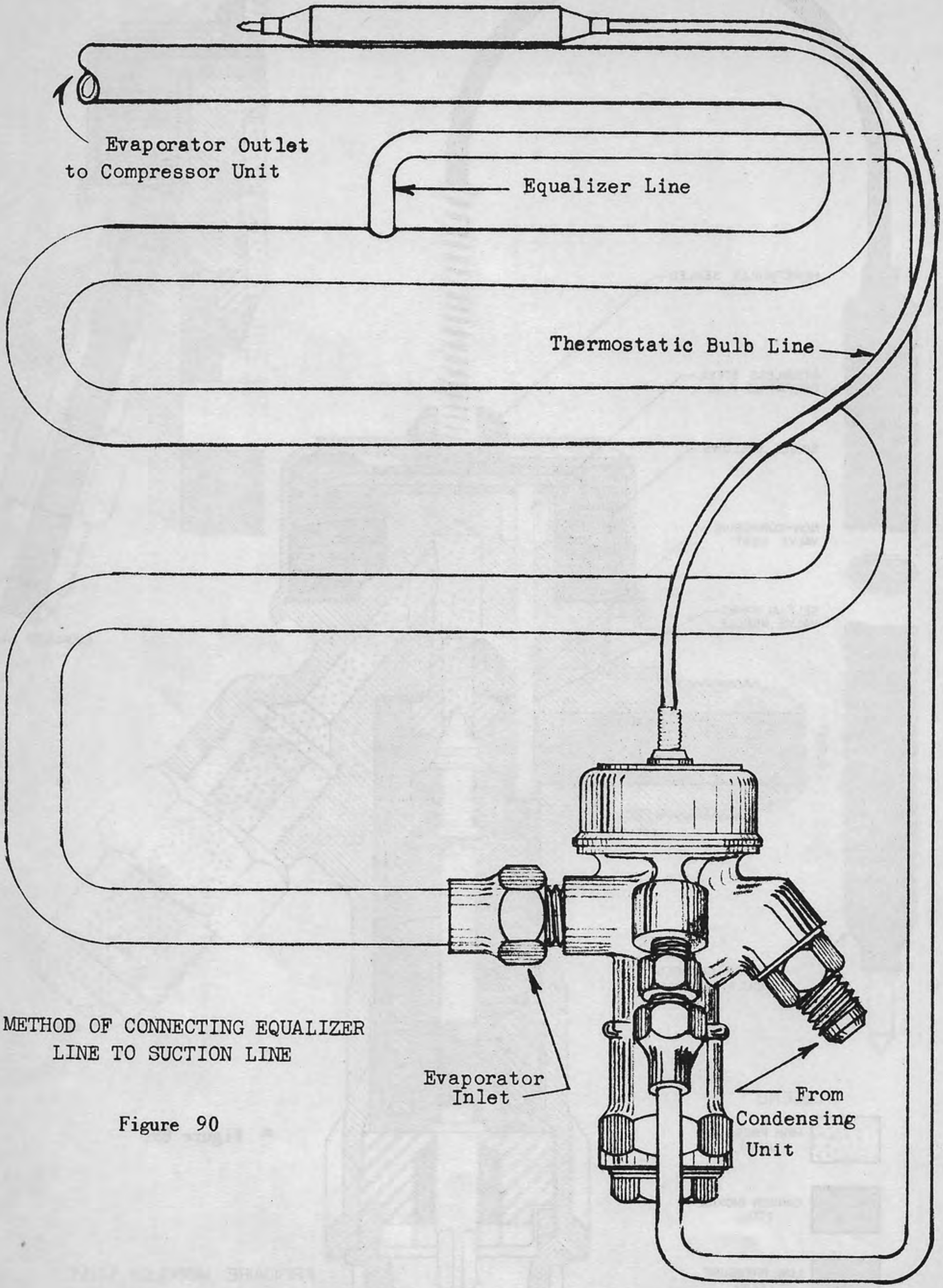

HEMETICALLY SEALED
STAINLESS STEEL OPERATING PINS
SINGLE BELLOWS
NON-CORROSIVE VALVE SEAT
SELF-ALIGNING VALVE NEEDLE
OUTLET
CO_2 GAS-CHARGED MODULATING BULB
EQUALIZER LINE
INLET
LEGEND
HIGH PRESSURE LIQUID
CARBON DIOXIDE (CO_2)
LOW PRESSURE LIQUID
FRIGIDAIRE MODULEX VALVE
MX-49 ECC
CAT. No. K-13225

Figure 89



METHOD OF CONNECTING EQUALIZER
LINE TO SUCTION LINE

Figure 90

WARNING: Do not attempt to work on the unit without removing fuse and moving the arm on the safety switch to the "OFF" position.

ADJUSTING COMPRESSOR BELT TENSION: Proper belt tension is essential if excessive replacements are to be avoided. Loose belts permit slipping and belt failure caused by overheating. Tight belts overload the belt fabric and cause abnormal side wear and are to be avoided as much as loose belts. To check a belt for proper tension, press down on one belt at a time halfway between the pulleys, using one finger. The belt should be depressed approximately one inch. The belts can be adjusted by raising or lowering the lock nuts on the belt adjusting rod. See Figure 79. Raising the lock nuts on the rod causes the motor to be pulled away from the compressor, thereby tightening the belts. Lowering the lock nuts moves the motor closer to the compressor and loosens the belts. *CAUTION:* With this belt adjusting device it is very easy to overtighten the belts; hence, check the belts while tightening. The lock nuts should be securely tightened when the service operation is finished.

REPLACING COMPRESSOR BELTS: When any of the belts become frayed or broken, it is important to replace all of the belts on the unit. This is necessary in order to keep all of the belts the same length. To replace belts, lower the lock nuts on the belt-adjusting rod until the motor can be moved far enough towards the compressor to easily install the new set of belts. The belts are stocked in matched sets and should be applied as such.

USE OF PRESSURE GAUGES: Both high pressure and low pressure gauges are installed on the condenser unit. The gauges are protected by means of one-way, shut-off valves. These shut-off valves should be turned to the closed position whenever the maintenance man has completed his service operations.

The refrigeration cycle is the same as for systems with which the yard forces are familiar. Methods used in routine jobs, such as checking compressor oil or refrigerant levels, adding freon to system, testing for leaks, etc., will apply to this system as well. The piping is somewhat different physically and there are not as many shut-off valves as in earlier systems, but proper use of the valves will still allow isolation of parts for repairs.

REPLACING COMPRESSOR SEAL:

1. Pump system down in same manner as described on Page 216 A.C. Manual.

2. Remove belt guard.

3. Remove compressor belts, flywheel, shaft key and eight screws holding seal to compressor body.

4. Remove old seal and clean shaft shoulder with lacquer thinner or carbon tetrachloride to remove all traces of oil and dirt.

5. Steel ring is inserted in composition gasket and the two pieces slipped over shaft with gasket against shoulder.

6. Leaded bronze seal ring is inserted in composition gasket and the two pieces are then placed in recessed portion of bellows. A slight film of Frigidaire oil is placed on face of leaded bronze seal ring, being careful that no oil gets on gasket. The assembly is then placed on shaft and eight cap screws re-applied.

7. Replace shaft key, flywheel, and compressor belts.

8. Open all valves, run system a few minutes and test for freon leaks. If none are found, let unit stand idle a few minutes and again test for leaks.

NOTE: When changing a seal, do not use a new bronze ring with old steel ring or vice versa; always apply new gaskets. The bellows does not have to be changed unless it is ruptured.

EXCHANGING COMPRESSOR:

1. Close suction valve and run compressor to pump system down until slight vacuum shows on low side gauge. If the pressure rises above one pound when compressor stops, run system again at intervals until gauge holds at 0 to 1 pound pressure. *CAUTION:* Be sure to remove compressor motor fuse whenever work is being performed on compressor.

2. Remove belt guard.

3. Close discharge valve at compressor.

4. Disconnect suction line from compressor by removing the four bolts holding suction valve to body.

5. Disconnect discharge line from compressor in the same manner as for suction line.

6. Remove four compressor mounting bolts.

7. Remove compressor from unit.

8. Apply the new compressor by reversing the above operations. Use new gaskets at the suction and discharge valve connections.

9. After all connections have been made, open suction and discharge valves slightly, and test for freon leaks.

10. Run system and check operation.

If leaks are detected around the compressor head screws, tighten the screws uniformly, omitting none. If this fails to stop the leak, new head gaskets as well as new copper **gaskets** under the four center screws should be installed. Pump the compressor down before making the change.

ADDING OIL: Preventing air from being drawn into the system at the time oil is being added is of great importance, and should be closely watched. Never allow the height of the oil in the container to go below 2" from the bottom. The charging operation should be stopped when this level is reached. With the charging line on the bottom of the container, it will be impossible for air to be drawn into the system.

The oil charging line should have a separate shut-off valve to control the oil flow from the container to the compressor. See Figure 91.

Remove low pressure gauge; apply test Tee in its place; re-apply low pressure gauge, and connect charging line. Be sure the valve in the charging line is closed. Purge the charging line by opening gauge valve and charging line valve. Then place line in oil.

Close the liquid valve and operate unit until suction pressure is reduced to 20". If pressure tends to build up after stopping, repeat the operation.

Stop the unit, be sure the end of the charging line is at the bottom of the container, open charging line valve, and watch oil in container. As soon as proper amount has been added, close shut-off valve, open liquid valve, and remove charging line. Figure 91 shows the details.

OIL CHARGE: Full oil charge for the system is 11 pints. The oil level in the compressor crankcase may be observed through the sight glass on the side of the crackcase. The hormal oil level, (condenser unit in operation and crankcase level) is between the upper and lower edges of the sight glass. Remedial measures should be taken only if the oil level varies beyond these limits. During the idle period the crankcase oil will absorb "Freon-12" and increase in volume, therefore the level of the oil should be checked only after sufficient operation to assure that the absorbed gas has been removed.

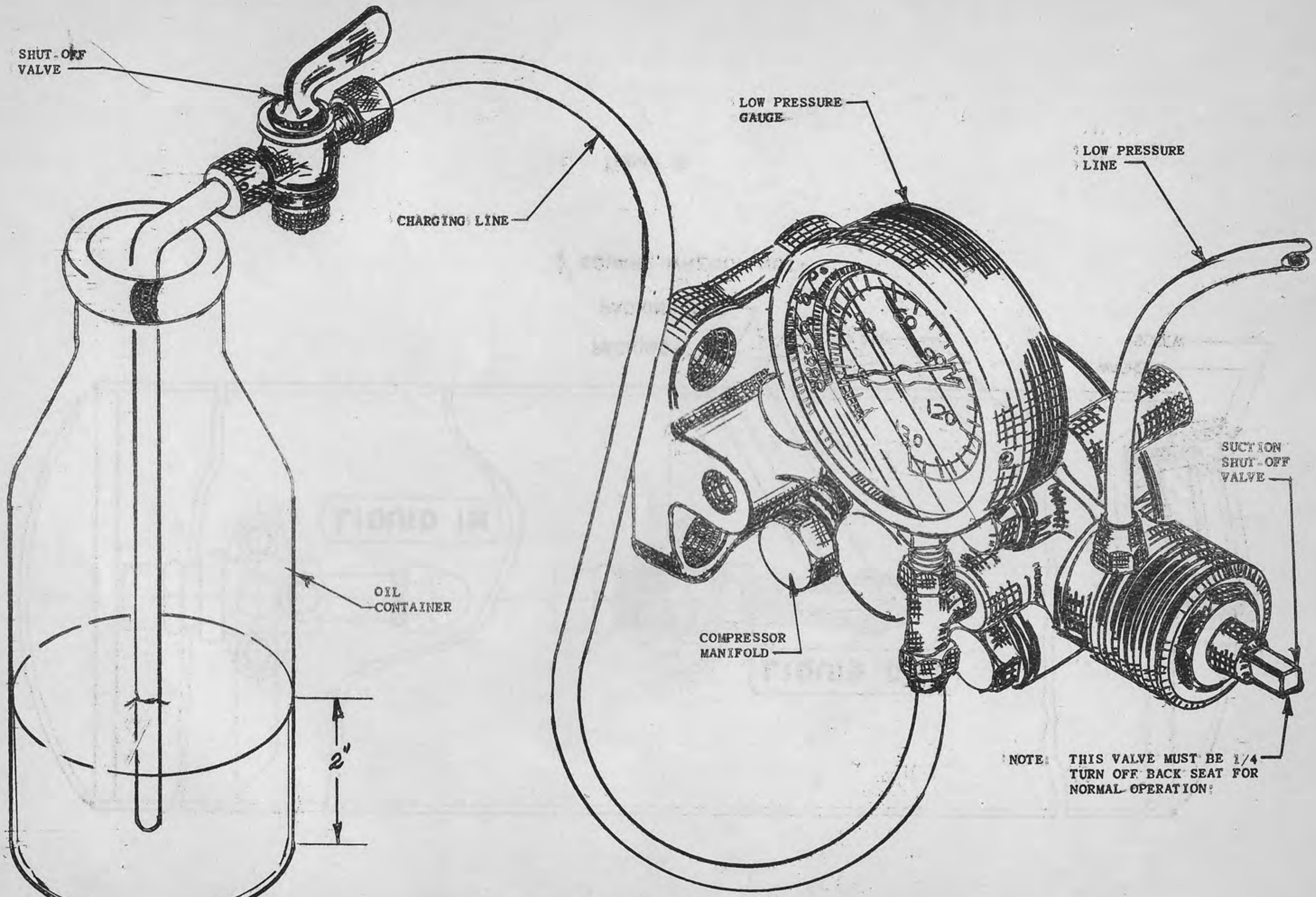
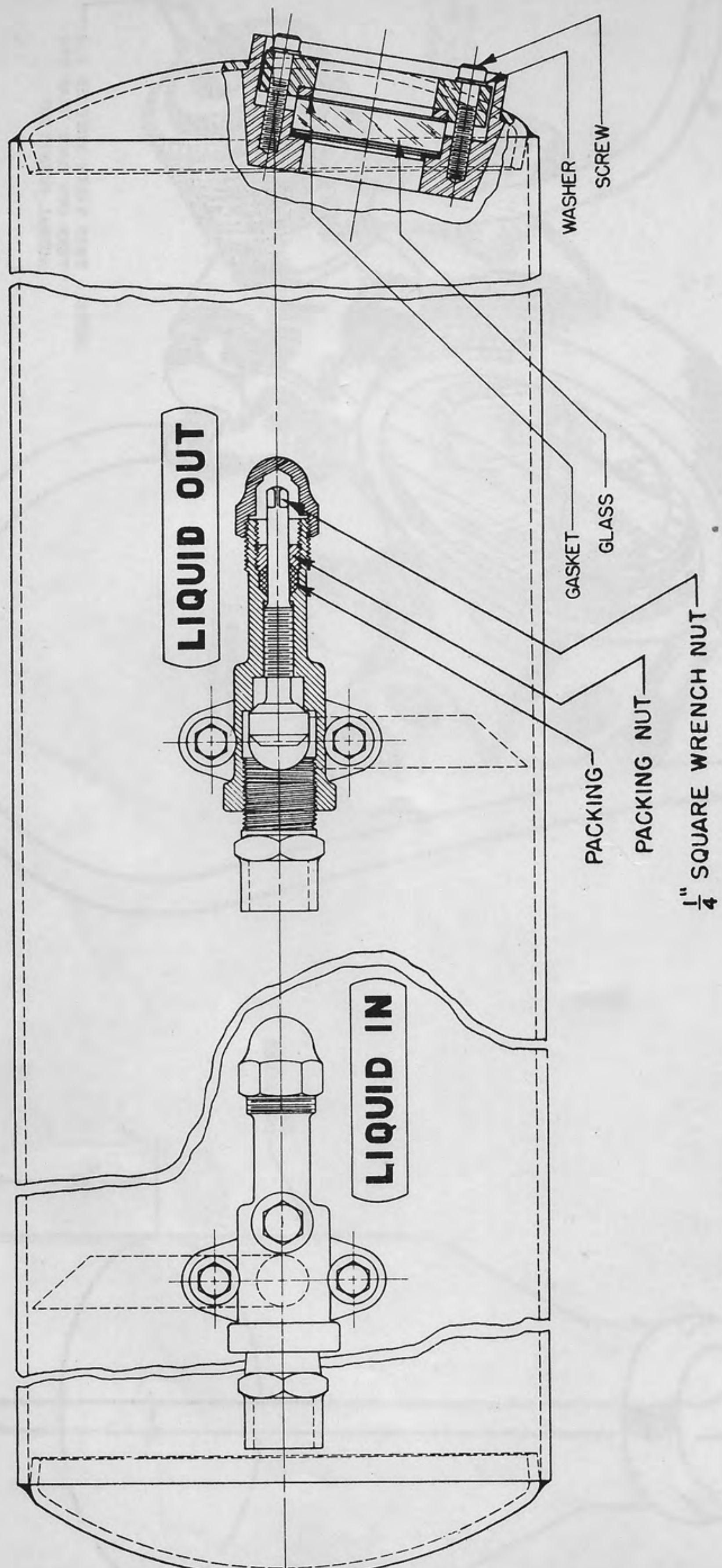


Figure 91

ARRANGEMENT FOR ADDING OIL TO SYSTEM



LIQUID OUT
LIQUID IN
WASHER
SCREW
GASKET
GLASS
PACKING
PACKING NUT
$\frac{1}{4}$" SQUARE WRENCH NUT

Figure 92

REMOVING OIL:

1. Carefully loosen (loosen only) the oil drain plug on the bottom of the compressor crankcase. Gas pressure within the crankcase will force oil out around the loosened plug.

2. Tighten plug, wipe the area around the plug carefully and test for leak.

CHECKING F-12 LEVEL: The units are equipped with one sight glass in the receiver. For normal operation, the liquid level should be approximately halfway up the sight glass while the system is in operation under full load conditions. With the system operating on half cooling, the compressor unit is running at low speed, the liquid level should be approximately three-quarters up the sight glass. See Figure 92.

ADDING F-12: The piping is somewhat different physically and there are not as many shut-off valves as in earlier systems, but proper use of the valves will still allow isolation of parts; therefore, instructions as covered in the A.C. Manual will apply.

When transferring F-12 from the cylinder to the car, with the drum ~~in an~~ upright position, start the unit; shortly after the unit starts, feel the drum. The liquid level can be determined by noting where the drum begins to cool; in other words, that part of the drum with liquid will very quickly begin to get cold. The upper part, or gas-filled portion of the drum will remain warm. In this way the starting liquid level in the drum can be determined and the amount drawn out can be observed.

LEAKING SHUT-OFF VALVES: The liquid line shut-off valve may leak through the packing around the stem. Tighten the packing, using the packing nut wrench.

The suction line shut-off valve cannot be repaired in the yard. If it leaks, it should be replaced by a new one, and the old one returned to the storeroom for further handling.

To remove the suction shut-off valve, pump the system down. When installing a new valve, be sure to use new gaskets taking care to remove any tracex of the old gaskets that might stick to the compressor flange.

SERVICING THE EXPANSION VALVE: If the valve requires adjustment, it is removed from the car and tested and adjusted in accordance with instructions included on drawing YD-A-56J issued with A.C. letter June 11, 1947.

PRESSURE CUT-OUT AND SAFETY SWITCH: See Figure 93. The YL-LOHH control consists of Hi-Lo pressure switch, manually operated safety switch and high pressure modulating switch. The safety switch has three positions "AUTO", "OFF", and "HAND". When in the "AUTO" position the system is under control of the Hi-Lo pressure switch. When placed in "HAND" position the Hi-Lo switch is by-passed and system operates without pressure control. Switch must be placed in "HAND" position by only competent craftsmen who should observe pressure gauges at the same time. Placing switch in "OFF" position will render system inoperative.

ADJUSTMENT OF SWITCHES: The adjustments for the pressure controls are made at the points shown in Figure 93.

SWITCH SETTINGS

	CUT-OUT	CUT-IN
HIGH PRESSURE	245 lbs.	185 lbs.
LOW PRESSURE	2 to 5 lbs.	35 lbs.
HIGH PRESSURE Modulating	210 lbs.	155 lbs.

Turning the adjusting nut to the left or counter-clockwise increases the pressures at which the controls operate; turning to the right or clockwise will decrease the operating pressures. One complete turn will change the high pressure operating point about 10 pounds, while one turn affects the low pressure adjustment approximately 3 pounds. The procedure for making high pressure adjustment ~~is~~ as follows:

1. Cover the air intake and disconnect the pump motor plug.

2. Start the system and allow it to operate until the condensing pressure as shown on the High Pressure gauge causes the system to first modulate at 210 pounds, which

indicates the high pressure modulating control is properly set, after which the pressure should build up to 245 pounds and cut-out. Make any adjustment as required.

3. After above adjustments have been made and the cut-out points have been properly set, remove the cover from the air intake and allow the compressor to cool until the cut-in resets (starts the motor) and observe the gauge pressure at that moment. This starting pressure should be between 180 to 200 pounds, but must not be over 200 pounds.

4. To check the cut-out setting of the high pressure modulating control, allow the compressor to continue to cool and place the water pump in operation. Observe the High Pressure Gauge and when the pressure reaches 155 pounds the system should go back onto full cooling.

5. After all adjustments have been made re-test to see that the cut-out and cut-in pressures fall within the ranges shown in the previous table.

Low pressure adjustment is made by turning the adjusting nut shown in Figure 93. To make this adjustment, run the compressor with the large suction valve closed until the unit stops. Check the low pressure gauge at this time and if it shows 2 to 5 pounds, the setting is satisfactory. Next open the suction valve and allow the pressure to build up until the unit starts. This pressure should be 35 pounds or less; neither the low pressure cut-out or cut-in setting has to be exact, but the cut-in must not be over 36 pounds

E L I M I N A T O R S.: The eliminators are located at the back of the unit and can be taken off by removing two screws at each end, pulling the bottom outward and then pulling downward to release the assembly from the three spring clips which hold it at the top. They should only be removed for the purpose of cleaning and repair or replacement of eliminators or condensers.

C O N D E N S E R   F A N   W H E E L S: It has been found that there is a tendency for a mineral deposit to form on the blades of the blower wheels. This should be kept in mind and an occasional check made. In the event that the scale does form it should be washed off with a mild Oakite solution. Rinse thoroughly with clean water after washing. If a scale formation is allowed to remain and build up, it will eventually throw the assembly out of balance and excessive vibration will result

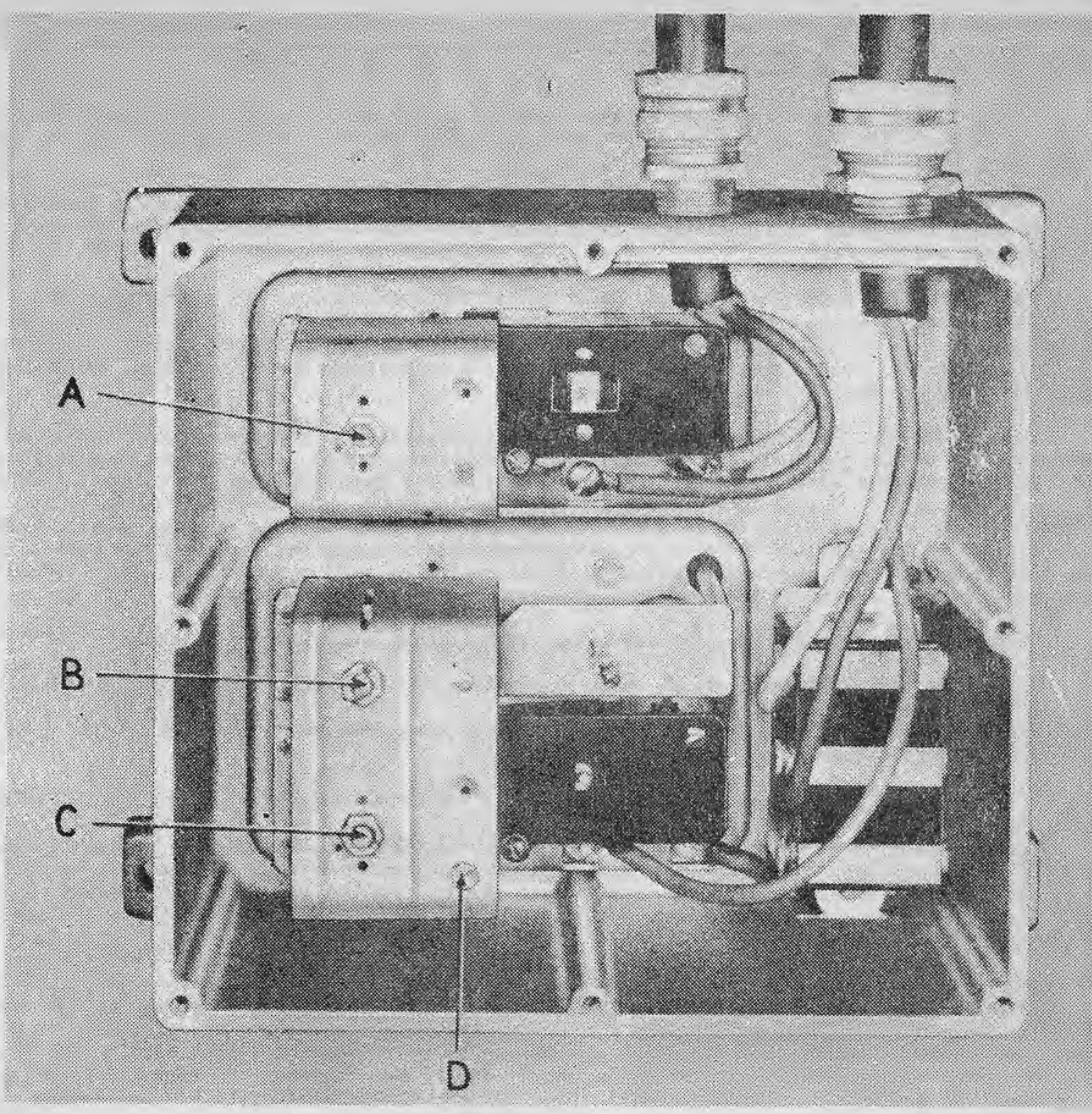
S P R A Y   N O Z Z L E S: The spray nozzles are of the self-cleaning type and can be dis-assembled. The spray as a whole is not removable. Access to spray nozzles can be accomplished by removing the blower assembly and working through the two openings.

R E C E I V E R: The receiver is equipped with sight glass to simplify the checking of the refrigerant level. The receiver is approximately 36" long. It is located at lower front right hand end of unit. See Figure 92. It has a capacity of 55 pounds of F-12 and is ample in size to allow for complete evacuation of the refrigerant lines without resorting to outside facilities for storage of refrigerant.

N O T E: Care should be taken when tightening the screws around receiver sight glass, as an unevenly applied prexsure may break the glass. Tighten the screws a little at a time in rotation.

W A T E R   L E V E L: The sump tank has a total capacity of approximately 80 gallons. When filling with a hose water is applied until it runs out the overflow. On the road, the water level will drop before the float valve opens to supply water from the car water system. The water level after several hours operation should be above the test pet cock located just above the strainer opening.

F L U S H I N G   O F   T A N K: Tanks will be flushed semi-monthly. There are two means provided for flushing the water tank. One set of clean out openings is located directly opposite each other at either end of the unit. This set is to be used for cleaning the mud sump. Remove the hand hole covers and direct a stream of water through the mud sump portion of the tank. Remainder of tank can be flushed by removing clean out cover plate at bottom center of right hand end and strainer seal plate at left hand end of unit. See Figures 82 and 83. Strainer should be removed before flushing tank.



"YL-LOHH" Pressure Cutout and
Safety Switch

Figure 93

a. High Pressure Modulating Adjustment
b. High Pressure Adjustment
c. Low Pressure Adjustment
d. Low Pressure Differential Adjustment

REMOVAL AND CLEANING OF STRAINER: Strainers will be cleaned each daily inspection. The strainer, Figure 82 is located adjacent to the pump assembly, being incorporated as part of the pump support and filler casting. It is removed by taking off the cover plate and withdrawing the strainer. Clean the strainer by vigorously flushing it with a stream of water.

When replacing the strainer be sure to have the handle in a vertical position so that it will locate in the slots at the top and bottom of the aperture. This assures proper positioning. Be sure that strainer cover plate is sufficiently tightened.

After flushing the tank or cleaning the strainer it should be refilled through the filler pipe. It is not necessary to measure the quantity of water being introduced as a visual check of the overflow will indicate when the tank is full.

AIR FILTERS: Air filters are the dry type, using galvanized steel wool as the filtering medium. They should be removed and cleaned daily. The removal can be accomplished by backing off the nuts holding the retaining lugs against the face of the filter, grasping the handles and lifting the filter from its position. Cleaning of the filters can be accomplished by jolting sufficiently to dislodge the dirt trapped in the filter, then brushing the loosened dirt off with a whisk broom.

PUMPING DOWN OF SYSTEM: Pumping down of the system is accomplished in the conventional manner of closing the liquid-out valve at the receiver, operate unit until 0 lbs. pressure is indicated and held on the compound gauge. Crack line valve until 1 lb. pressure shows on compound gauge and then close liquid line valve.

SEASONAL DRAINING: During seasonal changes, temperatures are often encountered where some cooling is required during a portion of the trip and there is also danger of water freezing during some other portion of trip. During this season, satisfactory cooling can be obtained with the unit operating as an air cooled condenser. In preparing the unit for this type operation the following steps should be taken:

1. Disconnect pump motor plug and secure same in pump motor dummy receptacle.

2. Shut off water valve inside water tank casing and drain line from car water tank.

3. Thoroughly flush tank, being certain that no water remains in the tank, supply line or spray nozzle assembly.

4. *IMPORTANT:* Drain pump by removing plug in bottom of pump. Replace and tighten plug.

PUMP: When preparing cars for cooling, the pump casing, impeller and seal assembly should be cleaned and lubricated as covered under "Renew Seal". If excessive vibration or heating is experienced after cars have been in cooling service inspect the pump impeller. A clogged impeller could cause either of these conditions. When assembling a pump after repairs have been made, it is important that all fits be clean and free from burrs.

RENEW SEAL: See Figure 94. When installing a new seal (No. K13880), care should be taken to see that it is properly applied. Take the 'Ni-Resist' floating seat and Neoprene seat ring assembly, oil the outer surface of the seat ring and push the assembly into the cavity, seating it firmly and squarely. *Never separate the two portions of this assembly.* If it is not possible to insert the assembly with the fingers, use the size tubing or sleeve which will make contact on the outer edge of the floating seat, not on the lapped seal face. The impeller hub should be thoroughly cleaned and a coating of light oil applied so that new spring and bellows assembly can be easily pushed onto hub. *Only push the rotating section of the seal on the hub far enough to get started properly. Final compression should come when the impeller assembly is put into position on the motor shaft. This is necessary to allow the seal seat faces to square up against each other in their correct operating position.*
The KRVS pump is illustrated on Page 139, Figure 94.

When the casing ring diametrical clearance reaches .050 to .060 inches it should be renewed. Both casing ring and impeller should be replaced to obtain proper clearance. *Never run seal dry.* Running dry for even 5 minutes will ruin the seal. Pump must contain water to assure lubrication of sealing faces.

MOTOR (Pump & Blower): These motors are totally enclosed ball bearing type. They are equipped with quick disconnect plugs.

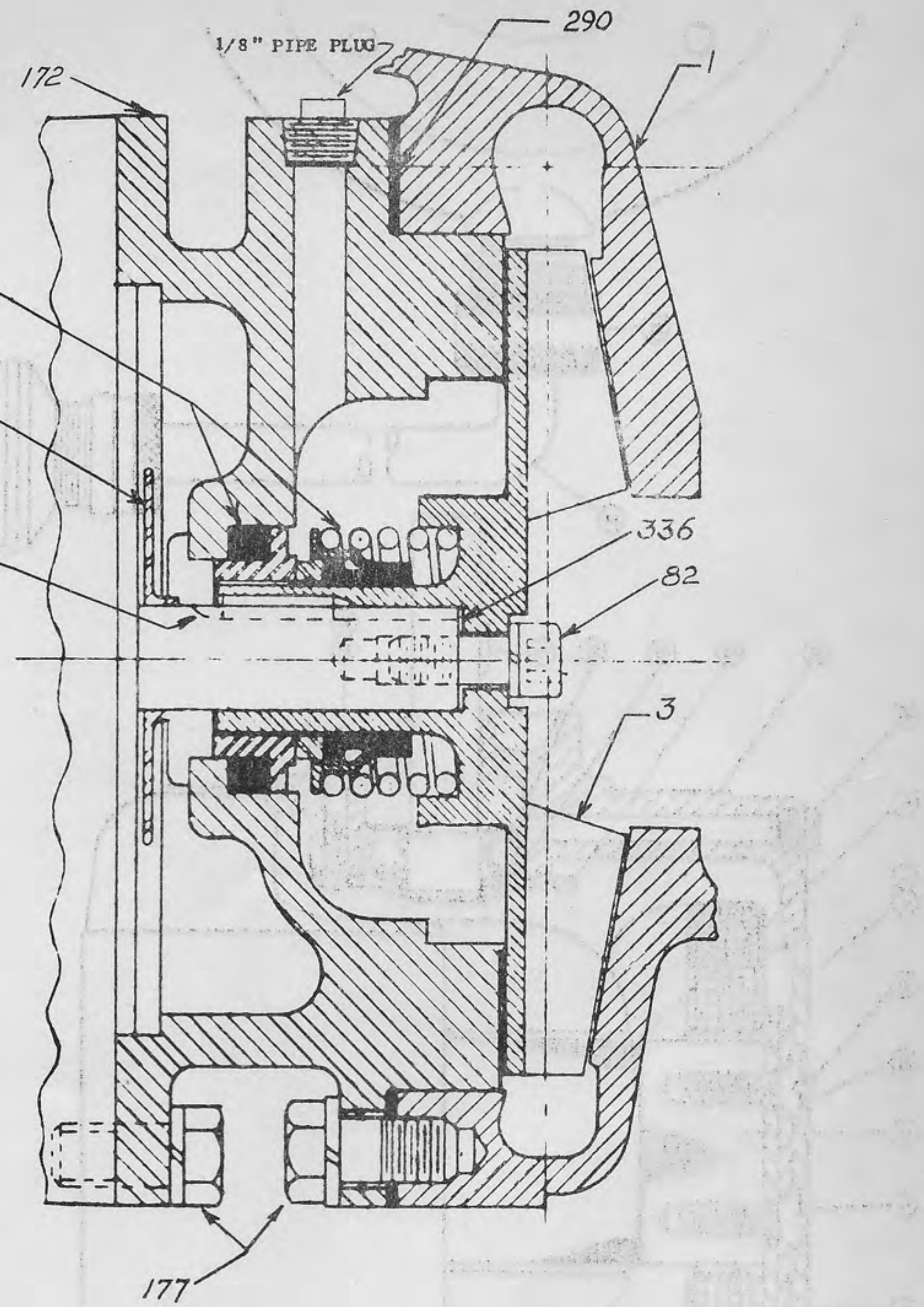
The pump motor is a quarter H.P., Delco type A 8312, 36 volt D.C., 2000 RPM. See Figure 95. A Bell type cover is provided for access to commutator and brushes.

Brushes should be renewed when they are worn to 3/4 of an inch. Measurements are made on the long side of the brush.

The fan motor is a one H.P., Delco type A 8303, 36 volt D.C., 1200 RPM. See Figure 96. Shaft extensions as shown in Figure 88 are used. Plate type covers are provided at the top and bottom for access to commutator and brushes. Brushes should be renewed when they are worn to 1/2 inch. Measurements are made on the long side of brush.

FLOAT VALVE: Refer to Figure 97. As the float falls the operating stem raises the poppett off its seat and water flows to maintain the proper level in the tank. When this level is reached the float raises, shutting off water supply. Air is vented from the top of the valve as it operates and is piped into the tank. This prevents dirt and other foreign matter from entering the valve.

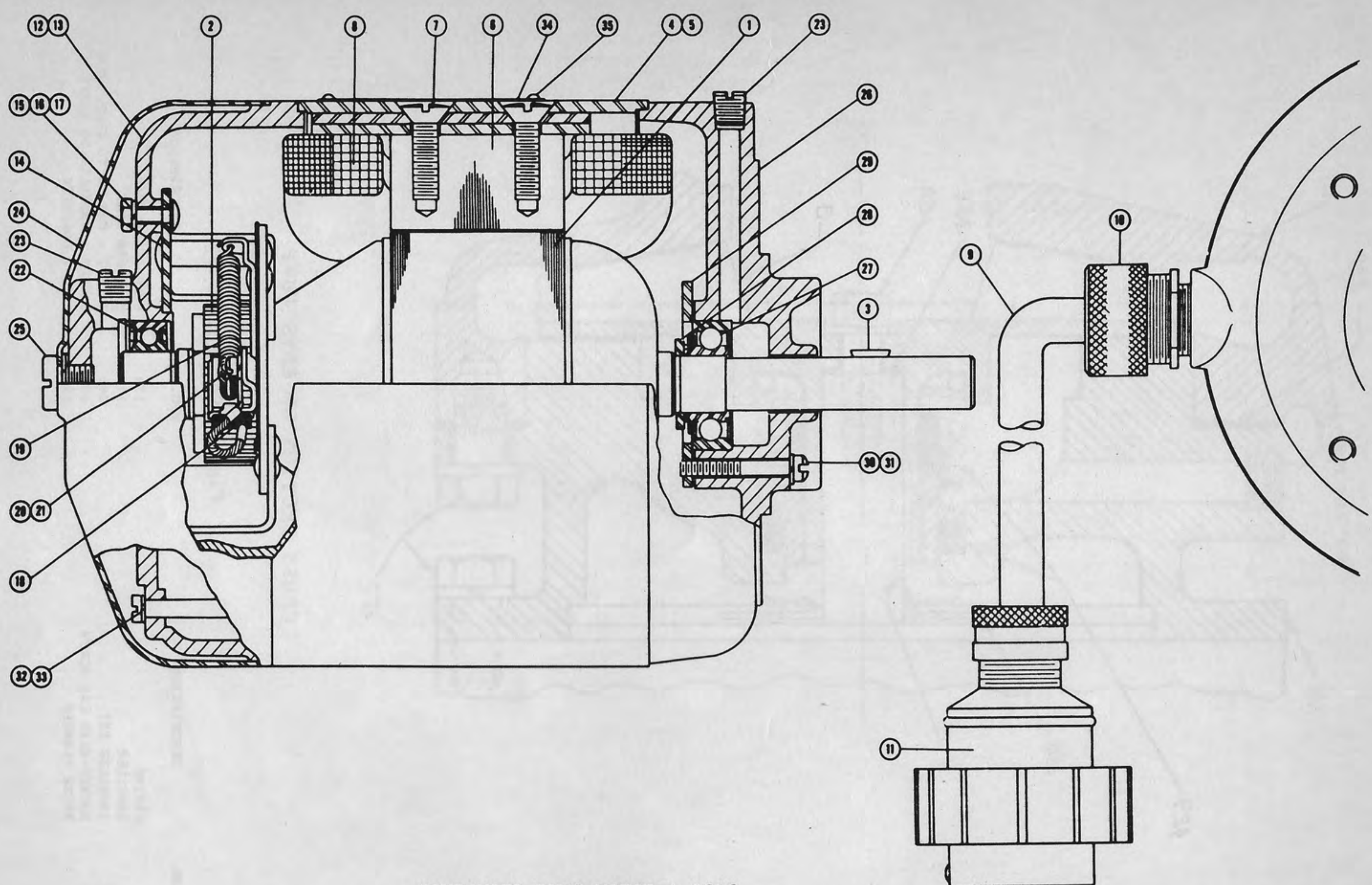
STRAINER: A "Y" type strainer is used in the water supply line to remove dirt and other foreign material from the water, before it enters float valve. It is to be maintained according to existing instructions. Figure 98 shows the details.



CROSS SECTION OF KRVS PUMP

Figure 94

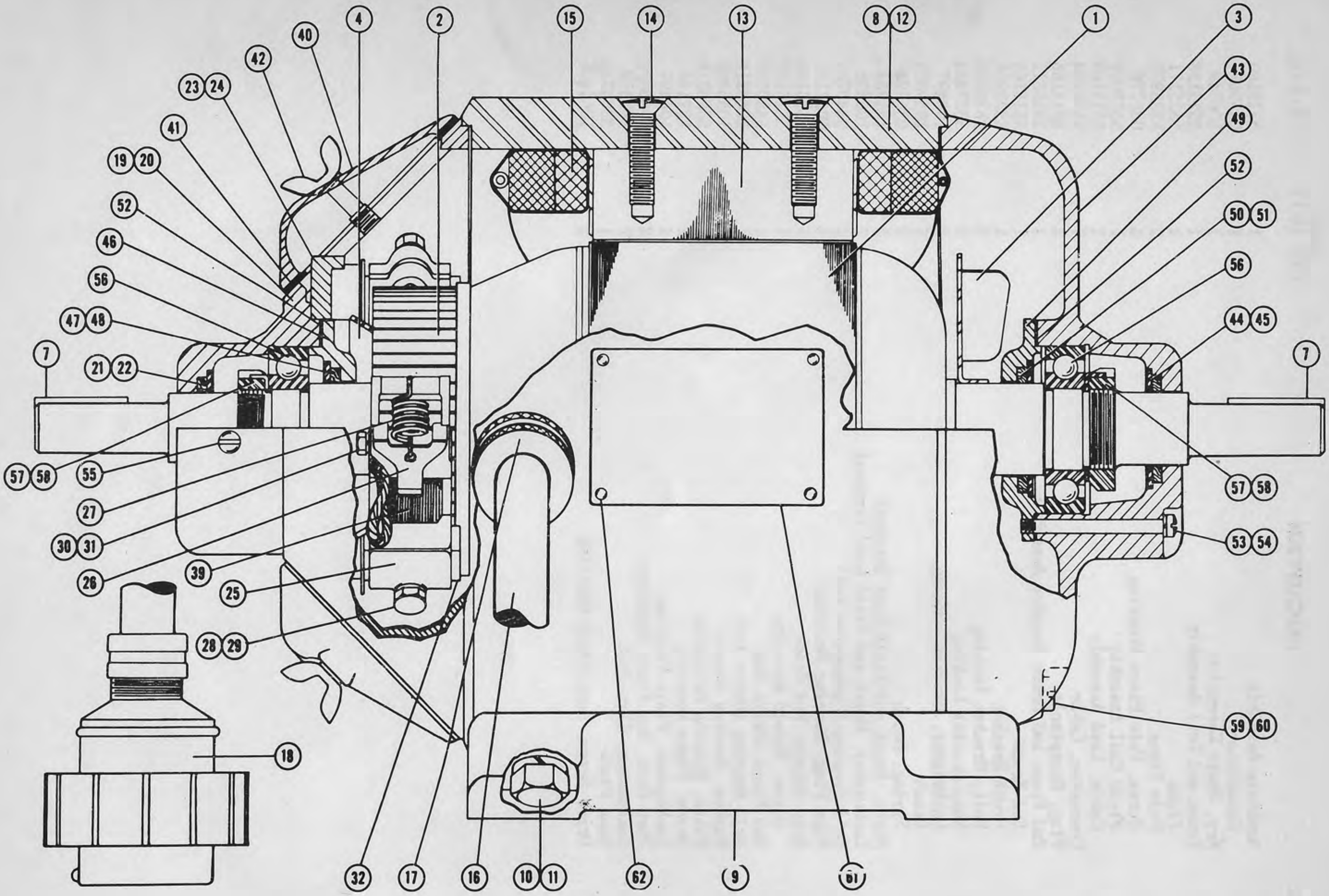
MFG. NO.	DESCRIPTION	MFG. NO.	DESCRIPTION
1	CASING	172	SUPPORTING HEAD
3	IMPELLER	177	HEX-HEAD BOLT
11	IMPELLER KEY	290	GASKET - CASING TO SUPP. HEAD
82	SOCKET-HEAD CAP SCREW	336	GASKET - IMPELLER TO SHAFT
157	WATER FLINGER	429	SEAL - COMPLETE



CONDENSER PUMP MOTOR A-8312

Figure 95

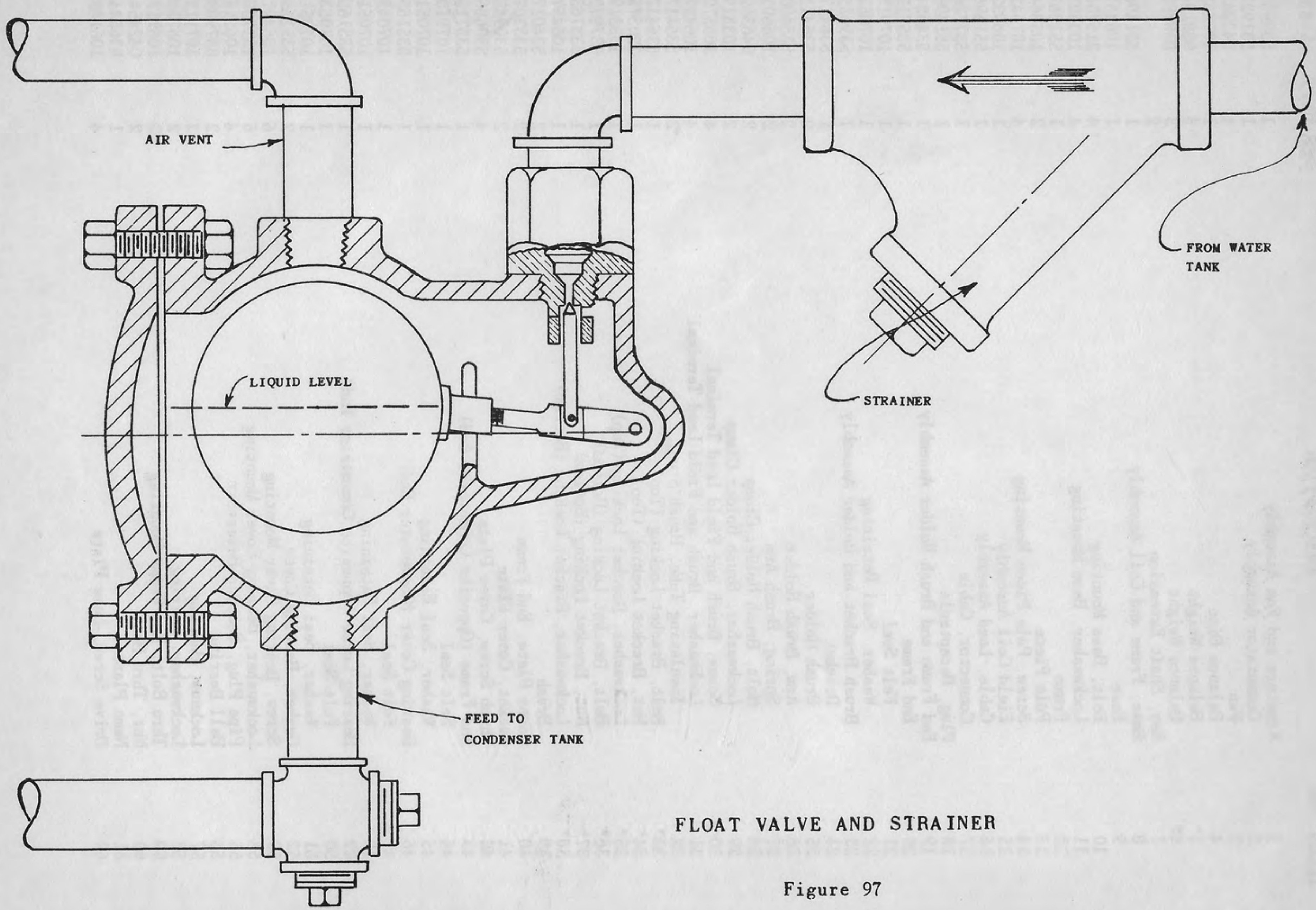
ILLUS. NO.	DESCRIPTION	QUAN. PER UNIT	A-8312
1	Armature Assembly	1	5515160
2	Commutator	1	045967
3	Key, Shaft Extension	1	106749
4	Frame and Coil Assembly	1	5515155
5	Frame	1	5515171
6	Pole Piece	2	5333975
7	Screw, Pole Piece Mounting	4	036776
8	Field Coil Assembly	1	5373009
9	Cable, Lead Assembly	1	5515169
10	Connector, Cable	1	5396284
11	Plug, Receptacle	1	5515166
12	End Frame and Brush Bracket Assembly	1	5356811
13	End Frame	1	5515165
14	Brush Bracket	1	5333926
15	Bolt, Bracket Locking	2	5336056
16	Nut, Bracket Locking	2	5337834
17	Lockwasher, Bracket Locking	2	106497
18	Brush	2	1059009
19	Spring, Brush	2	036304
20	Screw, Brush and Field Lead Terminal	2	131954
21	Lockwasher, Brush and Field Lead Terminal	2	106496
22	Ball Bearing (Commutator End)	1	5340769
23	Pipe Plug, Bearing Reservoir	4	1062157
24	Drip Shield, End Frame	1	5515168
25	Screw, Shield Mounting	1	5515167
26	End Frame (Drive End)	1	5430766
27	Ball Bearing (Drive End)	1	1064218
28	Washer, Bearing Spacer	1	1055828
29	Plate, Bearing Retaining	1	5396278
30	Screw, Plate Mounting	2	132146
31	Lockwasher, Plate Mounting	2	106497
32	Thru Bolt, End Frame Mounting	2	1066972
33	Lockwasher, Thru Bolt	2	103319
34	Name Plate	1	5308735
35	Drive Screw, Name Plate Mounting	2	1061405



CONDENSER BLOWER FAN MOTOR A-8303

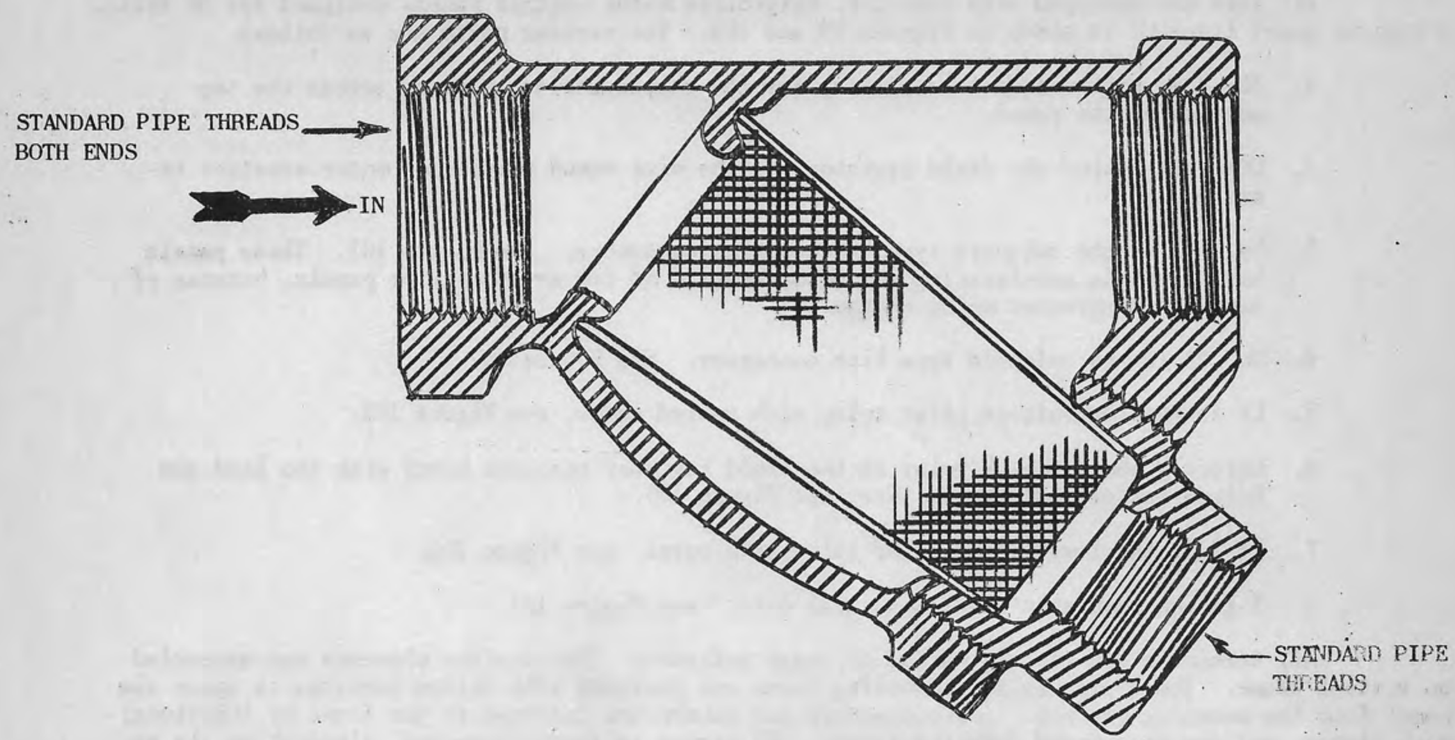
Figure 96

ILLUS. NO.	DESCRIPTION	QUAN. PER UNIT	A 8303
1	Armature and Fan Assembly	1	5399371
2	Commutator Assembly	1	5319239
3	Fan	1	042243
4	Balance Disc	1	1072389
5*	Balance Weight	3	038194
6*	Balance Weight	3	038195
7	Key, Shaft Extension	2	-
8	Base, Frame and Coil Assembly	1	5514960
9	Base	1	1064517
10	Bolt, Base Mounting	4	215735
11	Lockwasher, Base Mounting	4	103323
12	Frame	1	5512635
13	Pole Piece	2	1058641
14	Screw, Pole Piece Mounting	4	1070426
15	Field Coil Assembly	1	1069324
16	Cable, Lead Assembly	1	5514981
17	Connector, Cable	1	5377264
18	Plug, Receptacle	1	5514982
19	End Frame and Brush Holder Assembly	1	5340342
20	End Frame	1	5357155
21	Felt Seal	1	1079138
22	Washer, Seal Retaining	1	1070518
23	Brush Bracket and Holder Assembly	1	5396355
24	Bracket	1	5364174
25	Brush Holder	2	5364114
26	Arm, Brush Holder	2	5354004
27	Spring, Brush Arm	2	1066014
28	Bolt, Brush Holder Clamp	2	046369
29	Lockwasher, Brush Holder Clamp	2	103319
30	Screw, Brush and Field Lead Terminal	4	1065723
31	Lockwasher, Brush and Field Lead Terminal	4	106497
32	Insulating Tube, Brush Stud	2	5364170
33*	Bolt, Bracket Locking (Top)	1	5364172
34*	Nut, Bracket Locking (Top)	1	120375
35*	Lockwasher, Bracket Locking (Top)	1	103319
36*	Bolt, Bracket Locking (Bottom)	1	037972
37*	Nut, Bracket Locking (Bottom)	1	5337834
38*	Lockwasher, Bracket Locking (Bottom)	1	106497
39	Brush	2	5340170
40	Cover Plate, End Frame	2	5333077
41	Gasket, Cover Plate	2	5309450
42	Thumb Screw, Cover Plate	4	5306893
43	End Frame (Opposite Commutator End)	1	5357156
44	Felt Seal	1	1079138
45	Washer, Seal Retaining	1	1070518
46	Bearing Cover (Commutator End)	1	5351658
47	Felt Seal	1	1070537
48	Washer, Seal Retaining	1	1070514
49	Bearing Cover (Opposite Commutator End)	1	5351659
50	Felt Seal	1	1070537
51	Washer, Seal Retaining	1	1070514
52	Gasket, Bearing Cover	2	5351655
53	Screw, Bearing Cover Mounting	6	106497
54	Lockwasher, Bearing Cover Mounting	6	132158
55	Pipe Plug, Bearing Reservoir	4	1062157
56	Ball Bearing	2	5379898
57	Locknut, Bearing	2	1071139
58	Lockwasher, Bearing	2	1067505
59	Thru Bolt, End Frame Mounting	2	1069191
60	Nut, Thru Bolt	2	042454
61	Name Plate	1	5365449
62	Drive Screw, Name Plate	4	1061405



FLOAT VALVE AND STRAINER

Figure 97



WATER STRAINER

Figure 98

NOTES

COMPRESSOR MOTOR CONTROL PANEL

All cars are equipped with type Q.F. Frigidaire Motor Control Panels designed for 36 Volts. A typical panel (type Q) is shown in Figures 99 and 100. The various parts are as follows:

1. The four external field resistors for the compressor are mounted across the top portion of the panel.

2. Directly behind the field resistors is the wire-wound compressor motor armature resistor.

3. No. 1A is the solenoid type accelerating contactor. See Figure 101. These panels have a single accelerating contactor instead of two as on earlier panels, because of improved compressor motor design.

4. No. 2A is the solenoid type line contactor. See Figure 100.

5. LV is the low voltage pilot relay with sealed cover, see Figure 102.

6. Directly above the LV relay is the field resistor terminal block with the lead and Edison battery adjustment line, see Figure 100.

7. LV-1 is the low voltage power relay with cover, see Figure 102.

8. T is the pneumatic timer with seal cover, see Figure 101.

All terminals are clearly marked for easy reference. The various elements are assembled on a steel frame. The frame has four mounting holes and provided with welded bushings to space the panel from the mounting surface. All contactors and relays are fastened to the frame by individual back plates, and can be removed from the front. All wiring is front connected, eliminating the necessity of removing the control panel to replace control elements.

OPERATION OF COMPRESSOR MOTOR CONTROL PANEL:

1. Close the blower fan circuit breaker on the vapor panel. This places the A.C. Blower Motor and exhaust fan in operation.

2. Place the control switch in a "Cool" position.

3. Press reset button to energize the LV relay. (The LV relay circuit is also closed through the normally open interlock contacts of the Gen. Auto. switch when the generator is operating). Closing the LV relay energizes the coil of the LV 1 relay closing its contacts. See Figure 103.

C O N D I T I O N S: (Item 3)

a. The low voltage relay is made sensitive to voltage (state of battery) by a combination of a coil across the battery and a current compensating coil in the compressor motor circuit.

b. When the reset button is released, coil circuits of LV and LV 1 are maintained through contacts on LV 1.

4. If cooling pilot relay is energized and pressure switch is closed another set of LV1 contacts energize the motor accelerating control circuits through 1A coil between terminals T and LR. This closes main contacts of 1A contactor.

5. With accelerating contactor 1A energized closed, the compressor motor, condenser fan and condenser pump start in series with the armature resistor. The auxiliary contact of 1A which shorts out all the external field resistor during the starting period only, improves the motor starting torque. The lifting of the 1A plunger releases the pneumatic timer and 1-1/2 to 3 seconds later the timer contact 1A closes, energizing the 2 A contactor coil. A contact of the 2A contactor interrupts circuit to 1A contactor coil, permitting accelerating contactor to open and timer to return to its original position. Contactor 2A is held closed through its own contacts in series with resistor No. 3.

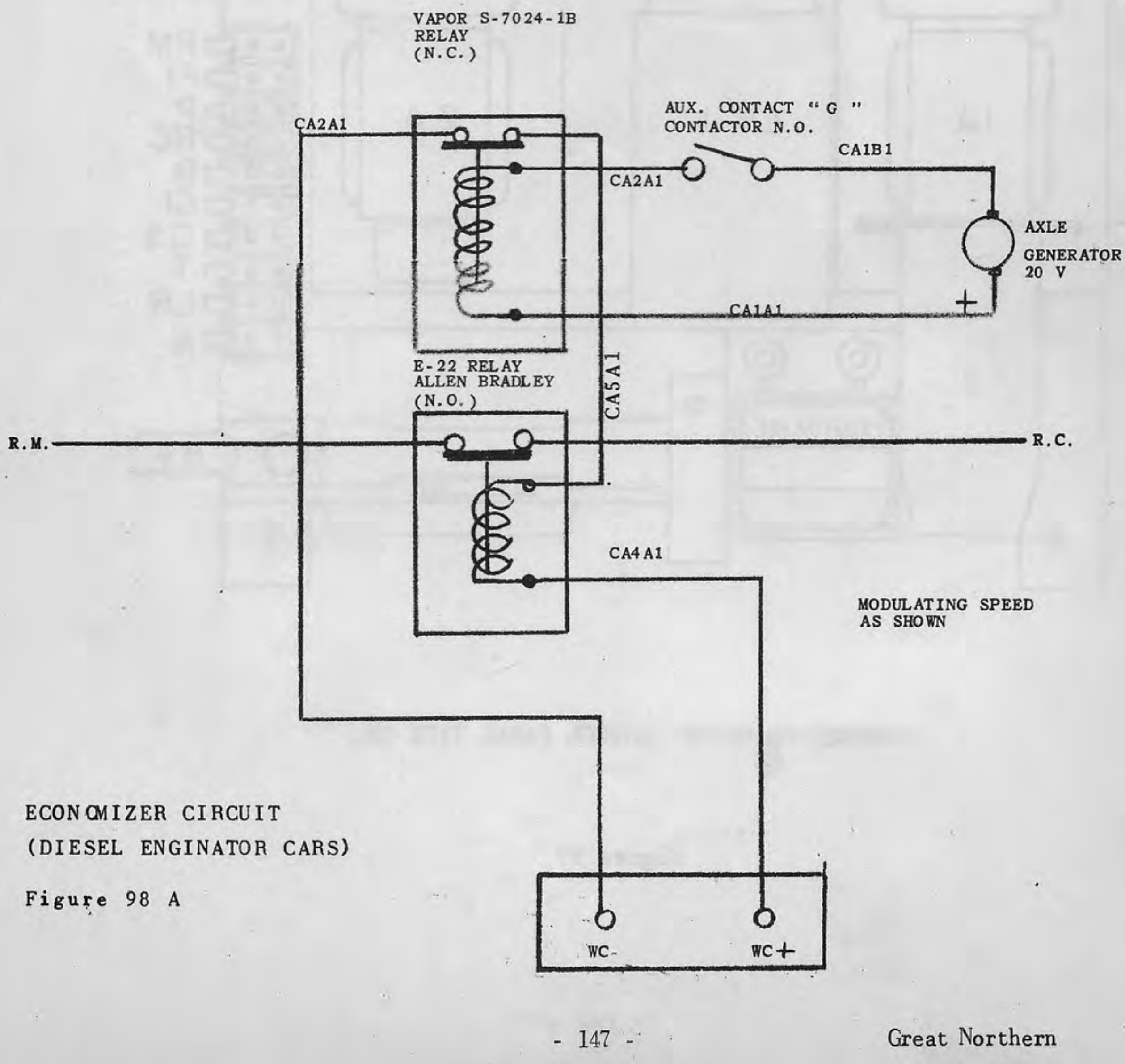
CONDITIONS: (Item 5)

a. If any control device interrupts the circuits during the accelerating period, the pneumatic timer returns to its starting position; this insures proper sequence of operation of the accelerating and line contactors at all times.

6. When the generator is not running, the battery is conserved by an economizer feature which shorts out a portion of the external field resistor through a normally closed interlock on the generator automatic switch (Genemotor car), thereby reducing compressor motor speed. Diesel Generator cars are equipped with a N.Y. Air Brake splined axle generator (20 Volts) operating a Vapor Relay S-7024-1B. When car is standing, the N.C. (normally closed) Vapor Relay contacts set up a circuit energizing the coil of an A.B. E-22 relay which shorts out a portion of the external field resistor. See wiring diagram 98-A.

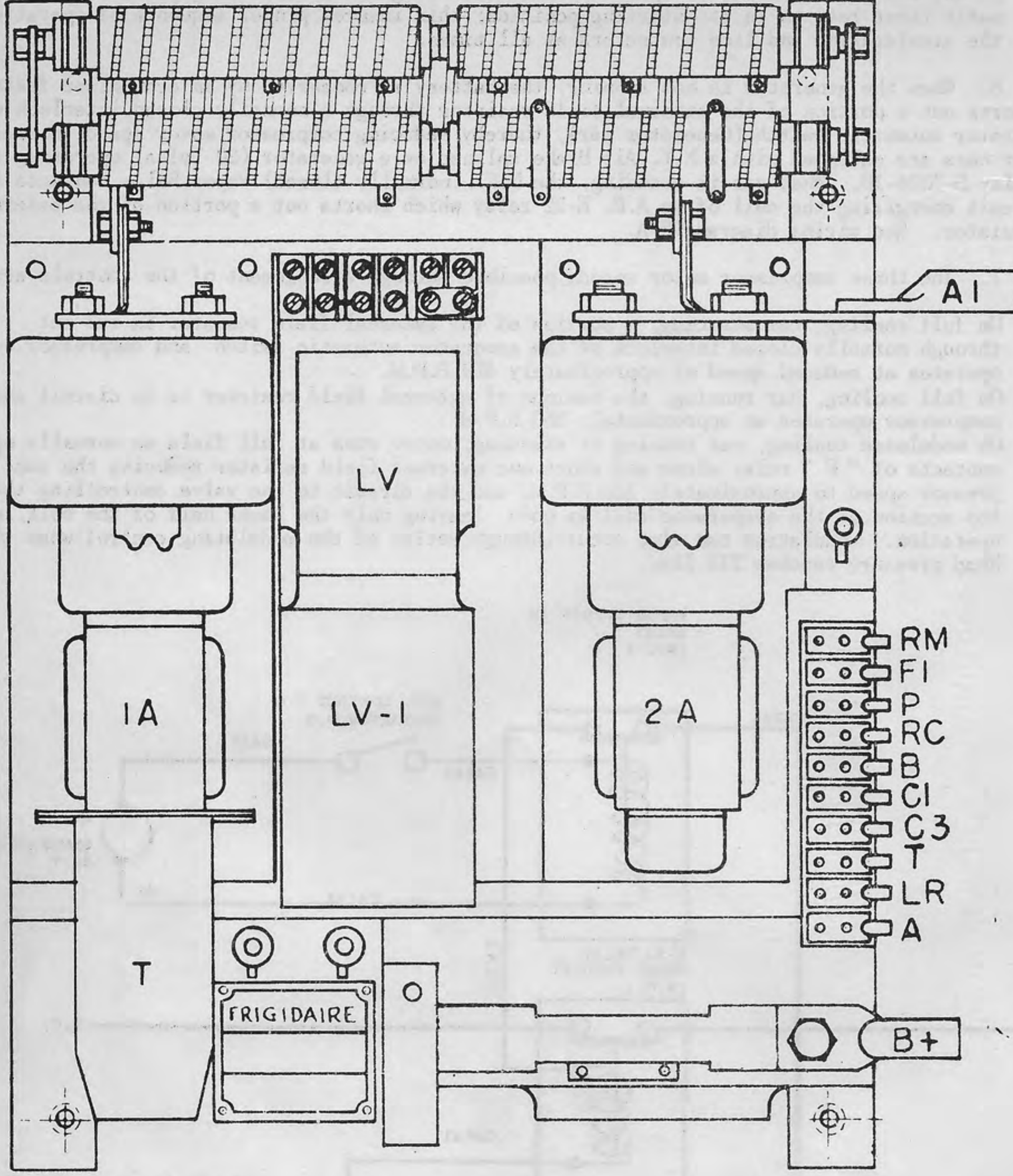
7. The three compressor motor speeds possible through arrangement of the controls are:

a. On full cooling, car standing, a portion of the external field resistor is cut out through normally closed interlock of the generator automatic switch and compressor operates at reduced speed of approximately 470 R.P.M.
b. On full cooling, car running, the maximum of external field resistor is in circuit and compressor operates at approximately 560 R.P.M.
c. On modulated cooling, car running or standing, motor runs at full field as normally open contacts of "P" relay close and short out external field resistor reducing the compressor speed to approximately 320 R.P.M. and the circuit to the valve controlling the top section of the evaporator coil is open, leaving only the lower half of the coil in operation. Modulation can also occur through action of the modulating control when the head pressure reaches 210 lbs.



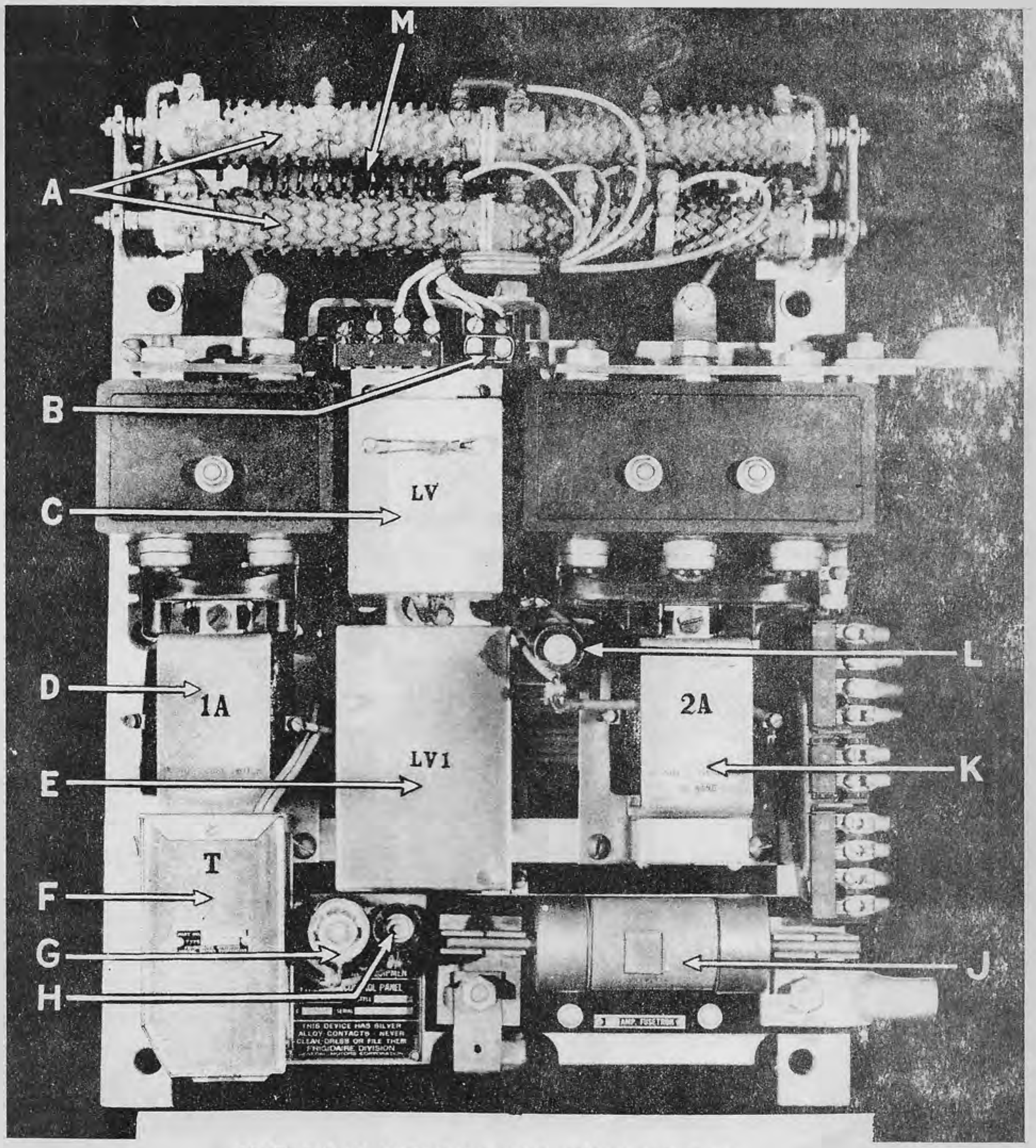
ECONOMIZER CIRCUIT
(DIESEL ENGINATOR CARS)

Figure 98 A



COMPRESSOR MOTOR CONTROL PANEL TYPE QF.

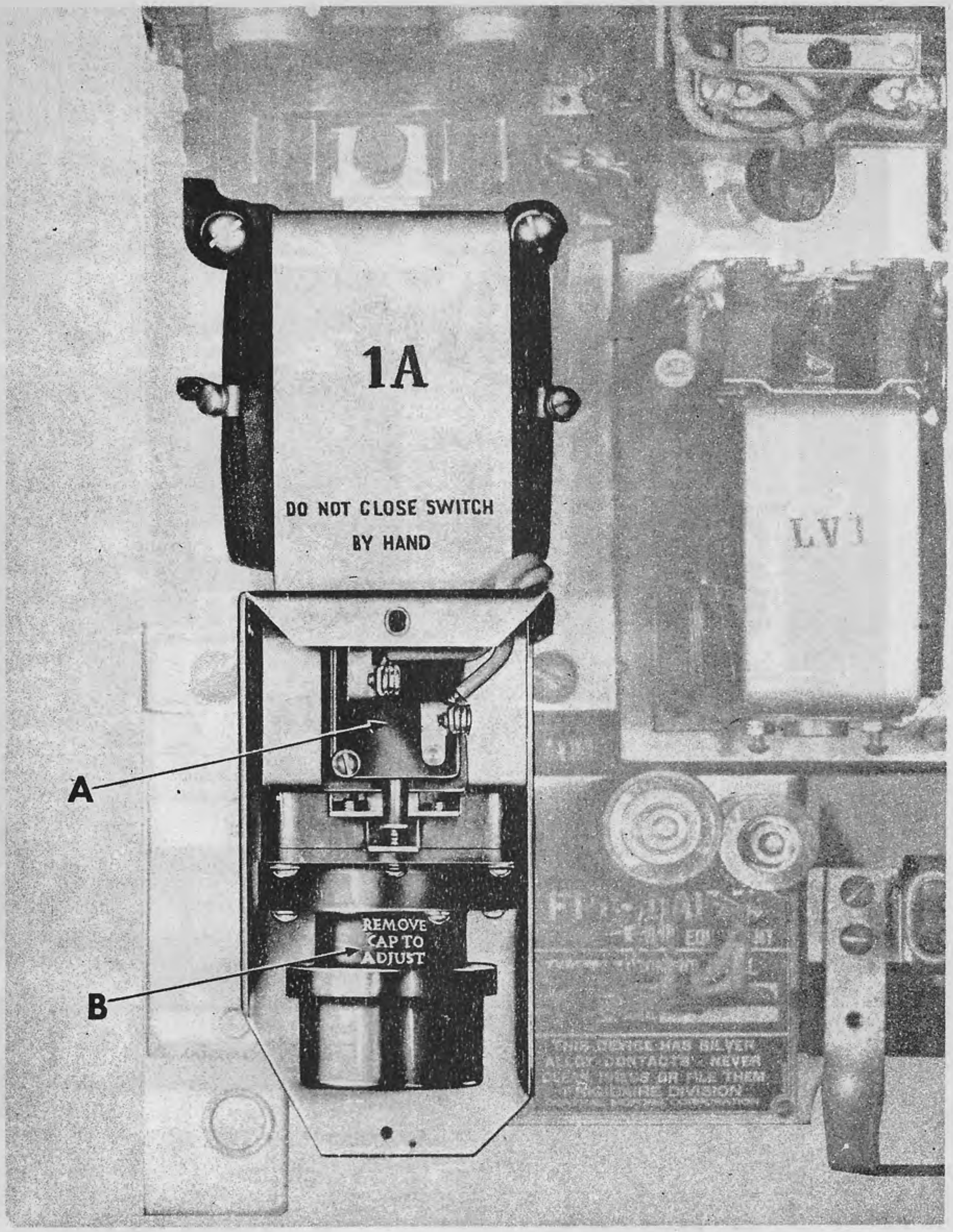
Figure 99



COMPRESSOR MOTOR CONTROL PANEL TYPE QF

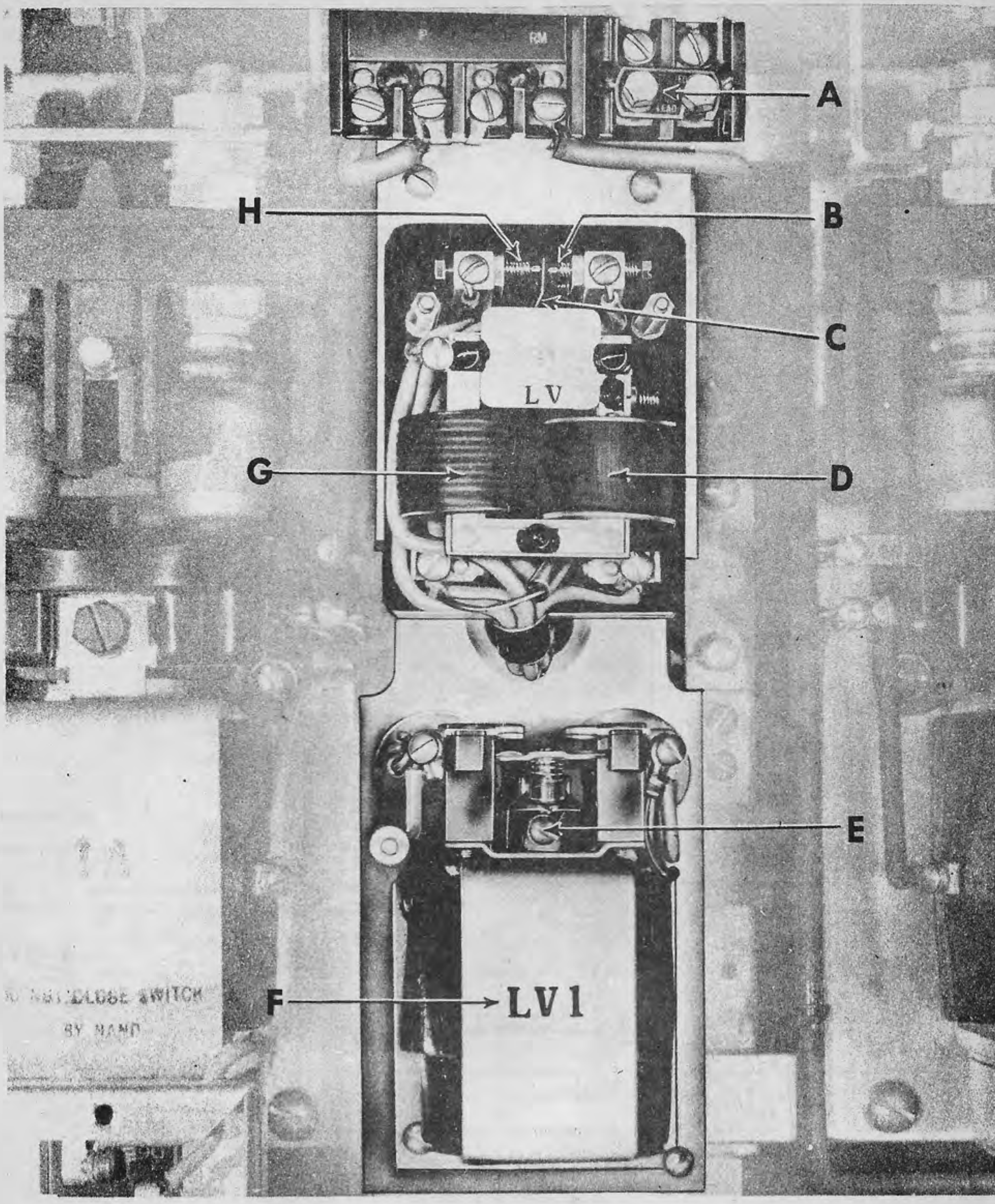
a.	External Field Resistors	g.	Resistor No. 2
b.	Edison Link	h.	Resistor No. 1
c.	Low Voltage Pilot Relay	j.	Compressor Motor Fuse
d.	Accelerating Contactor	k.	Line Contactor
e.	Low Voltage Power Relay	i.	Resistor No. 3
f.	Pneumatic Timer	m.	Armature Resistor

Figure 100



<u>Pneumatic Timer "T" (Close up)</u>
a. Timer Switch b. Timer Mechanism

Figure 101

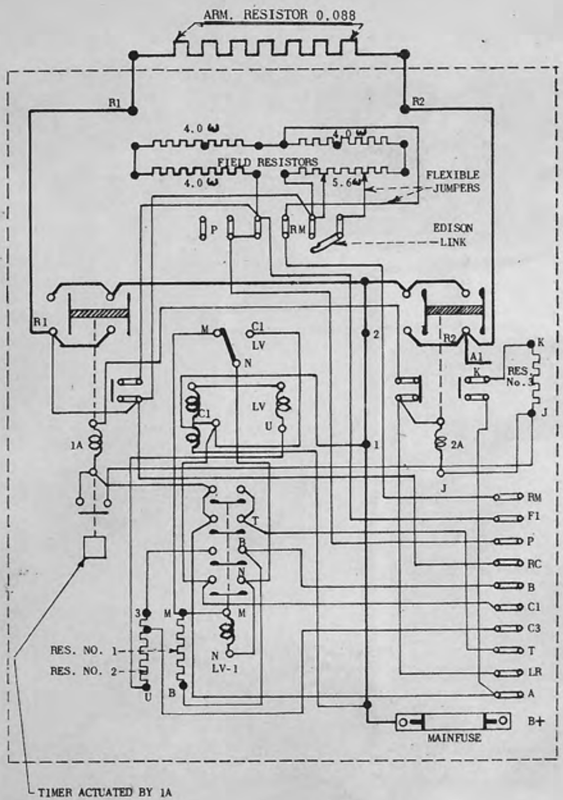


"LV" and "LVI" Relay (close up)

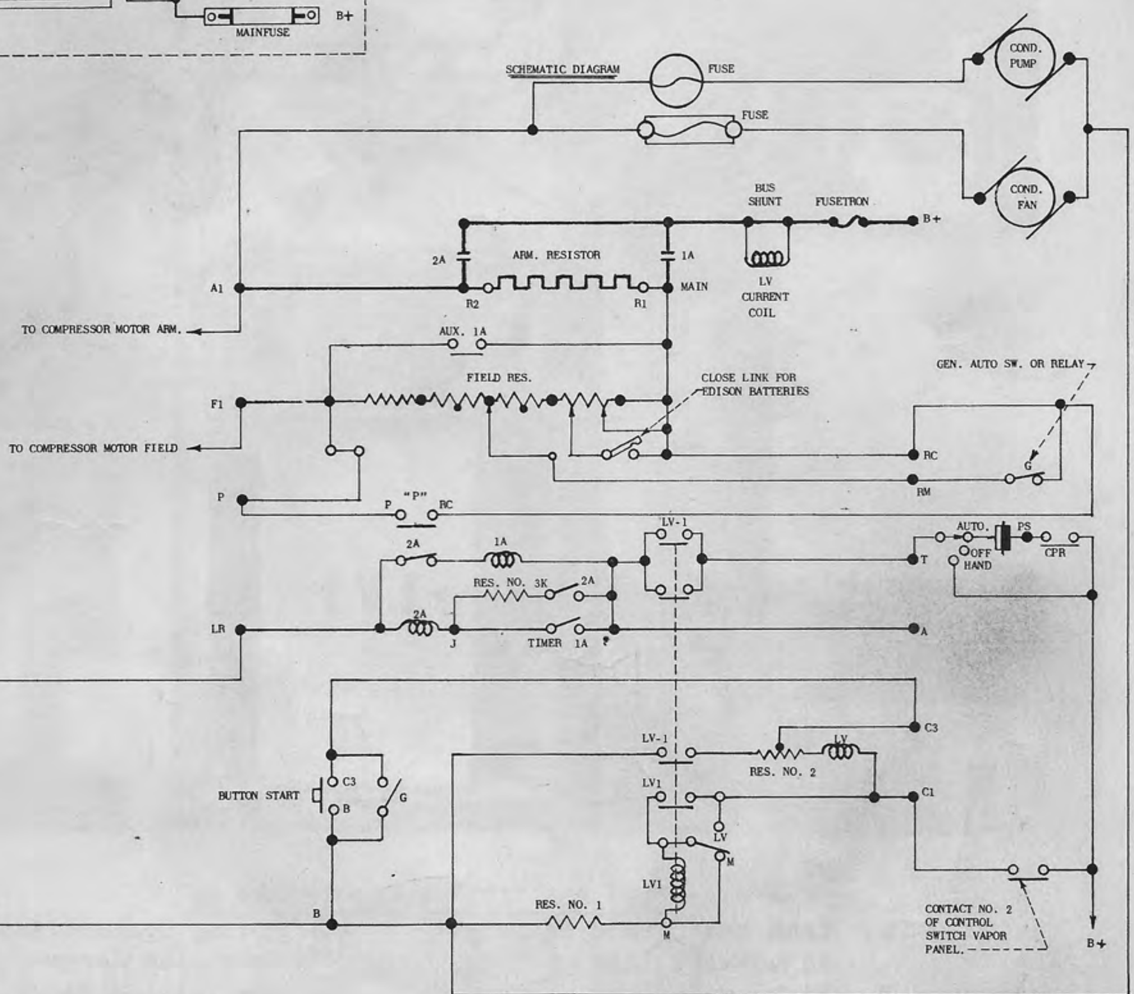
a. Lead and Edison Battery Adjustment Link
b. Pick-up Contact
c. Moving Contact
d. 1/2 Voltage Coil
e. Moving Contact Assembly Retaining Screw
f. Low Voltage Power Relay
g. Current Coil Wound Over 1/2 Voltage Coil
h. Drop-out Contact

Figure 102

PANEL WIRING DIAGRAM - TYPE QF



RESISTANCE VALUES		
NAME	PART NO.	OHMS RES. AT 25° C
LV RELAY POTENTIAL COIL	R-4308	8.75
LV RELAY POTENTIAL & CUR. COILS	R-4309	5.75 POT. - 0.0038 CUR.
LV-1 RELAY COIL	RY-1905	35.0
1A CONTACTOR COIL	RH-4710	7.2
2A CONTACTOR COIL	RH-4710	7.2
RESISTOR NO. 1	X-106055	40.0
RESISTOR NO. 2	X-106061	155 TAPPED AT 135
RESISTOR NO. 3	X-106067	28.0



COMPRESSOR MOTOR CONTROL PANEL TYPE Q F

Figure 103

TESTING LOW VOLTAGE RELAY

The low voltage pilot relay is constructed on the design of a sturdy voltmeter. It has two electric magnet poles formed by a horse-shoe shaped laminated iron core and a laminated rotor. The rotor is spring loaded so as to hold its pole ends away from the field poles. See Figure 104.

As there is no method of reversing the polarity of the field poles when the coils are energized, the rotor tends to pull into the magnetic field and remain there.

Attached to the rotor shaft is a contact arm, similar to a voltmeter needle which floats between two stationary adjustable contacts when the battery voltage is between the cut-in and cut-out values. The right contact completes the circuit to the low voltage control relay (LV1), the left contact shorts out the circuit to the coil of the low voltage control relay (LV1) causing the LV1 to drop out.

There are three coils wound on the low voltage pilot relay laminated core; two are voltage coils and are connected in series; the third is a current coil wound over the left voltage coil and connected across a calibrated portion of the compressor motor buss bar conductor (between the left compressor motor fuse clip and the rear contacts of the 1A and 2A contactors). There are two connection points on the buss bar, marked No. 1 and No. 2. The current coil lead is connected to No. 1 when lead batteries are used and to No. 2 for Edison batteries.

The function of the current coil is to compensate for the voltage drop during the compressor motor starting cycle. It is energized by the flow of current through the compressor motor circuit. The voltage across the current coil varies according to the current drawn by the compressor motor and is at its peak at the closing of the compressor motor circuit.

The direction of the current flow through the current winding must be the same as the voltage coil over which it is wound; otherwise instead of strengthening the field of the pilot relay and holding it in, it will neutralize the field and relay will drop out by moving the rotor contact to the left and shorting out the low voltage relay (LV1) coil.

In maintaining good operation of the low voltage pilot relay it is imperative that the contacts of the low voltage control relay (LV1) be kept in a good state of cleanliness as one set of these contacts carries the two to three volts to the coil of the low voltage pilot relay. Any dirt on the contacts will cause the rotor of the low voltage pilot relay to pull into the short circuiting position. The following steps are to be taken when adjusting the relays:

1. Turn cooling off.
2. Remove buss bar from fuse clip on compressor motor panel.
3. Disconnect C1 and B terminal on compressor motor control panel.
4. Remove contact block on plunger of low voltage control (LV1) relay; clean and re-apply.
5. Connect B terminal on motor panel.
6. Apply ammeter shunt of 500 ampere capacity in compressor motor fuse clips.
7. Connect No. 2 lead from low voltage relay tester to C1 terminal on motor control panel.
8. Connect No. 3 lead from low voltage relay tester to C1 lead removed from motor control panel.
9. Connect No. 4 lead from low voltage relay tester to B terminal on motor control panel.
10. Turn dial on low voltage tester counter-clockwise to full stop.
11. Turn on cooling and press reset button momentarily. The LV Timer, 1A, LV1 and 2A relays will close and compressor will run.

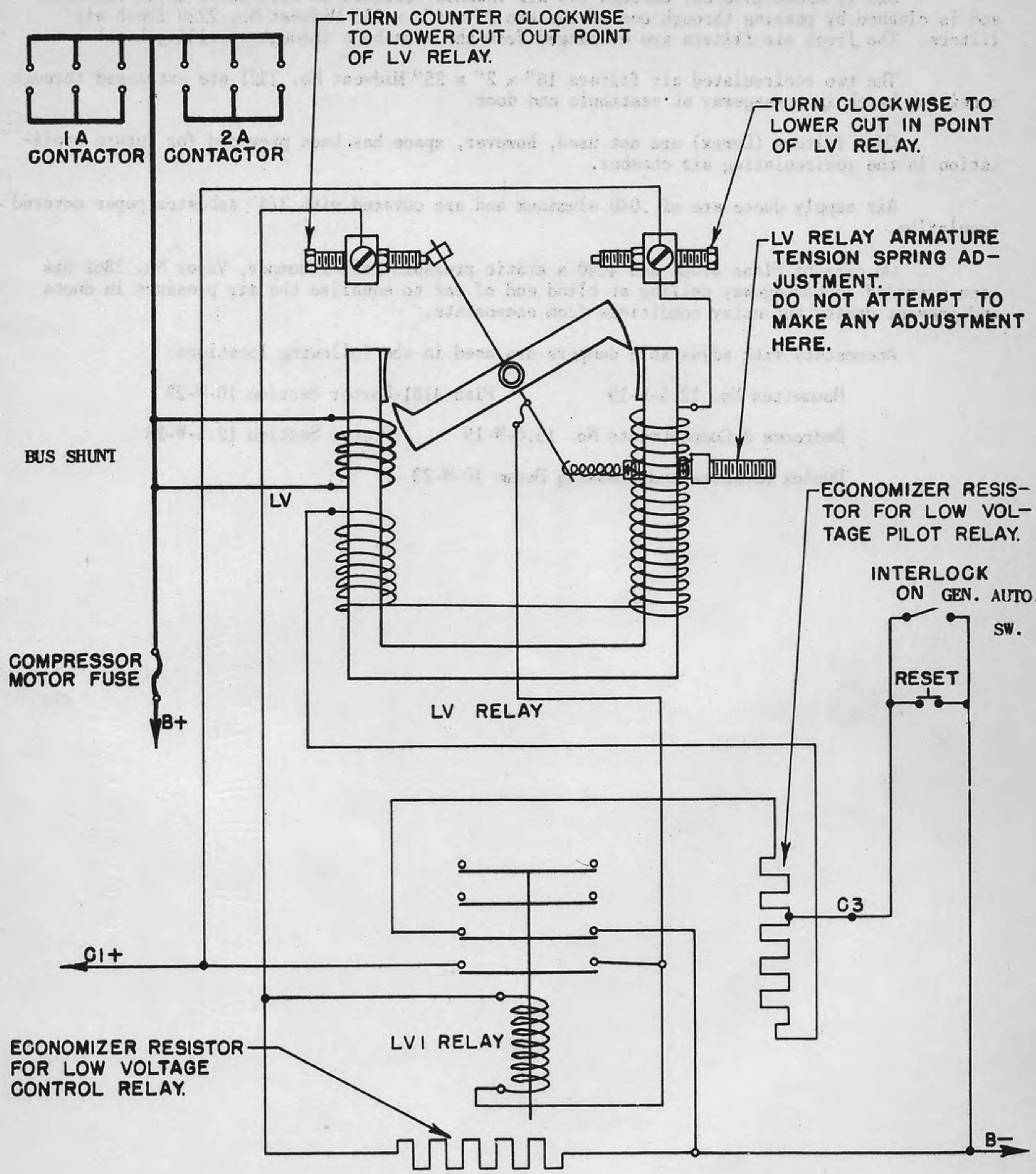
12. Remove wires from RC and RM terminals on panel. This puts the compressor motor external field resistors in the circuit and operates the motor at full speed. The motor armature current must be about 275 amperes to provide a good field in the current coil on the low voltage pilot relay which is necessary when setting the drop out voltage.

13. Turn the dial on the low voltage tester clockwise and observe at what voltage the low voltage pilot relay shorts out the *LV1* relay coil. Adjust to 26 volts. Turn adjustment on left stationary contact clockwise to raise drop-out voltage, and counter-clockwise to lower drop out voltage.

14. Short-out reset button circuit at terminals *C3* and *B* on motor control panel (with jumper) while turning dial on low voltage tester counter-clockwise and observe at what voltage the low voltage pilot relay completes the circuit to the *LV1* relay coil. Adjust to 28 volts. Turn adjustment on right stationary contact clockwise to lower cut in voltage and counter-clockwise to raise cut-in voltage. Be sure to remove jumper wire on *C3* and *B* after the adjustment is made.

15. Disconnect tester leads, reconnect panel leads, apply relay covers, remove ammeter shunt, apply compressor motor buss.

NOTES



LOW VOLTAGE RELAY CONNECTION DIAGRAM

Figure 104

AIR DISTRIBUTION

Air is drawn into car through two air intakes, located in roof sheet above vestibule and is cleaned by passing through one of the two 9" x 4" x 25" Midwest No. 2220 fresh air filters. The fresh air filters are exchanged from the vestibule through a ceiling hatch.

The two recirculated air filters 16" x 2" x 25" Midwest No. 2321 are exchanged through a ceiling hatch in passageway at vestibule end door.

Odor filters (Dorex) are not used, however, space has been provided for future application in the recirculating air chamber.

Air supply ducts are of .040 aluminum and are covered with 3/4" asbestos paper covered insulation.

On cars of Plans 4108A and 4180 a static pressure relief damper, Vapor No. 7862 has been provided in passageway ceiling at blind end of car to equalize the air pressure in ducts and prevent drafty and noisy conditions from anemostats.

Anemostats with adjustable dampers are used in the following locations:

Roomettes No. 12.5-W-19 — Plan 4181-Porter Section 10-W-23

Bedrooms & Compartments No. 15.0-W-19 — Porter Section 12.5-W-23

Duplex Roomette and Dressing Rooms 10-W-23

All cars are equipped with Vapor Company's Zone heat system. The Zone heat system used on sleeping cars prior to 1946 has been covered in the A.C. Manual. In the later Zone heat systems certain devices have been eliminated and others improved or modified for simplification of operation and maintenance. Heating layouts are shown on Figures 106 and 109.

The steam lines have been placed in a floor trench on both sides of car adjacent to the outside wall. Suitable access plates are provided.

VAPOR HEATING

REGULATOR: The new No. 953 or 958 Vapor regulator, Figure 105, is the heart of the heating system. It performs the functions of three devices used in former Vapor Zone systems, namely the No. 901 regulator, No. 244 constant pressure valve, and No. 1651 flow limit valve. Its function is to reduce and regulate steam supply to maintain a constant supply of steam in the loop.

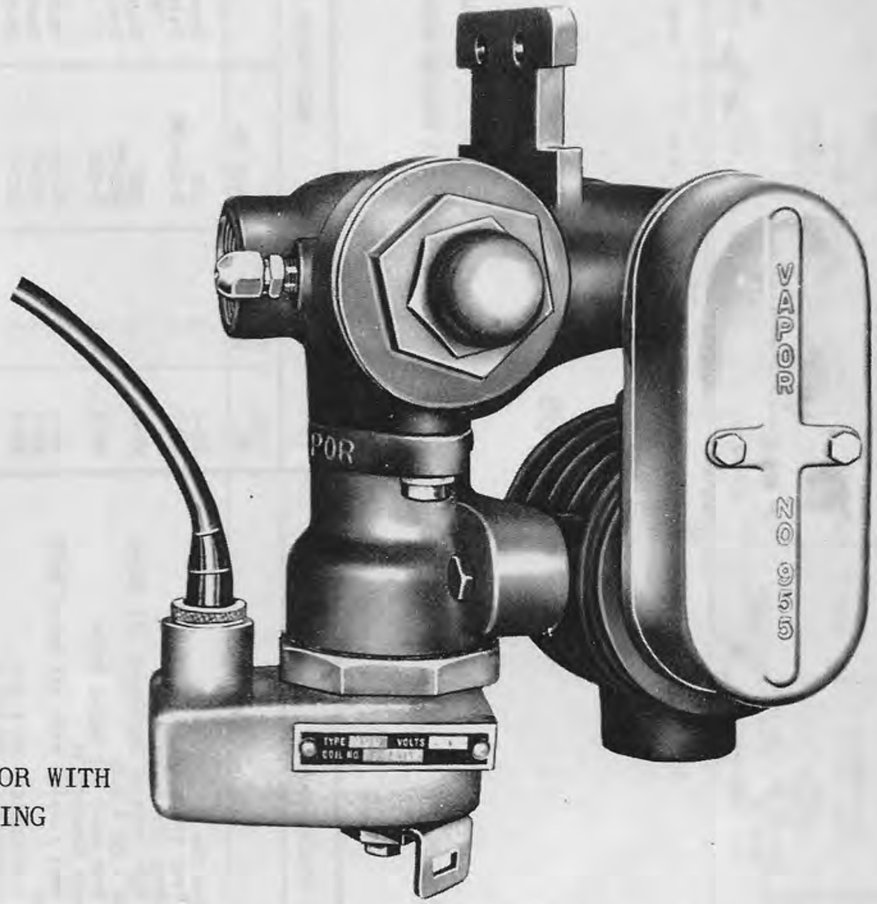


Figure 105

VAPOR NO. 953 REGULATOR WITH NEW STYLE COIL HOUSING

Steam at trainline pressure enters the inlet side of the regulator where it passes through a strainer to No. 242-CC needle valve assembly. This needle valve is spring loaded and set to reduce steam pressure to 40 lbs. Adjustment of this setting can be made with screw under large acorn nut on the left-hand front of regulator. See Figures 110-A and 111.

The steam at reduced pressure flows through cored port in the top of casting to regulator side. The regulator has a No. 900-Q needle valve assembly at top and No. 900-E economy diaphragm at the bottom. Action of the economy diaphragm is transmitted through an operating rod assembly to a fulcrum arm acting against the needle valve. See Figure 112. Regulated steam passes through needle valve to outlet side of regulator. Some of the regulated steam passes through another port to the flow limit valve. When the pressure in supply loop and flow limit valve chamber reaches 3 or 8 lbs., the spring pressure on flow limit valve will be overcome and valve will pop open, allowing steam to pass into diaphragm chamber. This will cause bellows diaphragm to expand and close the regulator needle valve. This cycle will repeat itself with flow limit valve opening and closing repeatedly to maintain 3 or 8 lbs. pressure in the loop. See Figure 113.

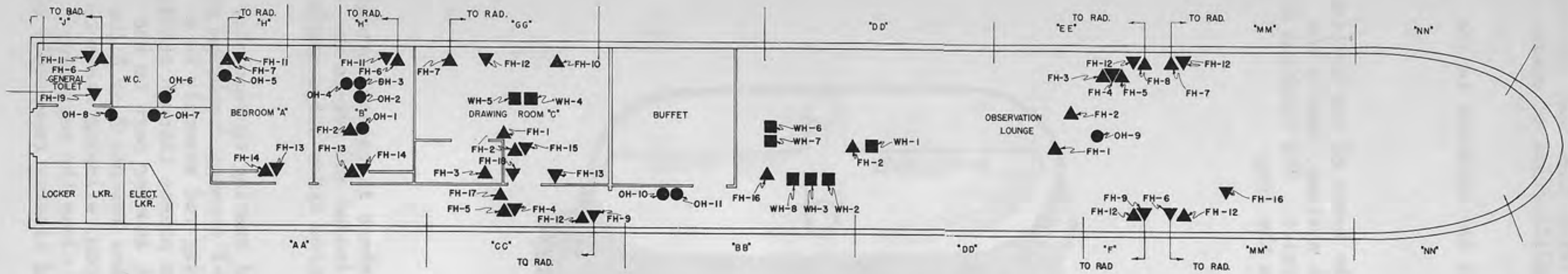


FIGURE 106

CODE

▲ F.H. - Floor Heat

● O.H. - Overhead Heat (Air Conditiining)

■ W.H. - Water Heating

HEATING LAYOUT FOR

GREAT NORTHERN BUILT BY P.C.W.

1 DRAWING ROOM - 2 BEDROOMS - BUFFET - OBS. LNGE.

STEAM HEAT SPECIALTIES (FLOOR HEAT)

Code No.	No. Used Per Car	Part No.	
FH-1	2	428	Strainer Tee
FH-2	4	S-155	Steam Trap Train Line
FH-3	2	S-124	Valve-Shut Off & Drain
FH-4	2	958	Vapor Safe Control Regulator (1) 441-4 Union - 32 V.D.C.
	2	955-TT	Drain Tube with (1) 441-2 Union
	2	955-RR2	Connector Receptacle
FH-5	2	970	Water Seal Fitting with (1) 441-6 Half Union
FH-6	3	LA-1675	Valve - Solenoid - 32 V.D.C.
FH-7	3	RA-1675	Valve - Solenoid - 32 V.D.C.
FH-8	1	LA-1677	Valve - Solenoid - 32 V.D.C.
FH-9	2	RA-1677	Valve - Solenoid - 32 V.D.C.
	9	881-N	Nipple - Inner Feed
	9	1671-SS	Connector - Complete 18" long
	8	18597	Name Plate - For Solenoid Valve
	1	886	Cap Unit Fin
FH-10	1	1698	Remote Control - Flexible Dim"A " = 83 1/2 + (6) 1643 - D 5
	8	A-886	Cap End
	3	888	Ell - Unit Fin
FH-11	3	1671-TT-1	Cord and Receptacle Assembly 1 ft. cord.
	2	908	1 3/8 in. O.D. Expansion Joint
FH-12	6	1671-TT-6	Cord and Receptacle Assembly 6 ft. cord.
	1	1643-EE	Remote Control Support

WASH WATER HEATING

Code No.	No. Used Per Car	Part No.	
WH-1	1	428	Strainer Tee
WH-2	1	S-124-HW	Valve-Shut Off & Drain - with HW Wheel (21465)
WH-3	1	960	Vapor Regulator with (2) 441-4 Union
	1	960-TT	Drain Tube with (1) 441-2 Union
WH-4	1	L-242	1" Pressure Regulating valve
WH-5	1	S-124	Valve-Shut Off & Drain
WH-6	1	588-6	Heater - Wash Water
WH-7	1	525-B	Valve-Water Mixing

WATER TANK AND FILLING VALVE PROTECTION

Code No.	No. Used Per Car	Part No.	
WH-8	1	948	Valve-Water Tank Loop Cut Out

THERMO. SPECIALTIES (FLOOR HEAT)

Code No.	No. Used Per Car	Part No.	
FH-13	3	32-RA-2547	Switch potentiometer - 32 V.D.C.
FH-14	2	32CWPB-2501-80°	Thermostat Bedrooms - 32 V.D.C.
FH-15	1	32CRPB-2501-80°	Thermostat Drawing Room - 32 V.D.C.
FH-16	2	32CRBA-2501-76°	Thermostat Observation Lounges 32 V.D.C.
FH-17	1	32CWBA-2501-76°	Thermostat Passage - 32 V.D.C.
FH-18	1	RN-2522-1-65°	Thermostat Layover - 32 V.D.C.
FH-19	1	CWB-2522-1-71°	Thermostat (Toilet) - 32 V.D.C.

CLAMPS & STANDS

	No. Used Per Car	Part No.	
	8	S-889	Bracket-Complete with 1 Bolt, 1 Cap Screw
	6	S-899-6	Support Stand
	2	S-899-10	Support Stand
	26	P-868	Bracket

RADIATION

No. Used Per Car	Length	Type	Symbol
1	12'-0"	UNIT	B-B
2	12'-0"	UNIT	D-D
1	8'-11"	UNIT	C-C
1	7'-10 1/4"	UNIT	E-E
1	3'-1 1/2"	UNIT	F
1	12'-0"	UNIT	A-A
1	8'-0"	UNIT	G-G
1	2'-10"	UNIT	K
1	2'-6 1/2"	UNIT	J
1	21 1/2"	UNIT	BUF
2	8'-11 1/2"	UNIT (Spec.Curved)	N-N
2	3'-3"	UNIT	H
2	9'-9"	UNIT	M-M
1	3'-5 1/4"	UNIT	"P"
1	8 7/16"	UNIT	"R"

STEAM HEAT SPECIALTIES (OVERHEAD)

Code No.	No. Used Per Car	Part No.	
OH-1	1	428	Strainer Tee
OH-2	1	S-124-OH	Valve-Shut Off & Drain - with OH Wheel (21465)
OH-3	1	958	Vapor Safe Control Regulator (1) 441-4 Union 32 V.D.C.
	1	B-440-TT	Drain Tube with 441 Union
OH-4	1	970	Water Seal Fitting with (1) 441-6 Half Union
OH-5	1	926	Retarder
	2	955-RR2	Connector Receptacle
OH-6	1	N-926	Retarder
OH-7	1	R-1668	Valve - Solenoid - 32 V.D.C.
OH-8	1	OS1643	Remote Control - Flexible Dim "A" = 48" + (3) 1643-D5

THERMO. SPECIALTIES (AIR COND.)

Code No.	No. Used Per Car	Part No.	
	1	9500-2	Thermostat Mtg. Plate
OH-9	1	DN-2501-76°	Thermostat - O.H. Heat in Duct 32 V.D.C.
OH-10	1	A-9600B-76°	Thermostat - Cooling - 32 V.D.C.
OH-11	1	A-9600B-78°	Thermostat - Cooling Modulating
	1	MZ-49131-MC	Control Panel Elec. Mech. A.C. - 32 V.D.C.

TRAIN LINE SPECIALTIES

Code No.	No. Used Per Car	Part No.	
	2	C-1196	Flexible Metalic Conduit with Insulation and 364 ccupler
	2	1117	End Valve
	2	1117-XX	End Valve Insulation
	1	of each	Platform Attachments 464-FF, 404-AB
	1	V-464	Platform Attachments 464-FF, 403-V, 405-C, 410-D, 404-AB

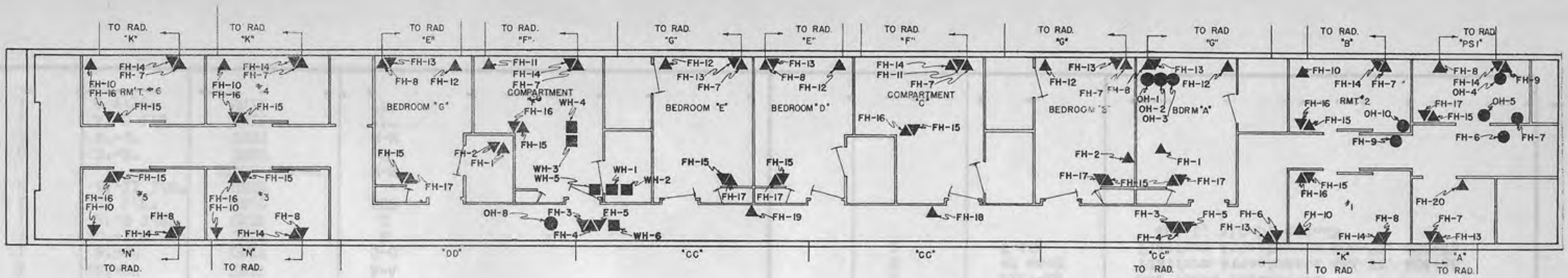


FIGURE 107

CODE

▲ F.H. - Floor Heat

● O.H. - Overhead Heat (Air Conditioning)

■ W.H. - Water Heating

HEATING LAYOUT FOR
GREAT NORTHERN BUILT BY P.C.W.
6 ROOMETTE - 5 DOUBLE BEDROOM - 2 COMPARTMENT

STEAM HEAT SPECIALTIES (FLOOR HEAT)

Code No.	No. Used Per Car	Part No.	
FH-1	2	428	Strainer Tee
FH-2	2	S-155	Steam Trap Train Line
FH-3	2	S-124	Valve-Shut Off & Drain
FH-4	2	953	Vapor Safe Control Regulator (1) 441-4 Union - 32 V.D.C.
	2	955TT	Drain Tube 10" Lg: with (1) 441-2 Union
	2	955-RR2	Connector Receptacle
FH-5	2	970	Water Seal Fitting with (1) 441-6 Half Union
FH-6	1	RA-1677	Valve-Solenoid - 32 V.D.C.
FH-7	8	LA-1675	Valve-Solenoid - 32 V.D.C.
FH-8	7	RA-1675	Valve-Solenoid - 32 V.D.C.
	16	881-N	Nipple-Inner Feed
	2	18597	Name Plate-For Solenoid Valve
FH-9	1	1698	Remote Control-Flexible Dim "A"= 70" + (5) 1643-D5
FH-10	3	1698	Remote Control-Dim "A"= 83½" + (6) 1643-D5
	3	1698	Remote Control-Dim "A"= 85" + (6) 1643-D5
FH-11	2	1698	Remote Control-Dim "A"= 88" + (6) 1643-D5
FH-12	3	1698	Remote Control-Dim "A"= 90½" + (7) 1643-D5
	2	1698	Remote Control-Dim "A"= 95" + (7) 1643-D5
	16	A-886	Cap-Unit Fin
	4	888	Ell-Unit Fin
FH-13	7	1671-TT-1	Cord & Receptacle Assembly - 1 Ft. Cord
	16	1671-SS	Connector-Complete 18" Long
	14	1643-EE	Remote Control Support
FH-14	9	1671-TT-6	Cord & Receptacle Assembly - 6 Ft. Cord

WASH WATER HEATING

Code No.	No. Used Per Car	Part No.	
WH-1	1	S-124-HW	Valve-Shut Off & Drain-with HW Wheel (21465)
WH-2	1	960	Vapor Regulator with (2) 441-4 Union
	1	960-TT	Drain Tube with (1) 441-2 Union
WH-3	1	525-B	Valve-Water Mixing with Bellows
WH-4	1	588-6	Heater-Wash Water

WATER TANK AND FILLING VALVE PROTECTION

Code No.	No. Used Per Car	Part No.	
WH-5	1	948	Valve-Water Tank Loop Cut Out

ANTI-FREEZE PROTECTION

Code No.	No. Used Per Car	Part No.	
WH-6	1	918	Retarder

THERMO. SPECIALTIES (FLOOR HEAT)

Code No.	No. Used Per Car	Part No.	
FH-15	14	32-RA-2547	Switch Potentiometer - 32 V.D.C.
FH-16	8	32CRPB-2501-80°	Thermostat Comp't. & Rmts. - 32 V.D.C.
FH-17	6	32CWPB-2501-80°	Thermostat Porter & Bdrms. - 32 V.D.C.
FH-18	1	32CWBA-2501-76°	Thermostat Passageway - 32 V.D.C.
FH-19	1	RN-2522-1-65°	Thermostat (Layover) - 32 V.D.C.
FH-20	1	32CWB-2522-1-71°	Thermostat Toilet - 32 V.D.C.

STEAM HEAT SPECIALTIES (OVERHEAD)

Code No.	No. Used Per Car	Part No.	
OH-1	1	S-124-OH	Valve Shut Off & Drain-with OH Wheel (21465)
OH-2	1	958	Vapor Safe Control Regulator (1) 441-4 Union - 32 V.D.C.
	1	B-440TT	Drain Tube with 441 Union
OH-3	1	970	Water Seal Fitting with (1) 441-6 Half Union
OH-4	1	926	Retarder
	2	955-RR2	Connector Receptacle
OH-5	1	N-926	Retarder
OH-6	1	R-1668	Valve-Solenoid - 32 V.D.C.
OH-7	1	OS1643	Remote Control-Flexible Dim "A"= 84" + (6) 1643-D5

* WAUKESHA FUEL CABINET PROTECTION

Code No.	No. Used Per Car	Part No.	
WAUK-1	1	S-155	Steam Trap
WAUK-2	2	S-124	Valve-Shut Off & Drain
WAUK	1	955-RR2	Connector Receptacle
WAUK-3	1	920	Retarder
WAUK-4	1	R-1668	Valve Solenoid

* NOTE: Waukesha fuel cabinet protection piping is not used on axle device equipped cars - consult car name sheet for identification.

THERMO. SPECIALTIES (AIR COND.)

Code No.	No. Used Per Car	Part No.	
	1	9500-2	Mtg. Plate
OH-8	1	DN-2501-76°	Thermostat-OH Heat (in duct) - 32 V.D.C.
OH-9	1	A9600B-76°	Thermostat-Cooling
OH-10	1	A9600B-78°	Thermostat-Cool. Mod. - 32 V.D.C.
	1	MZ-49131-MC	Control Panel Frig. - 32 V.D.C.

CLAMPS & STANDS

Code No.	No. Used Per Car	Part No.	
	6	S-889	Bracket-Complete with 1 Bolt, 1 Cap Screw
	6	S-899-10	Support Stand
	24	P-868	Bracket

RADIATION

No. Used Per Car	Length	Type	Symbol
3	6'-5 1/2"	UNIT	"G"
1	4'-9"	"	"H"
2	4'-7"	"	"F"
4	3'-11 1/8"	"	"B"
1	3'-11 1/8"	"	"K"
2	3'-11"	"	"E"
1	2'-5 1/8"	"	PS1
1	2'-5"	"	"A"
1	19 1/2"	"	"J"
1	16 1/8"	"	PS2
3	12'-0"	"	"C-C"
1	12'-0"	"	"D-D"
1	2'-10 1/2"	"	"N"
1	2'-6 5/8"	"	"L"
1	1'-8 1/4"	"	"M"
1	7 3/8"	"	"O"

TRAIN LINE SPECIALTIES

Code No.	No. Used Per Car	Part No.	
	2	364	Coupler
	2	1117	End Valve
	2	1117XX	End Valve Insulation
	1	of each	Platform Attachments 464-FF - 404-AB
	1	V-464	Platform Attachments 464-FF, 403-V, 405-C 410-D, 404-AB

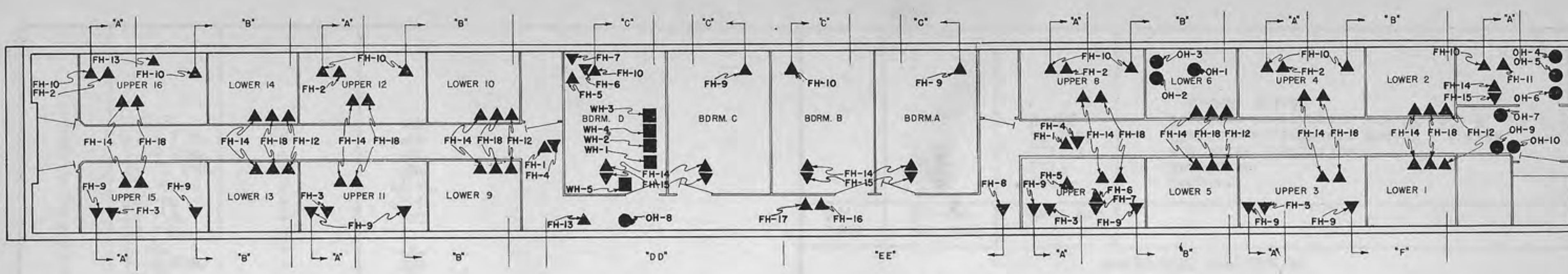


FIGURE 108

CODE

▲ F.H. - Floor Heat

● O.H. - Overhead Heat (Air Conditioning)

■ W.H. - Water Heating

HEATING LAYOUT FOR

GREAT NORTHERN

16 DUPLEX ROOMETTE - 4 BEDROOM

STEAM HEAT SPECIALTIES (FLOOR HEAT)

Code No.	No. Used Per Car	Part No.	
FH-1	2	428	Strainer Tee
FH-2	4	1698	Remote Control - Dim "A"= 44-1/2 + (3) 1643-D5
FH-3	4	1698	Remote Control - Dim "A"= 43-1/2 + (3) 1643-D5
FH-4	2	S-155	Steam Trap Train Line
FH-5	2	S-124	Valve-Shut Off & Drain
FH-6	2	953	Vapor Safe Control Regulator (1) 441-4 Union - 32 V.D.C.
	2	955-TT	Drain Tube 10" Lg: with (1) 441-2 Union
	2	955-RR2	Connector Receptacle
FH-7	2	970	Water Seal Fitting with (1) 441-6 Half Union
FH-8	1	RA-1677	Valve-Solenoid - 32 V.D.C.
FH-9	10	LA-1675	Valve-Solenoid - 32 V.D.C.
FH-10	11	RA-1675	Valve-Solenoid - 32 V.D.C.
	22	881-N	Nipple-Inner Feed
	5	18597	Name Plate-For Solenoid Valve
FH-11	1	1698	Remote Control-Flexible Dim "A"= 53-1/2" +(4) 1643-D5
	9	1643EE	Remote Control Support
FH-12	8	S-1643	Remote Control-Flex. Dim. "A"= 124" + (9) 1643-D5
	8	1643-GG	Remote Control-Clamp
FH-13	2	918	Retarder
	15	886	Cap-Unit Fin
	1	888	Ell-Unit Fin
	1	1671-TT-6	Cord & Recept. Assy. 6 Ft. Cord
	22	1671-SS	Conn. Complete 18" Long
	7	A-886	End Cap
	21	1671-TT-1	Cord & Recpt. Assy. - 1 Ft. Cord

WASH WATER HEATING

Code No.	No. Used Per Car	Part No.	
WH-1	1	S-124-HW	Valve-Shut Off & Drain-with HW Wheel (21465)
WH-2	1	960	Vapor Regulator with (2) 441-4 + (1) 1" Ips. Street Ell
	1	960-TT	Drain Tube with (1) 441-2 Union
WH-3	1	525-B	Valve-Water Mixing with Bellows
WH-4	1	588-6	Heater-Wash Water

WATER TANK AND FILLING VALVE PROTECTION

Code No.	No. Used Per Car	Part No.	
WH-5	1	948	Valve-Water Tank Loop Cut Out

THERMO. SPECIALTIES (FLOOR HEAT)

Code No.	No. Used Per Car	Part No.	
FH-14	21	RA32-2547	Switch Potentiometer - 32 V.D.C.
FH-15	5	32CWPB-2501-80°	Thermostat Bedrooms & Porter Section 32 V.D.C.
FH-16	1	32CWBA-2501-76°	Thermostat Pass'way - 32 V.D.C.
FH-17	1	RN-2522-1-65°	Thermostat Layover - 32 V.D.C.
FH-18	16	32-CRPB-2501-80°	Thermostat Rmts. - 32 V.D.C.

CLAMPS & STANDS

Code No.	No. Used Per Car	Part No.	
	22	S-889	Bracket-Complete with 1 Bolt, 1 Cap Screw
	22	S-899-10	Support Stand
	10	P-868	Bracket

RADIATION

No. Used Per Car	Length	Type	Symbol
1	12'-0"	UNIT	"D-D"
1	11'-5 1/4"	"	"E-E"
4	3'-3"	"	"C"
1	2'-0"	"	"P.S.1."
1	5'-0 3/8"	"	"F"
7	4'-6"	"	"B"
1	2'-8"	"	"G"
8	2'-0"	"	"A"

STEAM HEAT SPECIALTIES (OVERHEAD)

Code No.	No. Used Per Car	Part No.	
OH-1	1	S-124-OH	Valve Shut Off & Drain-with OH Wheel (21465)
OH-2	1	958	Vapor Safe Control Regulator (1) 441-4 32 V.D.C.
	1	B-440-TT	Drain Tube
OH-3	1	970	Water Seal Fitting with (1) 441-6 Half Union
OH-4	1	926	Retarder
	2	955-RR2	Connector Receptacle
OH-5	1	N-926	Retarder
OH-6	1	R-1668	Valve-Solenoid - 32 V.D.C.
OH-7	1	OS1643	Remote Control-Flexible Dim "A"= 60" +(4) 1643-D5

THERMO. SPECIALTIES (AIR COND.)

Code No.	No. Used Per Car	Part No.	
	1	9500-2	Mtg. Plate - 32 V.D.C.
OH-8	1	DN-2501-76°	Thermostat-OH Heat (in duct) - 32 V.D.C.
OH-9	1	A96COB-76°	Thermostat-Cooling - 32 V.D.C.
OH-10	1	A9600B-78°	Thermostat-Fan Cool. Mod. - 32 V.D.C.
	1	MZ-49131-MC	Control Panel Frig. - 32 V.D.C.

TRAIN LINE SPECIALTIES

Code No.	No. Used Per Car	Part No.	
	2	C-1196	Flexible Metallic Conduit with Insulation and 364 Coupler
	2	1117	End Valve
	2	1117XX	End Valve Insulation
	1	of each	Platform Attachments - 464-FF, 404-AB
	1	V-464	Platform Attachments - 464-FF, 403-V, 405-C, 410-D, 404-AB

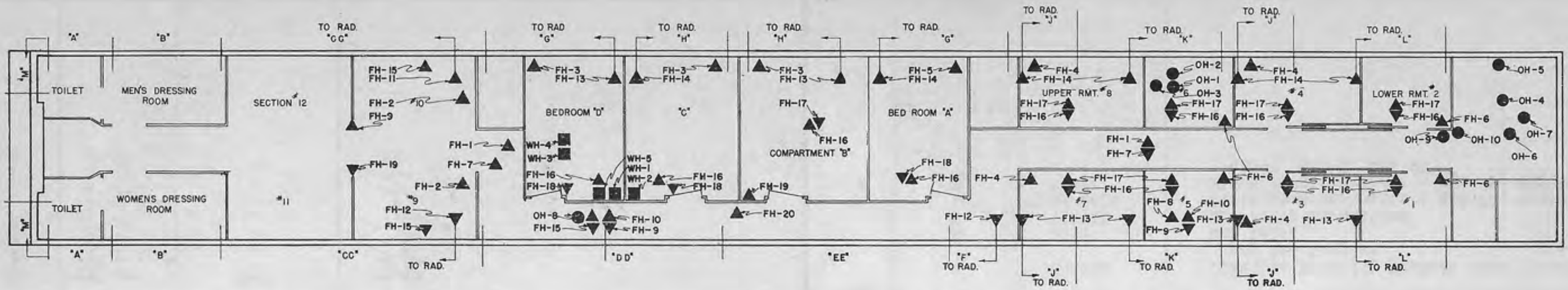


FIGURE 109

CODE

▲ F.H. - Floor Heat

● O.H. - Overhead Heat (Air Conditioning)

■ W.H. - Water Heating

HEATING LAYOUT FOR

GREAT NORTHERN BUILT BY P.C.W.

1 COMPARTMENT - 3 BEDROOM - 7 DUPLEX RMT. -

4 OPEN SECTION - 1 DUPLEX RMT.

STEAM HEAT SPECIALTIES (FLOOR HEAT)

Code No.	No. Used Per Car	Part No.	
FH-1	2	428	Strainer Tee
FH-2	2	1698	Remote Control "A" = 45 1/2" + (3) 1643 D 5
FH-3	1	1698	Remote Control "A" = 88" + (6) 1643 D 5
FH-3	1	1698	Remote Control "A" = 90½" + (7) 1643 D 5
FH-3	1	1698	Remote Control "A" = 95" + (7) 1643 D 5
FH-4	2	1698	Remote Control "A" = 44½" + (3) 1643 D 5
FH-4	2	1698	Remote Control "A" = 43½" + (3) 1643 D 5
FH-5	1	1698	Remote Control "A" = 98½" + (7) 1643 D 5
FH-6	4	S-1643	Remote Control Dim "A" - 124" + (9) 1643 D 5
FH-7	2	S-155	Steam Trap Train Line
FH-8	2	S-124	Valve - Shut Off and Drain
FH-9	2	953	Vapor Safe Control Regulator (1) 441-4 Union 32 V.D.C.
	2	955 TT	Drain Tube 10" lg. with (1) 441-2 Union
	2	955-RR2	Connector Receptacle
FH-10	2	970	Water Seal Fitting with (1) 441-6 Half Union
	8	A-886	End Cap

WASH WATER HEATING

Code No.	No. Used Per Car	Part No.	
WH-1	1	S-124-HW	Valve - Shut off and Drain with HW Wheel (21465)
WH-2	1	960	Vapor Regulator with (2) 441-4 (1) 1" IPS Street Ell
	1	960-TT	Drain Tube with (1) 441-2 Union
WH-3	1	525-B	Valve - Water Mixing with Bellows
WH-4	1	588-6	Heater - Water Water

WATER TANK AND FILLING VALVE PROTECTION

Code No.	No. Used Per Car	Part No.	
WH-5	1	948	Valve - Water Tank Loop Cut Out

STEAM HEAT SPECIALTIES (OVERHEAD)

Code No.	No. Used Per Car		
OH-1	1	S-124-OH	Valve Shut Off & Drain with OH Wheel (21465)
OH-2	1	958	Vapor Safe Control Regulator (1) 441-4 Union 32 V.D.C.
	1	B-440TT	Drain Tube with 441 Union
OH-3	1	970	Water Seal Fitting with (1) 441-6 Half Union

FH-11	1	LA-1677	Valve Solenoid 32 V.D.C.
FH-12	2	RA-1677	Valve Solenoid - 32 V.D.C.
FH-13	6	LA-1675	Valve Solenoid - 32 V.D.C.
FH-14	6	RA-1675	Valve Solenoid - 32 V.D.C.
	15	881-N	Nipple - Inner Feed
	1	18597	Name Plate for Solenoid Valve
	6	1643-GG	Remote Control Support
FH-15	3	918	Retarder
	7	886	Cap - Unit Fin
	9	888	Ell - Unit Fin
	14	1671-TT-1	Cord & Recept. Assy. 1 Ft. Cord
	1	1671-TT-6	Cord & Recept. Assy. 6 Ft. Cord
	15	1671-SS	Conn. Complete 18" long.
	8	1643-EE	Remote Control Support
FH-16	12	32-RA-2547	Switch Potentiometer 32 V.D.C.
FH-17	9	32CRFB-2501-80°	Thermostat Compt. & Rmts. 32 V.D.C.
FH-18	3	32CWPB-2501-80°	Thermostat Bdrms.32 V.D.C.
FH-19	3	32CWBA-2501-76°	Thermostat open Sec. & Pass. 32 V.D.C.
FH-20	1	RN-2522-1-65°	Thermostat Layover 32 V.D.C.

CLAMPS & STANDS

Code No.	No. Used Per Car	Part No.	
	14	S-889	Bracket - Complete with 1 Bolt, 1 Cap Screw.
	14	S-899-10	Support Stand
	19	P-868	Bracket

* WAUKESHA FUEL CABINET PROTECTION

Code No.	No. Used Per Car	Part No.	
WAUK-1	1	S-155	Steam Trap
WAUK-2	2	S-124	Valve - Shut Off and Drain
WAUK	1	955-RR2	Connector Receptacle
WAUK-3	1	920	Retarder
WAUK-4	1	R-1668	Valve Solenoid

* NOTE: Waukesha fuel cabinet protection piping is not used on axle device equipped cars - consult car name sheet for identification.

OH-4	1	N-926	Retarder
	2	955-RR2	Connector Receptacle
OH-5	1	926	Retarder
OH-6	1	R-1668	Valve Solenoid - 32 V.D.C.
OH-7	1	OS1643	Remote Control - Flexible Dim. "A" = 60" + (4) 1643-D5

THERMO. SPECIALTIES (AIR COND.)

Code No.	No. Used Per Car	Part No.	
	1	9500-2	Mtg. Plate
OH-8	1	DN-2501-76°	O.H. Heat in Duct - 32 V.D.C.
OH-9	1	A9600E-76°	Thermostat Cooling - 32 V.D.C.
OH-10	1	A960CB-78°	Thermostat Cool. Mod. - 32 V.D.C.
	1	MZ-49131-MC	Control Panel Frig. - 32 V.D.C.

TRAIN LINE SPECIALTIES

Code No.	No. Used Per Car	Part No.	
	2	364	Coupler
	2	1117	End Valve
	2	1117 XX	End Valve Insulation
	1	of each	Platform Attachments 464-FF, 404-AB
	1	V-464	Platform Attachments 464-FF, 403-V, 405-C, 410-D, 404-AB.

RADIATION

No. Used Per Car	Length	Type UNIT	Symbol
2	6'-5½"		"G"
2	6'-7"	"	"B"
2	5'-0 1/4	"	"L"
2	4'-7"	"	"H"
2	4'-6"	"	"K"
2	3'-2 3/4"	"	"A"
1	23 1/4"	"	"O"
1	2'-2"	"	"N"
2	2'-01/4"	"	"M"
4	2'-0"	"	"J"
2	12'-0"	"	O-O
1	12'-0"	"	D-D
1	12'-0"	"	E-E
1	2'-1½"	"	"F"
2	2'-6 5/8"	"	"P"
1	2'-6 1/4"	"	"R"
1	19"	"	"S"
1	2'-1 3/4"	"	"T"

No. 953 VAPOR REGULATOR ASSEMBLY

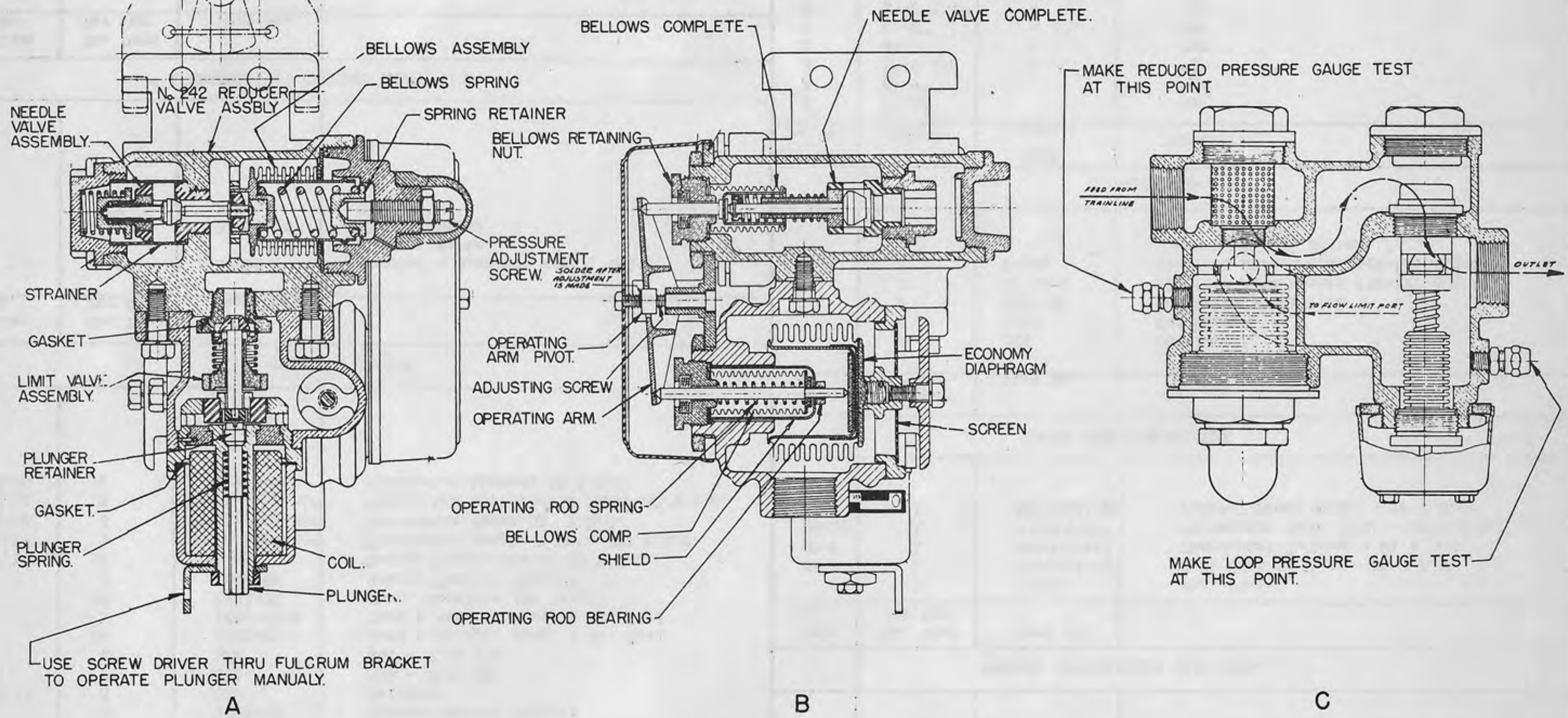
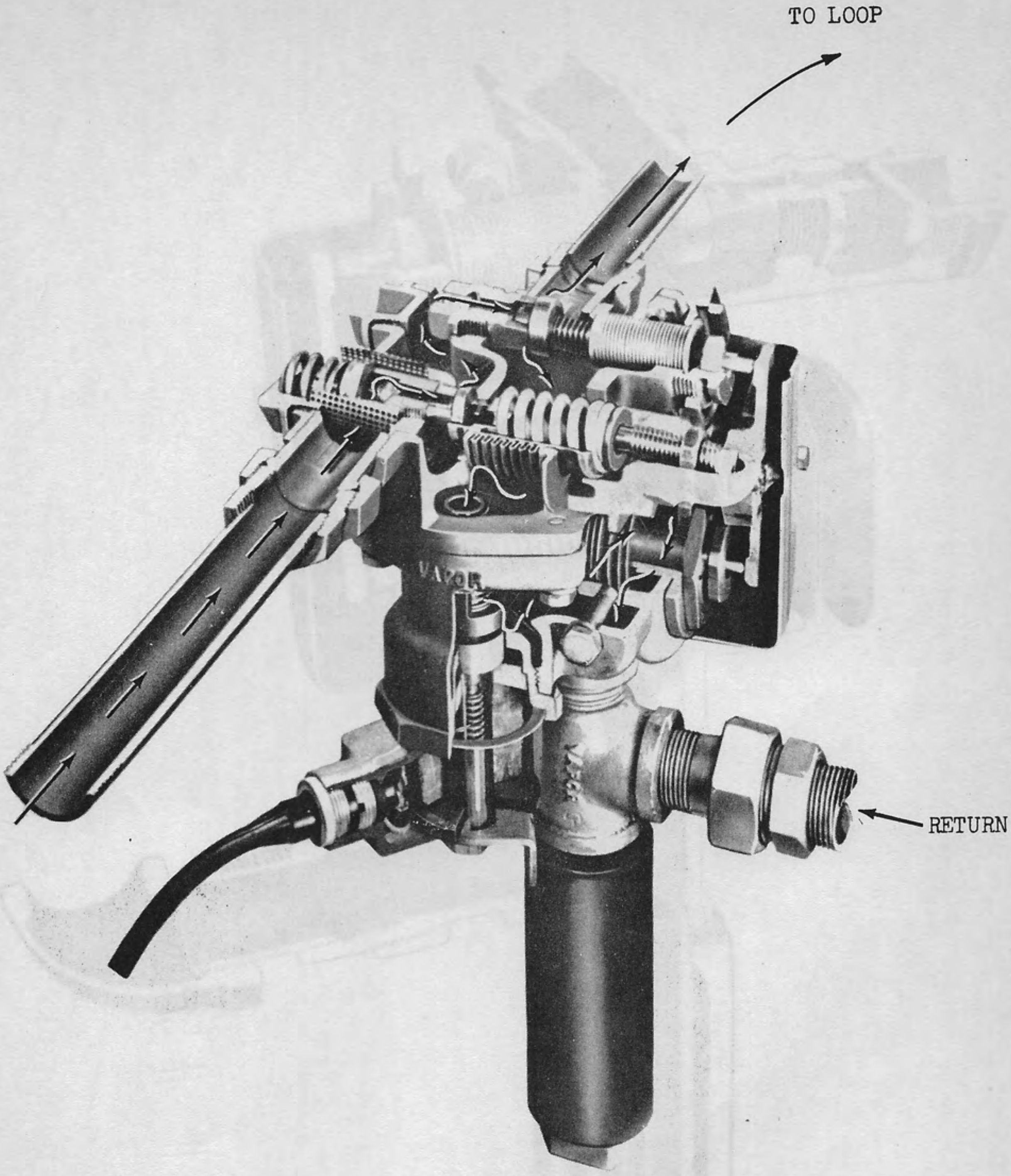
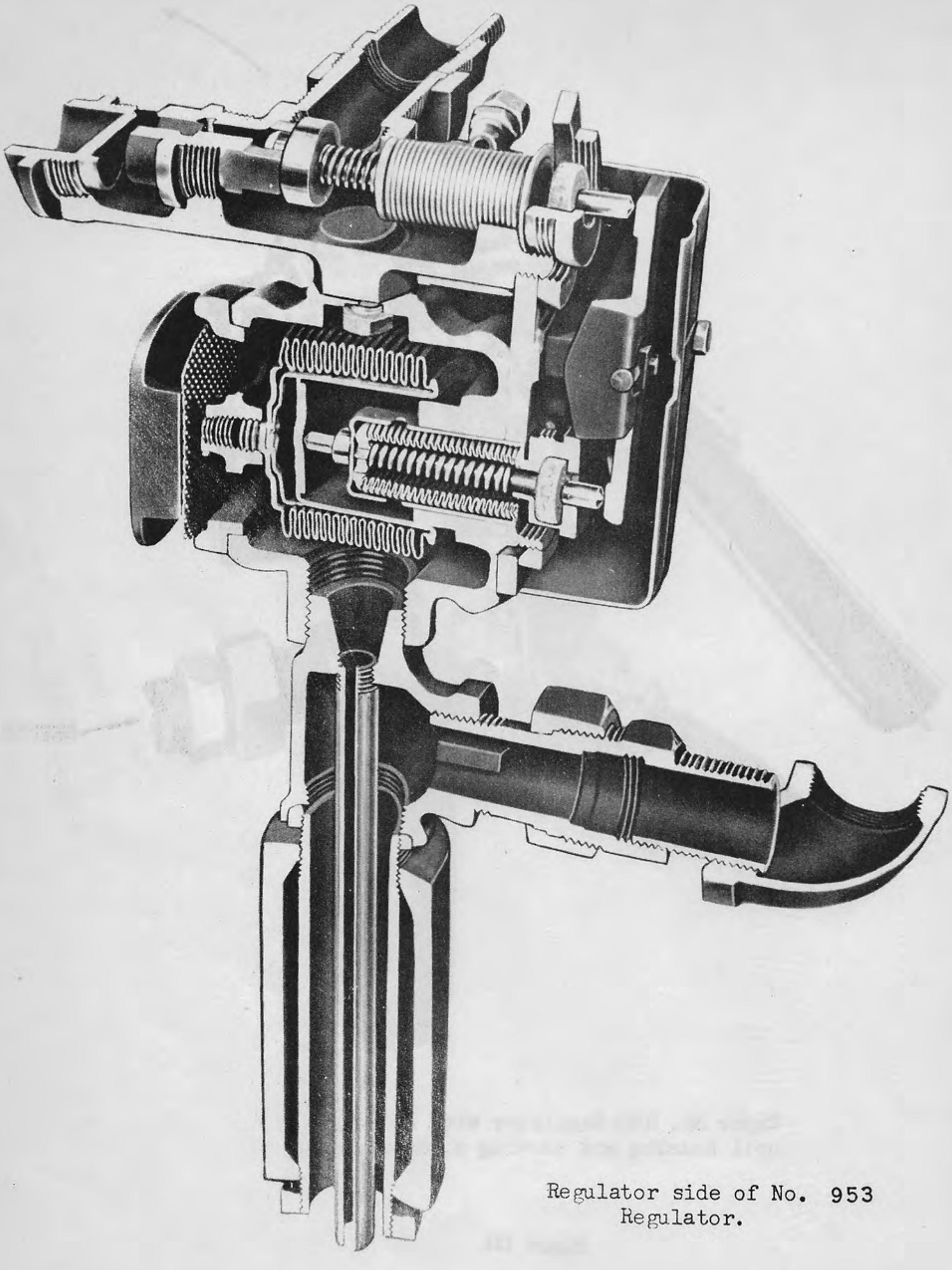


Figure 110



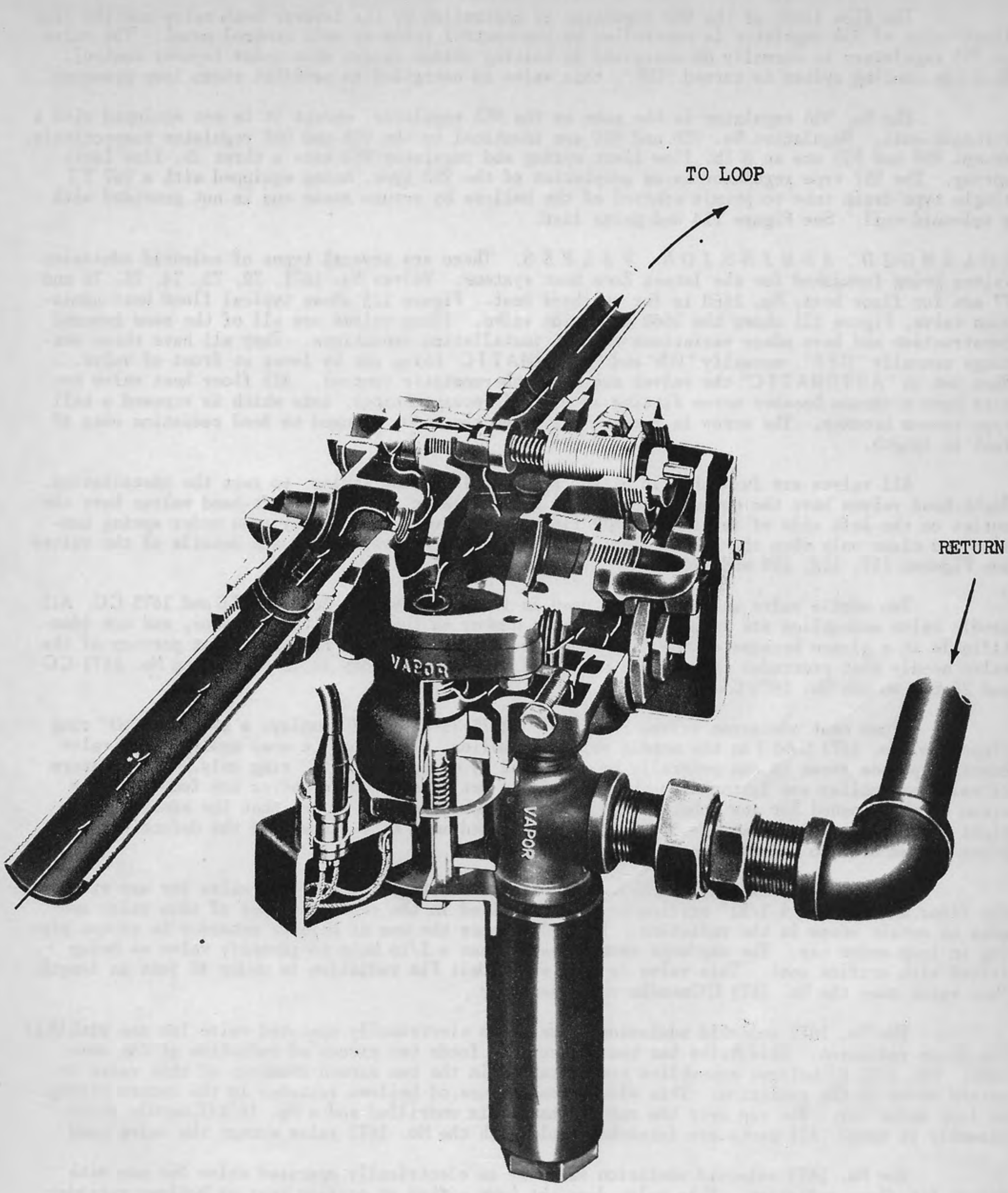
Vapor No. 953 Regulator with Old Style
coil housing and showing steam circuit.

Figure 111



Regulator side of No. 953
Regulator.

Figure 112



Vapor No. 953 Regulator with New Style
coil housing and showing steam circuit.

Figure 113

The flow limit of the 953 regulator is controlled by the layover heat relay and the flow limit valve of 958 regulator is controlled by the control relay on main control panel. The valve on 953 regulators is normally de-energized in heating season except when under layover control. When the cooling system is turned "ON", this valve is energized to prohibit steam loop pressure.

The No. 956 regulator is the same as the 953 regulator, except it is not equipped with a solenoid coil. Regulators No. 958 and 959 are identical to the 953 and 956 regulator respectively, except 958 and 959 use an 8 lb. flow limit spring and regulator 953 uses a three lb. flow limit spring. The 957 type regulator is an adaptation of the 953 type, being equipped with a 957 TT single type drain tube to permit control of the bellows by return steam and is not provided with a solenoid coil. See Figure 114 and parts list.

SOLENOID ADMISSION VALVES: There are several types of solenoid admission valves being furnished for the latest Zone heat systems. Valves No. 1671, 72, 73, 74, 75, 76 and 77 are for floor heat; No. 1668 is for overhead heat. Figure 115 shows typical floor heat admission valve, Figure 121 shows the 1668 admission valve. These valves are all of the same general construction and have minor variations to suit installation conditions. They all have three settings manually "OFF", manually "ON" and "AUTOMATIC" being set by lever at front of valve. When set on "AUTOMATIC" the valves are under thermostatic control. All floor heat valve bodies have a vacuum breaker screw fitting in rear of return chamber, into which is screwed a ball type vacuum breaker. The screw is removed only when the valve is used to feed radiation over 40 feet in length.

All valves are furnished in either right or left-hand styles, to suit the installation. Right-hand valves have the outlet on the right side of lever arm, while left-hand valves have the outlet on the left side of lever arm. All floor heat valves are normally open under spring tension and close only when the solenoid coil is energized. For variations and details of the valves see Figures 117, 118, 119 and 120.

Two needle valve assemblies are used in floor heat valves No. 1671-CC and 1675 CC. All needle valve assemblies are marked with the part number on the rim of the actuator, and are identifiable at a glance because of the difference in the size of valve needles. That portion of the valve needle that protrudes through the bottom of needle valve body is 35-64" on the No. 1671-CC and 26-64" on the No. 1675 CC.

Floor heat admission valves 1671-72-73-74-75-76-77 and 79 employe a synthetic "O" ring (Vapor Co. No. 1671 CA-1) in the needle valve assemblies. This forms a seal and when the valve assembly passes steam it can generally be corrected by changing the "O" ring only. The armature of valve assemblies are fastened to the stem with a set screw. Where valves are found passing steam or when opened for any other reason, a check should be made to see that the armature is tight on the stem. Any that are found loose or shifted must be replaced and the defective assemblies turned over to the storekeeper for handling.

The No. 1671 solenoid admission valve is an electrically operated valve for use with Unit fin floor radiation. A 3/32" orifice seat is installed in the return chamber of this valve and acts to retain steam in the radiation. This eliminates the use of bellows retarder in return piping to loop under car. The cap over return chamber has a 3/16 hole to identify valve as being fitted with orifice seat. This valve is used where Unit Fin radiation is under 40 feet in length. This valve uses the No. 1671 CC needle valve assembly.

The No. 1672 solenoid admission valve is an electrically operated valve for use with Unit Fin floor radiation. This valve has two outlets and feeds two pieces of radiation at the same time. No. 1671 EE bellows assemblies are installed in the two return chambers of this valve to retain steam in the radiation. This eliminates the use of bellows retarder in the return piping to loop under car. The cap over the return chamber is undrilled and a No. 1671 CC needle valve assembly is used. All parts are interchangeable with the No. 1671 valve except the valve body.

The No. 1673 solenoid admission valve is an electrically operated valve for use with Vulcan Fin floor radiation. This valve does not have either an orifice seat or bellows retarder; therefore, a retarder must be installed in the return piping to the loop under car. The cap over the return chamber has a 1/2" hole to indicate valve is not equipped with retarder or orifice seat. A No. 1671 CC needle valve assembly is used and all parts are interchangeable with the No. 1671 valve except the cap over return chamber.

The No. 1674 solenoid admission valve is an electrically operated valve for use with Unit Fin floor radiation. This valve has two outlets and feeds two pieces of radiation at the same time. Orifice seats are installed in the two return chambers of this valve to retain steam in the radiation. This eliminates the use of bellows retarder in return piping to loop under car. The cap over return chamber has a 3/16" hole to identify the valve as being fitted with orifice seat. All parts of this valve are interchangeable with the No 1671 except the body. This valve uses the No. 1671 CC needle valve assembly.

The No. 1675 solenoid admission valve is an electrically operated valve for use with Unit Fin floor radiation. A No. 1671 EE bellows assembly is installed in the return chamber of this valve and acts to retain steam in the radiation. This eliminates the use of a bellows retarder in the return piping to the loop under car. This valve is used where less radiation is needed and a No. 1675 CC needle valve assembly is used. The cap over the return chamber is undrilled and all parts except the needle valve assembly and the cap over the return chamber are interchangeable with the No. 1671 valve.

The No. 1676 solenoid admission valve is an electrically operated valve for use with Vulcan Fin floor radiation. This valve has two outlets and feeds two pieces of radiation at the same time. This valve does not have either an orifice seat or a bellows retarder in lines to the loop under car. A No. 1671 CC needle valve assembly is used and parts are interchangeable with No. 1672 valve.

The No. 1677 solenoid admission valve is an electrically operated valve for use with Unit Fin floor radiation. A No. 1671 EE bellows assembly is installed in the return chamber of this valve and acts to retain steam in the radiation. This eliminates the use of a bellows retarder in the return piping to the loop under the car. The cap over the return chamber is undrilled and a No. 1671 CC needle valve assembly is used. Parts are interchangeable with the No. 1671 valve.

The No. 1668 solenoid steam admission valve is an electrically operated valve for use with overhead heat. It is similar to the floor heat valves, but this valve has no return chamber, as the steam feeds through valve to radiator and outlet of radiator is connected direct to return piping under car. This valve is normally closed under spring tension and the needle valve assembly is different from those on floor heat valves. The solenoid coil is not interchangeable. The valve is mounted at overhead radiator and an OS-1643 manual remote control cable is used for hand operation.

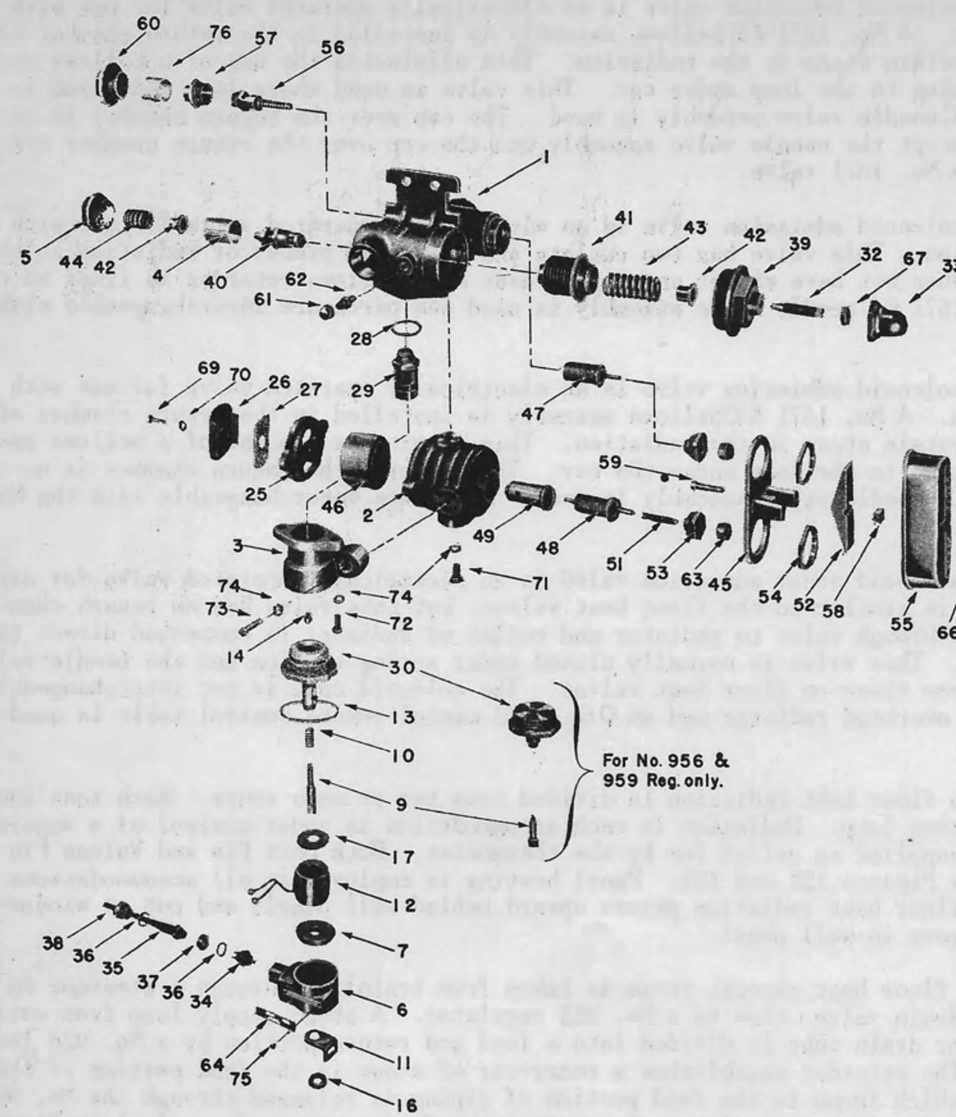
RADIATION: The floor heat radiation is divided into two or more zones. Each zone loop feeds the radiation in that loop. Radiation in each accommodation is under control of a separate thermostat and heat is supplied as called for by the thermostat. Both Unit Fin and Vulcan Fin radiation are used. See Figures 122 and 123. Panel heating is employed in all accommodations that is, air warmed by floor heat radiation passes upward behind wall panels and out at window capping and through louvers in wall panel.

In the common floor heat circuit steam is taken from trainline through a strainer to a No. S-124 shut-off and drain valve, then to a No. 953 regulator. A steam supply loop from outlet of regulator to regulator drain tube is divided into a feed and return portion by a No. 926 loop retarder, Figure 127. The retarder establishes a reservoir of steam in the feed portion of the loop. The condensate, which forms in the feed portion of piping is released through the No. 926 retarder into the return portion of the loop. Steam from the feed portion of supply loop flows through a No. 970 water seal fitting to solenoid admission valves. Steam feeds from this valve into a radiator condensate which forms in outer tube of radiator returns through a valve body outlet in return portion of loop, then to No. 955 TT drain tube on regulator. One or more valves may be operated on each supply loop and the steam circuit will be the same for each one. Figure 124 shows this circuit.

When the steam pressure within the supply loop reaches three lbs. the flow limit valve in the regulator opens and steam is admitted into regulator bellows chamber: bellows expands shutting off steam supply. Condensate in bellows chamber drains through inner portion of drain tube.

The overhead heating system heats the fresh and re-circulated air according to temperature demands. The overhead radiator is mounted in back of evaporator as part of the A.C. unit. Steam for this radiator is supplied in a manner similar to floor heat, except that an N-926 retarder is used in the return to the loop from the radiator. A typical overhead circuit is shown in Figure 125.

The No. 970 water seal is a fitting which serves to keep the steam admission valve from being heated while all valves are in the "OFF" position. Steam from feed portion of the regulator flows through the water seal fitting to inlet side of admission valves, when any valve in the loop is opened. Figure 126.



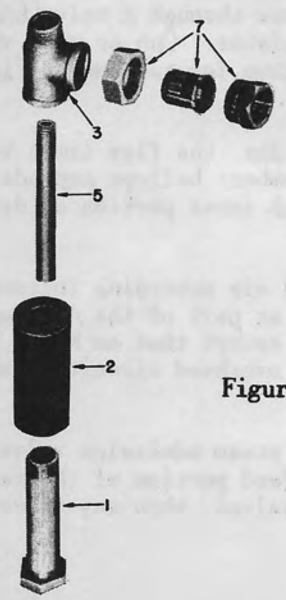


Figure 114

LIST OF PARTS
NO. 955-TT DRAIN TUBE

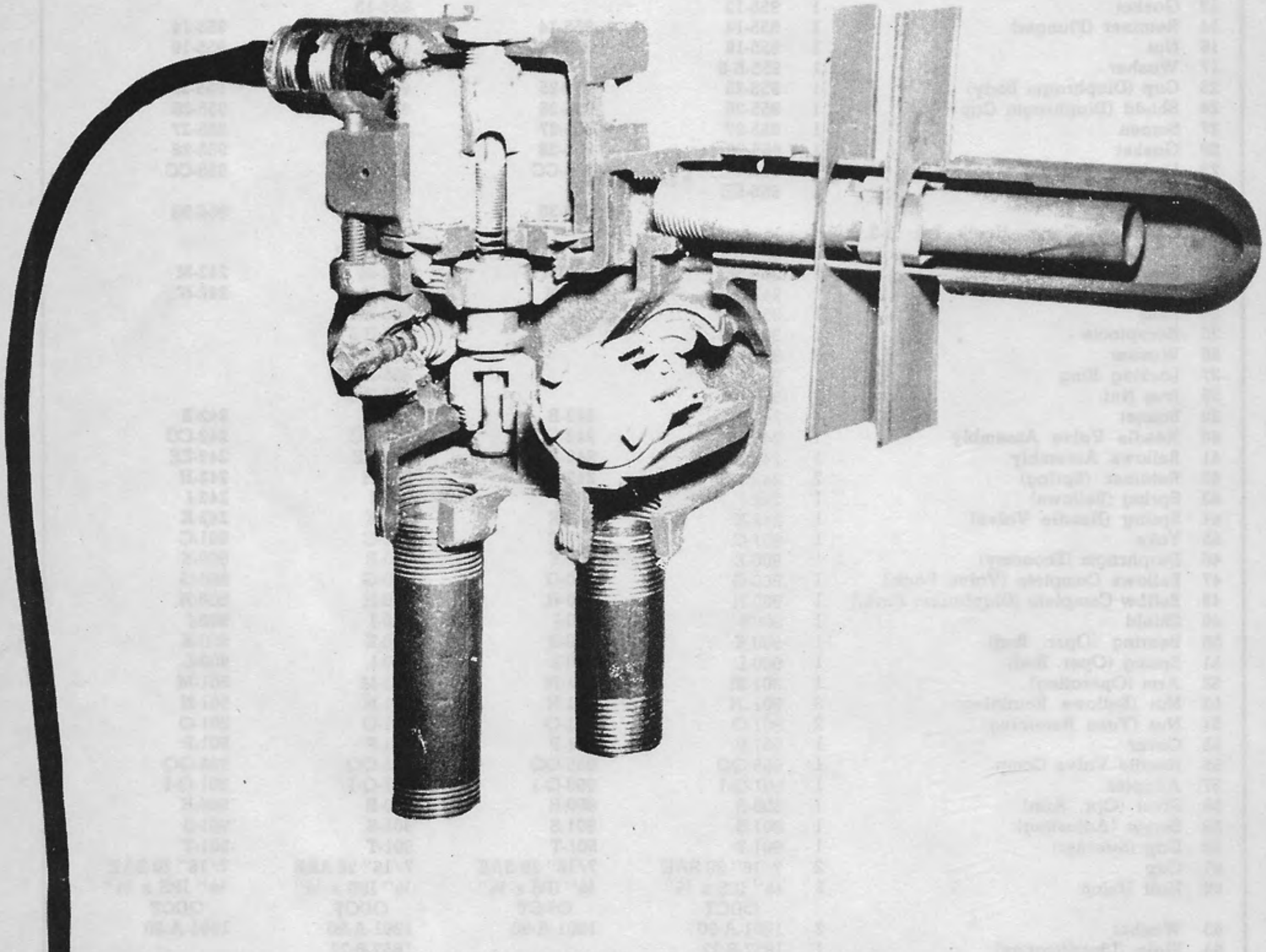
Sym.	Part No.	Description	Amt.
1	B-440-T-1	Tube	1
2	B-440-T-2	Jacket	1
3	955-TA-3	Tee	1
5	955-TA-5	Inner Tube	1
7	441-2	Union Complete	1

LIST OF PARTS
NO. B-440-TT DRAIN TUBE

Sym.	Part No.	Description	Amt.
1	B-440-T-1	Tube	1
2	B-440-T-2	Jacket	1

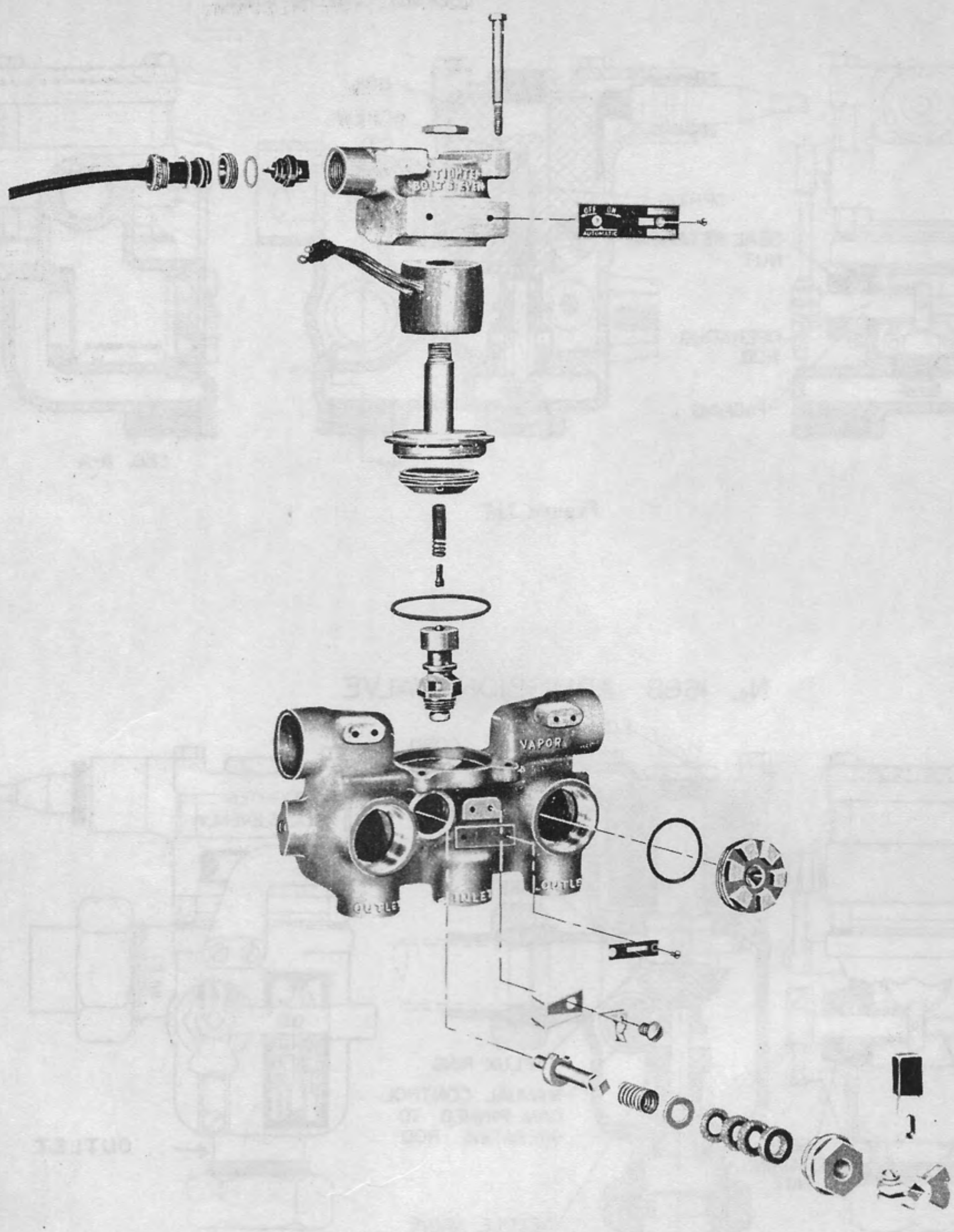
VAPOR SAFE-CONTROL REGULATOR PARTS LIST

Sym.	Description	Amt.	Part No. 955	953	956	958	959
1	Body	1	955-1		955-1	955-1	955-1
2	Housing (Diaphragm)	1	955-2		955-2	955-2	955-2
3	Body (Safe-Control Valve)	1	955-3		955-3	955-3	955-3
4	Strainer	1	955-4		955-4	955-4	955-4
5	Cap (Bottom)	1	955-5		955-5	955-5	955-5
6	Housing (Solenoid)	1	955-6			955-6	
7	Washer	1	955-7				
9	Plunger	1	955-9		956-29	955-9	956-29
10	Spring (Plunger)	1	955-10		955-10	955-10	955-10
11	Bracket (Relief Valve Operating)	1	955-11		955-11	955-11	955-11
12	Coil	1	955-B-2			955-B-2	
13	Gasket	1	955-13			955-13	
14	Retainer (Plunger)	1	955-14		955-14	955-14	955-14
16	Nut	1	955-16		955-16	955-16	955-16
17	Washer	1	955-R-8				
25	Cap (Diaphragm Body)	1	955-25		955-25	955-25	955-25
26	Shield (Diaphragm Cap)	1	955-26		955-26	955-26	955-26
27	Screen	1	955-27		955-27	955-27	955-27
28	Gasket	1	955-28		955-28	955-28	955-28
29	Limiting Valve Assembly	1	955-CC	953 CC	955-CC	958-CC	958-CC
30	Adapter Assembly	1	955-EE			955-EE	
30	Cap	1			956-30		956-30
31	Connector Comp. (Incl's R-2, R-3, and R-5)	1	955-RR-2			955-RR-2	
32	Screw	1	242-M		242-M	242-M	242-M
33	Cap	1	242-N		242-N	242-N	242-N
34	Plug	1	955-R-1			955-R-1	
35	Receptacle	1	955-R-2			955-R-2	
36	Washer	2	955-R-3			955-R-3	
37	Locking Ring	1	955-R-4			955-R-4	
38	Jam Nut	1	955-R-5			955-R-5	
39	Bonnet	1	242-B		242-B	242-B	242-B
40	Needle Valve Assembly	1	242-CC		242-CC	242-CC	242-CC
41	Bellows Assembly	1	242-EE		242-EE	242-EE	242-EE
42	Retainer (Spring)	2	242-H		242-H	242-H	242-H
43	Spring (Bellows)	1	242-J		242-J	242-J	242-J
44	Spring (Needle Valve)	1	242-K		242-K	242-K	242-K
45	Yoke	1	901-C		901-C	901-C	901-C
46	Diaphragm (Economy)	1	900-E		900-E	900-E	900-E
47	Bellows Complete (Valve Pack.)	1	900-G		900-G	900-G	900-G
48	Bellōw Complete (Diaphragm Pack.)	1	900-H		900-H	900-H	900-H
49	Shield	1	900-J		900-J	900-J	900-J
50	Bearing (Oper. Rod)	1	900-K		900-K	900-K	900-K
51	Spring (Oper. Rod)	1	900-L		900-L	900-L	900-L
52	Arm (Operating)	1	901-M		901-M	901-M	901-M
53	Nut (Bellows Retaining)	2	901-N		901-N	901-N	901-N
54	Nut (Yoke Retaining)	2	901-O		901-O	901-O	901-O
55	Cover	1	901-P		901-P	901-P	901-P
56	Needle Valve Comp.	1	955-QQ		955-QQ	955-QQ	955-QQ
57	Adapter	1	901-Q-1		900-Q-1	901-Q-1	901-Q-1
58	Pivot (Opr. Arm)	1	900-R		900-R	900-R	900-R
59	Screw (Adjusting)	1	901-S		901-S	901-S	901-S
60	Cap (Strainer)	1	901-T		901-T	901-T	901-T
61	Cap	2	7/16" 20 SAE		7/16" 20 SAE	7/16" 20 SAE	7/16" 20 SAE
62	Half Union	2	⅛" IPS x ¼" ODCT		⅛" IPS x ¼" ODCT	⅛" IPS x ¼" ODCT	⅛" IPS x ¼" ODCT
63	Washer	2	1901-A-90		1901-A-90	1901-A-90	1901-A-90
64	Plate (Identification)	1	1657-B-22			1657-B-22	
65	Union Complete (Not Furnished with Reg.)	1	441-4		441-4	441-4	441-4
66	Cap Screw (Hex. Hd.)	2	¼" 20 x ½" LG		¼" 20 x ½" LG	¼" 20 x ½" LG	¼" 20 x ½" LG
67	Locknut	1	244-17		244-17	244-17	244-17
68	Union Complete (Not Furnished with Reg.)	1	441-3		441-3	441-3	441-3
69	Cap Screw (Hex. Hd.)	1	5/16" 18 x ¾" LG		5/16" 18 x ¾" LG	5/16" 18 x ¾" LG	5/16" 18 x ¾" LG
70	Lockwasher (St'd)	1	5/16" Split Type		5/16" Split Type	5/16" Split Type	5/16" Split Type
71	Cap Screw (Hex. Hd.)	3	⅜"-16 x ¾" LG		⅜"-16 x ¾" LG	⅜"-16 x ¾" LG	⅜"-16 x ¾" LG
72	Cap Screw (Hex. Hd.)	2	⅜"-16 x 1" LG		⅜"-16 x 1" LG	⅜"-16 x 1" LG	⅜"-16 x 1" LG
73	Cap Screw (Hex. Hd.)	1	⅜"-16 x 1½" LG		⅜"-16 x 1½" LG	⅜"-16 x 1½" LG	⅜"-16 x 1½" LG
74	Lockwasher (St'd)	6	⅜" Split Type		⅜" Split Type	⅜" Split Type	⅜" Split Type
75	Screw (Rd. Hd. Mach.)	2	#6-32 x 3/16" LG			#6-32 x 3/16" LG	
76	Strainer	1	955-76		955-76	955-76	955-76
77	Solenoid and Adapter Assembly, Inc. Sym. 9, -10, -11, -13, -14, -16, -30, -78	1	955-BB			955-BB	
78	Solenoid Housing Assembly Inc. Sym. 6, -7, -12, -17, -34, -36, -37, -64, -75	1	955-BB-1			955-BB-1	



Typical Floor Heat Admission Valve.

Figure 115



1674 Admission Valve

Figure 116

No. 1673 ADMISSION VALVE

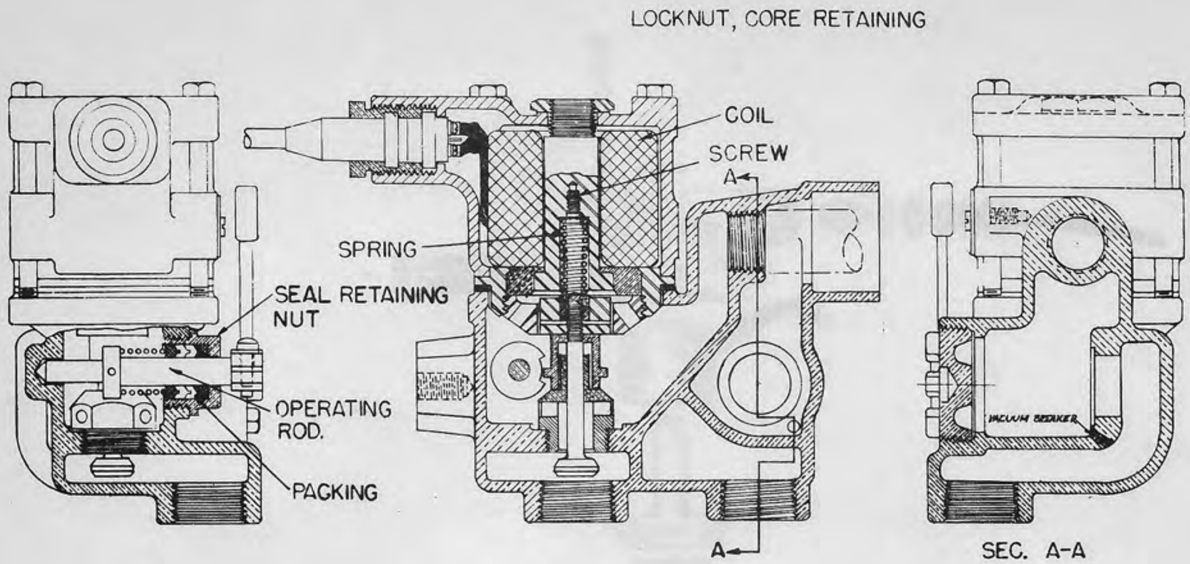


Figure 117

No. 1668 ADMISSION VALVE

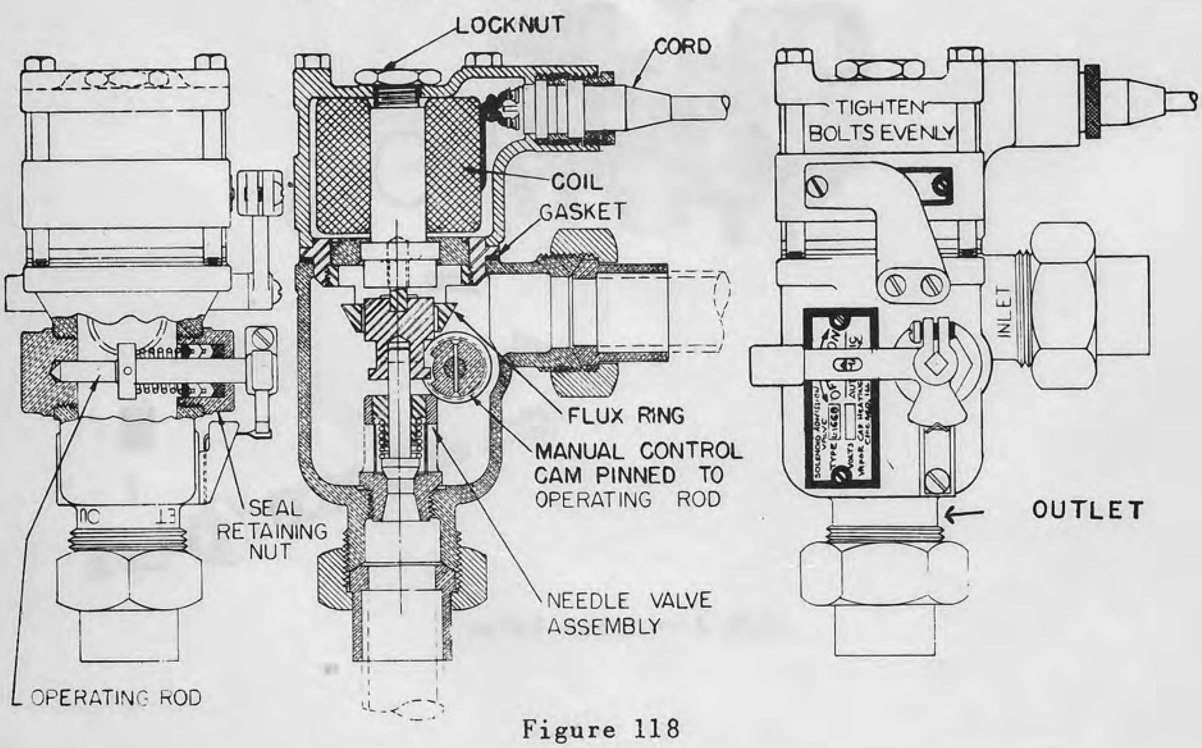


Figure 118

No. 1671 SOLENOID STEAM ADMISSION VALVE

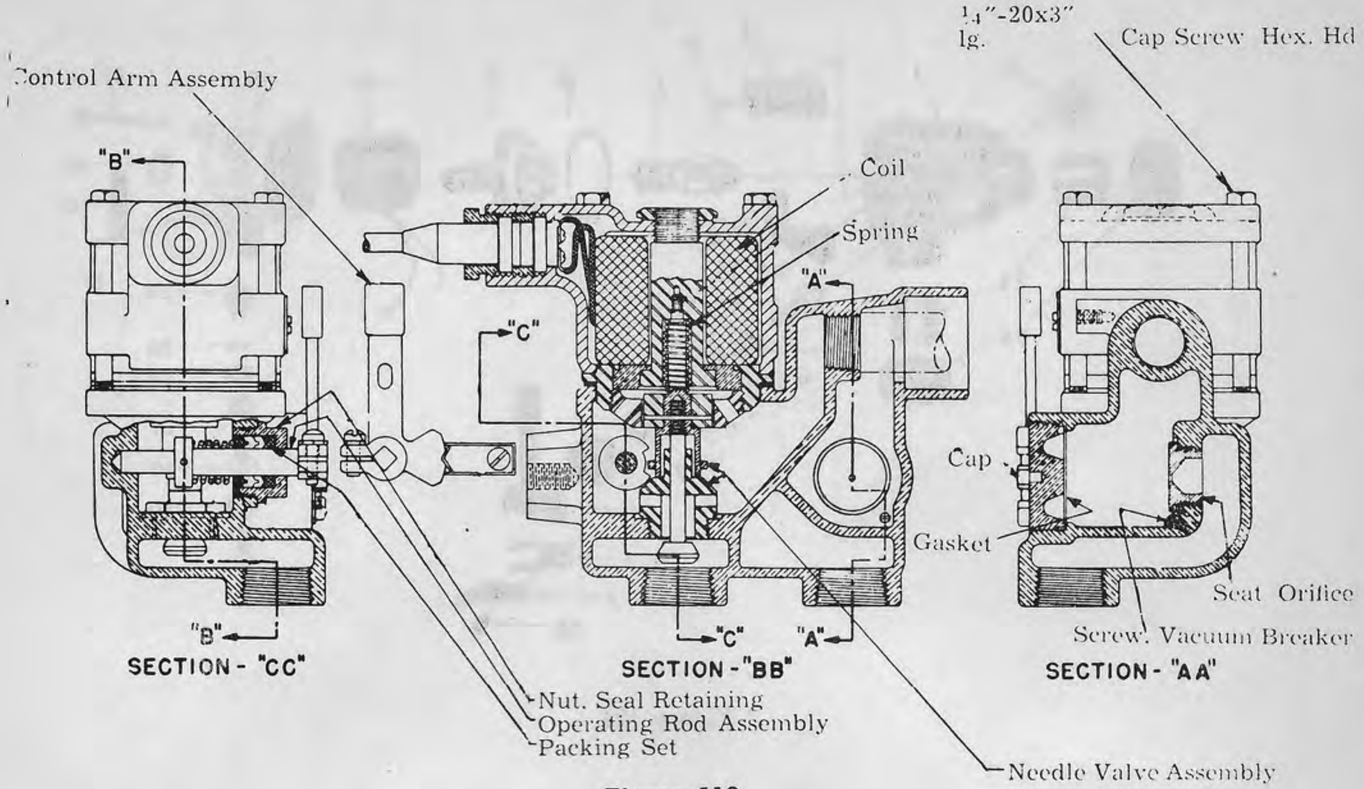


Figure 119

No. 1672 SOLENOID STEAM ADMISSION VALVE

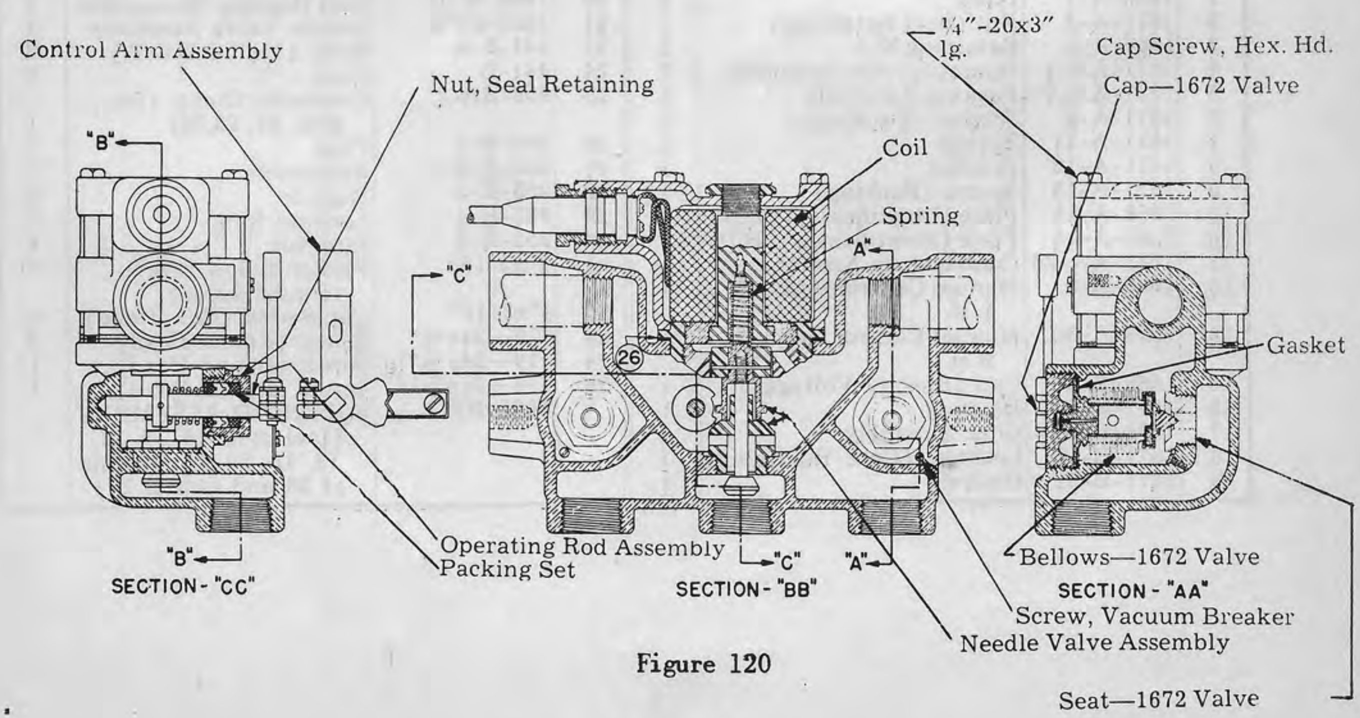


Figure 120

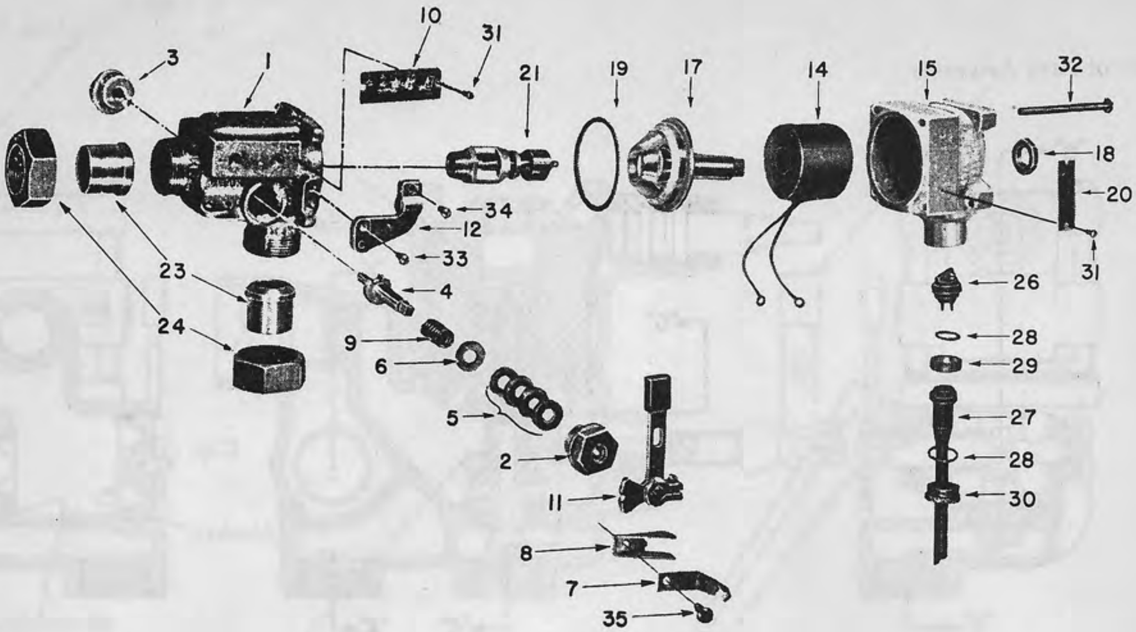


Figure 121

LIST OF PARTS

Sym.	Part No.	Description	Amt.	Sym.	Part No.	Description	Amt.
1	1668-A-1	Body	1	20	1668-B-22	Coil Housing Nameplate	1
2	1671-A-2	Nut (Seal Retaining)	1	21	1668-CCB	Needle Valve Assembly	1
3	1668-A-3	Retaining Nut	1	23	441-3-A	Body (1⅛" O.D.C.T.)	2
4	1671-AA-4	Operating Arm Assembly	1	24	441-B	Ring	2
5	1671-AA-7	Packing Assembly	1	25	955-RR-2	Connector Comp. (Incl. sym. 27, 28,30)	1
6	1671-A-8	Washer (Packing)	1				
7	1671-A-11	Spring	1	26	955-R-1	Plug	1
8	1671-A-12	Bracket	1	27	955-R-2	Receptacle	1
9	1671-A-13	Spring (Packing)	1	28	955-R-3	Washer	2
10	1668-A-15	Plate (Identification) L.H.	1	29	955-R-4	Locking Ring	1
10	1668-A-14	Plate (Identification) R.H.	1	30	955-R-5	Jam Nut	1
11	1671-AA-23	Control Arm Assembly	1	31	4"x3/16"	Parker Kalon Screw (Binder Head)	4
12	1668-A-31	Manual Control Bracket L.H.	1	32	4"x3/16"	Cap Screw (Hex. Head)	4
12	1668-A-30	Manual Control Bracket R.H.	1	33	#10—24x½"	Screw (Round Head)	2
				34	#10—24x⅜"lg.	Screw (Round Head)	1
14	1668-B-2	Coil (Specify Voltage)	1	35	#10—24x5/16"	Screw (Round Head)	1
15	1671-B-3	Housing	1		1668-BB-1	SOLENOID ASSEMBLY (Incl. sym. 14, 15, 17, 18, 19, 20, 26, 29, one of 28 and two of 31)	
17	1668-BB-15	Core Assembly	1				
18	1671-B-18	Locknut (Core Retaining)	1				
19	1671-B-21	Gasket	1				

VAPOR UNIT FIN RADIATION

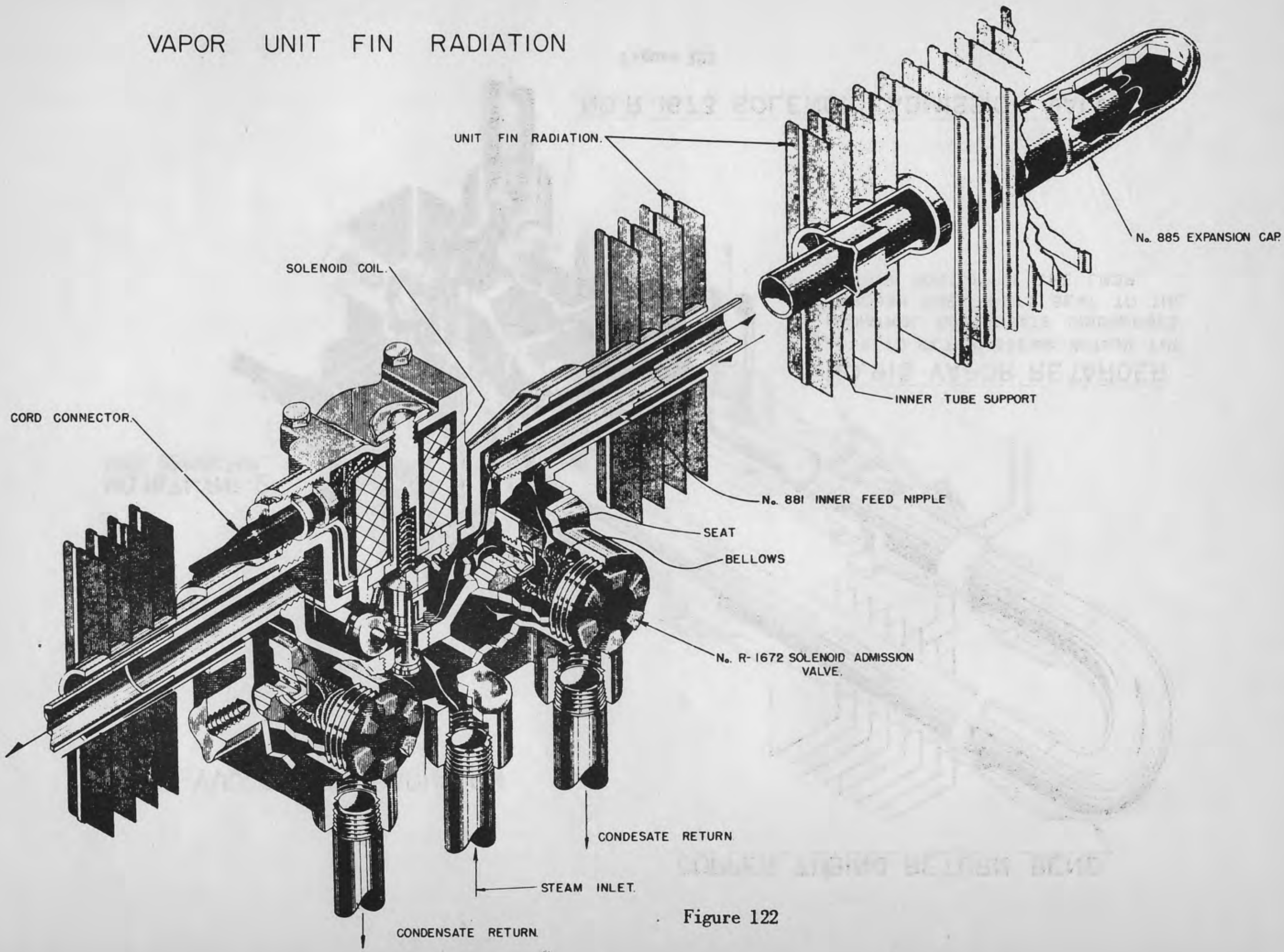


Figure 122

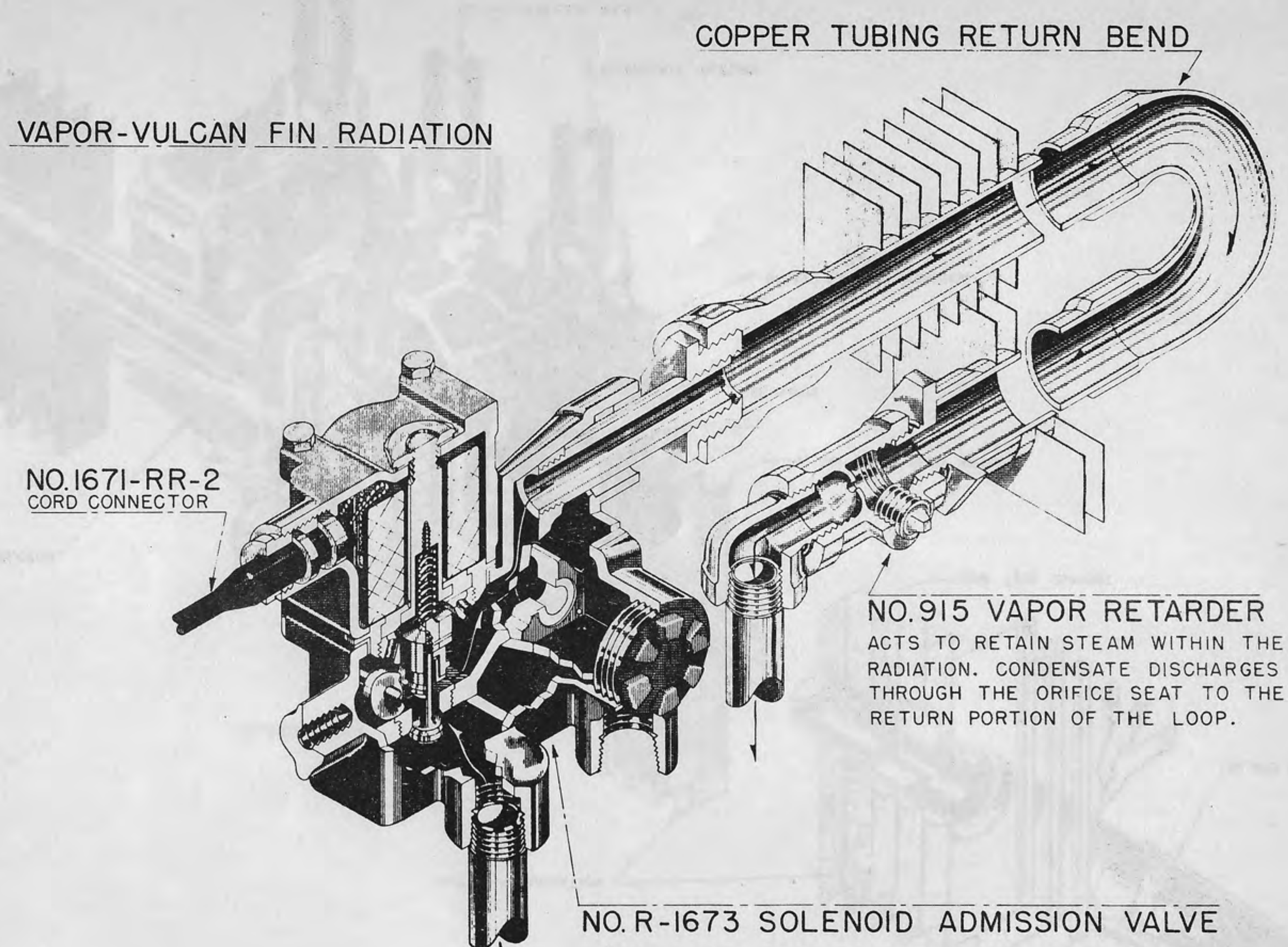

VAPOR-VULCAN FIN RADIATION
COPPER TUBING RETURN BEND
NO.1671-RR-2
CORD CONNECTOR
NO.915 VAPOR RETARDER
ACTS TO RETAIN STEAM WITHIN THE RADIATION. CONDENSATE DISCHARGES THROUGH THE ORIFICE SEAT TO THE RETURN PORTION OF THE LOOP.
NO. R-1673 SOLENOID ADMISSION VALVE

Figure 123

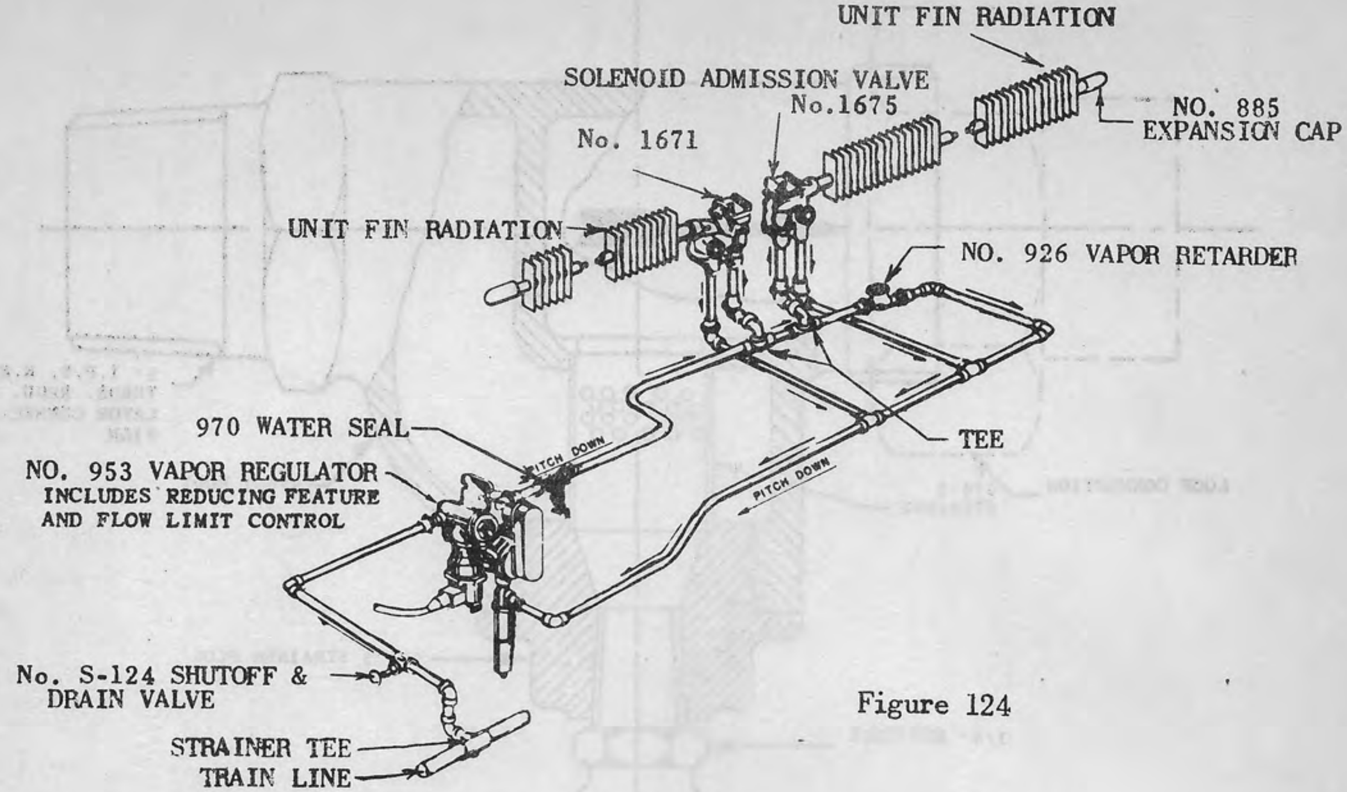


Figure 124

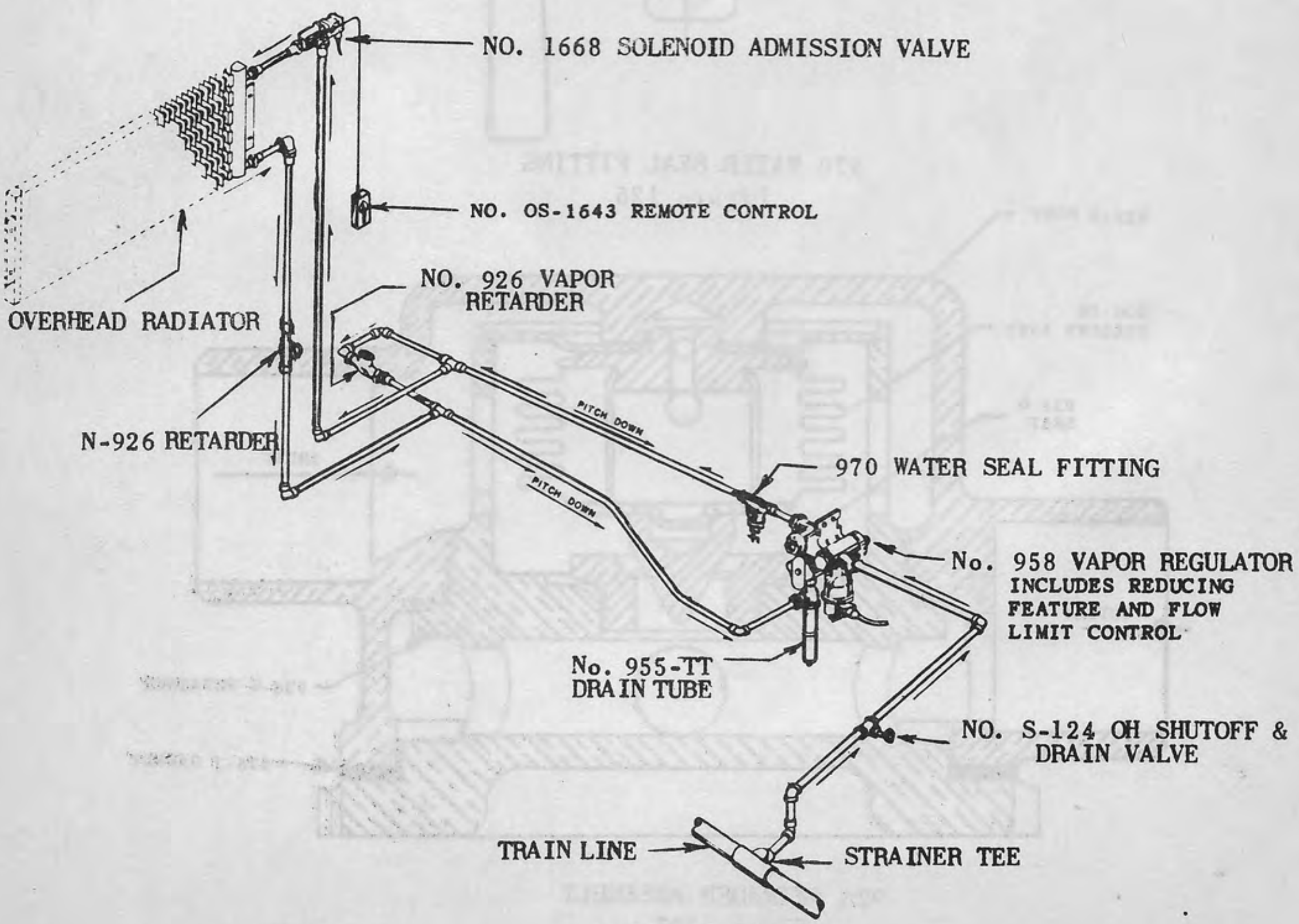
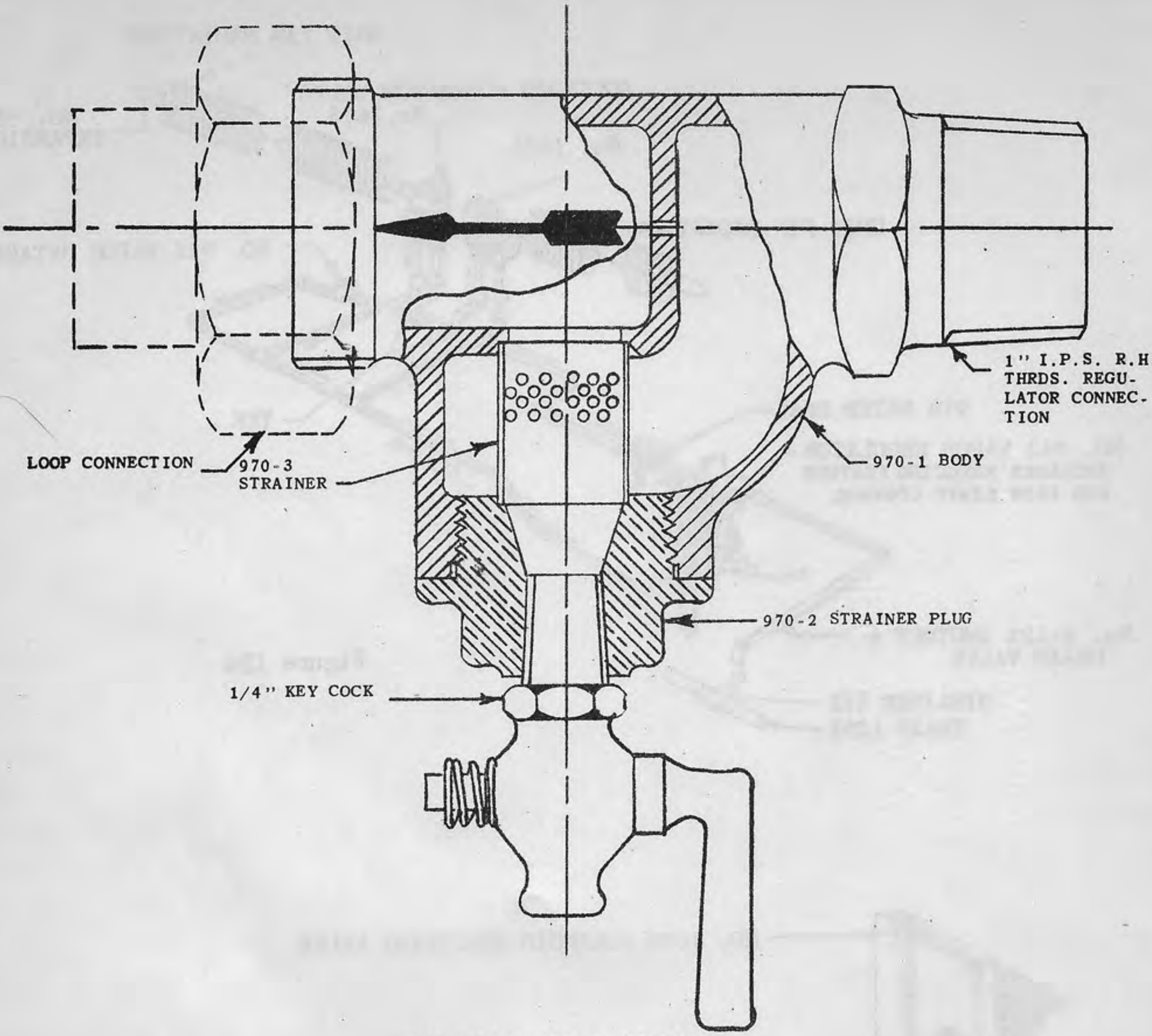
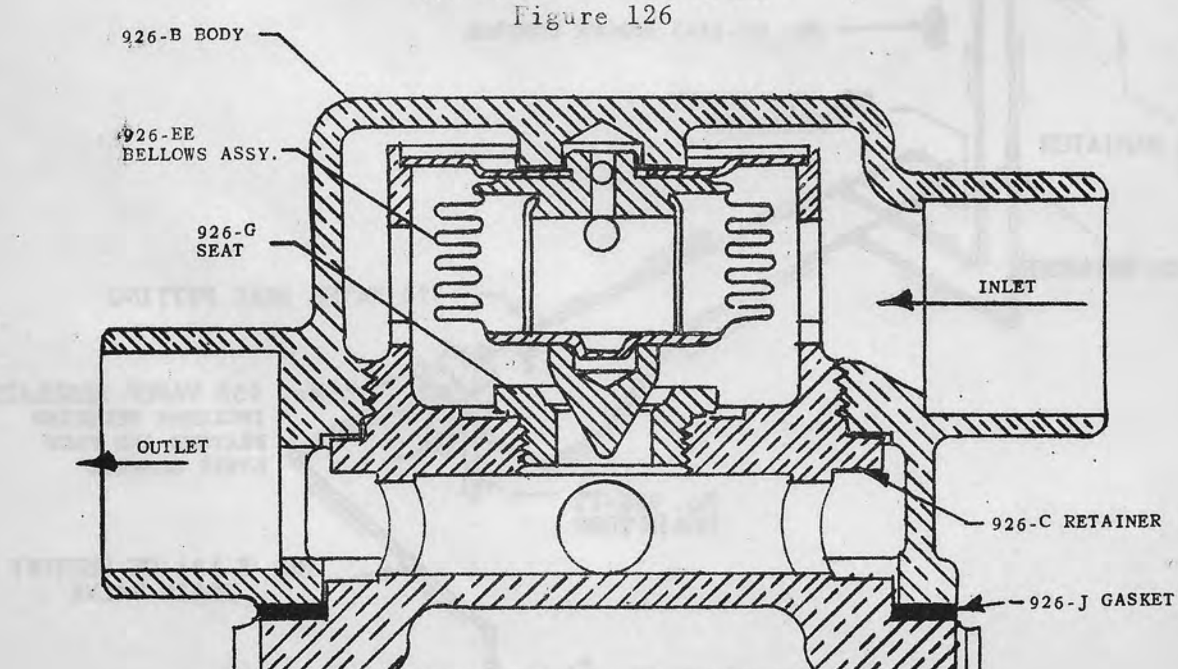


Figure 125



970 WATER SEAL FITTING
Figure 126



926 RETARDER ASSEMBLY
Figure 127

CHECK FOR CAUSE OF STEAM BLOWING AT REGULATOR: A blowing of steam from outer drain tube of 953 or 958 regulator indicates a defective retarder, which can be located as follows:

1. If only No. 1671 or 1674 valve is used on the loop, the blowing of the outer drain tube of regulator is due to a faulty bellows in the loop retarder.

2. In the case of the No. 1668 valve used with overhead radiators, a blowing with valve energized indicates a faulty bellows in the loop or return line retarder.

3. In all cases above if blowing continues with all valves shut off, the bellows in loop retarder is faulty.

A blowing of steam from inner drain tube of No. 953 or 958 regulator indicates a defective regulator and trouble can be located as follows:

1. If dirt has lodged between the Vapor valve and seat of regulator, it can be dislodged by closing S-124 shut-off valve for a few minutes and then re-opening valve.

2. If blow continues, the thermostatic bellows is probably defective. Check for cause of regulator not feeding steam to system.

3. Lever arm adjustment loose. (See shop test of regulators item No. 6).

Several things may interfere with the regulator supplying steam to system. The following checks should be made.

1. Be sure S-124 valve is open.

2. Dirt under seat of flow limit valve may prevent proper operation.

3. Broken or missing inner drain tube allowing steam from return piping to actuate 900-E bellows.

4. Clogged strainers. (If strainer is found in regulator side as shown in Figure 114 it is to be removed and discarded).

5. Lever arm adjustment too tight. (See shop test of regulators item No. 6).

To free dirt under seat of flow limit valve, insert a screw driver through rectangular opening in the bracket at rear of valve; then using bracket as a fulcrum, push up the plunger and hold in this position, pressure will equalize and the additional steam will have a flushing action.

Two fittings are provided in the regulator for mounting steam gauges to determine the operating pressures. The fitting close to the inlet is used to check reducing valve pressure, the opposite fitting is used to check the loop pressure.

A common indication of reducing portion of regulator being set too high is the high pitched singing of the regulator. Apply test gauge to regulator "Reduced Pressure Test" fitting (see Figure 128). If pressure varies more than 10% from the setting, the regulator is definitely defective.

Where a regulator is definitely defective, it can be easily removed by disengaging the clamp on supporting bracket and breaking three unions. New regulator can be quickly applied and old regulator tested and adjusted on test rack in shop. See testing instructions which follow.

An escape of steam through the tell-tale hole in pressure reducing valve spring bonnet indicates a rupture in the bellows seal which encloses spring. It will be necessary to replace seal in order to correct this condition.

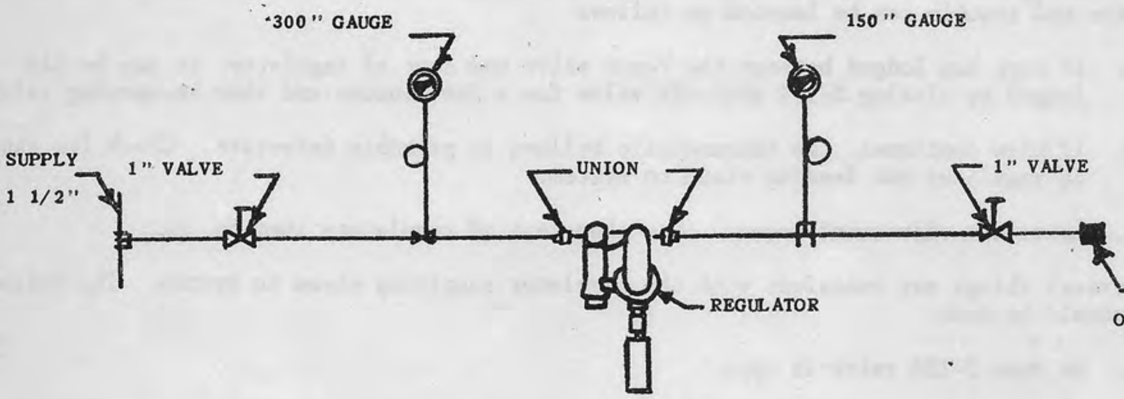
SHOP TEST OF VAPOR REGULATORS:

1. Make up test assemblies, as shown below. Outlet end fitted with 150 lbs. gauge 1" shut-off valve and restriction washer, having 1/4" orifice. Inlet end fitted with 300 lbs gauge, 1" shut-off valve and union for attaching to 1-1/2" supply.

2. Connect regulator to inlet fitting.

3. Connect outlet fitting to regulator.

4. Raise plunger on flow limit valve all the way up. Gauge pressure will then show pressure at which reducing valve is set.



REDUCING VALVE PRESSURE RANGE

Inlet	Outlet	Inlet	Outlet
75 lbs.	51 lbs.	150 lbs.	50 lbs.
100 lbs.	51 lbs.	175 lbs.	49 lbs.
125 lbs.	50 lbs.	200 lbs.	49 lbs.
		225 lbs.	48 lbs.

Figure 128

To adjust tension on reducing valve spring, remove the reducing valve screw bonnet and adjust the reducing valve screw to give the correct reducing valve pressure as outlined above.

5. After operation 4, release plunger on flow limit valve. Pressure should drop and remain constant. Gauge reading will now show the loop pressure.

6. To correct a lever arm adjustment, should it ever become loose, unsolder adjusting screw on fulcrum arm and turn the screw down until steam blows from regulator inner drain tube. Then turn the screw back until steam blow stops. Adjusting screw should now be tightened one full turn and re-soldered so that adjustment will not change.

THERMOSTATIC BELLOWS: The following thermostatic bellows, Figure 129 are used in Zone heat systems:

1. No. 900-E used in steam regulators.

2. No. 1671-EE used in bodies of floor heat admission valves No. 1672, No. 1675 and No. 1677; also in No. 918 retarder.

3. No. 920-EE used in conjunction with No. 1668 admission valve, located in return piping under car. This bellows is also used as a retarder for supply loops.

4. 926-EE is used in the 926 loop retarder.

REPLACING VALVE SOLENOID COIL (Floor Valve):

1. Unscrew jam nut at receptacle and pull receptacle loose from plug.

2. Remove locking ring holding connector plug (Use wrench Q-1662).

3. Pull out connector plug and dis-connect two leads.

4. Remove four hexhead bolts holding solenoid housing.

5. Remove core retaining locknut and lift off solenoid housing assembly.

6. Lift out old solenoid coil and place new coil in its place.

7. Re-assemble by reversing above operations.

CAUTION: Check the solenoid housing gasket closely, replace, if necessary.

REPLACING SOLENOID MANUAL CONTROL ARM ASSEMBLY (Floor Valve):

1. Remove control arm.

2. Remove seal retaining nut.

3. Pull control arm assembly out.

4. Re-assemble by reversing above operations.

REPLACING SOLENOID NEEDLE VALVE ASSEMBLY (Floor Valve):

1. Remove solenoid housing assembly as called for under "Replacing Valve Solenoid Coil".

2. Remove manual control arm assembly as called for under "Replacing Solenoid Manual Control Arm Assembly".

3. Lift out core assembly.

4. Using socket wrench Q-1625 with guide Q-1624, the needle valve assembly can be screwed free of valve body and lifted out.

5. Re-assemble by reversing above operations.

REPLACING ORIFICE SEATS IN VALVE BODIES:

1. Using wrench Q-1623, remove cap over the return chamber.

2. Screw orifice seat out of cap and apply new.

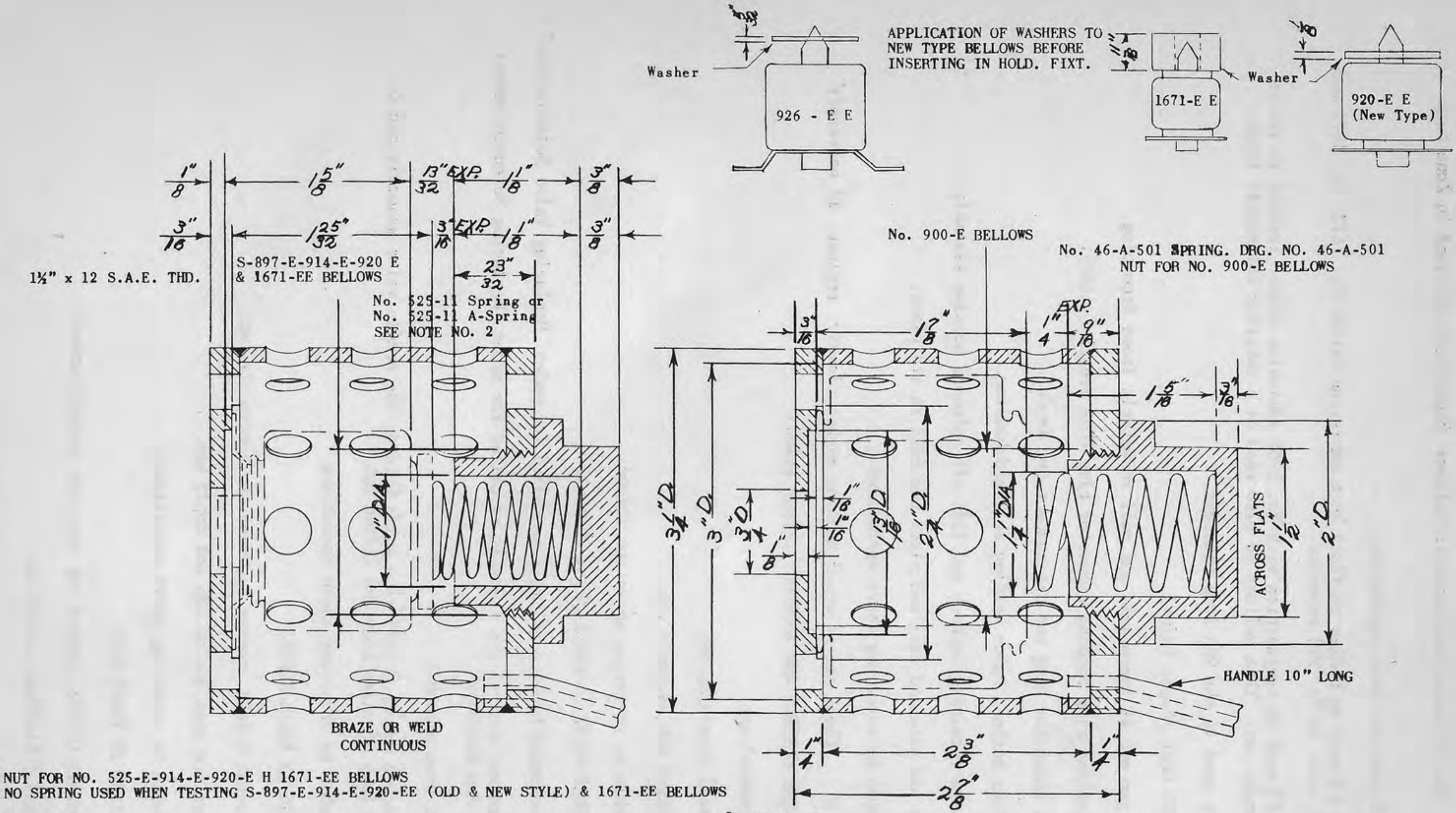
3. Re-assemble by reversing above operations.

REPLACING 1671-EE BELLOWS IN VALVE BODY:

1. Using wrench Q-1623, remove cap over the return chamber.

2. Screw 1671-EE bellows out of cap.

3. Re-assemble by reversing above operations.



NUT FOR NO. 525-E-914-E-920-E H 1671-EE BELLOWS
NO SPRING USED WHEN TESTING S-897-E-914-E-920-EE (OLD & NEW STYLE) & 1671-EE BELLOWS

NOTE NO. 2
WHEN TESTING BELLOWS OF THE NO. 525 VALVE BE SURE TO USE THE RESPECTIVE SPRINGS FOR EACH BELLOWS AS FOLLOWS:
NO. 525-104-135° BELLOWS USE SPRING NO. 525-11
NO. 525-104-A-115° BELLOWS USE SPRING NO. 525-11-A.
NO. 525-104-B-160° BELLOWS USE SPRING NO. 525-11

*NOTE NO. 1
SUBMERGE IN COLD WATER BEFORE APPLYING. BELLOWS SHOULD THEN BE TIGHT AGAINST INTERNAL STOP DUE TO VACUUM WITHIN.
WHEN SUBMERGED IN BOILING WATER EXPANSION SHOULD BE AS FOLLOWS:
NO. 900-E-1/4" - No. 525=13/32"
NO. S-897-E-914-E-920-EE = 3/16" & 1671-EE = 1/8"
NO. 926-EE = 0.110".
SUBMERGE IN COLD WATER AFTER TESTING BEFORE REMOVING FROM FIXTURE. WHEN TESTING 1671-EE & NEW STYLE 920-EE BELLOWS, FOLLOW PRELIMINARY PROCEDURE INDICATED IN UPPER RIGHT HAND CORNER.

BELLOWS TESTING FIXTURE

Figure 129

WATER HEATING AND PROTECTION LOOP

The steam supply for these features is taken off steam trainline through Vapor No. 124 shut-off valve, No. 960 Vapor hot water regulator and No. 948 cut-out valve. The 948 valve has two outlets marked "Winter" and "Summer", see Figure 130. If the movable wing in the valve is set for Summer operation, steam flows directly to Vapor Company's 588-6 wash water heater and back through the 960 regulator drain. A check valve prevents steam backing into protection loop. When the 948 valve is placed on the Winter setting steam flows through the No. 1 fill valve through the steam protection loop around the No. 2 fill valve, then to the wash water heater. See Figure 131.

The Vapor 960 hot water regulator shown in Figure 132 controls steam to the loop. A pressure regulating valve is not used ahead of this type regulator. As in the case of other Vapor regulators, the return of steam from the loop causes a thermostatic bellows in the lower port of the regulator to expand. The expansion of this bellows moves an operating rod and lever arrangement to close a needle valve and shut-off the admission of steam to the loop. The needle valve is re-opened to again feed steam to the loop when the thermostatic bellows contracts.

A blow of steam from the regulator indicates sticking of the needle valve or a ruptured bellows. A sticking needle valve can usually be cleared up by closing the 124 shut-off valve ahead of the regulator for a few minutes and then re-opening. This action will dislodge any dirt particles between the valve and seat. Testing for a ruptured bellows will be done in accordance with existing instructions.

The Vapor 948 cut-out valve, operation of which was described previously, should be placed in the Winter or Summer position in accordance with existing instructions. The valve should not require much maintenance, however, if it is necessary to overhaul proceed as follows. See Figure 130.

1. Remove nut and indicator handle (Sym. 7 and 7).
2. Unscrew gland and bonnet (Sym. 4 and 3).
3. Remove stem, spring and packing (Sym. 2, 5 and 8).
4. Clean and inspect each part for wear and replace parts as necessary.
5. Re-assemble valve, making sure that the stem moves freely before putting the valve back into service again.

The Vapor wash water heater No. 588-6 is shown in Figure 134.

Vapor 525-B mixing valve is shown in Figure 135. Cold water from water tank enters inlet on mixing valve. The heated water from the wash water heater flows to the hot water inlet of the mixing valve, where it is mixed with the cold water so that the temperature of water delivered to car basins is 135 degrees.

Note in Figure 135 that spring No. 525-11 opposes bellows No. 525-104 locating the piston at the hot and cold water inlet ports in proper position to permit right mixture. Water in bellows chamber under 135 degrees causes bellows to contract under spring tension, allowing more hot water through inlet port. Water over 135 degrees causes bellows to expand, allowing more cold water to flow.

These mixing valves are originally set to deliver hot water at the basin faucets at a temperature of 135 degrees. If repairs are made to valve it must be adjusted while in place and the cars on steam, holding a thermometer under the hot water faucet and regulating the adjusting screw until water temperature of 135 degrees is obtained.

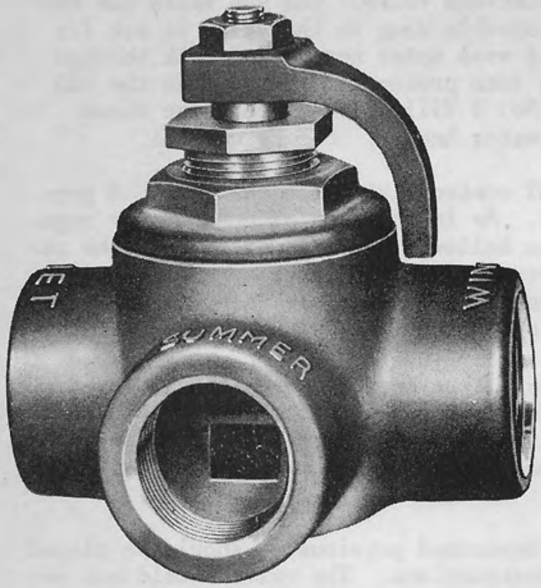
Vapor S-155 steam trap Figure 133 is a bellows type non-adjustable trap. The expansion of the 900-E diaphragm closes the valve with the presence of steam. In the absence of steam, the bellows contracts and the spring loaded valve opens to drain the condensate from the loop.

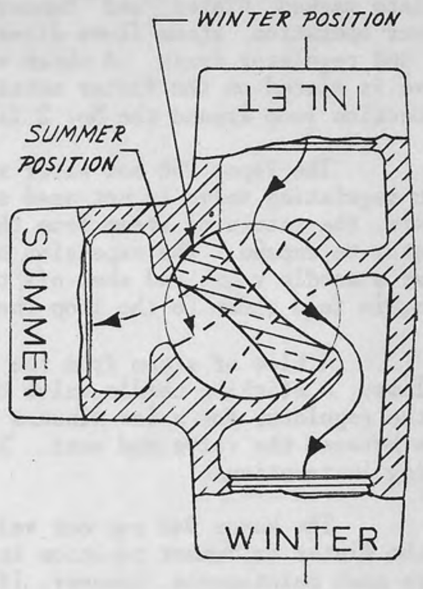
Crane Company's swing check valve No. 1302 is provided to prevent a reverse flow of steam through the steam protection loop when the 948 valve is on Summer operation.

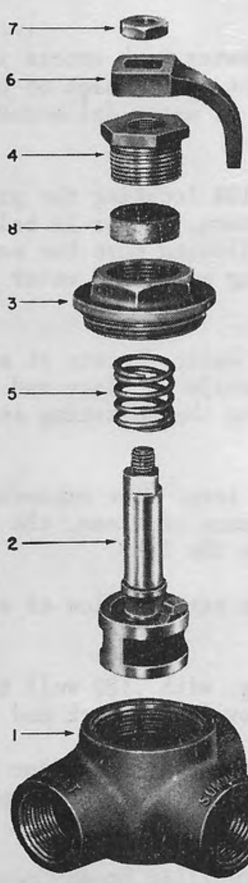
S T E A M   T R A I N L I N E: is 2-7/8" O.D. welded, annealed steel tubing, with .120 wall thickness and welded joints, 2-1/2" extra heavy wrought iron pipe, nipples are provided at each end.

E N D   V A L V E S   A N D   M E T A L L I C   C O N D U I T: Cars are equipped with Vapor number F-1117, 2-1/2" end valve. The flexible metallic connectors are Barco, 2-1/2" or Vapor Company's, 2-1/2" with Vapor No. 364 heads.

For details refer to manual entitled "Maintenance Instructions of Metallic Steam Conduits", Superintendent of Yards Department, July 1947 and letter of October 25, 1950.







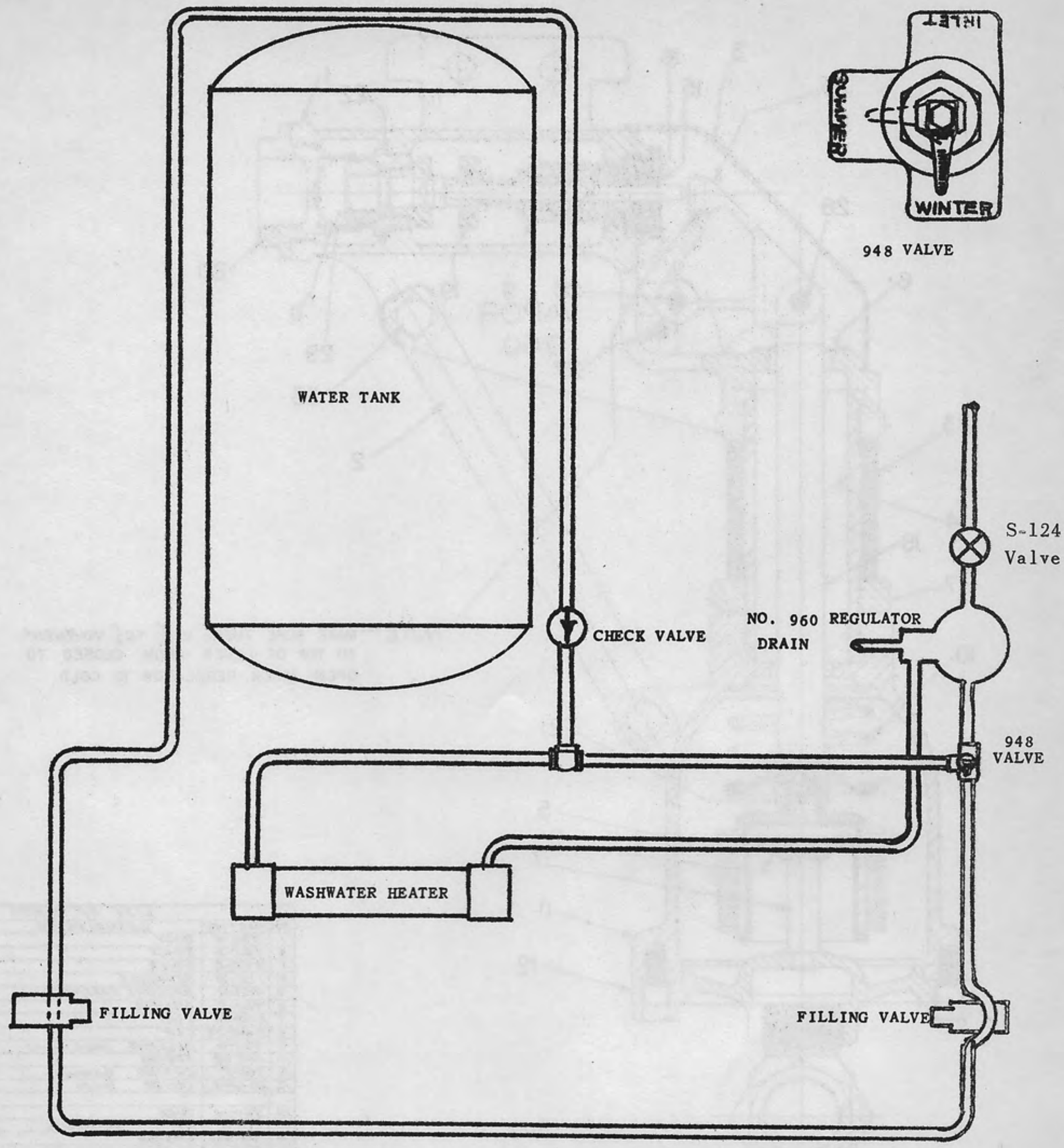
LIST OF PARTS

NO. 948 CUT-OUT VALVE

Sym.	Part No.	Description	Amt.
1	948-A	Body	1
2	948-B	Stem	1
3	948-C	Bonnet	1
4	948-D	Gland	1
5	948-E	Spring	1
6	948-F	Indicator Handle	1
7	120-K	Nut 3/8"-16 (Jam Type)	1
8	120-P	Packing	1

948 Valve WINTER - SUMMER

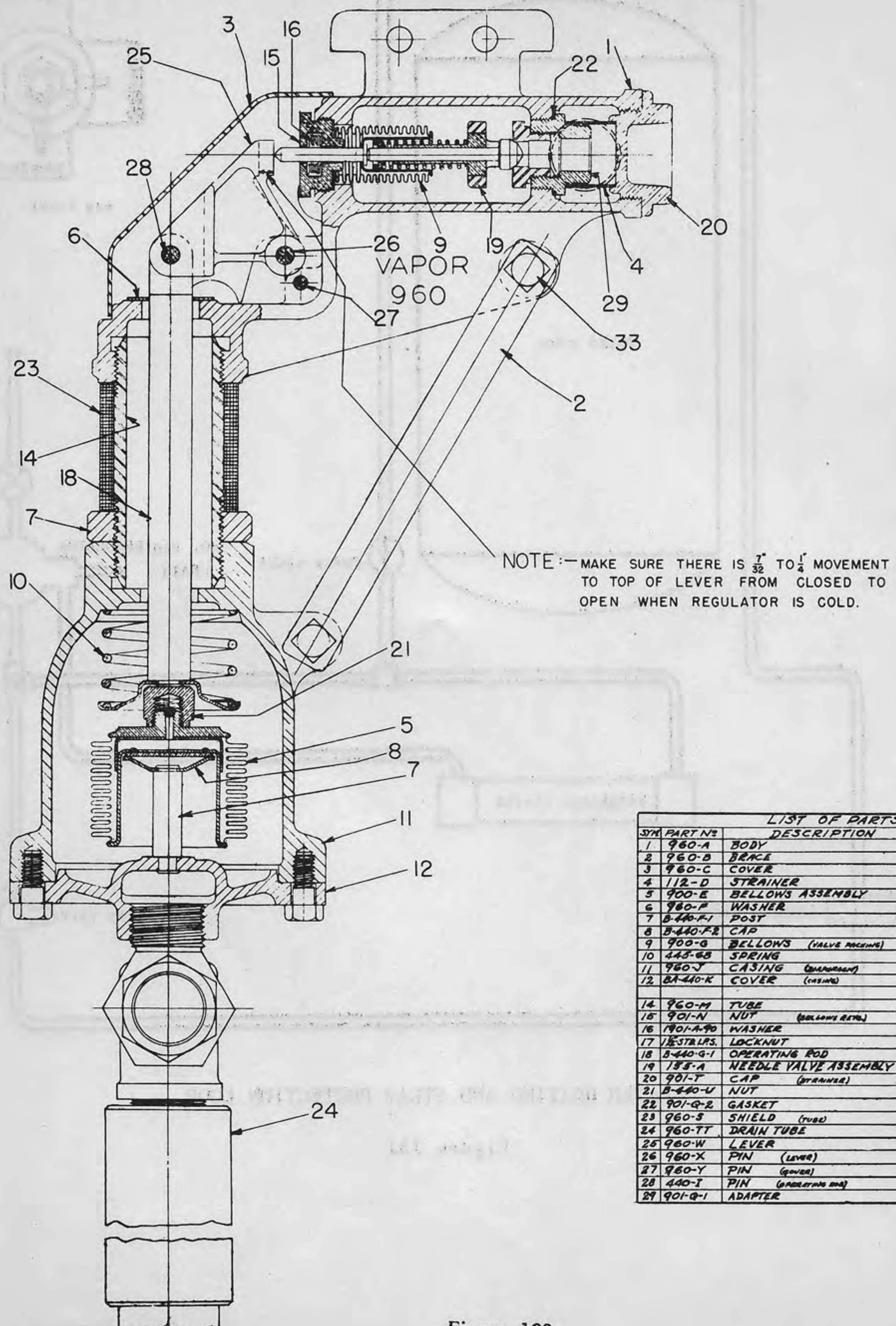
Figure 130



WATER HEATING AND STEAM PROTECTION LOOP

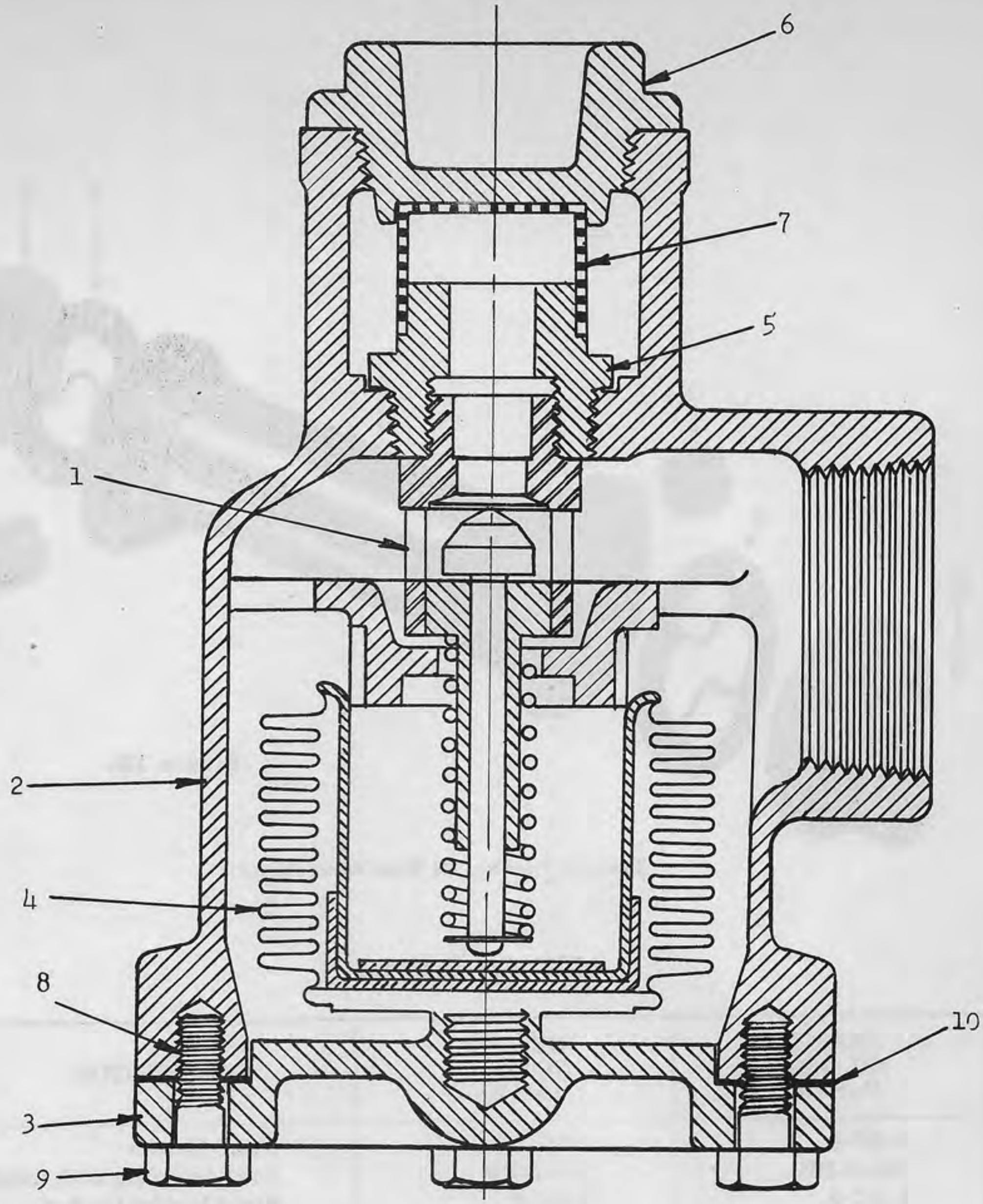
Figure 131

No. 960 VAPOR REGULATOR



LIST OF PARTS				
SYM.	PART No.	DESCRIPTION	UNIT	MATERIAL
1	960-A	BODY	1	MALL.IRON
2	960-B	BRACE	1	H.R.STEEL
3	960-C	COVER	1	H.R.STEEL
4	112-D	STRAINER	1	BRASS
5	900-E	BELLOWS ASSEMBLY	1	
6	960-F	WASHER	1	SH.BRASS
7	B-440-F-1	POST	1	STEEL C.P.
8	B-440-F-2	CAP	1	SH.BRASS
9	900-G	BELLOWS (VALVE PACKING)	1	
10	445-68	SPRING	1	STAINLESS STEEL
11	960-J	CASING (DIAPHRAGM)	1	GREY IRON
12	BA-440-K	COVER (CASING)	1	MALL.IRON
14	960-M	TUBE	1	[illegible]
15	901-N	NUT (BELLOWS RETG.)	1	BRASS ROD
16	1901-A-90	WASHER	1	FELT
17	1½-STD.I.P.S.	LOCKNUT	1	MALL.IRON
18	B-440-G-1	OPERATING ROD	1	C.R.STEEL
19	155-A	NEEDLE VALVE ASSEMBLY	1	
20	901-T	CAP (STRAINER)	1	[illegible]
21	B-440-U	NUT	1	BRASS ROD
22	901-Q-2	GASKET	1	SOFT COPPER
23	960-S	SHIELD (TUBE)	1	BLK.RUBBER
24	960-TT	DRAIN TUBE	1	
25	960-W	LEVER	1	[illegible]
26	960-X	PIN (LEVER)	1	BRASS ROD
27	960-Y	PIN (COVER)	1	BRASS ROD
28	440-I	PIN (OPERATING ROD)	1	BRASS ROD
29	901-Q-1	ADAPTER	1	[illegible]

Figure 132



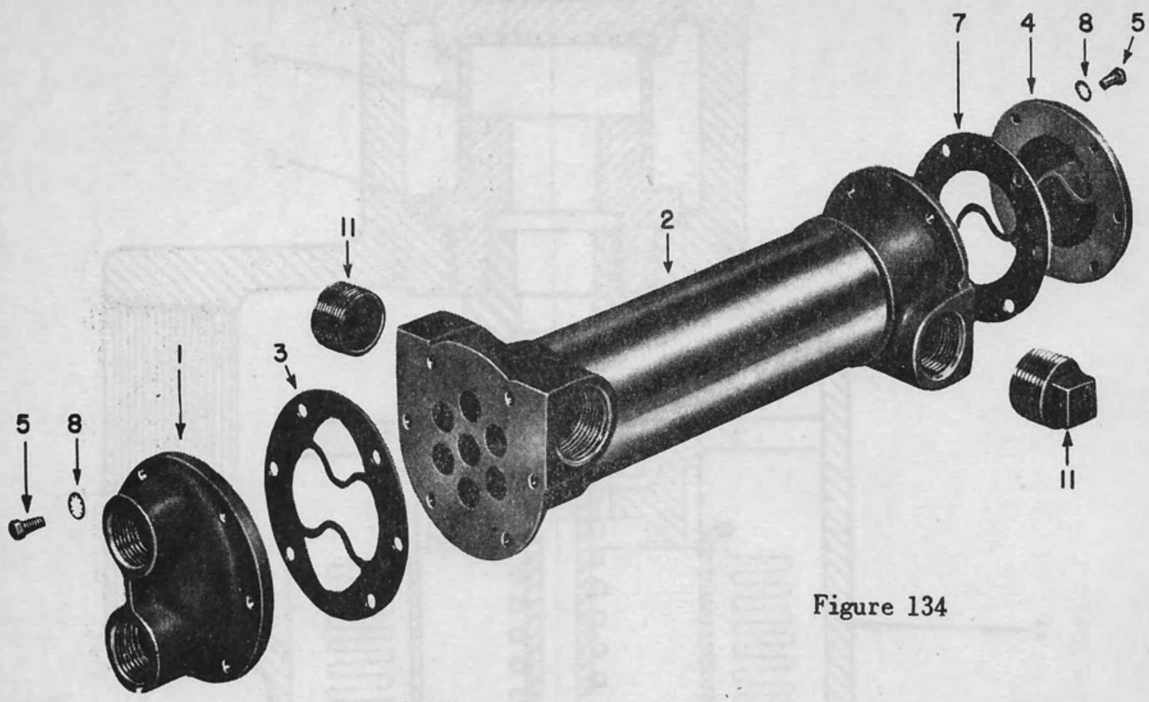
VAPOR S-155 STEAM TRAP

Figure 133

SYM.	PART NO.	DESCRIPTION	AMT.
1	155-A	VALVE COMPLETE	1
	900-Q-4	Spring, Valve	1
	900-Q-5	Washer, Valve Stem	1
	900-Q-6	Pin, Valve Stem	1
2 **	S-155-B	**Body, Cast Iron	1
3 **	900-D	**Cover, Diaphragm	1
4	900-E	Diaphragm, Economy	1
5	901-Q-1	Adapter, Valve	1
6	901-T	Cap, Strainer	1
7	112-D	Strainer	1
8	901-V	Stud (5/16" - 18 x 1 1/8" Lg.)	4
9	5/16" - 18 Hex.	Nut	4
* 10	* S-155-G	* Gasket, Cover	1

*NOTE: The No. S-155-G Gasket is not essential when trap is underneath a railroad car and the condensate spills to the ground. Therefore, on such installations, if and when the gasket wears out, it need not be replaced.

**NOTE: In place of the iron parts indicated by the double asterisk (**), the following brass parts are used on the No. 155 Brass Body Type Steam Trap:
No. 155-B Body, Brass
No. 155-D Cover, Diaphragm (Brass)
1" Std. Pipe Brass Plug, Sq. Shank.



Exploded View No. 588 Wash Water Heater.

LIST OF PARTS

SYM.	HEATER NO. 588-2 Part No.	HEATER NO. 588-6 Part No.	DESCRIPTION	AMT.
1	1-SC-8	1-SC-5	Front Header	1
2	588-2-BB	588-6-BB	Body complete with tubes	1
3	8-SC-8	8-SC-5	Front Header Gasket	1
4	4-SC-8	4-SC-5	Rear Header	1
5	¼"-20 x ½"	5/16"-18 x ¾"	Cap Screw, Hex. Hd.	12
7	9-SC-8	9-SC-5	Rear Header Gasket	1
8	¼" Shakeproof	5/16" Shakeproof	Lock Washer	12
11	1" Std.	1" Std.	Pipe Plug	2

NOTE: When ordering parts specify number and size of heater.

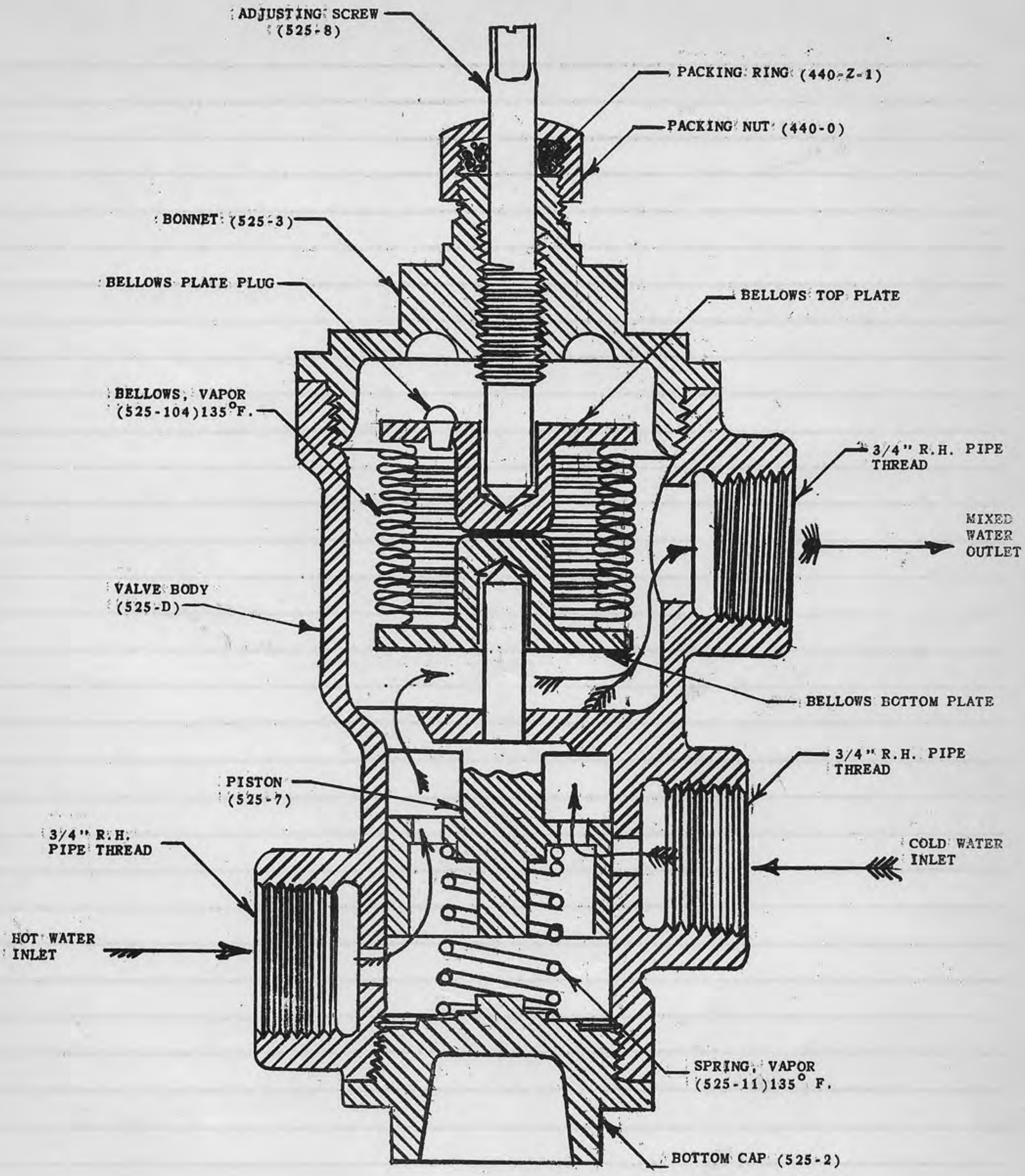


Figure 135

WATER MIXING VALVE

NOTES

AIR CONDITIONING CONTROL

Cooling and heating equipment is controlled through Vapor Company's MZ-49131-MC air conditioning control panel.

This panel contains seven relays, six circuit breakers, the emergency heat switch, blower fan speed switch, resistors for overhead heat and cooling tube compensation circuits and a seven position control (seasonal) switch.

The Vapor 9116-11X control switch provides for temperature selection in both heating or cooling. It is an 11 contact switch which makes circuits as follows for each setting. See schematic wiring diagram, Figure 136 and physical wiring diagram, Figure 137.

1. Center "off" Contact No. 3 completes a circuit through the normally closed emergency heat switch, to the 65° layover heat tube and relay. This places car floor heat under control of the 65° layover tube through flow limit valves on the 953 regulators. Contact No. 9 completes a circuit through a No. 2550 AW resistor to the heater winding on the 76° overhead heat tube. This lowers the operating point of the overhead tube to 65°.

2. "Cool" - "Night" "Cooler" or "Warmer"
   In any "cool" position of the switch contacts No. 1-2 and 3 make circuits as follows:

Contact No. 1 completes a circuit to cooling and cooling modulating tubes through separate 270 ohm resistors.

Contact No. 2 completes a circuit to C 1, on the compressor motor control panel providing a positive feed to the low voltage and LV1 relay.

If the cooling tube is calling, (mercury up) the contact of the cooling pilot relay closes the pressure switch circuit to the compressor motor control panel through terminals 18 and 19. If the low voltage relay is reset (generator running or push button pressed) the compressor will run, its speed dependent on the cooling modulating tube.

If the cooling modulating tube is calling, (mercury up) the cooling modulating relay will energize the freon solenoid valve (open) and de-energize the "P" relay. The "P" relay opens the circuit around compressor motor field resistor section, (terminals RC and P on compressor motor control panel) and the compressor runs at full speed with full evaporator.

Contact No. 3 completes a circuit, as in the "off" position placing the 65° layover tube in control of floor heat (and overhead heat lockout if compressor is running) by energizing the flow limit valves of the regulators. Thus if cooling is satisfied and conditions require heat, heat will be provided by floor heating only to 65° at the layover tube even though the control switch is in a "cool" position.

With the switch in the "cool" "Night" position contact No. 8 completes a circuit through a 2550 AU resistor to the heater windings of cooling and cooling modulating tubes. This lowers the operating point of the cooling tube to 71° and the cooling modulating tube to 73°.

With the switch in the "Cool" "Cooler" position contact No. 7 completes a circuit to cooling and cooling modulating tube heater windings through two (2) 2550 AU resistors in series. This lowers the operating point of tubes 2 degrees, to 74° cooling and 76° cooling modulating.

With the switch in the "Cool" "Warmer" position contact No. 6 closes, but the circuit to heater windings of cooling and cooling modulating tubes is open. (resistor blank). Thus tubes regulate at uncompensated or normal temperatures. Cooling 76° - Cooling modulating 78°.

With the control switch in any "Heat" position contact No. 4 and No. 5 make circuits as follows:

Contact No. 4 completes a circuit to the 76° overhead heat tube and relay through two 270 ohm resistors. This places the overhead heat tube, located in the duct, in control of the overhead heat admission valve. Contact No. 5 completes a circuit providing a positive feed to floor heat tube and relay circuits. ("C" connection on remote control units). This places floor heat tubes in control of their individual admission valves.

The temperature at which floor heat admission valves will open is dependent on the setting of the potentiometer in the individual accommodation. The temperature at which the overhead heat admission valve and floor heat admission valves for passageway will open depends on the setting (in heat side) of the control switch as follows:

In the "Heat" "Night" position of the switch, contact No. 9 completes a circuit to the overhead heat tube and passageway and open section floor heat tube heater windings through a 2550 A.W. resistor. This lowers the operating point of these 76° tubes to 65°.

In the "Heat" "Day" position of the switch, contact No. 10 completes a circuit through a 2550-CC resistor to parallel circuits as follows:

Cars of Plan 4108-A and 4180 - 3 circuits namely:

1. Through a 2550 BE resistor (RR on drawings)
2. Through a 2550 AW resistor and overheat heat tube heater winding in series.
3. Through a 2550 AW resistor and passageway floor heat tube heater winding in series.

This arrangement lowers the operating point of these 76° tubes to 71°.

Car of Plan 4181 and 4109-A - 5 circuits namely:

1. Through a 2550-AS resistor (RR on drawings)
2. Through a 2550-AW resistor and overhead heat tube heater winding in series.
3. Through a 2550-AW resistor and passageway floor heat tube heater winding in series.
4. Through a 2550-AW resistor and even side sections floor heat tube winding in series.
5. Through a 2550-AW resistor and odd side sections floor heat tube winding in series.

This arrangement lowers the operating point of the 76° tubes to 71°.

In the "Heat" "Warmer" position of the switch, contact No. 1 completes a circuit through a 2550-BG resistor to the parallel circuits as outlined above. This arrangement lowers the operating point of the 76° tube to 74°. Note that a different resistor is required in the "RR" position for the two arrangements to obtain the same tube compensation. Overhead cycling resistors provide 4° additional heat to the tubes when the tube is calling (mercury down).

ELECTRICAL SYSTEM

These cars use two electrical lighting systems. A 32 volt D.C. system supplied by the battery and a 110 volt A.C. system supplied by a motor alternator.

Cars are equipped with the following batteries:

WAUKESHA ENGINATOR EQUIPPED CARS:

Exide, EPTA-25, 706 AH, 16 cells, 2 cell trays, 1250 SPGR, Wood Tray with rubber jars.

SAFETY GENEMOTOR EQUIPPED CARS:

Exide, EPTB-45, 1294 AH, 16 cells, 2 cell trays, 1250 SPGR, Wood tray with rubber jars.

Batteries are installed in two stainless steel battery boxes of four trays each. A Safety Company's Motor alternator, Type M.G. 17, No. 315552, 2 KW (Figure 147) is mounted under car on resilient mounting. Operation of the alternator is controlled by Safety Company's step starter, No. 309551 located in the electric locker. (Figures 147 and 145 show the step starter, relay and parts lists. The circuit wiring to step starter is designed so the closing of any circuit breaker in the alternating current section of the distribution panel completes a direct current circuit to start the motor alternator. See Figure 146 for circuit arrangement.

Additional information on Safety motor alternaters is outlined on pages 96 to 120 in the Car Lighting Maintenance Manual.

FANS

One 8" rubber blade, 3 speed, Westinghouse Electric Company's 32 volt, circulating bracket type fan is used in Drawing Rooms, Compartments, Bedrooms, Roomettes and Open Sections.

EXHAUST FANS

PLAN 4181:

One 9" Safety Company's No. 80981 for electric locker.

One 9" Safety Company's No. 80981 for toilets in dressing rooms having connecting ducts.

One R.S. 705-T connected to ducts to supply air to open sections.

PLAN 4180:

One 9" Safety Company's No. 80981 for electric locker and general toilet having connecting ducts.

One 7" R.S. 705-T

PLAN 4108-A:

Three 9" Safety Company's No. 80981 for duplex roomettes.

One 9" Safety Company's No. 80981 for electric locker and general toilet.

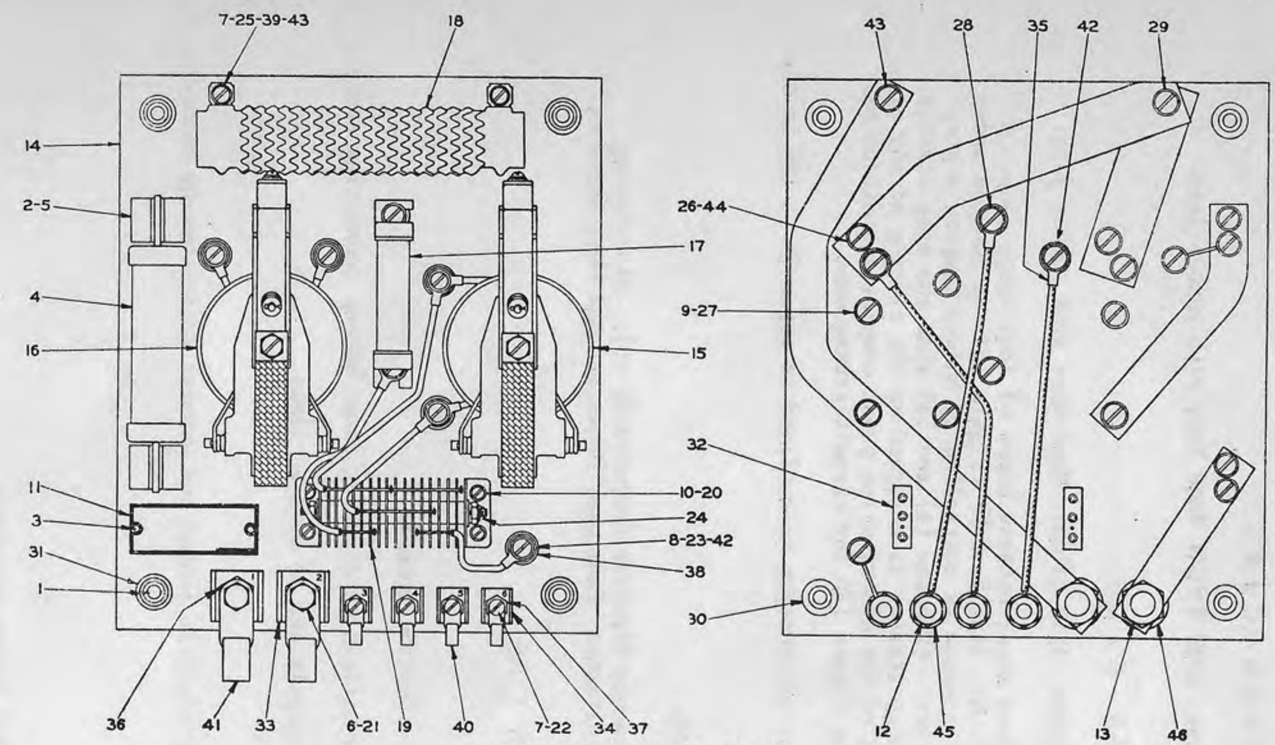
One 10" Safety Company's No. 80978 for bedrooms.

PLAN 4109-A:

One 9" Safety Company's No. 80981 for electric locker and general toilet.

One 10" Safety Company's No. 80978 for Observation-Lounge.

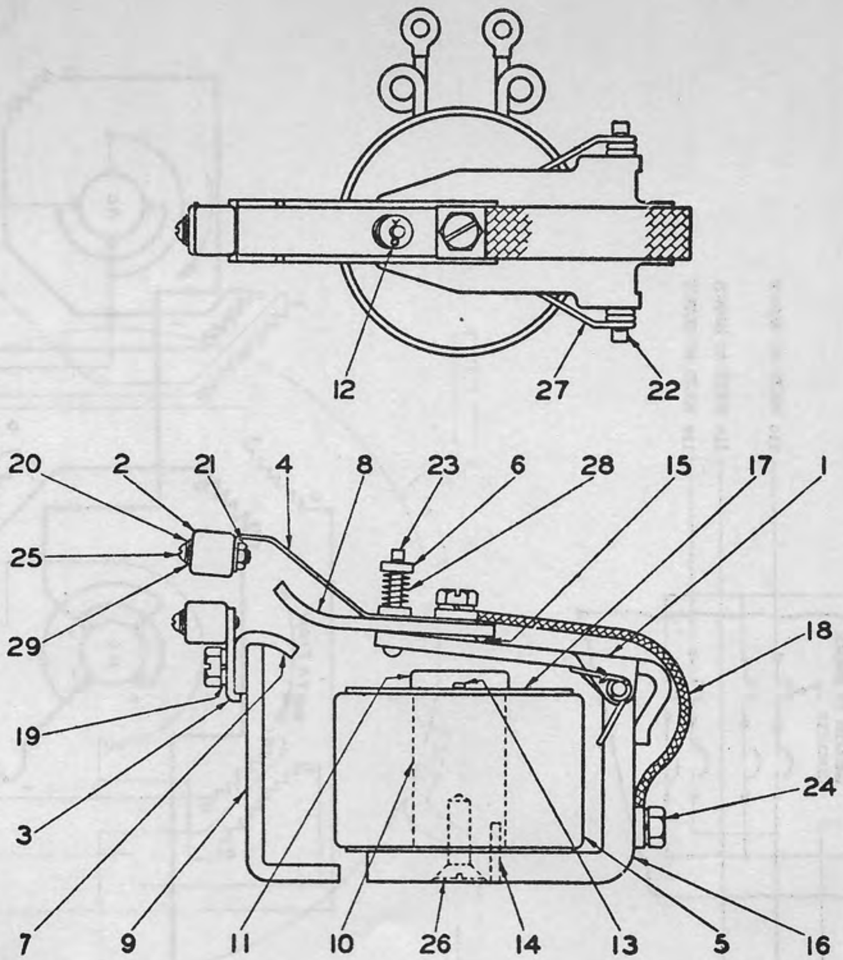
One 10-7/8" Blower fan, Westinghouse Electric Rex-Vane Type "O" for Buffet.



STEP STARTER No. 309551

Item No.	Description	Cat. No.	No. Requ'd.	Item No.	Description	Cat. No.	No. Requ'd.
1	Bushing	301222	4	24	Screw	10186	2
2	Clip Plate	4744	2	25	Screw	6771	2
3	Drive Screw	52905	2	26	Screw	50181	6
4	Fuse	301354	1	27	Screw	58630	2
5	Fuse Clip	302499	2	28	Screw	4629	11
6	Lockwasher	4319	2	29	Screw	6777	2
7	Lockwasher	58139	6	30	Spacer (Bottom)	301221	4
8	Lockwasher	22262	10	31	Spacer (Top)	301220	4
9	Lockwasher	22261	2	32	Strap	309594	2
10	Lockwasher	59583	4	33	Terminal	27875	2
11	Name Plate	63764	1	34	Terminal	307665	4
12	Nut	22192	4	35	Terminal	21499	3
13	Nut	27879	2	36	Terminal Post	27876	2
14	Panel	309552	1	37	Terminal Post	307666	4
15	Relay Complete	309591	1	38	Terminal Post	4581	7
16	Relay Complete	300824	1	39	Terminal Post	309593	2
17	Resistance Unit	309606C	1	40	Terminal Lug	301320	4
18	Resistor	309558	1	41	Terminal Lug	26899	2
19	†Selenium Rectifier	309559	1	42	Washer	7277	20
20	Screw	2948	4	43	Washer	58847	4
21	Screw	55812	2	44	Washer	53484	8
22	Screw	52218	4	45	Washer	21187	8
23	Screw	5480	7	46	Washer	27883	2

Figure 144



RELAY COMPLETE No. 309591

Item No.	Description	Cat. No.	No. Req'd.
1	Armature	300827	1
2	Carbon	300832	2
3	Carbon Support—Bottom	300537	1
4	Carbon Support—Top	300831	1
5	Coil Complete for Relay 309591	309592	1
6	Collar	64248	2
7	Contact	300830	1
8	Contact Break Arm	300828	1
9	Contact Support	300829	1
10	Core	300834	1
11	Core Cap	300835	1
12	Cotter Pin	20166	3
13	Cotter Pin	59101	1
14	Dowel	58812	1
15	Drive Screw	53135	1
16	Frame	300826	1
17	Insulating Washer	151752	2
18	Lead Complete	300875	1
19	Lockwasher	22261	3
20	Lockwasher	53899	2
21	Nut	52884	1
22	Pin	59080	1
23	Pin	58809	1
24	Screw	300538	3
25	Screw	4682	2
26	Screw	58191	1
27	Spring	300833	1
28	Spring	300900	1
29	Washer	4348	2

Figure 145

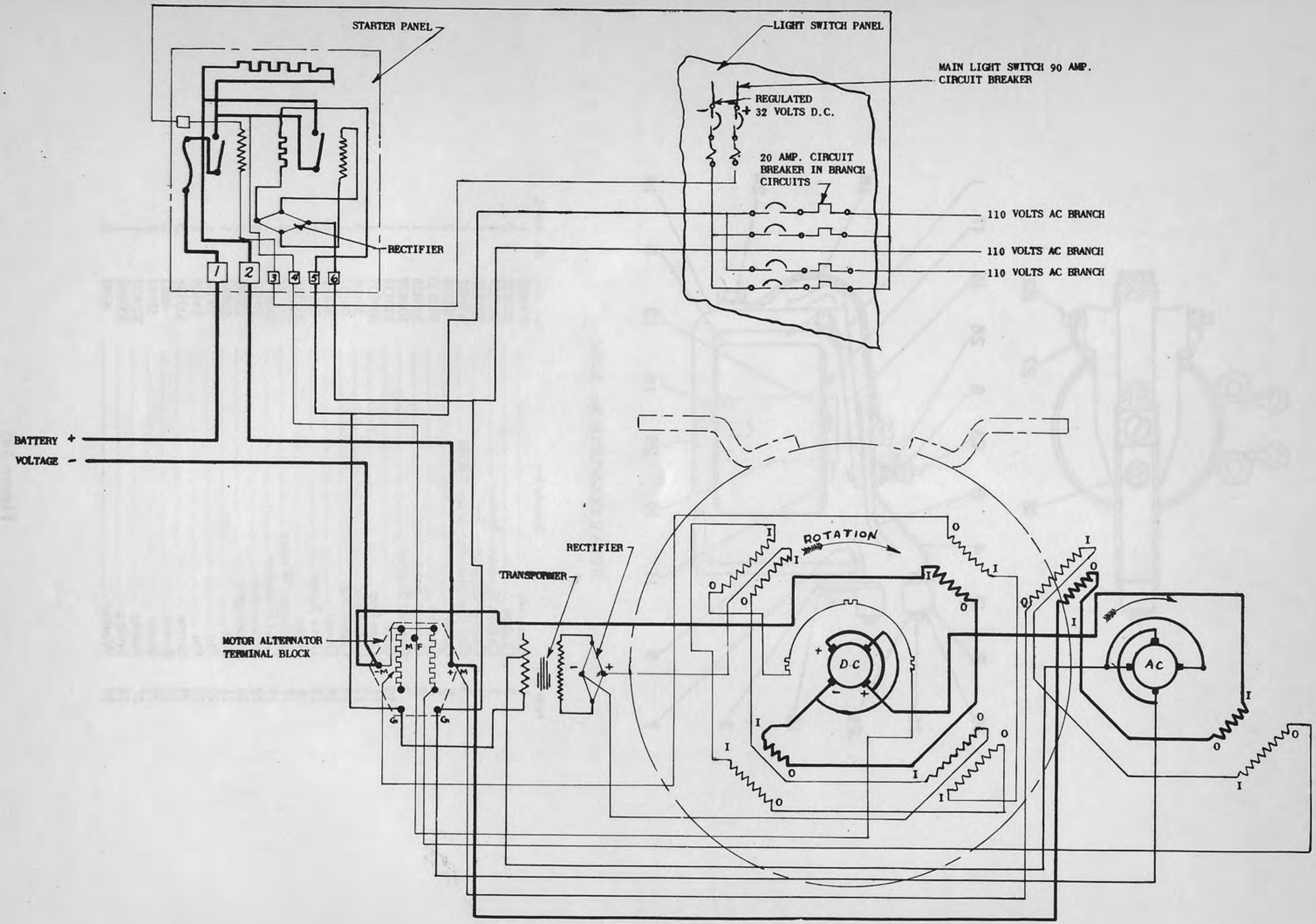


Figure 146

WIRING DIAGRAM OF MOTOR ALTERNATOR WITH STARTER

CHARGING RECEPTACLES

Two per car, one on each side - 150 ampere, 125 volt, 2 pole non-swival type Pyle-National Company's type BCRFD - 1315 CM.

BATTERY TRAINLINE CONNECTORS

Two per car, Pyle-National Company's No. TLP-2240, 46" overall with No. 4/o wires.

BATTERY TRAINLINE RECEPTACLES

Four per car, two on each end, Pyle-National Company's No. TLRVT-200 PA.

INSPECTION LIGHT

An inspection light is located overhead at A.C. unit that operates on the access door switch. This consists of a permanently connected extension cord; a Type No. 101 Woodhead with molded rubber handle and guard. The cord is a Whitney-Blake, two-conductor, No. 18 type SJ all rubber covered coiled cord 48" in length that is equivalent to 25 ft. when extended.

Generator and cooling pilot light circuits use type S-6, 6 watt, 60 volt lamps.

Two Safety Company's type S-1050-E 40 volt lamp regulators are used with negative regulation. The carbon pile being negative and the RC wire positive. Regulators are to be set at 31 volts.

A single pole switch is provided in the electric locker which disconnects the positive side of the battery from the car wiring.

32 VOLTS DIRECT CURRENT: is supplied from batteries and generator, used unregulated for air-conditioning compressor motor and air brake controls. It is regulated for air-conditioning and heating controls, room blow fans and incandescent lights, including the emergency lights.

32 volt D.C. incandescent lights are used in rooms to supplement the main lighting and to provide light in case of an alternating current failure. A circuit breaker is provided for emergency lighting which controls halls and passageways, while emergency lights in rooms are subject to local switch.

Emergency lights are checked with the motor alternator off. The exact type of lamp and location is contained in lamp specifications on Pages 214 to 222.

MAIN SWITCHBOARD: The main switchboard is made up of various circuit breaker and fuses to protect the individual circuits.

TRAINLINE SWITCH:

1 - 400 amp. double pole knife switch fused with 350 amp. bussman superlag fuses.

BATTERY DISCONNECT SWITCH:

1 - Single pole knife switch.

MAIN LIGHT SWITCH:

2 - 90 amp. capacity Westinghouse De-ion type circuit breakers; one for each lamp regulator.

BRANCH CIRCUIT BREAKERS:

20 amp. double pole, Westinghouse De-ion protect circuits.

32 volt circuit - Vest. door step sign & general toilet - Emergency lights - Berth lights - Annexes - Bracket fans.

110 volt circuit - Passageway - Room ceiling - Roomette ceiling

BRANCH CIRCUIT FUSED:

Cooling pilot light - General Pilot light - Marker light - Door Engine - Water Cooler - Fuel light (Wau.) - Cool mod. relay - Razor rec. - Ex. fans.

C A L L   B E L L   S Y S T E M : The call bell system is similar to the type used on present lightweight cars, using four dry cells for power with trainline feature. An Edwards annunciator has two 6 watts, 115 volt lamps controlled by a small relay known as a light relay. This relay is composed of a blank drop operating against two spring contacts, and is usually located at the lower right-hand corner of the annunciator. Re-setting the annunciator opens the relay contacts, Figure 148.

F L U O R E S C E N T   L I G H T I N G : The average life of fluorescent type lamps depends upon the number of times the lamp is turned on. Under conditions where a lamp burns almost continuously the rated life of that lamp is more likely to be obtained than one that is turned off and on at short intervals.

In general, the characteristics of all fluorescent lamps are the same, see Pages 96 to 106 of your Car Lighting Maintenance Manual. The interior construction of the "Bipin instant start" and "Slimline" lamps are identical with the bipin pre-heat (starter) type lamp. The bipin instant-start has the pins short circuited inside end caps and will not operate on pre-heat ballast circuits. The Slimline has the filament coil supports connected together and forms a single contact at each end of the lamp. With these arrangements the filaments cannot be pre-heated. Therefore, to compensate for the lack of pre-heating a much higher voltage is impressed across the terminals to force the electrons through the lamp. This high voltage produces a severe shock to the electron emitting surface of the filament cathode and some of the coating of the cathode flakes off. This is repeated for each start of the lamp until eventually the lamp will not burn.

A characteristic of instant start circuits is the difficulty of starting under conditions where the humidity is high. To insure starting under these conditions, a thin metallic starting stripe is painted on the outside and lengthwise of the lamp. This provides a path for the electrons to pass from cathode to cathode and produces a capacitive action which assures starting under all conditions.

The instant-start and Slimline lamps do not use starters and do not blink on and off when the lamps fail to start; therefore, the section pertaining to starters and compensators does not apply. The behavior chart, pages 224 to 229 applies particularly to starter type fluorescent lamps.

N O T E :

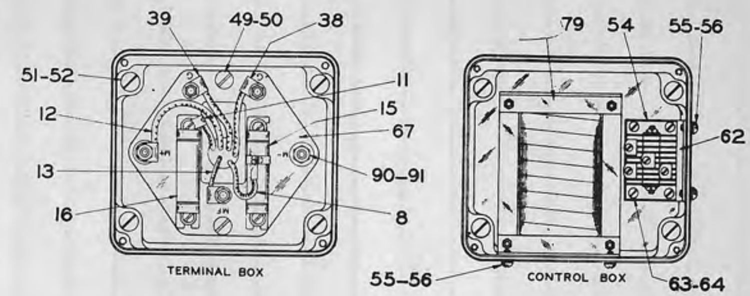
Fluorescent lamps do not have a voltage rating marked on the lamp, but are governed instead by the length, diameter and wattage. This means then that a lamp of any given length, diameter and wattage can be used on a circuit of any voltage with the proper ballast.

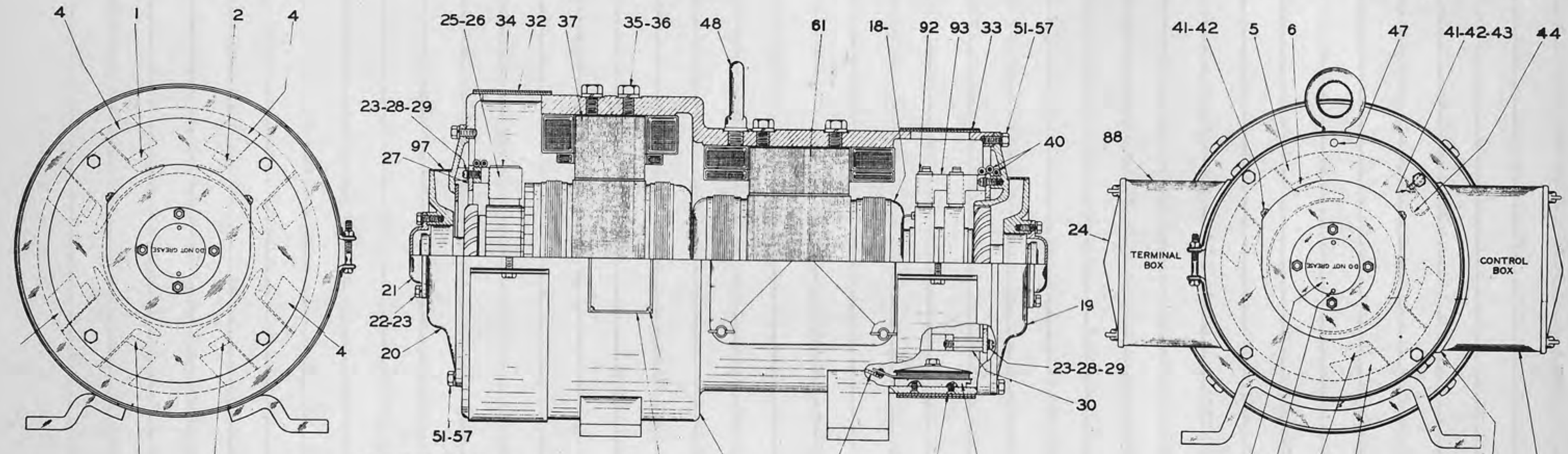
It should be remembered that it is the function of the ballast to deliver to fluorescent lamps the proper lamp voltage and current required. The lamp voltage and current vary with the length, diameter and wattage.

It follows then that the ballast used must be of specifications to suit the circuit voltage and the design of the lamp.

I N S P E C T I O N   P R O C E D U R E : will be as outlined in instructions from Superintendent of Yards Office, dated May 1, 1949, covered by letter dated July 1, 1949.

ITEM NUMBER	NAME	CAT. NO.	NO. REQUIRED
1	MOTOR AUX. COIL	SEE TABLE	2
2	MOTOR SERIES COIL	"	1
3	MOTOR SERIES COIL	"	1
4	MOTOR SHUNT COIL	"	4
5	ALT. SHUNT COIL	"	2
6	ALT. SERIES COIL	"	1
7	ALT. SERIES COIL	"	1
8	LEAD	316965	2
11	LEAD	316968	1
12	LEAD	316969	1
13	LEAD	310604	1
14	SCREW	11220	4
15	RESISTANCE UNIT	316516-C	1
16	RESISTANCE UNIT	23863-C	1
17	MAGNET FRAME COMP.	315757	1
18	ARMATURE COMP.	315546	1
19	HEAD A.C. END	315543	1
20	HEAD D.C. END	315818	1
21	GREASE CAP	316832	2
22	LOCKWASHER	3924	33
23	SCREW	54981	8
24	TERMINAL BOX COVER	315744	2
25	BRUSH BOX COMP	305983	2
26	BRUSH BOX COMP.	316411	2
27	INSULATOR	306766	2
28	WASHER	56659	24
29	SCREW	56498	24
30	STUD	306780	4
31	COMPENSATING UNIT	310968	2
32	HAND HOLE COVER COMP.	310206	1
33	HAND HOLE COVER COMP.	64232	1
34	BRUSH	310531	4
35	SCREW	51398	12
36	LOCKWASHER	4214	12
37	POLE	309892	4
38	CONNECTOR	310602	1
39	CONNECTOR	310603	1
40	CONNECTOR	309351	4
41	SCREW	1523	5
42	LOCKWASHER	22262	6
43	WASHER	7277	1
44	CLIP	309743	1
45	NAME PLATE	313052	1
46	DRIVE SCREW	53134	4
47	PIN	58633	2
48	EYE BOLT	53313	1
49	WASHER	59324	2
50	SCREW	58361	2
51	LOCKWASHER	4319	18
52	SCREW	500427	8
53	CONNECTOR	309136	1
54	RECTIFIER	309189	1
55	SCREW	5711	6
56	LOCKWASHER	52909	8
57	SCREW	51182	8
61	POLE	306746	2
62	RECTIFIER SUPPORT	315761	1
63	SCREW	5167	4
64	LOCKWASHER	54444	4
67	TERMINAL BLOCK	315738	1
79	TRANSFORMER COMP.	312709	1
87	CONTROL HOUSING	315733	1
88	TERMINAL BOX	315734	1
89	BOX GASKET	315748	2
90	NUT	7144	4
91	WASHER	22204	4
92	BRUSH	316327	4
93	BRUSH BOX COMP.	316325	4
94	INSTRUCTION PLATE	316644	2
95	DRIVE SCREW	53131	4
97	SCREENS	307879	2





ITEM 1 MOTOR AUX COIL	ITEM 2 MOTOR SERIES COIL	ITEM 3 MOTOR SERIES COIL	ITEM 4 MOTOR SHUNT COIL	ITEM 5 ALT. SHUNT COIL	ITEM 6 ALT. SERIES COIL	ITEM 7 ALT. SERIES COIL
316958	316956	316957	309999	316959	310533	315759

Nº 315552 2KW ALTERNATOR

Figure 147

N O T E S

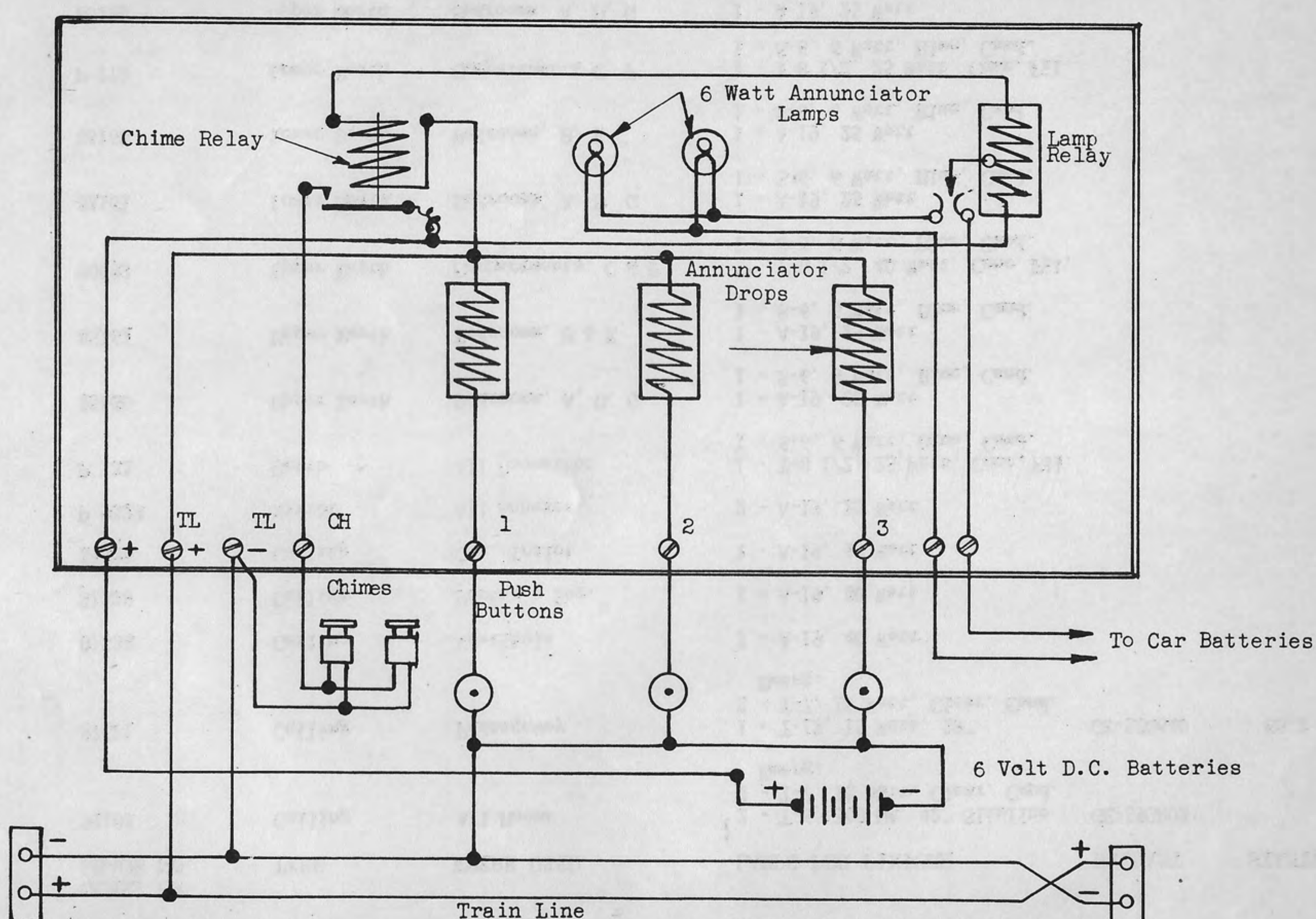


Figure 148

NOTE: 16 to 28 Drop Annunciators illuminated by 2 lamps.

CALL BELL CIRCUIT

LAMPING SPECIFICATIONS

"PASS" SERIES CARS - PLAN 4180 - LOT 6877

FIXTURE NO.	GLASS OR SHADE NO.	TYPE	WHERE USED	LAMPS PER FIXTURE	BALLAST	STARTER
SC 91034	91103	Ceiling	All Rooms	2 - T-6, 300 MA, 42" Slimline 2 - T-7, 15 Watt, Clear, Cand. Emerg.	GE-59G802	
SC 88155	87681	Ceiling	Passageway	1 - T-12, 15 Watt, 18" 2 - T-7, 15 Watt, Clear, Cand. Emerg.	GE-58G640	FS-2
SC 81525	81528	Ceiling	Vestibule	1 - A-19, 40 Watt		
SC 81525	81528	Ceiling	Porter's Sec.	1 - A-19, 40 Watt		
SC 81525	81528	Ceiling	Gen. Toilet	1 - A-19, 40 Watt		
L 6665	P 9323	Mirror	All Annexes	2 - A-19, 25 Watt		
L 9322	P 733	Berth	All Roomettes	1 - T-8 1/2, 25 Watt, Conc. Fil. 1 - S-6, 6 Watt, Blue, Cand.		
SC 87037	85160	Upper Berth	Bedrooms, A, D, G	1 - A-19, 25 Watt 1 - S-6, 6 Watt, Blue, Cand.		
SC 87036	85161	Upper Berth	Bedrooms, B & E	1 - A-19, 25 Watt 1 - S-6, 6 Watt, Blue, Cand.		
SC 90085	90093	Upper Berth	Compartments, C & F	1 - T-8 1/2, 40 Watt, Conc. Fil. 1 - S-6, 6 Watt, Blue, Cand.		
SC 87036	85161	Lower Berth	Bedrooms, A, D, G	1 - A-19, 25 Watt 1 - S-6, 6 Watt, Blue, Cand.		
SC 87037	85160	Lower Berth	Bedrooms, B, E	1 - A-19, 25 Watt 1 - S-6, 6 Watt, Blue, Cand.		
L 9322	P 773	Lower Berth	Compartments C, F	1 - T-8 1/2, 25 Watt, Conc. Fil. 1 - S-6, 6 Watt, Blue, Cand.		
SC 87036	85161	Upper Berth	Bedrooms, A, D, G	1 - A-19, 25 Watt 1 - S-6, 6 Watt, Blue, Cand.		

LAMPING SPECIFICATIONS

"PASS" SERIES CARS - PLAN 4180 - LOT 6877

FIXTURE NO.	GLASS OR SHADE NO.	TYPE	WHERE USED	LAMPS PER FIXTURE	BALLAST	STARTER
SC 87037	85160	Upper Berth	Bedrooms, B, E	1 - A-19, 25 Watt 1 - S-6, 6 Watt, Blue, Cand.		
SC 89912	89735	Upper Berth	Compartments, C, F	1 - A-19, 25 Watt 1 - S-6, 6 Watt, Blue, Cand.		
L 6016	P 9026	Door	Blind End	1 - A-19, 25 Watt		
P.S.C.M. Co.	-	Step	Vestibule	1 - A-17, 15 Watt		
Woodhead No. 101	-	Inspection	Ex. O.H. Unit	1 - A-19, 25 Watt		
Crouse-Hinds V189	V-18 Globe V-95 Guard	Inspection	Ex. Blower & Door Engine	1 - A-19, 25 Watt		
Bryant 410	-	Locker	Control (Ground Indicator)	1 - A-19, 25 Watt		
Bryant 410	-	Locker	Electric	1 - A-17, 15 Watt		
Edwards CS-218	-	-	Annunciator	2 - S-6, 6 Watt, Clear Cand.		
Kirkland 659 D/E	-	Pilot	-	1 - S-6, 6 Watt, Clear, Cand. 60 Volt		
P.S.C.M. Co.	-	Sign	Car Number	3 - S-6, 3 Watt, Clear, Cand.		

LAMPING SPECIFICATIONS

"RIVER" SERIES CARS - PLAN 4180 - LOT 6889

FIXTURE NO.	GLASS OR SHADE NO.	TYPE	WHERE USED	LAMPS PER FIXTURE	BALLAST	STARTER
SC 90916	91103	Ceiling	Upper Roomettes	2 - T-6, Slimline, 200 MA, 42" 2 - T-7, 15 Watt, Clear, Cand. Emerg.	GE-59G569	
SC 90917	91103	Ceiling	Lower Roomettes	2 - T-6, Slimline, 200 MA, 42" 2 - T-7, 15 Watt, Clear, Cand. Emerg.	GE-59G569	
SC 90917	91103	Ceiling	Dress. Rooms	2 - T-6, Slimline, 200 MA, 42" 2 - T-7, 15 Watt, Clear, Cand. Emerg.	GE-59G569	
SC 88155	87681	Ceiling	Passageway	1 - T-12, 15 Watt, 18" 2 - T-7, 15 Watt, Clear, Cand. Emerg.	GE-58G640	FS-2
SC 90915	87681	Ceiling	Passageway at Upper Roomettes	1 - T-12, 15 Watt, 18" 2 - T-7, 15 Watt, Clear, Cand. Emerg.	GE-58G640	FS-2
SC 81525	81528	Ceiling	Vestibule	1 - A-19, 40 Watt		
SC 81534	81528	Ceiling	Gen. Toilet	A - A-19, 25 Watt		
L 6665	P 9323	Mirror	Annexes & Bedroom C	2 - A-19, 25 Watt		
SC 88819	85160	Upper Berth	Open Section	1 - A-19, 25 Watt 1 - S-6, 6 Watt, Blue, Cand.		
SC 88820	85161	Upper Berth	Open Section	1 - A-19, 25 Watt 1 - S-6, 6 Watt, Blue, Cand.		
SC 91034	91103	Ceiling	Bedrooms & Compts.	2 - T-6, 300 MA, 42" Slimline 2 - T-7, 15 Watt, Clear, Cand. Emerg.	GE-59G802	

LAMP SPECIFICATIONS

"RIVER" SERIES CARS - PLAN 4181 - LOT 6889

FIXTURE NO.	GLASS OR SHADE NO.	TYPE	WHERE USED	LAMPS PER FIXTURE	BALLAST	STARTER
SC 87036	85161	Lower Berth	Open Section	1 - A-19, Watt 1 - S-6, 6 Watt, Blue, Cand.		
SC 87037	85160	Lower Berth	Open Section	1 - A-19, 25 Watt 1 - S-6, 6 Watt, Blue, Cand.		
SC 87037	85160	Berth	Lower Rmts. 1 & 5	1 - A-19, 25 Watt 1 - S-6, 6 Watt, Blue, Cand.		
SC 87036	85161	Berth	Lower Rmts. 2 & 6	1 - A-19, 25 Watt 1 - S-6, 6 Watt, Blue, Cand.		
L 9332	P 773	Berth	Upper Rmts.	1 - T-8 1/2, 25 Watt, Conc. Fil. 1 - S-6, 6 Watt, Blue, Cand.		
SC 87037	85160	Reading	Bedrooms A & C	1 - A-19, 25 Watt 1 - S-6, 6 Watt, Blue, Cand.		
SC 87036	85161	Upper & Lower Berth	Bedrooms A & C	1 - A-19, 25 Watt 1 - S-6, 6 Watt, Blue, Cand.		
SC 87036	85161	Reading	Bedroom D	1 - A-19, 25 Watt 1 - S-6, 6 Watt, Blue, Cand.		
SC 87037	85160	Upper & Lower Berth	Bedroom D	1 - A-19, 25 Watt 1 - S-6, 6 Watt, Blue, Cand.		
SC 90085	90093	Reading	Compartment B	1 - T-8 1/2, 40 Watt, Conc. Fil. 1 - S-6, 6 Watt, Blue, Cand.		
L 9322	P 773	Lower Berth	Compartment B	1 - T-8 1/2, 25 Watt, Conc. Fil. 1 - S-6, 6 Watt, Blue, Cand.		
SC 89912	89735	Upper Berth	Compartment B	1 - A-19, 25 Watt 1 - S-6, 6 Watt, Blue, Cand.		
SC 90914	87245	Step	Upper Roomettes	1 - S-6, 6 Watt, Clear, Cand.		

LAMPING SPECIFICATIONS

"RIVER" SERIES CARS - PLAN 4181 - LOT 6889

FIXTURE NO.	GLASS OR SHADE NO.	TYPE	WHERE USED	LAMPS PER FIXTURE	BALLAST	STARTER
L 6016	P 9026	Door	End	1 - A-19, 25 Watt		
P.S.C.M. Co. 218-C-62	-	Step,	Vestibule	1 - A-17, 15 Watt		
Crouse-Hinds V-189	V-18 Glove V-95 Guard	Inspection	Ex. Blower & Dr. Eng.	1 - A-19, 25 Watt		
Woodhead No. 101	-	Inspection	O.H. Unit	1 - A-19, 25 Watt		
Bryant 410	-	Locker	Control (ground indicator)	1 - A-19, 25 Watt		
Bryant 410	-	Locker	Electric	1 - A-17, 15 Watt		
Edwards CS-218	-	-	Annunciator	2 - S-6, 6 Watt, Clear, Cand.		
Kirkland 659D/E	-	Pilot	-	1 - S-6, 6 Watt, Clear, 60 V.		
P.S.C.M. Co.	-	Sign	Car Number	3 - S-6, 3 Watt, Clear, Cand.		

LAMPING SPECIFICATIONS

"GLACIER" SERIES CARS - PLAN 4108-A - LOT 6890

FIXTURE NO.	GLASS OR SHADE NO.	TYPE	WHERE USED	LAMPS PER FIXTURE	BALLAST	STARTER
SC 90916	91103	Ceiling	Upper Roomettes	2 - T-6, 200 MA, 42" Slimline 2 - T-7, 15 Watt, Clear, Cand. Emerg.	GE-59G569	
SC 90917	91103	Ceiling	Lower Roomettes	2 - T-6, 200 MA, 42" Slimline 2 - T-7, 15 Watt, Clear, Cand. Emerg.	GE-59G569	
SC 88155	87681	Ceiling	Passageway	1 - T-12, 15 Watt, 18" 2 - T-7, 15 Watt, Clear, Cand. Emerg.	GE-58G640	FS-2
SC 90915	87681	Ceiling	Passageway at Upper Roomettes	1 - T-12, 15 Watt, 18" 2 - T-7, 15 Watt, Clear, Cand. Emerg.	GE-58G640	FS-2
SC 81525	81528	Ceiling	Vestibule	1 - A-19, 40 Watt		
SC 81525	81528	Ceiling	Porter's Sec.	1 - A-19, 40 Watt		
SC 81525	81528	Ceiling	General Toilet	1 - A-19, 40 Watt		
L 6665	P 9323	Mirror	Bedrooms	2 - A-19, 25 Watt		
SC 87036	85161	Reading	Rooms A & C	1 - A-19, 25 Watt 1 - S-6, 6 Watt, Blue, Cand.		
SC 91033	91103	Ceiling	Bedrooms	2 - T-6, 300 MA, 42" Slimline 2 - T-7, 15 Watt, Clear, Cand. Emerg.	GE-59G802	
SC 87037	85160	Upper & Lower Berth	Rooms A, B, C, D	1 - A-19, 25 Watt 1 - S-6, 6 Watt, Blue, Cand.		
SC 87036	85161	Upper & Lower Berth	Rooms A, B, C, D	1 - A-19, 25 Watt 1 - S-6, 6 Watt, Blue, Cand.		

LAMPING SPECIFICATIONS

"GLACIER" SERIES CARS - PLAN 4108-A - LOT 6890

FIXTURE NO.	GLASS OR SHADE NO.	TYPE	WHERE USED	LAMPS PER FIXTURE	BALLAST	STARTER
SC 87036	85161	Berth	Lower Rmts. 2, 6, 10, 14	1 - A-19, 25 Watt 1 - S-6, 6 Watt, Blue, Cand.		
SC 87037	85160	Berth	Lower Rmts. 1, 5, 9, 13	1 - A-19, 25 Watt 1 - S-6, 6 Watt, Blue, Cand.		
L 9332	P 773	Berth	Upper Rmts.	1 - T-8 1/2, 25 Watt, Conc. Fil. 1 - 8-6, 6 Watt, Blue, Cand.		
SC 90914	87245	Step	Upper Rmts.	1 - S-6, 6 Watt, Clear, Cand.		
L 6016	P 9026	Door	End	1 - A-19, 25 Watt		
P.S.C.M. Co.	-	Step	Vestibule	1 - A-17, 15 Watt		
Woodhead No. 101	-	Inspection	O.H. Unit	1 - A-19, 25 Watt		
Crouse-Hinds V-189	V-18 Globe V-95 Guard	Inspection	Ex. Blower & Door Engine	1 - A-19, 25 Watt		
Bryant 410	-	Locker	Control (ground indicator)	1 - A-19, 25 Watt		
Bryant 410	-	Locker	Electric	1 - A-17, 15 Watt		
Edwards CS-218	-	-	Annunciator	2 - S-6, 6 Watt, Clear, Cand.		
Kirkland 659 D/E	-	Pilot	-	1 - S-6, 6 Watt, Clear, Cand., 60 V.		
P.S.C.M. Co.	-	Sign	Car Number	3 - S-6, 3 Watt, Clear, Cand.		

LAMPING SPECIFICATIONS

"PRIEST" RIVER - PLAN 4109-A - LOT 6878

FIXTURE NO.	GLASS OR SHADE NO.	TYPE	WHERE USED	LAMPS PER FIXTURE	BALLAST	STARTER
SC 89297	91103	Ceiling	Drawing Room C	4 - T-6, 200 MA, 42" Slimline 2 - T-7, 15 Watt, Clear Cand. Emerg.	GE-59G569	
SC 89289	91103	Ceiling	Bedroom A & B	2 - T-6, 25 Watt, 200 MA, 42" Slimline 2 - T-7, 15 Watt, Clear Cand, Emerg.	GE-59G569	
SC 88155	87681	Ceiling	Passageway	1 - T-12, 15 Watt, 18" 2 - T-7, 15 Watt, Clear Cand, Emerg.	GE-58G640	FS-2
SC 81534	81528	Ceiling	Vestibule	1 - A-19, 25 Watt		
SC 78835	54413	Ceiling	Buffet	1 - A-23, 75 Watt		
SC 87036	85161	Upper & Lower Berth	Room A	1 - A-19, 25 Watt 1 - S-6, 6 Watt, Blue Cand.		
SC 87037	85160	Reading	Room A	1 - A-19, 25 Watt 1 - S-6, 6 Watt, Blue Cand.		
SC 87037	85160	Upper & Lower Berth	Rooms B & C	1 - A-19, 25 Watt 1 - S-6, 6 Watt, Blue Cand.		

FIXTURE NO.	GLASS OR SHADE NO.	INDIRECT GLASS OR SHADE NO.	TYPE	WHERE USED
SC 8045010	SC 85904 SC 85905 SC 85906 SC 85907 SC 85908 SC 86377 SC 88328 SC 88329 SC 88330 SC 88331 SC 88332	SC 85966 SC 85967 SC 85868 SC 85969 SC 85970	Ceiling	Lounge Obsv.

A total of 13 T-12, 18" 15 Watt Lamps using G.E. 58G670 Ballast and FS-2 Starters.
A total of 18 T-12, 48" 40 Watt Lamps using G.E. 58G943 Ballast and FS-4 Starters.
A total of 19 T-8, 15 Watt, Blue Night Lights.

LAMPING SPECIFICATIONS

"PRIEST" RIVER - PLAN 4109 - LOT 6878

FIXTURE NO.	GLASS OR SHADE NO.	TYPE	WHERE USED	LAMPS PER FIXTURE	BALLAST	STARTER
SC 87036	85161	Reading	Room B & C	1 - A-19, 25 Watt 1 - S-6, 6 Watt, Blue Cand.		
SC 90278	86063	Mirror	Room A & B	1 - T-8 1/2, 25 Watt, Stretched Fil.		
SC 91132	90022	Mirror	Room C Annex	1 - T-8, 15 Watt, 18"	GE-58G670	FS-2
SC 91132	90022	Mirror	Room C Annex	1 - T-8, 15 Watt, 18"	GE-58G670	FS-2
SC 90278	86063	Mirror	General Toilet	1 - T-8 1/2, 25 Watt, Stretched Fil.		
SC 85548	82279	Desk	Lounge	1 - T-8 1/2, 25 Watt, Stretched Fil.		
New Metal Craft Co.	C & D Drg. No. 3-992-2	Table	Lounge	2 - A-19, 25 Watt		
P.S.C.M. Co.	Drg. 379-D-74	Wardrobe	Room C	1 - A-17, 15 Watt		
Pyle Nat'l. Co.	MLSP-35-R MLSP-35-L	Marker	Obs. End	1 - A-19, 25 Watt		
Gen'l. Advertising Co.	Pullman Drg. 85-E-84	Their Drg. 66 & 67	Tail Sign	Neon		
Mars Company	-	Their Drg. OS-250-RE-14	-	2 - P-21, 250 Watt, Clear		
GH-24 Crouse-Hinds	Guard GH-24	Bulkhead	Buffet	1 - A-21, 50 Watt		
P.S.C.M. Co.	-	-	Refrigerator	1 - T-8 1/2, 25 Watt, Stretched Fil.		
P.S.C.M. Co.	Pullman Drg. 98-T-84	Work	Buffet	1 - T-8 1/2, 25 Watt, Stretched Fil.		
P.S.C.M. Co.	Pullman Drg. 218-C-98	Step	Vestibule	1 - A-17, 15 Watt		
P.S.C.M. Co.	Pullman Drg. 99-E-39	Sign	Car Number	3 - S-6, 3 Watt, Clear Cand.		

NOTES

BEHAVIOR		POSSIBLE CAUSE	CORRECTIVE ACTION
ENDS REMAIN LIGHTED		1. Ends of lamp remain lighted; stater failure due to: Short-circuit condenser in starter or switch contacts welded together.	Replace starter.
		2. In new installation,may be circuit wiring or ground fault.	Check circuit wiring.
	1. Accompanied by shimmering effect during "lighted" period.	Normal failure; active material on electrodes exhausted; voltage needed for operation exceeds voltage supply.	Replace lamp.
	2. Blinking of relatively new lamp.	1. Possibly lamp at fault.	Replace lamp. Investigate further if successive lamps blink or flicker in same lamp holders.
BLINKING ON AND OFF		2. Starter defective, causing on - off blink or prolonged flashing at each start.	Replace starter.
		3. Low ballast rating.	Check ballast.
		4. Cold drafts hitting tube.	Enclose or protect lamp.
		5. Low circuit voltage (Decreased ease of starting; also 1% change in light output for each 1% change in voltage, with output of " lagging" lamp - in 2 lamp circuit - decreasing much faster than that of " leading" lamp.)	Check voltage and correct if possible.
		6. Loose circuit contact (likely at lamp holder) causing on-off blink.	Lamp holders rigidly mounted; lamp securely seated.
	3. With 2-lamp ballast: If one lamp starts, one end of the other may blink on and off without starting; occasionally, both lamps may start.	Individual starter leads from the two pairs of lamp holders may be criss-crossed. (If this is the case, one lamp will not make starting effort unless the other is in its lamp holders).	Rewire starter leads.

a

	BEHAVIOR	POSSIBLE CAUSE	CORRECTIVE ACTION
NORMAL END OF LAMP LIFE.	Lamp won't operate; or flashes momentarily then goes out; or blinks on and off.	Normal failure; active material on electrodes exhausted; voltage needed for operation exceeds voltage supply.	Replace lamp.
END BLACKENING	1. Dense blackening at one end or both, extending 2" - 3" from base.	Normal - End of Life.	Replace lamp.
	2. Blackening, generally within 1" of ends.	Mercury desposit, common especially with 1" lamps.	Should evaporate by itself as lamp is operated.
	3. Blackening early in life indicates active material from electrodes being spattered off to rapidly.	1. Starter defective, causing on-off blink or prolonged flashing at each start.	Replace starter.
		2. Ends of lamp remain lighted; starter failure due to: Short-circuit condenser in starter or switch contacts welded together.	Replace starter.
		3. No starting compensator in leading circuit of 2-lamp ballast.	Install compensator in series with starter in leading circuit. (None required for 100 watt lamps).
		4. Ballast improperly designed or outside specifications for lamp wattage or wrong ballast being used.	Use ballast of correct rating for lamp size.
		5. Too low or too high voltage.	Check voltage with range on ballast name plate.
		6. Loose circuit contact (likely at lamp holder) causing on-off blink.	Lamp holders rigidly mounted; lamp securely seated.
DARK STREAKS	Streaks lengthwise of tube.	Globules of mercury on lower (cooler) part.	Rotate tube 180° -Mercury may evaporate by increased warmth, though it may condense out again on cool side.
RINGS	Brownish rings at one end or both ends about 2'' from base.	Sometimes a natural development during life.	Has no effect on lamp performance.
DENSE SPOTS	Black, about 1/2" wide, extending about halfway around tube, centering about 1'' from base.	Normal - but if early in life indicates excessive starting or operating current.	Check for ballast off-rating or unusually high circuit voltage.

b

BEHAVIOR		POSSIBLE CAUSE	CORRECTIVE ACTION
NO STARTING EFFORT OR SLOW STARTING	1.	Open circuit in electrodes, due to broken electrode, air leak, open weld, etc.	If open circuit is shown by test or inspection as in Item No. 9 (below) replace lamp.
	2.	Burned-out electrode (might be caused by placing one end of lamp across 115 volts).	If open circuit is shown by test or inspection as in Item No. 9 (below) replace lamp.
	3.	Air leak in lamp. In test with test lamp (See item No. 9) leak is indicated by absence of glow, through electrode lights up.	Replace lamp.
	4.	Starter at end of life.	Replace starter.
	5.	Starter sluggish.	Replace starter.
	6.	No starting compensator in leading circuit of 2-lamp ballast.	Install compensator in series with starter in leading circuit. None required for 100 watt lamps.
	7.	Low ballast rating.	Check ballast.
	8.	Remote possibility of open-circuited ballast.	Check ballast.
	9.	Burned-out lamp electrodes due to: Broken lamp holders. Lamp holders with attached starter sockets, surface-mounted on metal. One strand of conductor touching grounded fixture. Improper wiring. D.C. operation without necessary additional resistance.	To determine necessity for replacing lamp, examine electrodes by viewing end of bulb against pin-hole of light. (Or test by connecting base pins in series with test lamp* on 115 v circuit. Fluorescent glow means intact electrodes and active electrons)
			* Correct Test Lamp Size. — for — Various F Lamps 60 W — 14 w to 40 w 25 w — Small diameter or miniature. 200 w — 100 w
		Ground from some other cause.	
	10.	Low circuit voltage (Decreased ease of starting, also 1% change in light output for each 1% change in voltage, with output of "lagging" lamp - in 2 lamp circuit - decreasing must faster than that of "leading" lamp)	Check voltage and correct if possible.

c

	BEHAVIOR	POSSIBLE CAUSE	CORRECTIVE ACTION
NO STARTING EFFORT, OR SLOW STARTING (Cont'd).		11. Possible open circuit.	Test lamp in another circuit, being sure of proper contact in lamp holders. Check voltage from one lamp holder to the other. (Use vottmeter or 220 v. 100 w test lamp. Only one connection at each holder should be alive, hence 4 ways to check two live ones). If no voltage indication from lamp holders, check circuit leads to holders. If still no voltage, check circuit connection.
FLICKER (NOT STROBOSCOPIC EFFECT)	1. Pronounced, irregular flicker on looking directly at lamp (spiraling, swirling, snaking, etc.)	1. New lamp may flicker.	Flicker should clear up after lamp is operated or turned on and off a few times.
		2. Starter not performing properly to pre-heat electrodes.	Replace starter.
		3. No starting compensator in leading circuit to 2-lamp ballast.	Install compensator in series with starter in leading circuit. None required for 100 w lamps.
		4. Ballast improperly designed or outside specifications for lamp wattage, or wrong ballast being used.	Use ballasts of correct rating for lamp size.
		5. High voltage starting.	Check voltage.
	2. Flicker suddenly occurring.	May suddenly develop in any lamp in normal service.	Should clear up if turned off for a few seconds.
	3. Persistent tendency to flicker.	Possibly lamp at fault.	Replace lamp. Investigate further if successive lamps blink or flicker in same lamp holders.

d

BEHAVIOR	POSSIBLE CAUSE	CORRECTIVE ACTION
SHORT LIFE	1. Mortality laws; that is, for 4000-hr. rated life, some will fail at shorter life; others last much longer than rated hours. 4000-hr. life based on operating lamp 6 hrs. for each start.	
	2. Starter defective, causing on-off blink or prolonged flashing at each start.	Replace starter.
	3. Ends of lamp remain lighted; starter failure due to Short-circuit condenser in starter or Switch contacts welded together.	Replace starter.
	4. No starting compensator in leading circuit of 2-lamp ballast.	Install compensator in series with starter in leading circuit. None required for 100-watt lamps.
	5. Ballast improperly designed or outside specifications for lamp wattage, or wrong ballast being used.	Use ballasts of correct rating for lamp size.
	6. Too low or too high voltage.	Check voltage with range on ballast name plate.
	7. Loose circuit contact (likely at lamp holder) causing on-off blink.	Lamp holders rigidly mounted, lamp securely seated.
	8. Too many lamp starts.	Average life rating based on frequency of starts.
DECREASED LIGHT OUTPUT	1. Where heat is confined around lamp, light output is lower.	Better ventilation of fixture.
	2. Cold drafts hitting tube.	Enclose or protect lamp.
	3. Low temperature operation (below 65^{o} light loss is 1% or more per degree F.)	Enclose.
	4. Low circuit voltage (Decreased ease of starting; also 1% change in light output for each 1% change in voltage, with output of " lagging" lamp - in 2 lamp circuit - decreasing much faster than that of " leading'' lamp.)	Check voltage and correct if possible.

BEHAVIOR		POSSIBLE CAUSE	CORRECTIVE ACTION
DECREASED LIGHT OUTPUT(Continued)		5. Dust or dirt on lamp, fixture, walls or ceiling.	Clean.
COLOR AND BRIGHTNESS DIFFERENCES.	1. Different Color appearance in different locations of same installation.	1. Actual slight differences (in white or daylight lamps) may be discernible; perhaps wrong color lamp used; possibly lamp outside limits of color standards, or apparent color difference may be only difference in brightness between old and new lamps.	Replace lamp, if objectionable.
		2. May be due to reflector finish, wall finish, other nearby light, room decorations, etc.	Interchange lamps before assuming color difference.
	2. Lamps operate at unequal brilliancy.	Low circuit voltage (Decreased ease of starting, also 1% change in light output for each 1% change in voltage, with output of " lagging" lamp - in 2 lamp circuit decreasing much faster than that of " leading'' lamp).	Check voltage and correct if possible.
NOISE	Humming sound, which may be steady, or may come and go.	1. Slight transformer hum inherent in ballast equipment; varies in different ballasts. Objectionable amount may be due to improper installation or improper ballast design.	Mount ballasts on soft rubber Celotex etc., to prevent transferring vibrations to supporting members, and to reduce hum to a minimum.
OVERHEATED BALLAST.		1. Short in ballast or capacitor.	Replace ballast or capacitor.
		2. Prolonged blinking tends to heat ballast, and heating is aggravated under high ambient temperature inside fixture housing.	See " BLINKING ON AND OFF" under BEHAVIOR and correct the cause.
		3. Short in wiring.	

VARIOUS FUSES AND HOLDERS USED ON NEW LIGHTWEIGHT CARS

FUSE
E-3640

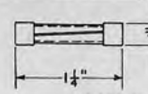
PLUG FUSE, ONE TIME BLOW
125 VOLTS

USED IN: —	110 V.	64 V.	32 V.
CONTROL CIRCUITS	5 AMPS	10 AMPS	10 & 15 A.
BRANCH LIGHT CIRCUITS	5 & 10 A.	15 & 20 A.	25 & 30 A.
PILOT LIGHT CIRCUITS	5 AMPS	5 AMPS	5 AMPS

FUSETRON
E-5742

PLUG FUSETRON, ONE TIME BLOW
125 VOLTS

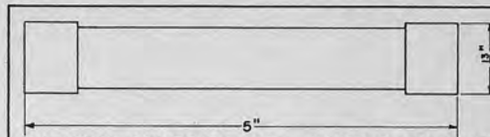
USED IN: —	110 V.	64 V.	32 V.
MOTOR CIRCUITS $\frac{1}{4}$ & $\frac{1}{3}$ H.P.		10 AMP.	15 AMP.
" " $\frac{1}{2}$ & 1 H.P.		15 AMP.	30 AMP.



GLASS CARTRIDGE FUSE
K-3284
SINGLE BLOW 5 A.

TYPE 3 MTH 250 VOLT or
TYPE 3 AGC 32 VOLT

USED IN: —	110 V.	64 V.	32 V.
RAZOR CONVERTER		5 A.	5 A.
PILOT LIGHT CIRCUIT	5 A.	5 A.	5 A.

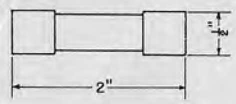


CARTRIDGE, SINGLE BLOW 600 V. E-3637 10 & 20 AMPERES

USED IN: —	110 V.	64 V.	32 V.
G.E. GENERATOR FIELD	20 A.	20 A.	
G.E. GENERATOR CONTROLS		10 A.	

FUSE
E-3637

CARTRIDGE, ONE TIME BLOW
250 VOLTS



FUSES

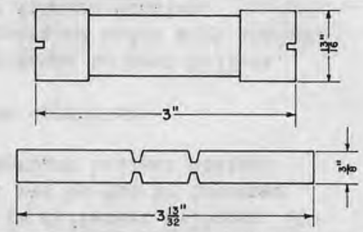
USED IN: —	110 V.	64 V.	32 V.
CONTROL CIRCUITS	6 A.	15 A.	15 A.
GENERATOR FIELD	15 A.	15 A.	15 A.
BRANCH LIGHT CIRCUIT	6 A.	15 A.	20 A.

FUSETRON
E-7969

CARTRIDGE, ONE TIME BLOW
250 VOLTS

FUSETRONS

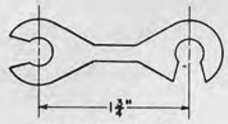
USED IN: —	220 V.	110 V.	64 V.	32 V.
MOTORS $\frac{1}{4}$ & $\frac{1}{3}$ H.P.	5 A.	5 A.	10 A.	20 A.
MOTORS $\frac{1}{2}$ & 1 H.P.	5 A.	10 A.	20 A.	30 A.



FUSE CARTRIDGE E-7774, 250 VOLTS

FUSE LINK E-2237, SUPERLAG 250 VOLTS

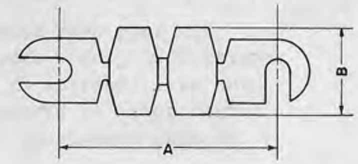
USED IN: —	110 V.	64 V.	32 V.
WAUK. ICE ENG. CRANKING CRT.		40 A.	60 A.
CONDENSER FAN CIRCUITS		40 A.	60 A.
EVAPORATIVE CONDENSERS		40 A.	60 A.
BUFFET APPLIANCES CRTS.		30 A.	60 A.



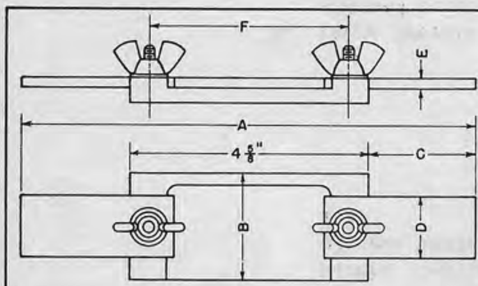
FUSE LINK K-6512
250 VOLTS

USED IN CIRCUITS FOR: —	110 V.	64 V.	32 V.
COLD WATER PUMPS		10 A.	20 A.
CONDENSER PUMPS		35 A.	65 A.
AIR CIRCULATING FANS		15 A.	30 A.
CONDENSER FANS		50 A.	90 A.

FUSE LINKS E-7606, 250 VOLTS, USED WITH CARTRIDGE E-2236 AND OPEN HOLDERS E-1022 & E-5877.



USED IN: —	110 V.	64 V.	32 V.
1.2 KVA ALTERNATOR		40 A.*	70 A.
2 KVA ALTERNATOR		70 A.	100 A.
2.2 KVA INVERTER			100 A.
6.2 KVA INVERTER (AMP.)	100 A.	200 A.	
8.0 KVA INVERTER (AMP.)	125 A.		
MAIN BATTERY SWITCH		150 A.	300 A.
TRAIN LINES		100 A.®	200 A.
MAIN LIGHT SWITCH		100 A.	200 A.
WAUK. GEN. CRANKING		100 A.	150 A.
GENERATORS $7\frac{1}{2}$ KW.	70 A.	125 A.	250 A.
" 10 KW.	100 A.	150 A.	300 A.
" 15 KW.	150 A.	250 A.	450 A.
" 20 KW.	200 A.	300 A.	600 A.
" 25 KW.	250 A.	400 A.	700 A.
" 30 KW.	300 A.	450 A.	800 A.
COMPRESSOR MOTORS	125 A.	200 A.	350 A.



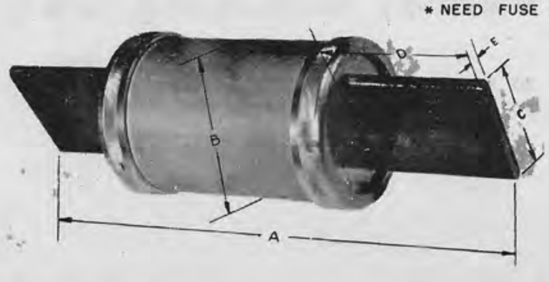
OPEN FUSE LINK HOLDER

FUSE AMP. FOR VARIOUS HOLDERS	CAT. No.	HOLDER DIMENSIONS A	B	C	D	E	F
70 & 100	E-1022	6"	$2\frac{7}{8}$"	$\frac{3}{4}$"	$1\frac{3}{16}$"	$\frac{1}{8}$"	$2\frac{1}{2}$"
125, 150 & 200							$2\frac{1}{2}$"
225, 300, 350 & 400	E-5877	$8\frac{5}{16}$"	$2\frac{1}{2}$"	$1\frac{5}{8}$"	$1\frac{7}{8}$"	$\frac{1}{4}$"	$2\frac{1}{2}$"
450 & 600	E-5877	$8\frac{5}{16}$"	$2\frac{1}{2}$"	$1\frac{5}{8}$"	$1\frac{7}{8}$"	$\frac{1}{4}$"	$2\frac{1}{2}$"
700							

LINK FUSE CAPACITY	LINK DIMENSIONS A	B
70 & 100	$2\frac{1}{2}$"	$\frac{5}{8}$"
125, 150 & 200	$2\frac{1}{2}$"	1"
225, 300, 350 & 400	$2\frac{1}{2}$"	$1\frac{1}{4}$"
450 & 600	$2\frac{1}{2}$"	$1\frac{1}{4}$"
700	$2\frac{1}{2}$"	$1\frac{1}{4}$"

® NEED FUSE CLIP ADAPTERS TO CHANGE FROM 200 AMPERES.
* NEED FUSE CLIP ADAPTERS TO USE E-7774 CARTRIGE.

E-2236



E-2236 CARTRIDGE
250 VOLTS

FUSE AMPERAGE FOR VARIOUS CARTRIGES	CARTRIDGE DIMENSIONS A	B	C	D	E
70 & 100	$5\frac{7}{8}$"	1"	$\frac{3}{4}$"	1"	$\frac{1}{8}$"
125, 150 & 200	$7\frac{1}{8}$"	$1\frac{1}{2}$"	$1\frac{1}{8}$"	$1\frac{3}{8}$"	$\frac{3}{16}$"
225, 300, 350 & 400	$8\frac{5}{8}$"	2"	$1\frac{5}{8}$"	$1\frac{7}{8}$"	$\frac{1}{4}$"
450 & 600	$8\frac{3}{4}$"	$2\frac{1}{2}$"	2"	$2\frac{1}{4}$"	$\frac{1}{4}$"
700	$10\frac{3}{8}$"	$2\frac{1}{2}$"	2"	$2\frac{1}{4}$"	$\frac{1}{4}$"

NOTES

FRIGIDAIRE REFRIGERATION EQUIPMENT IN OBSERVATION CAR

The complete buffet refrigerator assembly used is Frigidaire No. EM 15964 and is divided into three components. Condensing Unit No. E M 15524, cooling unit Model F P X 28 No. 15558, and tubing and fittings. Various accessories are used for control and operation of the refrigerant within these components.

The compressor and condenser along with their standard accessories are mounted on a single frame which is in turn located in the buffet. Figure 151 shows the condensing unit, and Pages 247 and 248 are a parts list with Frigidaire parts numbers.

The temperature of the compressor compartment must be maintained at 50°F, or above, at all times, for proper operation of the refrigerating system during cold weather. Sufficient ventilation must also be provided to keep the condensing unit compartment temperature and the condensing pressure normal.

The F P X 28 cooling unit is mounted in the top of the refrigerating locker and employes thermal air circulation. The unit consists of the conventional channeled plate surrounding ice cube trays. Air falls from the unit when cooled, and rises, along walls of the refrigerating compartment, when warmed.

All refrigerant lines are of soft copper tubing and all joints sweated with 95-5 solder.

Flexible couplings are installed in the suction line near the condensing unit. When soldering copper tubing to the flexible coupling, care must be exercised to keep the temperature of the coupling as low as possible.

Frigidaire Modulex Expansion Valve, M X 3 - AP meters the refrigerant into the cooling unit in quantities sufficient to assure adequate refrigeration. The bulb is clamped to the suction line immediately adjacent to the cooling unit to properly control the flow of refrigerant into the evaporator coil.

The "Modulex" expansion valve operates much the same as the conventional thermostatic expansion valve. It has only one bellows assembly, however, while the conventional valve has two. A metal cap seals the power element charge in the valve. Three push pins transmit the bellows movement to the needle carriage. Only one spring is used. Place below the needle, it serves the purpose of both valve-adjusting spring and closing spring. Temperature and pressure above the bellows controls the refrigerant flow. The pressure bellows is responsive to cooling unit pressure. See Figure 153.

The degree to which the cooling unit is flooded depends upon the adjustment of the expansion valve spring. The valve should be adjusted to maintain the least possible superheat of the refrigerant vapor in the cooling unit, while not permitting liquid refrigerant to flood into the suction line.

Under normal operating conditions the Modulex valve should not require adjustment. Adjustable packing space around the stem prevents loss of refrigerant during the time seal plug is removed. The end of the stem is square to accommodate a standard 3/16" valve wrench. The adjusting stem has a left-hand thread arranged so that turning it clockwise (viewed from the stem end of the valve) produces a higher superheat (less refrigerant). Turn the stem counter-clockwise for a lower superheat (more refrigerant) or a more flooded cooling unit.

When the refrigerating system is not functioning properly, do not arbitrarily blame the Modulex valve. Many refrigerant control valves are needlessly replaced when the trouble is often due to improper installation of the valve or some irregularity in another part of the system. Always make a thorough investigation of the entire system and a definite analysis of the trouble before attempting to rectify it.

If the suction pressure is lower than was anticipated, it is no fault of the valve, provided the superheat of the vapor at the end of the cooling unit is normal. The low suction pressure may be due to the load being light at the time or the condensing unit having more capacity than necessary, due to an incorrect replacement.

GENERAL SERVICE OPERATIONS

The service operations starting on next page are applicable to Frigidaire condensing units charged with F-12, and used in Buffet refrigeration systems.

One point cannot be stressed too strongly - the fact that the gauges must be accurate. Gauge errors of a couple of pounds will be sufficient to five false information. It follows therefore, that gauges should be checked frequently and replaced whenever necessary.

ATTACHING THE LOW PRESSURE GAUGE:

Stop the unit.
Remove the suction valve cap.
Turn the suction valve all the way to the left closing off the control line and gauge connection.
Remove the 1/4" pipe plug in the suction line valve, install a 1/4" flare connector and attach the gauge.
Turn the suction valve one turn to the right.
Purge gauge line at the flare nut on gauge.

ATTACHING THE HIGH PRESSURE GAUGE:

Stop the unit.
Remove the discharge valve cap.
Turn the discharge valve all the way to the left.
Remove the plug in the compressor head, install a 1/4" flare connector and attach the gauge.
Turn the discharge valve to the right just enough to cause the gauge to register. Purge the gauge line at the flare nut on the gauge.

NOTE: Never turn the discharge valve all the way to the right with the condensing unit operating as the gauge will be damaged and leaks may develop around the compressor head, due to excessive pressure.

EVACUATING THE COOLING UNIT, LIQUID AND SUCTION LINES (REMOVING REFRIGERANT):

Stop the unit.
Close the liquid line valve by turning it all the way to the right.
Attach a low pressure gauge.
Turn the suction valve one turn to the right.
Operate the unit until 0 lb. pressure is obtained in the suction side.
Stop the unit to see if this pressure holds for a few minutes. If pressure builds up, repeat this operation until the pressure reading remains at zero.
Crack the liquid valve and allow one or two pounds pressure to build up in the low pressure side. This operation is necessary in order to prevent air and moisture being drawn into the system.

PURGING AIR FROM THE COOLING UNIT:

All systems that have been opened should have the air blown out with refrigerant vapor. To purge the system, proceed as follows:

With the unit stopped, turn the suction valve all the way to the right, (do not attempt to purge through a valve-in-head compressor) then loosen the flare nut on the suction line at the compressor.

Crack the liquid valve until the refrigerant vapor escapes freely at the suction valve flare nut, then close the liquid valve.

Tighten the flare nut and test carefully for leaks.

NOTE: Wear goggles when purging.

PURGING AIR FROM THE CONDENSING UNIT:

Install High and Low pressure gauges.
Stop the unit and allow it to remain inoperative at least 15 minutes.
Turn the discharge valve all the way to the left and then unscrew the plug in the side of the discharge valve a few turns, allowing gasses to escape until the pressure is reduced to normal.
Crack the valve by turning it slightly to the right so that the refrigerant and air mixture will be forced out.

Turn the discharge valve all the way to the left and tighten the plug into place.

It may be necessary to repeat these operations if the condensing unit operating head pressure remains abnormally high.

TESTING FOR "FREON - 12" LEAKS.

See Page 214, A.C. Manual.

ADDING REFRIGERANT:

The proper method of adding refrigerant is through the low side of the condensing unit:

Stop the unit. Turn the compressor suction valve all the way to the left and attach a low pressure gauge.

Attach a length of 1/4" tubing to the line tee connection and to the refrigerant drum. The drum should always remain upright while the compressor is being charged.

Purge the 1/4" charging line by cracking the valve on the drum and then crack the flare nut connections on the compressor.

Turn the suction valve all the way to the right.

Start the unit and then open the valve on the drum slightly to maintain a steady back pressure of 10 lb. or less. In this way a given amount of refrigerant will be charged into the system and can be determined by weighing the drum before and after each charging operation. The longer the condensing unit runs the wider the valve will have to be opened due to the fact that the drum is getting colder and will not give up the vapor as fast as at the start of the charging.

When the charging is completed, stop the unit and then close the valve on the drum. Start and stop the unit until it has pumped the charging line to one pound pressure. Turn the suction line valve all the way to the left.

Remove the gauge and charging line and replace the blind flare nut and control line.

Turn the suction valve one turn to the right.

ADDING OIL:

Preventing air from being drawn into the unit at the time oil is being added is of greatest importance, and the operation should be watched very closely.

There should be at least 2" of oil in the glass container after the correct amount for the system has been drawn out. The most practical type of container to usw is a flat type, small neck, quart bottle, which should be securely corked when not in use.

A mark of some kind should be put on the outside of the container 2" from the bottom. Oil should be put in up to the mark, to which should be added the amount to be put into the system. The charging operation should be stopped when this mark is reached. With the charging line on the bottom of the container, it will be impossible for air to be drawn into the system.

NOTE: Inasmuch as one pint of oil is equivalent to one pound, only 1 1/2 pounds of oil may be safely added at one filling when using a quart bottle as the container.

The oil charging line of 1/4" tubing should have a separate hand shut-off valve included in it to provide a positive control of the oil flow from the container to the compressor at the time of charging.

Turn the suction valve on the compressor all the way to the left. Attach the low pressure gauge.

Remove the control line opposite the gauge connection and attach the oil charging line in its place and purge the line. Be sure the shut-off valve in the line is closed.

With the unit operating, turn the suction valve all the way to the right until the suction pressure is reduced to 15". If the pressure tends to build up after stopping, repeat the above operation.

Stop the unit, make sure the end of the charging line is in the bottom of the container, open the valve in the oil charging line and watch the oil in the container to ascertain when the oil level reaches the mark on the container.

As soon as the proper amount of oil has been added, close the shut-off valve in the charging line, turn the suction valve all the way to the left, remove the gauge and charging line and replace the flare nut and control line.

Turn the suction valve one turn to the right.

CHANGING THE COMPRESSOR:

Attach the low pressure gauge.
Start the unit and close the suction valve slowly.
When the gauge shows 0 lb. pressure stop the unit.

If the gauge remains at 0 lb. pressure for two minutes, turn the suction valve slightly to the left until the gauge shows one or two pounds pressure and then close it again.

Place safety switch on "OFF" position. Remove fuse and remove the belt.

Turn the discharge valve all the way to the right. Loosen the 1/4" plug provided for the gauge connection and slowly purge the gas trapped in the compressor head.

Unscrew the cap screws which hold the compressor head in place and loosen the head. Remove cap screws holding the compressor in place.

Do not disconnect the suction and discharge lines from the head.

Remove the old compressor and measure the exact amount of oil in the crankcase. Remove flywheel and install it on new compressor.

Remove the head from the new compressor after discharging the holding charge. Make certain that there is exactly as much oil in the new compressor as there was in the one removed.

Bold the new compressor in place, replace the compressor head and belt, be sure that the sealing surfaces of valve plate and head are free from paint. Use new gaskets under the head and valve plate.

Tighten the compressor head bolts evenly, and remove head pressure gauge connection. With the suction valve closed and head pressure gauge connection open, operate the compressor to evacuate the crankcase.

Crack the suction valve, admitting refrigerant vapor to the crankcase and again close the valve.

Again operate the compressor to evacuate the crankcase.

Complete refrigerant connections and open valve to operating position.

RENEW COMPRESSOR SEAL:

Attach low pressure gauge.

Close suction valve slowly. Do not permit the compressor to pump oil. It may be necessary to start and stop the compressor several times before it will run without oil pumping.

Evacuate crankcase until gauge reads approximately 0 lb. pressure. Never permit a compressor with a leaking seal to pump a vacuum on the crankcase.

Open suction valve slightly to build up the crankcase pressure to approx. 1 or 2 pounds pressure.

Close discharge valve.

Remove the compressor.

Remove belt, flywheel and key from the shaft.

Remove the cap screws holding the seal cover plate.

Remove the bellows assembly, seal ring and packing assembly. To remove the seal ring and packing, use a tool made as shown in Figure 149.

Clean thoroughly and remove all oil from seal housing and shaft. This can best be done by using lacquer thinner or carbon tetrachloride and Kleenex type cosmetic tissues as the cloth. Do not use rags or cloth as lint and possible dirt or grit may cause future trouble.

Press ring and packing assembly on the shaft. (The seal ring and packing must be free of oil, grease, etc.) This can be done by means of a piece of 1 1/8" copper tube about 8" long. This tube should be cut squarely so that even pressure is applied to the seal ring. Do not twist or turn the tube while pressing the seal ring in place. By notching one end of the 1 1/8" tube it can also be used to hold the tissues in cleaning the shaft.

Place a film of clean, dry Frigidaire oil on the seal face. Turn small spring as shown in Figure 149.

Install the seal in position by means of a centering tool. Use a new lead gasket under the seal shoulder.

Place cover plate over seal assembly and bolt down with cap screws. Remove the centering tool.

Re-install compressor and flywheel, using new head gaskets.

Remove the plug in the discharge valve, to permit air to escape. Operate compressor with plug removed until low pressure gauge shows 20". Stop the unit. If the vacuum holds, open suction valve to build up pressure and again evacuate. Replace the plug in discharge valve and open suction valve until pressure builds up to 35 lb. Then close.

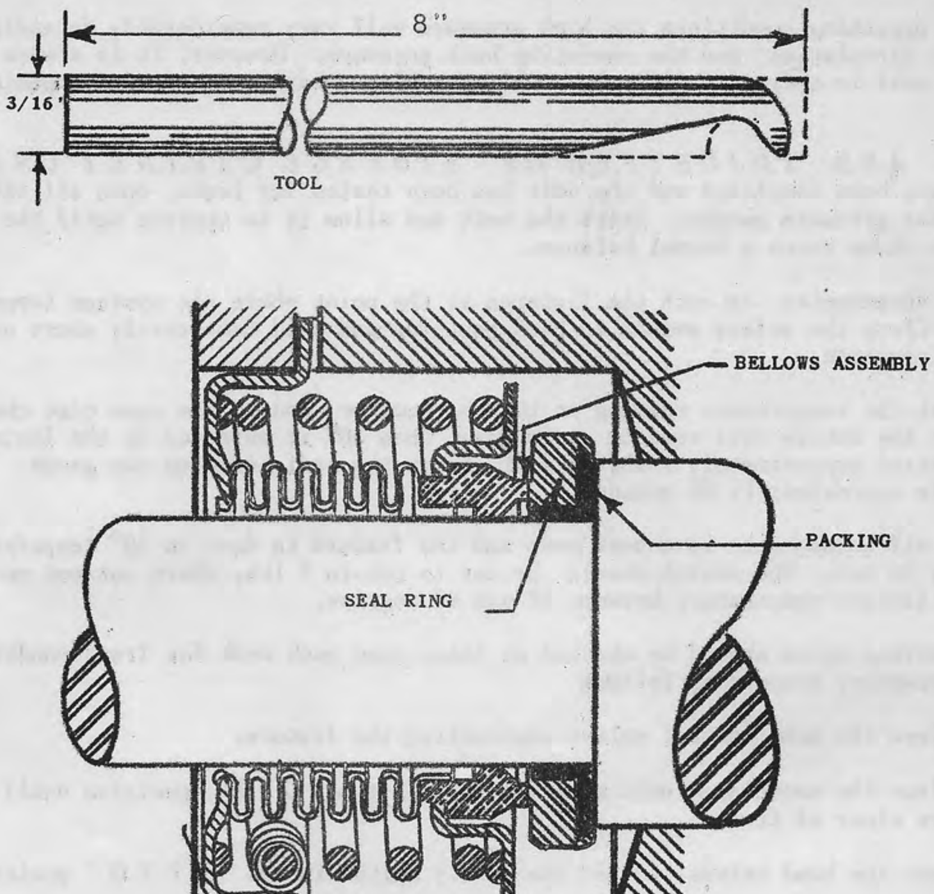
Test for leaks in the seal.

Open both suction and discharge valves to operate position and test head gaskets for leaks.

Remove gauge and place unit in operation.

CHECKING OIL:

Should the compressor be noisy or appear to be improperly lubricated, the oil level in the crankcase should be checked. The depth of the oil when checked through the oil charging hole with a measuring rod in a vertical position should be at least 3/4". Make sure that the remainder of the system has been operating properlj before adding oil.



ASSEMBLY DETAILS FOR REPLACING COMPRESSOR SEALS

Figure 149

CHECKING HEAD PRESSURE ON IDLE AND OPERATING CONDENSING UNITS:

Attach a high pressure gauge and stop the unit, if it has been running. Allow it to stand idle until the condenser, etc., have cooled to room temperature and the high pressure gauge shows no further drop. Take the temperature of the room near the condensing unit and by the aid of a refrigerant pressure temperature chart, ascertain if the high pressure as indicated by the gauge is correct for that temperature.

For example, it will be found that for the 70° F. room temperature, the high pressure gauge should indicate approximately 70 pounds pressure for F-12 refrigerant with condensing unit idle and cooled down to room temperature. Refer to Refrigerant Pressure - Temperature Chart, Page 144, A.C. Manual. If the pressure is higher, air is probably present in the system. When this condition is found, the unit should be purged carefully at the discharge line and the testing repeated until the high pressure gauge will indicate an idle pressure within five pounds of that indicated on the chart for that particular room temperature.

Under operating conditions the high pressure will vary considerably depending upon air temperature, air circulation, and the operating back pressure. However, it is always desirable to know while the unit is operating, just how well operating conditions are met, especially in regard to ventilation.

STARTING AND ADJUSTING OF STORAGE CABINET UNITS: After repairs have been completed and the unit has been tested for leaks, open all valves and install high and low pressure gauges. Start the unit and allow it to operate until the pressure on the high and low sides reach a normal balance.

Place thermometer, in each the fixtures at the point where the average temperature condition exists. Close the safety switch to hand position and hold temporarily short circuiting the pressure switch contacts.

Observe the temperature reading on the thermometer, and at the same time check the cooling unit to see that the entire coil surface is in use. When 38° is obtained in the fixture, set the low pressure control approximately 1 lb. to 2 lb. below the indication on the gauge. This cut-out setting should be approximately 28 pounds.

After all adjustments have been made and the fixture is down to 38° temperature, the cut-in point may be set. The switch should be set to cut-in 7 lbs. above cut-out point. This should maintain fixture temperature between 38 and 48 degrees.

All cooling units should be checked at least once each week for frost condition, If defrosting is necessary proceed as follows:

1. Close the hand control valves controlling the fixture.

2. Place the condensing unit safety switch in the "OFF" position until the coils are clear of frost.

3. Open the hand valves and set the safety switch in the "AUTO" position.

ELECTRICAL CONTROLS: The condensing unit employs compressor of proper capacity, driven by a 32 volt, 1/2 Horsepower D.C. motor.

The electrical controls consists of the following:

Y L Pressure control,

Safety switch,

Low voltage relay,

Line contactor.

The Y L and safety switch assembly incorporates the 3 position safety switch, the high low pressure control, and the overload protector, enclosed in waterproof case.

The Frigidaire type Y L - L O H pressure control is used on buffet installations. This control has both high and low pressure control elements, and is used where both, or low pressure control only is required. The instruction sheet for operating and adjusting the switch is contained inside the switch cover.

The overload protector is of conventional, manual reset design. The overload heater element (B 19.5) is rated at 14.5 amperes.

1/2 H. P. M O T O R: This motor is equipped with sealed ball bearings and a grease reservoir with lubrication sufficient for one year. A grease filler and relief plug are provided and a good grade of ball bearing grease should be added once a year. Be sure that the relief plug is removed when adding grease and that sufficient grease is added to come out this opening. Figure 150 shows the Delco A 7729 motor parts list on Page 241.

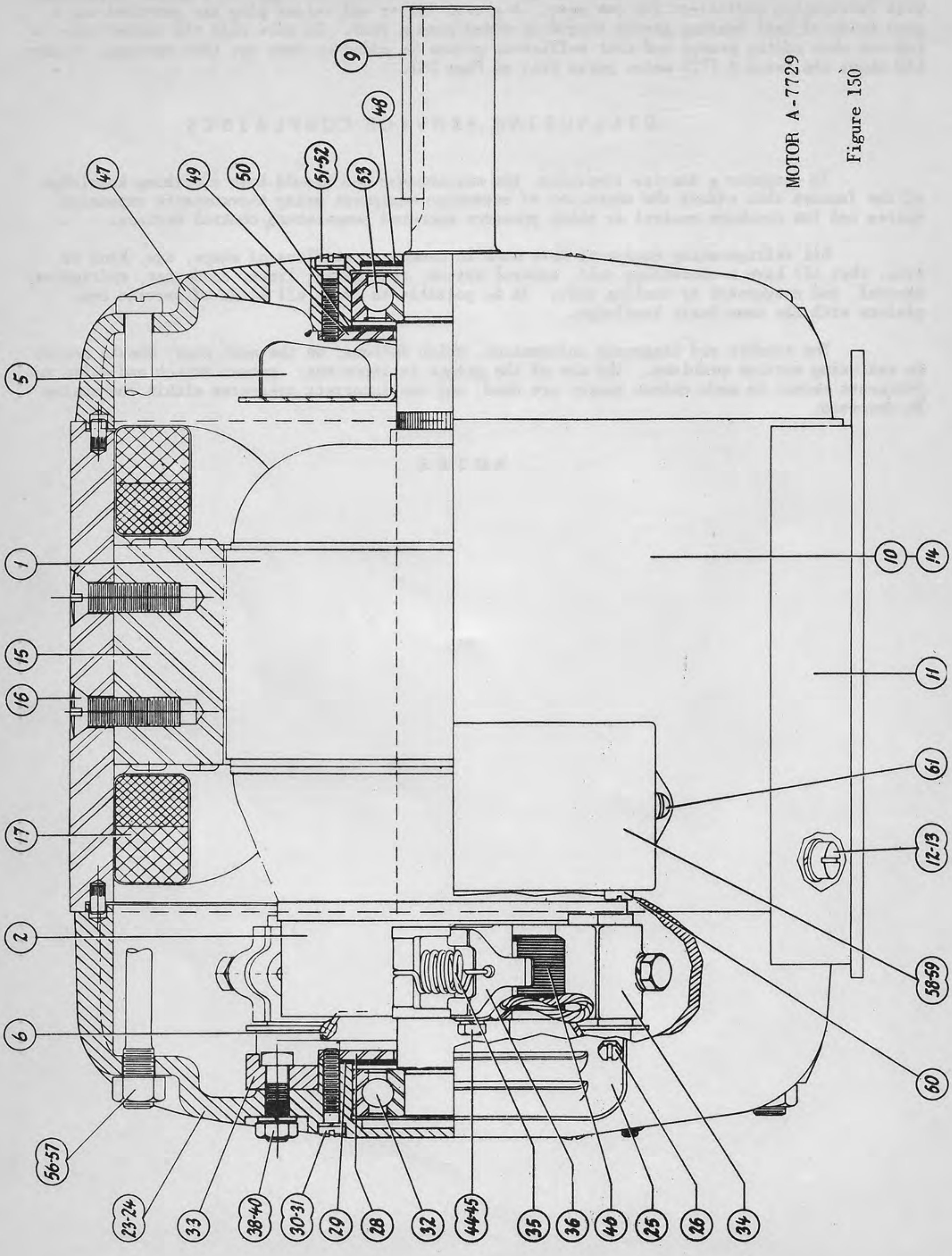
D I A G N O S I N G S E R V I C E C O M P L A I N T S

To diagnose a service complaint, the maintenance men should have a working knowledge of the factors that effect the operation of expansion equipment using thermostatic expansion valves and low pressure control or other pressure operated temperature control devices.

All refrigerating equipment have much in common, regardless of shape, age, kind or size, they all have a condensing unit, control switch, refrigerant lines, condenser, refrigerant control, and evaporator or cooling unit. It is possible to treat all kinds of service complaints with the same basic knowledge.

The trouble and diagnosis information, which follows, on the next page, should assist in analyzing service problems. The use of the gauges is important; proper switch and valve adjustments cannot be made unless gauges are used; nor can incorrect pressures within the system be observed.

N O T E S



MOTOR A-7729

Figure 150

COMPRESSOR MOTOR - BAR REFRIGERATION - A-7729

PIECE NO.	DESCRIPTION	QUANTITY PER UNIT
5346505	Armature and Fan Assembly	1
039234	Commutator Assembly	1
1055940 *	Tube - Insulating	1
039201 *	Tube - Insulating	2
043635	Fan	1
038416	Disc - Balance	1
038194 *	Weight Balance	1
038195 *	Weight Balance	1
038078	Key - Shaft	1
5382362	Base - Frame and Coil Assembly	1
1060419	Base	1
042514	Screw - Base Mounting	4
103320	Lockwasher - Base Mounting	4
5325368	Frame	1
041809	Pole Piece	2
036776	Screw - Pole Piece Mounting	4
5350045	Field Coil Assembly	1
1880376 *	Condenser Assembly	2
115402 *	Screw - Condenser Mounting	2
106497 *	Lockwasher - Condenser Mounting	2
041808 *	Grommet - Lead Insulating	3
5305972	End Frame and Brush Bracket Assembly.	1
5305971	End Frame	1
1055445	Cover Plate - End Frame	2
5321076	Screw - Cover Plate	4
5382440	Bearing	1
042655	Brush Bracket and Holder Assembly	1
038636	Spring - Brush	2
037972	Bolt - Bracket Locking (Top)	1
049681	Nut - Bracket Locking (Top)	1
106497	Lockwasher - Bracket Locking (Top)	1
037972 *	Bolt - Bracket Locking (Bottom)	1
049681 *	Nut - Bracket Locking (Bottom)	1
106497 *	Lockwasher - Bracket Locking (Bottom)	1
038581	Screw - Brush Lead Terminal	2
106496	Lockwasher - Brush Lead Terminal	2
038660	Brush	2
5382098	End Frame - (Opp. Comm. End)	1
5382440	Bearing	1
5300356 *	Washer - Spring	2
1069250	Thru Bolt - End Frame Mtg.	2
042455	Nut - Thru Bolt	2
038004	Conduit Box	1
038005	Cover - Conduit Box	1
042453	Screw - Cover	2
042453	Screw - Conduit Box Mtg.	2
5		
5308735 *	Name Plate	1
5327153 *	Drive Screw - Name Plate	2

* Not Illustrated.

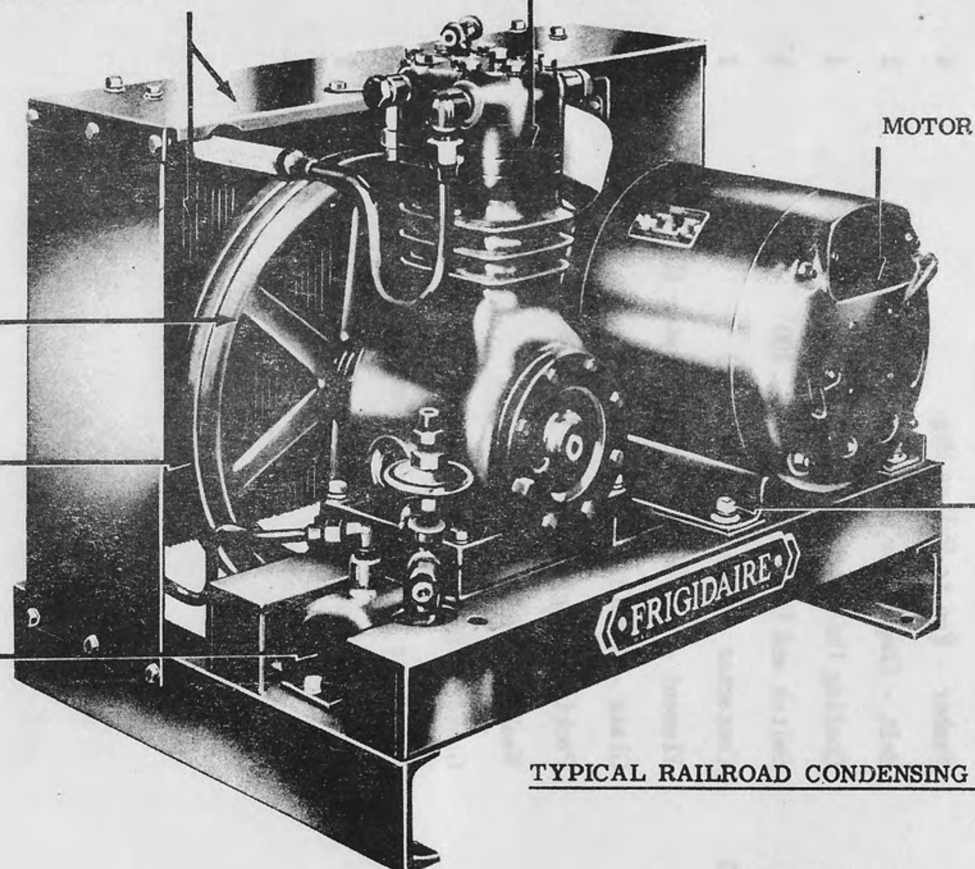
BEHAVIOR	POSSIBLE CAUSE	CORRECTIVE ACTION
Compressor cuts out on high head pressure.	Air in system	Purge air from system
	Blocked air circulation or insufficient air over condenser.	Clean condenser; introduce more air through condenser.
	High condensing medium temperature.	Ventilate compressor compartment.
	Overcharge of refrigerant	Check refrigerant charge - remove refrigerant if necessary.
	High pressure cut-out improperly set.	Reset high pressure cut-out.
Gauge reading low on high side.	Excessive air through the condenser.	Regulate air flow through condenser.
	Low condensing medium temperature.	Raise temperature of condensing medium
	Liquid refrigerant flooding back.	Adjust expansion valve; check thermal bulb clamp.
	Leaky discharge head valve.	Check with gauges; if leaking replace valves.
	Shortage of refrigerant.	Check flow through sight glass.
	Expansion valves leaking through. Valves wire-drawn on needle or seat due to vapor pressing through valve.	Change valve.
	Worn cylinders.	Pump down, if worn replace compressor.
Low suction pressure and compressor short-cycle on low pressure control.	Low pressure cut-out incorrectly set.	Reset. Low pressure control setting should be 2 lbs. lower than normal operation.
	Leaky discharge valve.	Test valve and replace.
	Thermal bulb on expansion valve discharge or stuck shut valve.	Hold bulb in warm hand and see if cooling coil floods, if not, bulb is discharged or valve is stuck, examine valve and replace if necessary.

BEHAVIOR	POSSIBLE CAUSE	CORRECTIVE ACTION
(Continued)		
	Shortage of refrigerant.	Check Freon pressures check refrigerant leaks, repair and recharge.
	Moisture in system.	Install dryer in liquid line.
	Restriction in liquid line, expansion valve or filter screen.	Pump down and examine filter screens; look for foreign matter in lines and valves.
	Too much oil circulating in system.	Check for excess oil remove surplus.
	Improper adjustment of expansion valves.	Adjust valves for more refrigerant flow.
High suction pressure.	Over-feeding of expansion valve.	Adjust expansion valve; check thermal bulb clamp.
	Compressor low in capacity.	Check compressor speed.
	Leaky suction valves.	Remove head, examine valve discs for wear.
Slow " Pump down "	Discharge valve leaks badly.	Test valve; if leaking remove head and replace valve plate.
	Compressor operating at low speed.	Check motor for voltage and belt slippage.
Knocking noise.	Loose fly-wheel.	Tighten fly-wheel.
	Too much oil in circulation may cause hydraulic knock.	Check crankcase oil level. Evacuate system and pump oil back in crankcase, if too much remove surplus.
	Slugging due to refrigerant flood back.	Check thermal bulb attachment on suction line for tightness.
	Excessive wear of moving parts in compressor.	Check location and replace part or compressor.
Motor blows fuses or trips overload.	Fuses too small.	Check switch and fuse with motor rating.
	Overload trips out.	Check heater element rating and time limit setting.

BEHAVIOR	POSSIBLE CAUSE	CORRECTIVE ACTION
(Continued)		
	Poor contact on switch or starter.	Examine contactor for burned or pitted contacts, contactor stuck, poor contact between switch blade and clip, loose fuse in clip, or loose connection in wiring switch or relay.
	Contactor fails to function.	Control wiring may be open or poor contact at controls.
	Low Voltage.	Line voltage may be low. Check voltage at service switch.
Hot Motor Bearings.	Improper oil for motor.	Use only recommended oil. Dirty or incorrect oil increases bearing friction.
Compressor fails to start.	Overload tripped.	Re-set overload.
	Blown fuse.	Determine cause and replace fuse after correction.
	Switch open.	Someone may have inadvertently pulled switch.
	Safety switch in "OFF" position.	Place safety switch on "AUTO" position.
	Dirty or burned contacts on starter.	Poor contact will not allow current to flow; clean or replace contacts.
	All controls check o.k. but motor fails to start.	Examine holding coil on starter contactor for open or burned out winding.
	No. F-12 in system.	Low pressure control remains open due to no pressure exerted on bellows. Test system for leaks, repair and recharge.

PARTS LIST GREAT NORTHERN - BAR REFRIGERATOR

PIECE NO.	DESCRIPTION	QUANTITY PER UNIT
E M - 15524	Condensing Unit	1
A-7729	Motor Compressor (1/2 H.P., 32 V See attached list for parts)	1
639464	Fan - Compressor Motor (10 1/2" Dia.-Suction)	1
5441630	Pulley - Compressor Motor (2 13/16" O.D.)	1
93802	Screw - Fan to Pulley Mtg.	4
616475	Washer - Fan to Pulley Mtg.	4
5441669	Belt - Compressor Motor Fan	1
E M - 15558	Cooling Unit - Dry Expansion (Model FPX 28)	1
E M - 14832	Switch and Case - Model Y L - 100	1
E A - 129593	Contactor - Line (Less Element)	1
5416277	Element - Contactor Overload Heater (B. 19.5)	1
541803	Glass - Liquid Line Sight	1
541617	Packing - Sight Glass	1
5416418	Washer - Sight Glass	1
5416419	Gasket - Sight Glass Seal Cap	1
E B - 49148	Connector - Suction Line Flexible	1
1133562	Valve - Two way Hand Shut-off (1/4" flare)	1
E B - 45398	Heat Interchanger	1



TYPICAL RAILROAD CONDENSING UNIT

#EM 15524

Figure 151

PARTS LIST CONDENSING UNIT EM 15524

PIECE NO.	DESCRIPTION	ITEMS PER UNIT
	COMPRESSOR BODY AND PARTS	
1135488	Body Assembly - Compressor	1
636985	Body - Compressor (Less Parts)	1
1125771	Eccentric Assembly	1
626970	Set Screw - Eccentric	2
616473	Washer - Eccentric (Lock)	2
1134511	Shaft - Eccentric	1
61200	Key - Eccentric Shaft	3
622565	Spacer - Eccentric Shaft	1
624361	Ball - Eccentric Shaft Thrust	1
1121628	Plug - Eccentric Shaft	1
624360	Gasket - Eccentric Shaft Plug	1
1134410	Seal - Eccentric Shaft Bellows	1
1135902	Seat and Packing - Eccentric Shaft Seal	1
639289	Plate - Eccentric Shaft Seal Cover	1
635875	Gasket - Eccentric Shaft Seal Cover Plate	1
5403406	Screw - Eccentric Shaft Seal Cover Plate Mounting	4
613515	Washer - Eccentric Shaft Seal Cover Plate Mounting (Lock)	4
SA-3694	Piston and Pin Assembly	2
636983	Pin - Piston	
630714	Screw - Piston Pin Locking	2
623189	Washer - Piston Pin Locking	2
630713	Rod - Connecting	2
624373	Plate - Compressor Body Bottom	1
624375	Gasket - Compressor Body Bottom Plate	1
5403406	Screw - Compressor Body Bottom Plate Mounting	12
613515	Washer - Compressor Body Bottom Plate Mounting (Lock)	12
630675	Cover - Gas Chamber	1
60413	Screw - Gas Chamber Cover Mounting	2
623189	Washer - Gas Chamber Cover Mounting (Lock)	2
1134660	Strainer - Gas Chamber (Screen)	1
1134182	Valve Assembly - Flapper	1
637208	Plate - Flapper Valve	1
1125052	Reed and Seat - Flapper Valve discharge	2
1125775	Spring and Button - Flapper valve Discharge	2
28252	Screw - Flapper Valve Spring and Reed Mounting	4
616476 6	Washer - Flapper Valve Spring and Reed Mounting (Lock)	4
637460	Reed - Flapper Intake Valve	2
630563	Pin - Flapper Intake Valve Reed Mounting	4
5444378	Gasket - Flapper Valve (To Cylinder Body)	1
1135947	Head - Cylinder	1
624355	Stem - Cylinder Head Valve	2
632921	Packing - Cylinder Head Valve	2
613544	Gasket - Cylinder Head Valve Packing	4
613529	Nut - Cylinder Head Valve Packing	2
624357	Gasket - Cylinder Head Plug	2
624353	Plug - Cylinder Head	2
5444376	Gasket - Cylinder Head (To Flapper Valve)	1
635405	Screw - Cylinder Head Mounting	

PIECE NO.	DESCRIPTION (Continued)	ITEMS PER UNIT
630741	Screw - Cylinder Head Mounting (Center)	2
613515	Washer - Cylinder Head Mounting (Lock)	6
624364	Gasket - Cylinder Head Mounting Screw (Center)	2
635921	Connector - Cylinder Head Discharge (½ to 3/8" Pipe)	1
EA-132440	Connector - Cylinder Head Suction (5/8" Flare)	1
624354	Plug - Compressor Body Oil Drain	1
638175	Plug - Compressor Body Oil Return	1
637011	Spacer - Compressor Body to Base Mounting	4
636032	Screw - Compressor Body to Base Mounting	4
613515	Washer - Compressor Body to Base Mounting (lock)	4

CONDENSER ASSEMBLY AND PARTS

1136498	Condenser Assembly	1
625043	Screw - Condenser to Base Mounting	4
613515	Washer - Condenser to Base Mounting	4
638281	Place - Condenser End	1
5408246	Screw - Condenser End Plate Mounting	4
616475	Washer - Condenser End Plate Mounting	4
5445205	Connector - Condenser Flexible	1
EA-133233	Elbow - Condenser Discharge	1
617747	Nut - Condenser Discharge Elbow (½" Flare)	1
EA-133239	Brace - Condenser to Compressor	1
5442555	Screw - Condenser Brace Mounting	1
5441632	Washer - Condenser Brace Mounting	1

RECEIVER AND PARTS

1134862	Receiver and Valve Assembly	1
84450	Valve - Receiver	1
42047	Gland - Receiver Valve	1
622922	Packing - Receiver Valve	1
613543	Gasket - Receiver Valve Packing	2
42048	Nut - Receiver Valve Packing	1
613516	Needle - Receiver Valve	1
633946	Plug - Receiver Fusible	1
634145	Plate - Receiver Fusible Plug	1
613518	Cap - Receiver Valve	1
635231	Screw - Receiver to Base Mounting	2
621887	Nut - Receiver to Base Mounting	2
616473	Washer - Receiver to Base Mounting	2
1135403	Filter Assembly - Refrigerant	1

MOTOR MOUNTING PARTS

EB-49131	Base - Motor Mounting	1
625043	Screw - Motor Base Mounting	4
60002	Washer - Motor Base Mounting (Plain)	4
633687	Washer - Motor Base Mounting (Lock)	4
626955	Screw - Motor to Base Mounting	4
640712	Nut - Motor to Base Mounting	4
93249	Washer - Motor to Base Mounting (Plain)	4
640761	Washer - Motor to Base Mounting (Lock)	4

FLYWHEEL AND MOUNTING PARTS

5441627	Flywheel - Compressor	1
90260	Nut - Flywheel Mounting	1

PIECE NO.	DESCRIPTION	ITEMS PER UNIT
	Flywheel & Mounting Parts (Cont'd)	
616473	Washer - Flywheel Mounting	1
	Miscellaneous Parts Not Illustrated	
5441800	Screw - Motor Pulley Set.	1

EM 15558 FPX COOLING UNIT

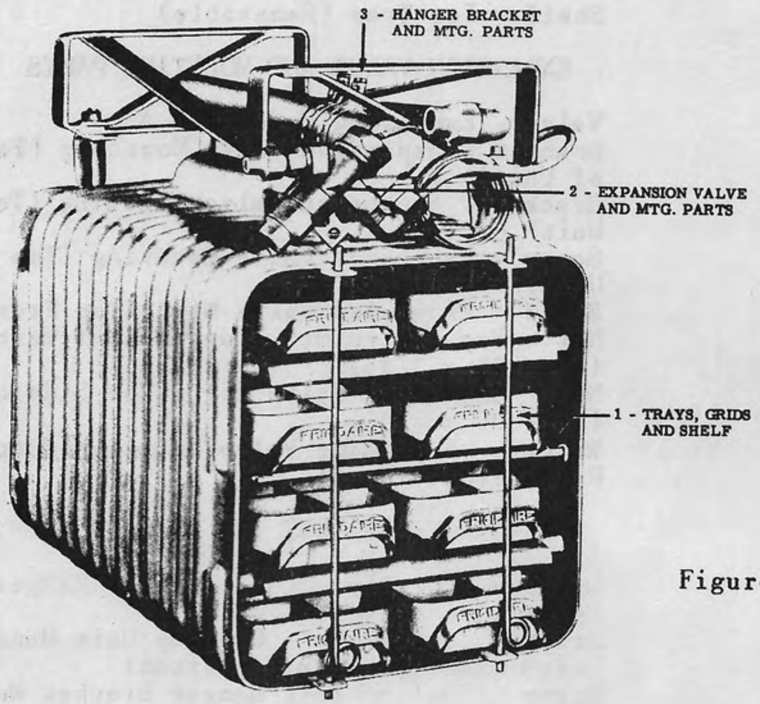


Figure 152

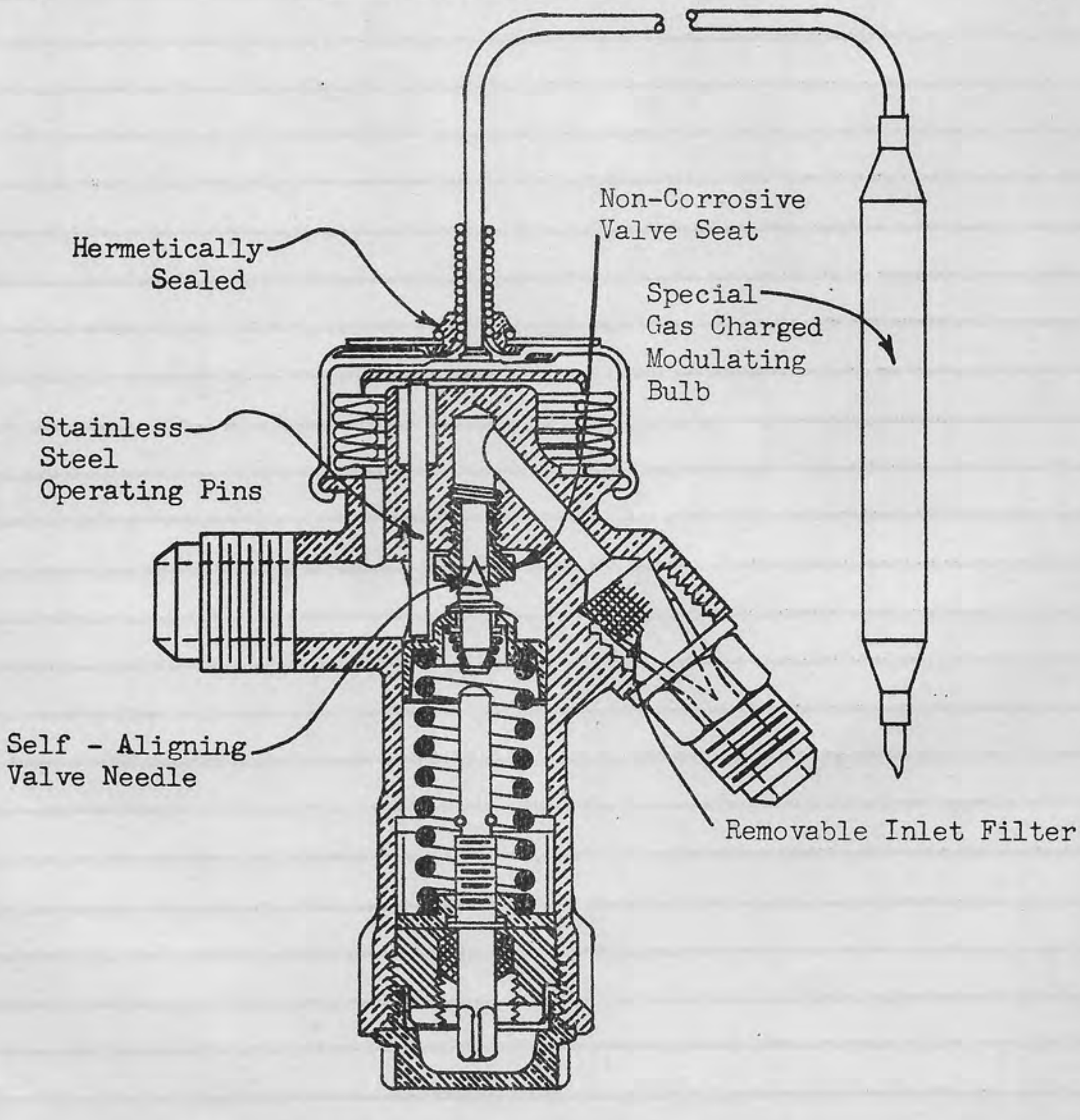
NOTES

PARTS LIST MODEL FPX-28 COOLING UNIT (DRY EXPANSION TYPE)

EM-15558

PIECE NO.	DESCRIPTION	ITEMS PER UNIT
	TRAYS, GRIDS, SHELF AND PARTS	
630837	Tray - Ice	8
5407415	Handle - Ice Tray	8
627300	Bail - Ice Tray Handle	8
629953	Screw - Ice Tray Handle Mounting	16
5852739	Grid and Handle - Ice Tray	8
624296	Stop - Ice Tray	3
622348	Screw - Ice Tray Stop Mounting	6
EB 49194	Retainer - Ice Tray	2
629279	Shelf - Ice Tray (Removable)	1
	EXPANSION VALVE AND MOUNTING PARTS	
1130957	Valve - Expansion Model MX3 AP	1
5443613	Bracket - Expansion Valve Mounting (Top Side of Unit)	1
EA 135380	Bracket - Expansion Valve Mounting (Top Front of Unit)	1
626170	Screw - Expansion Valve Mounting (Top Side of Unit)	1
630231	Screw - Expansion Valve Mtg. (Top Front of Unit)	2
616395	Nut - Exp. Valve Mt. (Top Side of Unit) (1/4 x20 x 7/16)	1
619078	Nut - Expansion Valve Mtg. (Top Side of Unit) (10 - 32 x 3/8)	1
[illegible]	Washer - Expansion Valve Mounting (Top Front of Unit) (Tooth Lock)	2
	HANGER BRACKET AND MOUNTING PARTS	
ED-33960	Bracket Assembly - Cooling Unit Hanger (For Units with Valve on Top Side)	1
ED-34767	Bracket Assembly - Cooling Unit Hanger (For Units with Valve on Top Front)	1
EA-132535	Screw - Cooling Unit Hanger Bracket Mounting (For ED-33960 Bracket)	4
EA-135381	Screw - Cooling Unit Hanger Bracket Mounting (For ED-34767 Bracket)	4
627792	Nut - Cooling Unit Hanger Bracket Mounting (For ED-33960 Bracket)	4
5858195	Nut - Cooling Unit Hanger Bracket Mounting (Stop) (For ED-34767 Bracket)	4
5404940	Washer - Cooling Unit Hanger Bracket Mounting (Left Rear ED-33960 Bracket)	1
	MISCELLANEOUS PARTS NOT ILLUSTRATED	
616435	Elbow Expansion Valve to Liquid Line (1/4")	1
EA-16229	Elbow - Suction Line 1/2" Flare)	1
636998	Nut - Suction Line (1/2" Flare)	1
613539	Nut - Liquid Line (1/4" Flare)	1
98959	Plug - Liquid Line (1/4" Flare)	1
98960	Plug - Suction Line (1/2" Flare)	1
628797	Connector (1/2" Pipe x 1/4" Flare)	1
624283	Clamp - Thermostat Switch Bulb Mounting (For Units with Valve on Top Side)	1

PIECE NO.	DESCRIPTION	ITEM PER UNIT
5442433	Seat - Valve Needle (.045 Orifice)	1
5442096	Pin - Valve Operating	3
5442097	Spring - Valve Adjusting	1
5442098	Receiver - Adjusting Screw Packing	1
5442099	Packing - Valve Adjusting Screw	1
5442100	Nut - Valve Packing	1
5444344	Connector - Valve Inlet (1/4 Inch Flare)	1
5444345	Screen - Valve Strainer	1
5442094	Ring - Strainer Screen Retaining	1
5442101	Plug - Seal	1
616365	Gasket - Seal Plug	1
1136265	Needle Assembly - Valve (35°)	1
5442112	Screw - Valve Adjusting	1
5444349	Nut - Valve Adjusting	1
5442114	Clamp Valve - Bulb Mounting	2
613545	Screw - Valve Bulb Clamp Mounting	2
635160	Nut - Valve Bulb Clamp Mounting	2



MODEL MX3-AP THERMOSTATIC EXPANSION VALVE

Figure 153

NOTES

The water raising system used is the standard air pressure type, furnishing hot or cold water to desired locations. Drinking water is cooled by means of mechanical refrigeration to keep water of proper temperature at the faucets at all times. Various items of the water system are explained herein.

P I P I N G : Water piping on the cars is placed in a floor trench on both sides of car adjacent to outside wall and insulated. Suitable access plates are provided.

W A T E R   T A N K : All cars have one 250 gallon stainless steel tank 23" in diameter and 11' 8" long. On Pullman built cars tank casings are stainless steel (.050" shell and .090" ends) lined with 2" Gustin-Bacon Fiberglass insulation. All piping in tank is either brass or soft drawn copper tubing. Joints are soldered with National Lead Company's No. 500. This type solder melts at approximately 508° Fahrenheit. A strainer, Cat. No. W-4268 is provided at the lower tank connection.

W A T E R   F I L L I N G   V A L V E : All cars are equipped with Westinghouse Air Brake Company's No. 500315 pressure water filling valves, one on each side of car. Valves are protected against freezing by the steam protection loop. Steam from this loop passes through a cored opening in one of the valve bodies as shown in Figure 154. The filling valve consists of an upper filling portion and a lower three way valve portion. For details, see Figure 154.

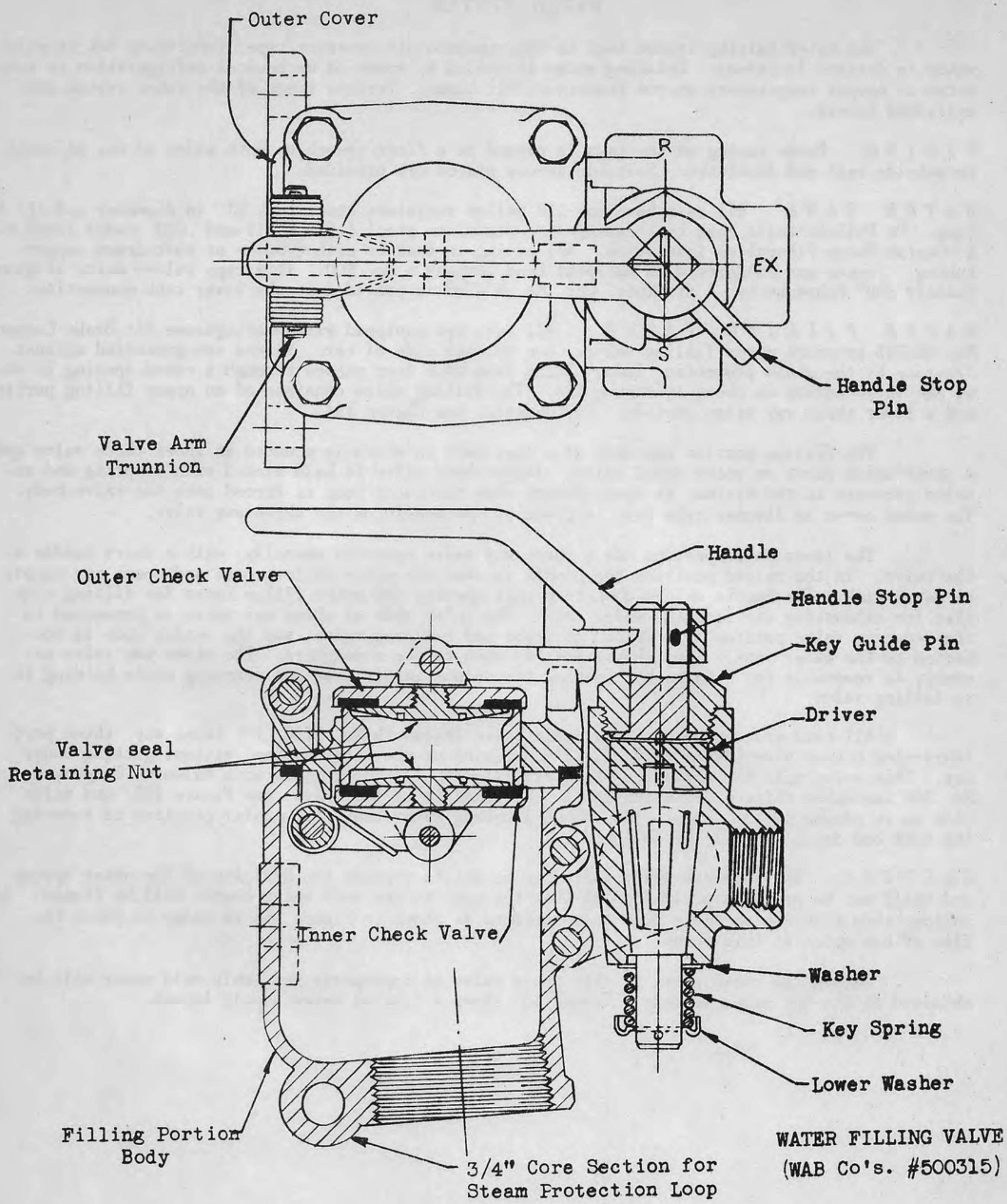
The filling portion consists of a cast body in which is mounted an inner check valve and a cover which forms an outer check valve. Inner check valve is held closed with a spring and retains pressure in the system; it opens inward when the water hose is forced into the valve body. The outer cover is flapper type held in place by the handle of the three way valve.

The lower valve portion has a three way valve operated manually, with a short handle at the valve. In the raised position the handle is over the water filler cover and opens air supply to water tank. The handle swings down to permit opening the water filler cover for filling tank, also for exhausting air from the water tank. The inlet side of three way valve is connected to the reducing valve portion of combined governor and reducing valve and the outlet side is connected to the water tank. The exhaust port is open to the atmosphere. The three way valve assembly is removable for repairs by breaking the unions in air line and removing bolts holding it to filling valve.

All cars are equipped with a drain valve (Walworth No. 1730, 1", three way, three port lubricated bronze plug valve) to facilitate draining of the water system, without getting under car. This valve will be lubricated whenever dis-assembled for repairs with Walworth Company's No. 580 insoluble white sterile lubricant. For details of the valve, see Figure 155, and valve hook up in piping system, Figure 156. When flushing water tank the regular practice of removing the tank end drain cap will be followed.

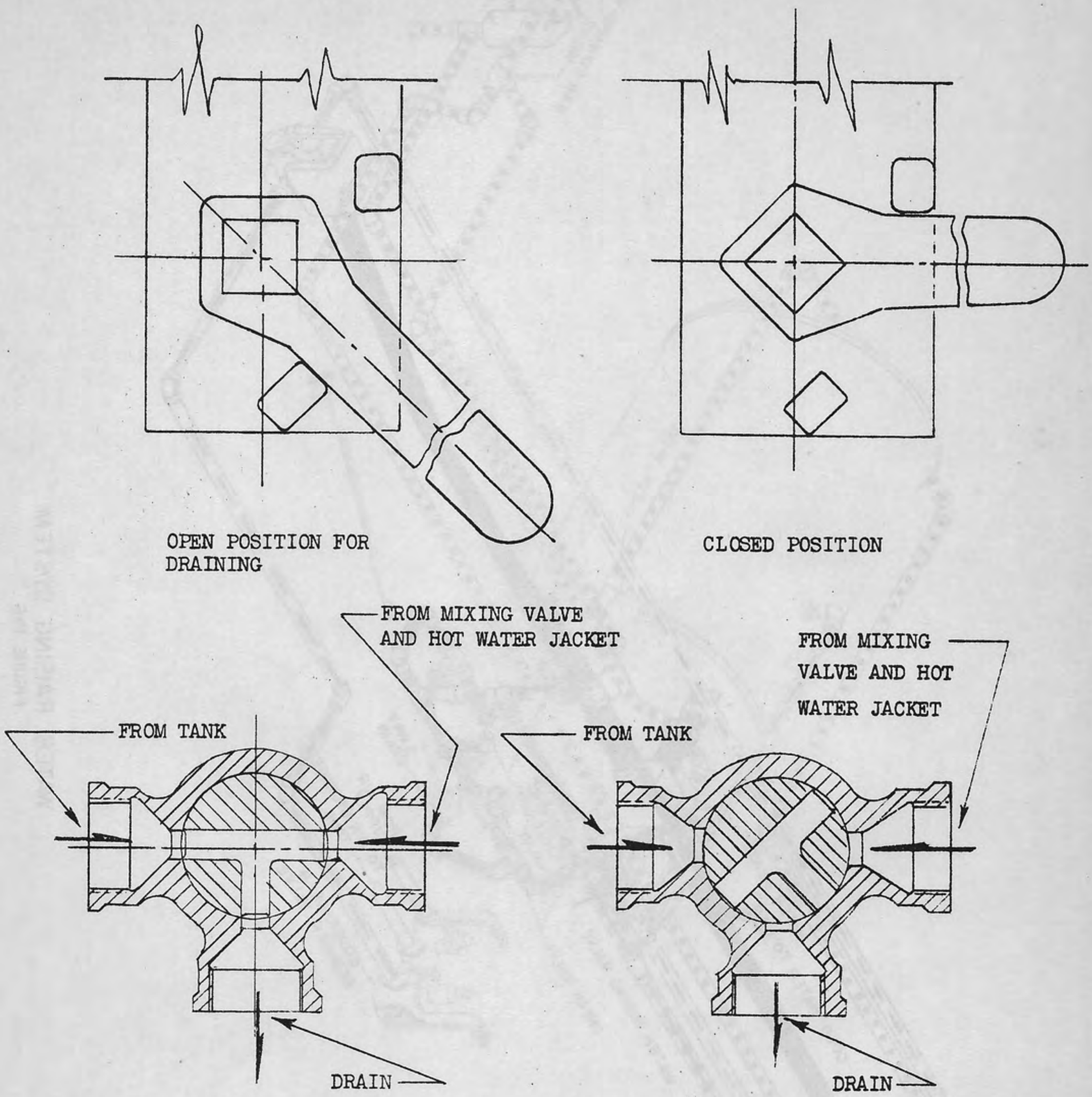
C A U T I O N : The Walworth drain valve can be set to prevent the draining of the water system and still not be properly positioned so that the port to the wash water heater will be closed. It follows then that the tee core must be positioned as shown in Figure 155 in order to check the flow of hot water at this point.

Should the cored ports of this drain valve be improperly set, only cold water will be obtained at the hot water faucets. Figure 157 shows a typical water supply layout.



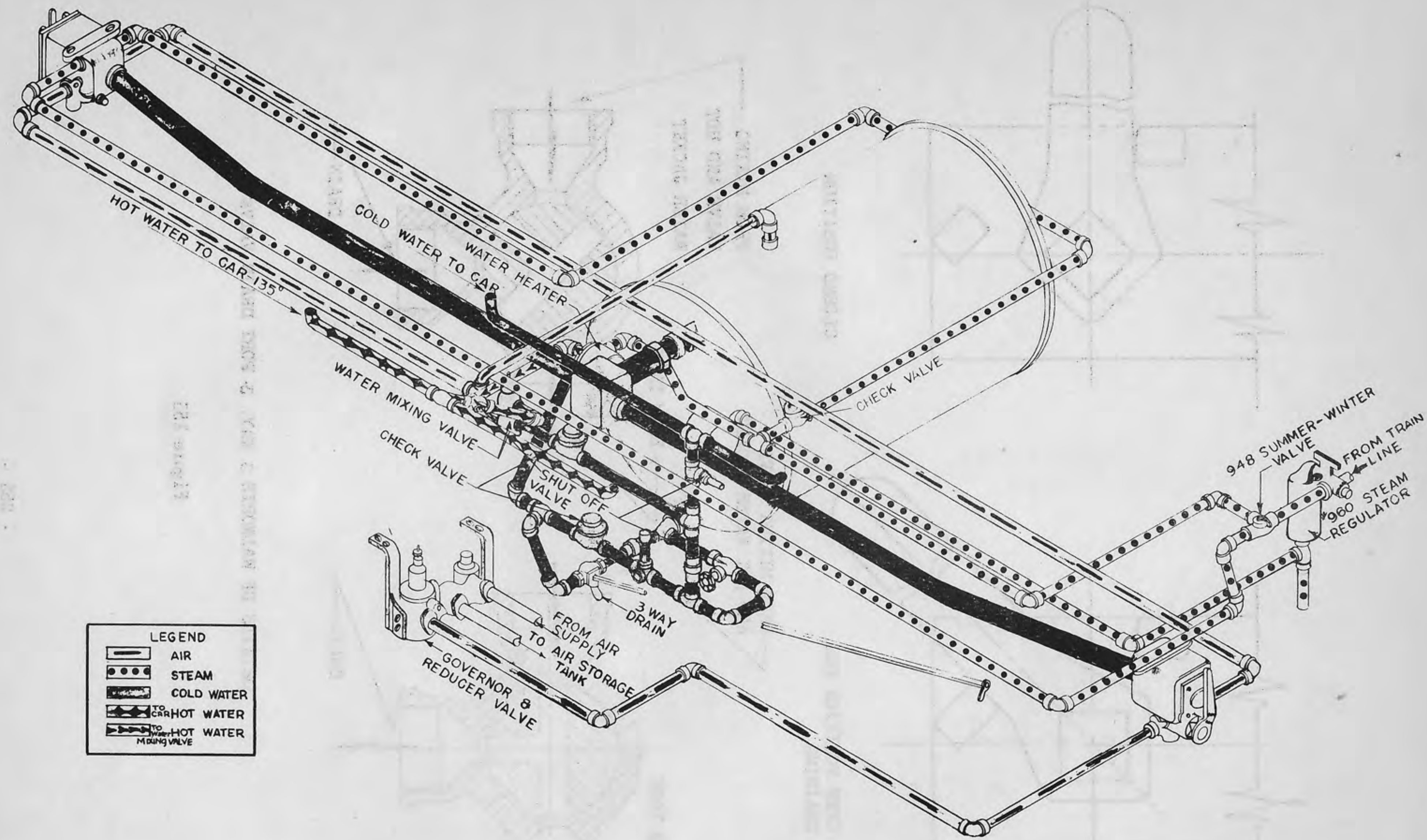
WATER FILLING VALVE
(WAB Co's. #500315)

Figure 154



DETAILS OF WALWORTH 3 WAY, 3 PORT DRAIN VALVE

Figure 155



WATER RAISING SYSTEM
FIGURE 156

GOVERNOR AND REDUCING VALVE: Westinghouse Air Brake Company's Type A-1-A combined governor and reducing valves are used on all cars to regulate air pressure in the water system. Valves are located adjacent to air reservoir tank and are set to regulate at 25 pounds. For details see Figure 158. Operation of this valve is as follows:

1. Air from brake system supply reservoir flows through cut-out cock 1, strainer 2 and passage A to chamber under diaphragm 3. Diaphragm spring 4 prevents diaphragm from lifting until there is 60 pounds or more pressure in the supply reservoir.

2. When the supply pressure reaches 60 pounds, the pressure of diaphragm spring 4 will overcome and diaphragm 3 is lifted off its seat.

3. Lifting of diaphragm 3 allows air to flow through choked passage B and cut-out cock 1A to the air pressure storage reservoir, which will build up to supply pressure.

4. Air will also flow through passage C and strainer 5 to chamber in reducing valve portion. Diaphragm 6 is held down by springs 7 and 8 to unseat valve 9.

5. With valve 9 open air will flow through passage D and piping through water filling valve to water tank.

6. When pressure in water tank reaches 25 pounds, the pressure of springs 7 and 8 will be overcome and diaphragm 6 will rise. Spring 10 will now close valve 9 to cut off supply pressure and limit pressure at water tank to 25 pounds.

7. In case supply pressure drops below the pressure in air storage reservoir, check valve 11 will be seated by spring 12 and prevent draining air storage reservoir.

8. Also in case supply pressure drops below 60 pounds, diaphragm 3 will be seated by spring 4 and shut-off supply reservoir so that excessive demand from water raising system will not interfere with braking operations.

9. Check valve 13 and spring 14 will act to prevent back flow from water tank.

10. Shut off cock handle operates both cut-out cocks 1 and 1A. Therefore, by turning this handle off, mt is possible to cut off supply reservoir and retain the pressure in air storage reservoir when exchanging the governor and reducer valves.

11. The felt strainer 2 and 5 have a tendency to shrink and allow dirt to pass through. This item must receive close attention when valve is serviced.

TO DRAIN CAR PROCEED AS FOLLOWS:

1. Lower handle on water filling valve.

2. Open water tank drain valve. (This valve also drains wash water heater).

3. Drain circulating drinking water system.

4. Allow all water to drain out.

NOTE: If air is not available either in the storage tank or yard supply, then as the tank is draining open each faucet for hot, cold and drinking water, and operate all hopper valves sufficiently to permit thorough gravity draining. When air is available, continue as follows:

5. Close circulating drinking water drain valve and tank drain valve.

6. Raise handle on water filling valve and wait about 5 minutes for air in storage tank to enter water tank if trainline air is not available.

7. Operate all hoppers and faucets to blow piping clear of water deposits, including drinking water faucets.

8. Open drain for circulating drinking water system, allow to blow and leave valve open.

9. Open water tank drain valve to blow out any trapped water, then close valve.

10. Close cock handle on governor reducer valve - leave closed.

11. Apply drain tag and record on mechanical record card.

TO PREPARE A DRAINED CAR FOR SERVICE PROCEED AS FOLLOWS :

1. Close drain for circulating water system.

2. Open cock handle on governor reducer valve.

3. Lower filling valve handle and remove drain tags.

4. Fill water tank and raise filling valve handle.

5. Operate all hoppers and faucets to purge air from piping. Check drain valves while operating and during flush.

6. Check for an unusual flow of water under car indicating an open valve.

7. Record on mechanical record card.

HOPPERS : Refer to Page 264 for details of the hopper types used in the various accommodations. Most of these hoppers are the standard type and maintenance procedures as known should be followed.

The hoppers in room annexes are Crane Company's No. R.R. 10214 blow out wall closets, see Figure 159. Crown type Sloan flush valves, Figure 161 are used. Included with the installation is a Sloan shut-off valve, Figure 160, Sloan V-100-A vacuum breaker.

The flush valve operates as follows (Refer to Figure 161). The double cup (S-14-A) divides the valve into an upper and lower chamber with equal water pressures in both chambers when valve is in the "CLOSED" position.

When the hand lever is pressed, the relief valve (C.R. 18-A) is tilted, which allows water to escape from the upper chamber. The water pressure in lower chamber (below cup S-14-A) now being greater, raises piston (S-60-A) from main seat (S-21) allowing water to flow down through valve outlet, through vacuum breaker to hopper.

While valve is in operation a small amount of water flows through by-pass and chamber of expellor (S-57) gradually filling upper chamber and equalizing pressures once more As upper chamber gradually fills, piston (S-60-A) returns to its seat (S-21) to close valve.

To regulate quantity of water, for four seconds flow, remove small cap at top of flush valve and turn adjusting screw down to decrease and up to increase. It is not necessary to shut off supply when making this adjustment.

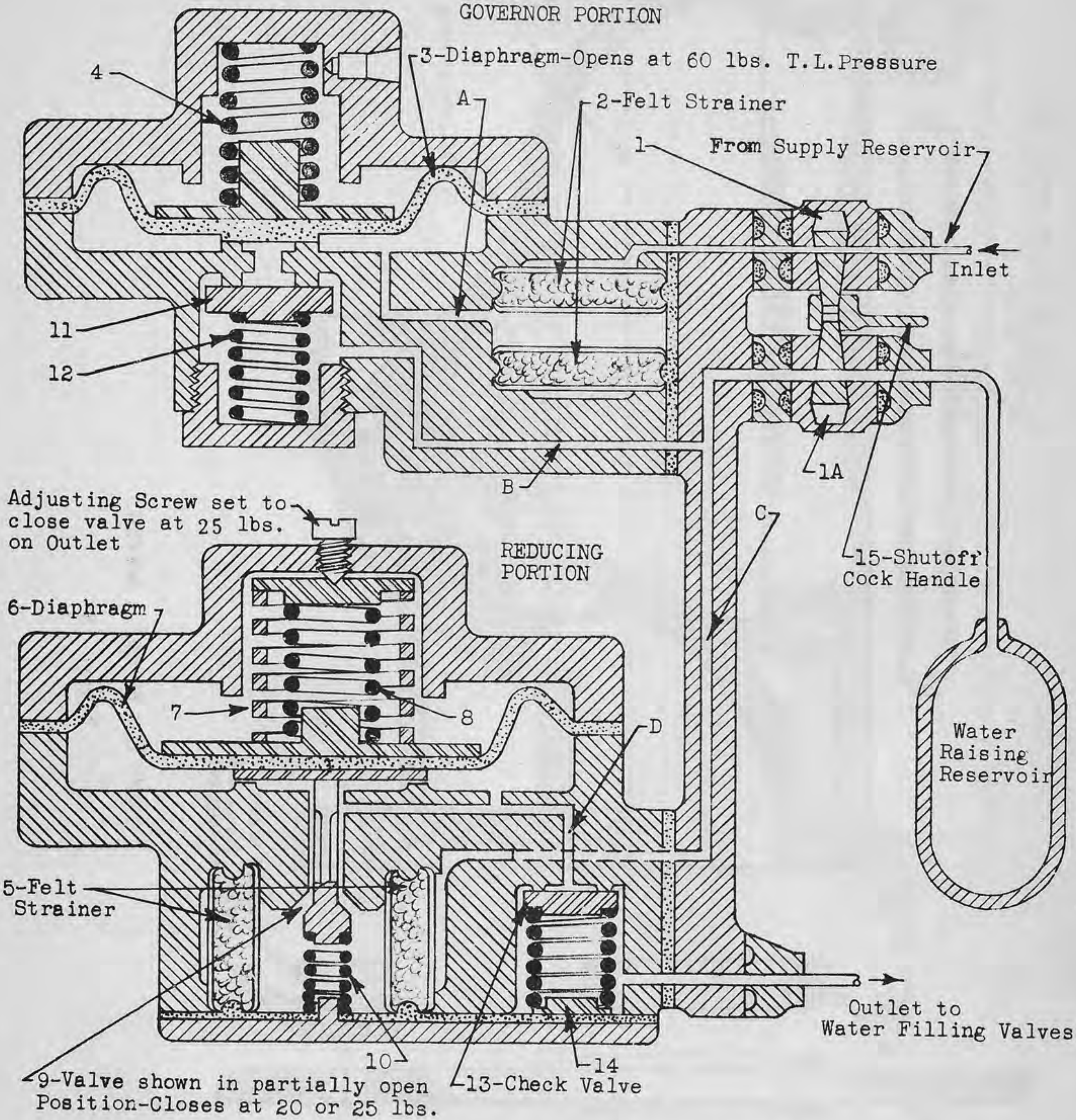
If ample flush is not obtained with adjusting screw up and shut off valve open, the reducer is set too low or there is an obstruction in the piping.

Some changes from the conventional types have been installed on these cars. All hoppers are equipped with a device, known as a vacuum breaker, to prevent any syphoning of contaminated or foreign matter back into the water system.

VACUUM BREAKERS : Two types - Sloan V-100-A, Figure 162 and Chicago Faucet Company's No. 893, Figure 163 - Vacuum breakers are used. When hopper is flushed, water pressure closes the air port and then flows into hopper bowl. When the water flow stops valve returns to its normal position, opening air port venting the piping. The valves have a rubber disc, which may become distorted and result in improper seating allowing water to leak.

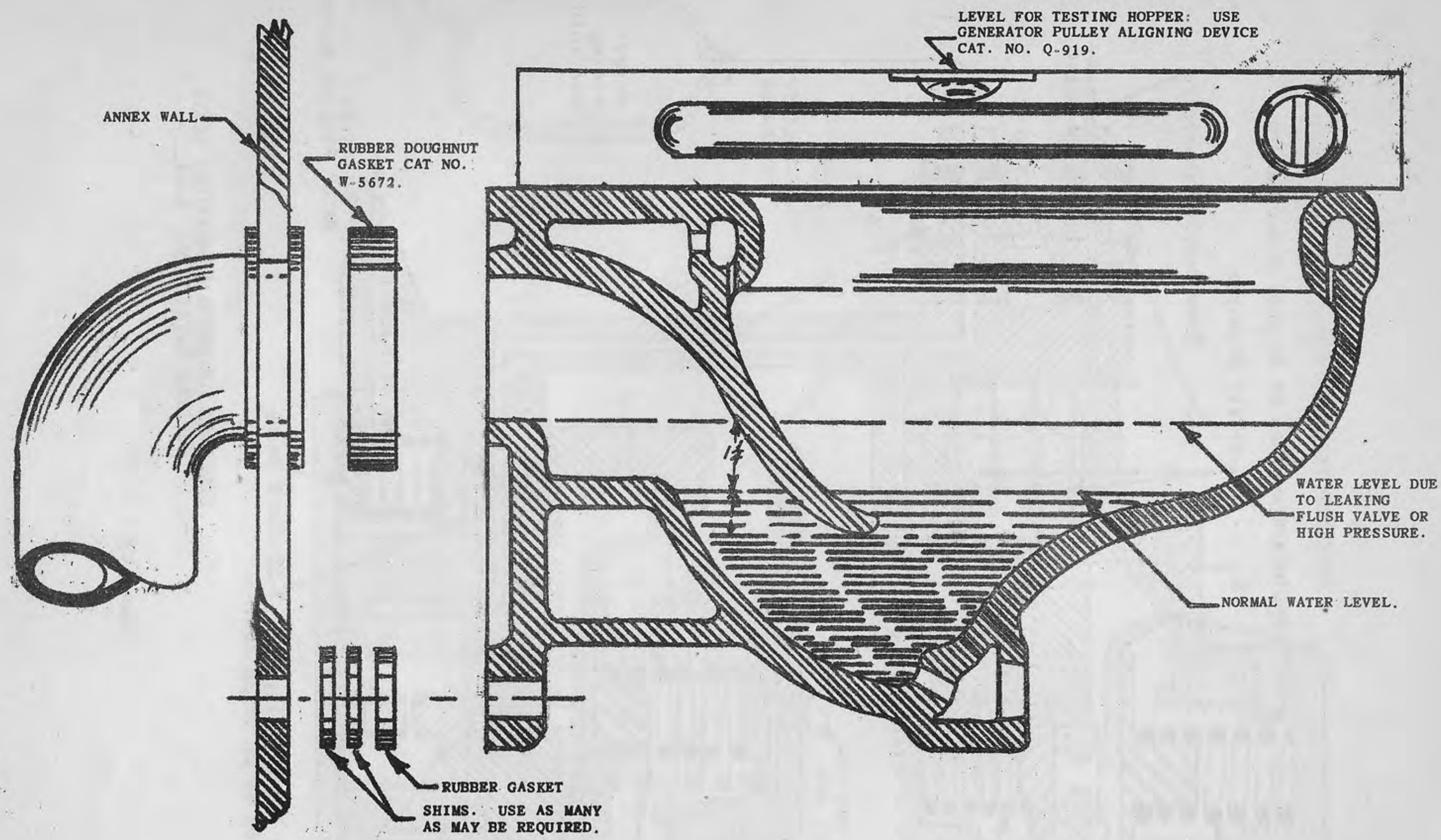
WASHSTANDS : Washstand in drawing room annexes are Pullman Standard, stationary, stainless steel type. Roomettes, bedroom and compartment annexes are provided with Pullman Standard folding type with stainless steel bowl and aluminum casing.

Basins in roomettes are equipped with a Pullman Standard latch to prevent opening the basin when bed is in Night position.



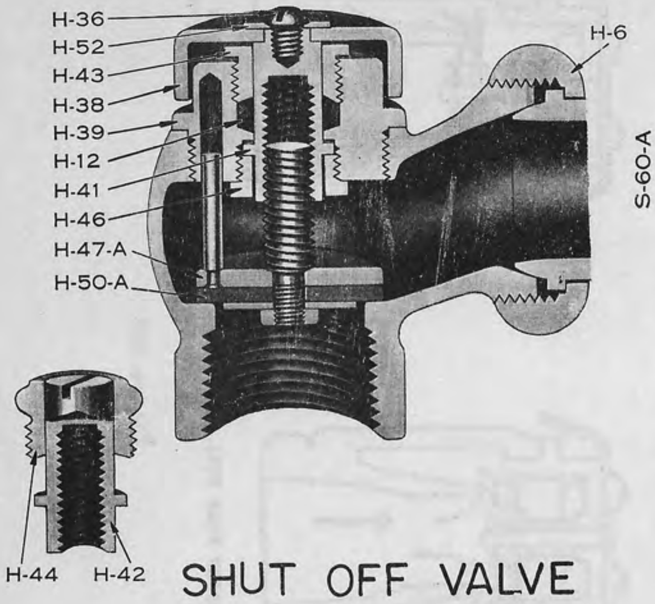
COMBINED GOVERNOR & REDUCING VALVE
PULLMAN CATALOG NO. W-4412

Figure 158



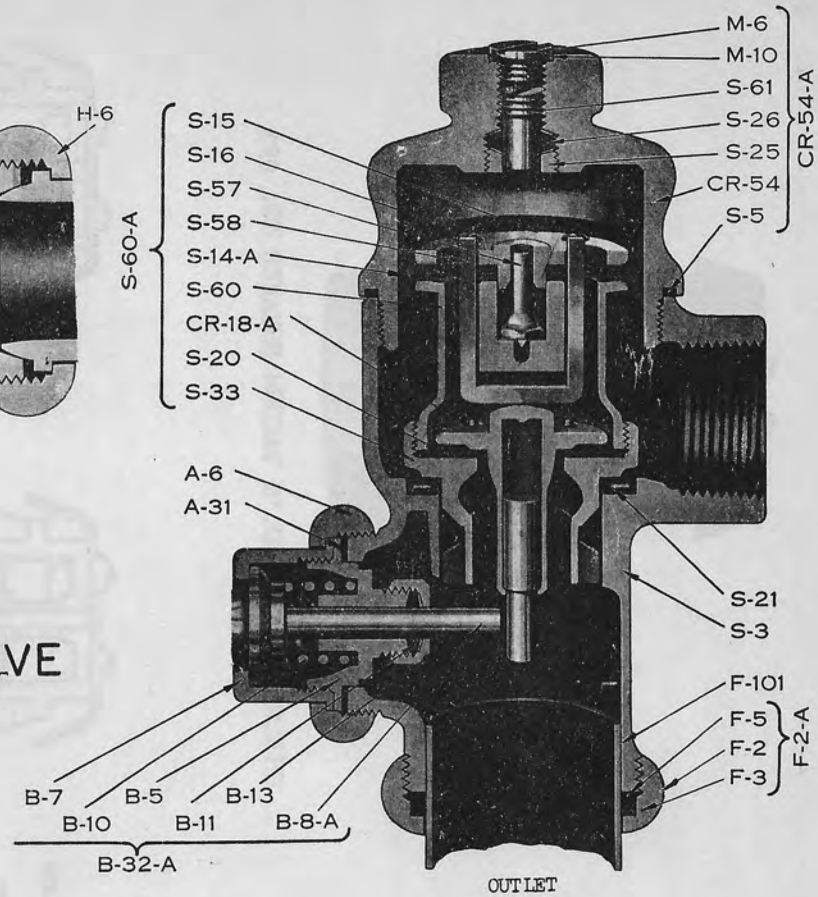
CRANE CO. RR 10214 HOPPER

Figure 159



SHUT OFF VALVE

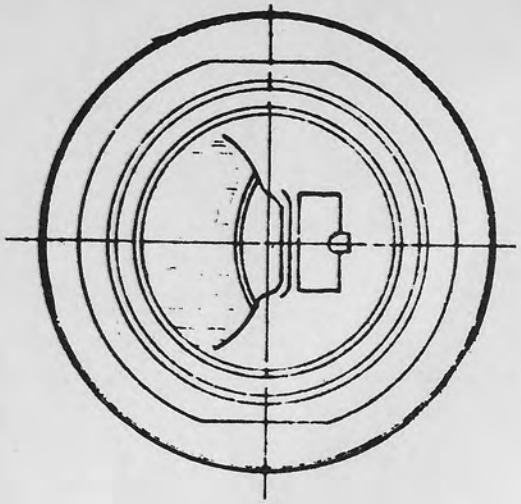
Figure 160

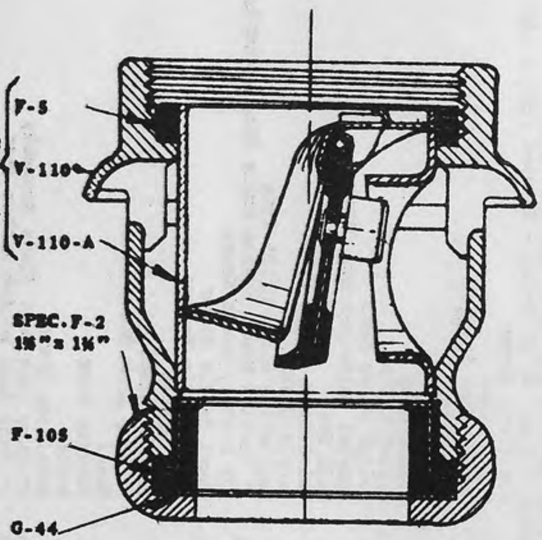


FLUSH VALVE

Figure 161

CR-54-A	Complete Cover Assembly - rough brass
M-6	Cover Screw
M-10	Cover Screw Gasket
S-24	Regulating Screw Packing Disc
S-26	Regulating Screw Packing
S-25	Regulating Screw Packing Gland
CR-54	Cover only, rough brass
S-5	Cover Gasket
Special S-60-AU Piston Assembly	
S-15-A Special Top Plate per dwg. 4790	
Marked - Spec. R. R. Valve - By-pass .025 x .960	
S-16	Top Plate Screw
S-14	Cup Leather
S-36	Cup Leather Spacer
S-58	Safety Bar
S-57	Expellor
S-60	Piston only
CR-18-A	Relief Valve
S-20	Relief Valve Seat
S-43	Special Guide per dwg. 9487
S-21	Main Seat
S-1	Valve Body, rough brass
A-31	Handle Gasket
S-61	Regulating Screw 9/16" long
H-40-A	1" Special Wheel Handle Angle Stop Assembly, B/P H-8761, rough brass
H-36	Wheel Handle Screw
H-52	Wheel Handle Washer
H-41	W.H. Socket
H-43	Packing Gland
H-47	1" Stop Cock Screw
H-38	Wheel
H-12	Packing Ring
H-39	Bonnet
H-46	Retaining Gland
H-48-A	1" Stop Cock Seat Plate Assembly
H-50-A	1" Stop Cock Molded Rubber Seat
H-51	1" Stop Cock Seat Washer
H-72	Nut





V-100-A VACUUM BREAKER, ROUGH BRASS

V-101-A UNIT ASSEMBLY

F-5 1 1/2" SLIP JOINT RUBBER

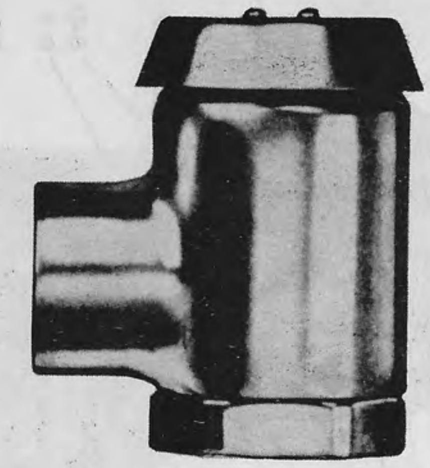
SPECIAL F-2 1 1/2" OUTLET COUPLING ROUGH BRASS

F-105 1 1/2" x 1 1/4" SLIP JOINT GASKET

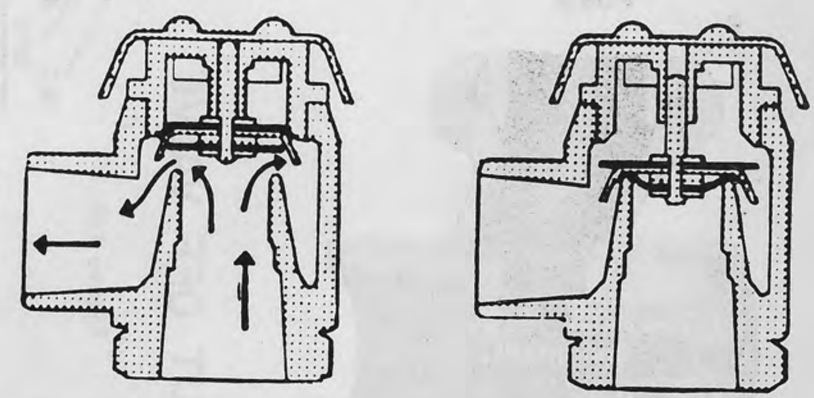
G-44 1 1/4" x 1 1/2" FRICTION RING

SLOAN VACUUM BREAKER

Figure 162



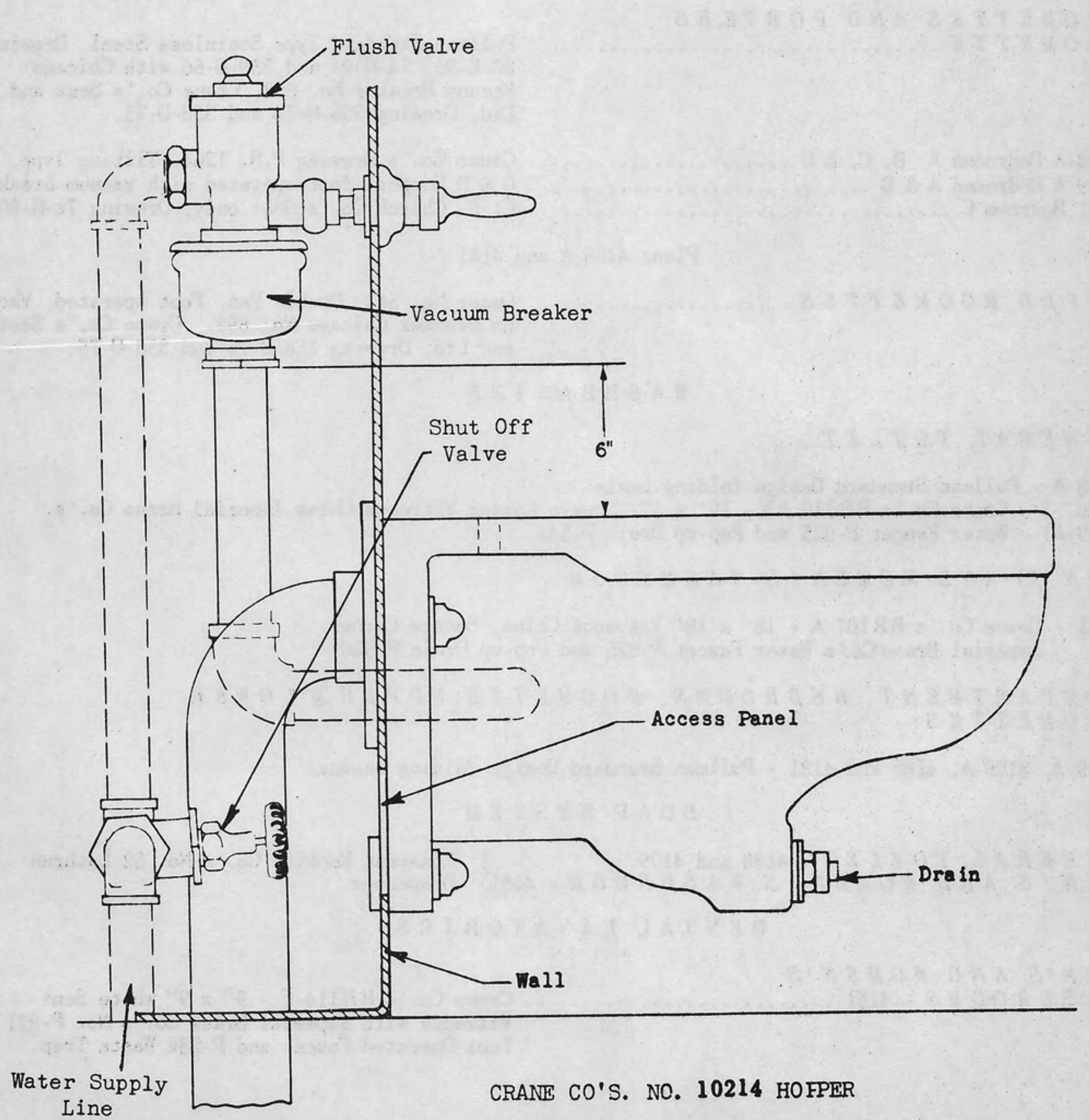
CHICAGO FAUCET CO.'S VACUUM BREAKER NO. 893



NORMAL OPERATION PASS FULL FLOW OF PIPE

VACUUM CONDITION CLOSES VALVE PREVENTS BACK SIPHONAGE

Figure 163



CRANE CO'S. NO. **10214** HOPPER

Figure 164

HOPPERS

Plans 4109-A, 4180 and 4181

GENERAL TOILET: .... Pullman Standard's open type, Drawing 74-E-99E and 83-E-96. Stainless Steel Base, Porcelain top, foot operated with Chicago No. 893 Vacuum Breaker, C. F. Church Co.'s Seat and Lid, Drawing 241-D-49 and 241-D-50.

4180 and 4181 (Compartments and Bedrooms) - 4109-A (Drawing Room and Bedroom)

COMPARTMENTS AND BEDROOMS AND 4109-A DRAWING ROOM: .... Crane Co.'s Drawing PSC 265 Wall Type RR 10214 with Crown 140 BYV flush valve and Sloan Vacuum Breaker V-100-A, C. F. Church Co.'s No. 273 Seat and Lid.

Plan 4180

ROOMETTES AND PORTERS ROOMETTE: .... Pullman Standard Type Stainless Steel, Drawing 83-E-96, 74-H-94 and 359-D-66 with Chicago Vacuum Breaker No. 893, Crane Co.'s Seat and Lid, Drawing 358-D-74 and 358-D-75.

4108-A Bedrooms A, B, C, & D .... Crane Co.'s Drawing P.R. 1264, Tilting Type,
4109-A Bedrooms A & B .... G & H Hoppers foot operated with vacuum breaker
4181 Bedroom C .... C. F. Church Co.'s Seat only, Drawing 7t-H-80.

Plans 4108-A and 4181

UPPER ROOMETTES .... Duner No. 563, Double Pan, Foot operated, Vacuum Breaker Chicago No. 893. Crane Co.'s Seat and Lid, Drawing 358-D-74 and 358-D-75.

WASHBASINS

GENERAL TOILET:

4108-A - Pullman Standard Design folding basin.
4180) - Crane Co.'s RR110 AV - 12" x 12" Square Corner Vitreous China Imperial Brass Co.'s.
4109-A) - Water Faucet P-825 and Pop-up Drain P-540.

MEN'S AND WOMEN'S WASHROOM:

4181 - Crane Co.'s RR107 A - 18" x 18" Vitreous China, Square Corner.
Imperial Brass Co.'s Water Faucet P-825 and Pop-up Drain P-540.

COMPARTMENT, BEDROOMS, ROOMETTE, UPPER & LOWER ROOMETTES:

4108-A, 4109-A, 4180 and 4181 - Pullman Standard Design folding basins.

SOAP SYSTEM

GENERAL TOILET - 4180 and 4109) Constant Hopkins Co.'s No. 52 Lathrun
MEN'S AND WOMEN'S WASHROOM - 4181) Dispenser

DENTAL LAVATORIES

MEN'S AND WOMEN'S WASHROOMS - 4181 .... Crane Co.'s RR114-F - 9" x 9" white Semi-Vitreous with Imperial Brass Co.'s No. P-821 Foot Operated Faucet and P-234 Waste Trap.

Plans 4108-A and 4181

LOWER ROOMETTES: .... Duner No. 554, Double Pan, Foot Operated Vacuum Breaker Chicago No. 893. Crane Co.'s Seat and Lid Drawing 358-D-74 & 358 D-75.

Plan 4108-A

GENERAL TOILET: .... Pullman Standard's Open Type, Drawing 74-E-99 E, Stainless Steel Base, Porcelain Top, Foot Operated Chicago No. 893 Vacuum Breaker, C. F. Church Co.'s No. 273 Open Front Seat and Lid.

WATER COOLER

GENERAL ELECTRIC COMPANY'S TYPE R.W.675A: The water cooler is located in locker at vestibule end of cars with the exception of the "River" series cars where it is located in locker at blind end of car. Ample space has been provided around cooler so that the air circulation will not be cut down. A duct arrangement has been fastened to cooler that encloses the lower grill when the locker door is closed this arrangement is made so air will not bypass condenser of water cooler. This cooler is an assembled unit consisting of a 32 V.D.C., 1/4 H.P., 1725 RPM motor that drives a direct connected condenser fan with a belt to the compressor that rotates at 595 RPM.

SERVICE PROBLEMS AND SOLUTIONS

The inspection and routine service should be performed on the same frequency basis as comparable items of air conditioning equipment.

Complaints received are of a general nature and it is the purpose of this section to enable the serviceman to locate and correctly identify source of trouble. In locating source of trouble it is particularly important that a systematic procedure as described below be followed:

COMPRESSOR: Experience will tell you when the compressor is operating normally, or if some unusual mechanical noise is prevalent, a hammering or knocking noise inditaces return of wet gas to suction side (liquid Freon slugging) and faulty expansion valve operation is indicated (See Service Section).

REFRIGERATION SERVICE: In some instances the cause of trouble will be immediately apparent but in the large majority of cases, some measuring of pressures, temperatures, and running time and other observations will have to be made before the cause is located. To determine the source of trouble it is desirable to make observations as follows:

1. Water temperatures and capacity check.
2. Suction pressure.
3. Discharge pressure (Head).
4. Temperature of liquid and suction lines.
5. Sound of expansion valve.
6. Running time.

CHECKING WATER TEMPERATURES: If test is made on car, cooler should have been running for at least one hour to allow piping and insulation to cool down. With proper operation and adjustment the outlet water temperature at the faucet nearest the water cooler should be between 45° and 50° F. Outlet water temperature at the last faucet in the recirculating line will be one to four degrees higher depending on car air and outside air temperature. If this differential is higher, then water is not circulating properly and plugged lines, pump or valves should be suspected. Before checking the temperature of the water approximately 1/2 pint should be drawn from the tap. Then place a thermometer under tap and draw sufficient water to give temperature reading

If cooler runs continuously for more than an hour and fails to bring the water temperature down to 50° F. without any water being drawn, then inadequate or no cooling capacity is indicated and the other observations should be made as described below:

If cooler fails to bring the water temperature down to 50° F. but cycles off and on, then the thermostat is not adjusted properly. See Thermostat Adjustment.

If cooler brings the water to 50° and cycles, it may still not have its full capacity since no water is being drawn; the cooler merely is overcoming the heat pickup through the piping. If past pervormance indicates the necexsity, a capacity test may be made by holding open the first faucet and cutting the pressure and flow down with the pressure reducing valve until a flow is established where the water leaving the faucet stays constantly at 50° F. By then measuring this rate of flow (by clocking time taken to fill a gallon container), checking the inlet water temperature at the drain nearest the cooler, and the ambient air temperature entering the condenser, the capacity may be checked with full capacity shown on chart below:

GENERAL CAPACITY DATA

GPH 50° OUTLET WATER

INLET WATER	ROOM TEMPERATURE			
TEMPERATURE	70	80	90	100
70	24.5	23.8	22.2	20.7
80	16.7	15.5	14.5	13.4
90	12.8	11.8	10.0	9.3
100	10.2	9.4	8.9	7.0

ATTACHING HIGH PRESSURE GAUGE: Backseat both compressor service valves and remove flare cap from Tee on gauge port and attached high pressure test gauge. Turn valve stem one turn clockwise to make gauge register pressure. Start the unit, normal head pressures will vary with ambient air temperatures, and should range from about 120-130 pounds with 70° air to 160-180 pounds with 90° air.

TEMPERATURE OF LIQUID AND SUCTION LINES: The temperature of the liquid line is an indication of head pressure and should be just slightly above temperature of air leaving condenser; that is, it should feel warm to the hand. If it is considerably warmer or cooler than the leaving air temperature, this is an indication of improper performance. The suction line temperature will vary with suction pressure. Ordinarily it should feel cool to the hand. A warm line will indicate a high suction pressure, whereas a very cold, frosted, or sweating line indicates low suction pressure or liquid Freon in the line.

The chart on Page 267 is not an inflexible guide, but is intended as an aid in interpreting common causes of trouble when variations from normal are observed in pressures and temperatures.

TROUBLE-SHOOTING CHART

First Observations: Inadequate or No Cooling, Continuous Operation Under Load.

Head Press.	Suc. Press.	Liquid Line	Suction Line	Other Observations	MAY BE CAUSED BY	CORRECTION
High	Normal	Warm	Normal		Condensing Unit has reduced capacity due to high head pressure caused by: 1. Dirty Condenser 2. Air in system 3. Excess Refrigerant 4. Improper air circulation	1. Clean 2. Purge air 3. Check weight of charge and release excess 4. Check location of unit and fan.
Low	High	Normal	Sweating	Compr. Head Cool, Crankcase may be sweating knocking in compressor	Expansion Valve stuck open allowing excess refrigerant into evaporator.	Replace valve
Low	Low to Normal	Cool	Warm	Hissing at expansion valve. Temp. drop in liquid line.	1. Shortage of Refrigerant 2. Obstruction in Liquid Line	1. Check for leaks and add Freon 2. Remove obstruction
Normal to low	Very low	Normal to cool	Normal to sweat		1. Expansion valve plugged with ice (moisture in system) or dirt. 2. Thermal bulb of expansion valve has lost charge 3. Suction check valve blocked	1. Clean valve, install dehydrator for removal of moisture 2. Check valve operation by warming bulb and checking for flooding 3. Replace valve

First Observation: Inadequate Cooling, Frequent Cycling.

Head Press.	Suc. Press.	Liquid Line	Suction Line	Other Observations	MAY BE CAUSED BY	CORRECTION
	Normal				1. Differential on control too small 2. Suction check valve not closing on off cycle	1. Adjust thermostat 2. Replace

COMMON CAUSES OF IMPROPER PERFORMANCE OF REFRIGERATION CYCLES AND THEIR CORRECTION

LOSS OF REFRIGERANT: Shortage of refrigerant may be caused by either careless charging or by a leak in the system. A definite sympton of excessive refrigerant shortage is an abnormally low head pressure as shown in chart. See "Discharge Pressure Measurement", for proper pressures. A minor shortage may be indicated only by hissing at expansion valve.

When searching for leaks, the first step is to attach both suction and head pressure gauges. With compressor idle and all valves open, pressure should be 25 pounds or higher. If considerable loss has occurred it may be necessary to add a small test charge. Go over each joint, connection and valve carefully with the Prestolite test torch.

Add refrigerant through hermetic fitting on compressor. Purge air from line before closing connection. Be certain to set drum in an upright position so that refrigerant is added as a vapor. 1 1/2 pounds of Freon-12 constitutes a full charge.

AIR IN SYSTEM: Air in the system may be caused by one of two reasons.

1. By careless installation methods permitting air to enter when any part of the system is opened for repair.

2. By a leak in the low side allowing air to be drawn into the system when operating under a vacuum (during pump-down).

Air is non-condensable and remains in the hermetic unit and condenser resulting in increased discharge pressures and reduced condenser efficiency. To distinguish whether air in system or an overcharge of refrigerant is causing the trouble (both produce excessive head pressures) it will be relatively easy to determine this by shutting off the unit and allowing it to cool. In the case of refrigerant overcharge, the discharge prexsure will return to the pressure that is normal for the existing air temperature (85 pounds gauge at 80^{o} temperature). If air is present the head pressure remains higher than normal after unit has cooled down to surrounding room temperature.

PURGING AIR: Purge air very slowly and carefully through the discharge service valve gauge port while unit is shut down and cool. When pressure drops to normal at surrounding temperature and head pressure remains normal while unit is operating, it is safe to assume that all the air has been removed.

OVERCHARGE OF REFRIGERANT: Excess refrigerant in the system will flood the lower passes of the condenser and reduce condenser efficiency resulting in a high discharge pressure. A quick indication of this will be that the lower sections of the condenser are considerably cooler when operating than those at the top. Purge excess refrigerant slowly through discharge service valve until head pressure is normal. Apply test as described in "Air in System" above to be certain that air in system is not the trouble. 1 1/2 pounds F-12 constitute a full charge.

MOISTURE IN SYSTEM: Moisture in a refrigerant system will cause corrosion and ice formation in low side resulting in clogged valves. Moisture may be admitted into the system by use of improperly dried tubing and other new parts, careless handling of refrigerant charging drums introducing moisture with Freon, disconnection of circuit while system is under vacuum and failure to purge charging lines, gauge lines, etc. The latter two reasons bring moisture in with air.

Erratic expansion valve operation or complete blocking of expansion valve due to ice forming in port will indicate moisture. To remove moisture, install a dehydrator (drier) in the liquid line at the receiver outlet and operate the unit for several hours. Keep suction pressure above 30 pounds by running water through the cooler. Otherwise moisture may freeze in the evaporator and not pass into the drier.

FAULTY EXPANSION VALVE OPERATION: The expansion valve is a delicate control instrument and rough handling or dirt in the system will damage it. The needle valve may become stuck either in an open or closed position. A closed valve will result in the machine pumping down to a very low suction pressure and may be attributed to several causes, as follows:

1. Dirt clogging port.

2. Ice plugging valve.

3. Thermal bulb has lost charge.

To determine if the last reason is causing the trouble, remove bulb from evaporator and hold in palm of hand. If no flooding of refrigerant is felt through valve, and in the suction line then bulb has lost charge.

If valve is stuck open, excess refrigerant is allowed to enter evaporator and compressor causing a knocking in compressor and other symptoms shown in chart. This is a serious condition. Slight tapping of the valve may release needle valve temporarily.

Replace any valve showing defect.

BY-PASS: If dirt is present and blocks by-pass passage, compressor motor may stall on start or else pick up speed slowly. Either condition can burn out motor. If by-pass passage has been enlarged by damage, a lack of capacity may result due to excessive by-passing of discharge gas during operation. This may also cause overheating of suction side of crankcase of compressor resulting in improper lubrication.

The operation of the by-pass may be checked by measuring the time taken to equalize suction and head pressures after machine cycles off. Time required should be between 30 and 60 seconds. Replace by-pass if operation is not correct.

FAULTY CHECK VALVE: A faulty check valve results in either a blocked suction line or an open line in which the hot gas escapes from the condenser through the suction side of the compressor and into the cool evaporator. This will cause frequent cycling.

THERMOSTAT CONTROL: Faulty controls should be replaced and adjusted according to water temperature.

CHECK CONTROL: This control has both differential adjustment (lowers "cut-out") and range adjustment (changes "cut-in" and "cut-out" together). Control is furnished with knob arranged for control of range adjustment. One complete turn of this knob represents a change of 10° F in both cut-in and cut-out temperatures. (Do not assemble control with knob on differential adjustment). Scale on front of control is only for guide purposes and is not necessarily correct. Always set thermostat by actual water temperatures.

RENEW CONTROL:

1. First remove thermal bulb from top of evaporator. This is done by chipping away the hydrolene insulation from around bulb. Bulb is located between water outlet and refrigerant outlet connections on top of evaporator. After bulb is exposed, loosen screw holding clamp and slide bulb out.

2. Remove screws at back of control casing holding control to bracket. Open cover and disconnect electrical leads.

3. Reverse procedure in replacing with new control. To replace insulation, heat the pieces of hydrolene in a container until it is a liquid, then pour hydrolene back in place.

ADJUST NEW CONTROL:

1. Remove knob retaining screw, control knob, and lock plates from top of control.

2. Set differential adjustment at 10° F. by scale and set range down to 40° F. by scale.

3. With unit operating, allow water to flow through cooler (about half-capacity). (Hold faucet open and cut flow down with valve, if cooler is on car). Keep thermometer in outlet water. When water has reached desired cut-in temperature (top of range, 50° F.) stop unit by raising range adjustment (turn screw clockwise until unit starts again). This sets the proper cut-in temperature.

4. Now with unit running, water temperature will continue to come down. When it has reached desired cut-out temperature (bottom of range, 47° F. recommended) raise "cut-out" by turning differential adjustment screw counter-clockwise until unit stops. This sets the proper differential.

5. Replace lock plate with large end over range screw. Replace knob with pointer on the numeral "10" engraved on plate. This is important in order to prevent anyone who may tamper with control from causing freeze-ups by setting it too low.

6. Allow cooler to cycle several times to check settings.

RENEW EXPANSION VALVE, EVAPORATOR, OR CHECK VALVE (LOW SIDE):

To remove parts from the low side, it is necessary to pump down the system to avoid losing charge. To do this proceed as follows:

1. Attach low and high pressure gauges.

2. Start unit.

3. Close receiver outlet valve.

4. Allow unit to operate until suction gauge shows a pressure of 2 to 5 pounds. *NOTE:* During this time keep a close watch on discharge gauge, should it suddenly start to rise, immediately stop compressor. This rise is due to an overcharge of refrigerant and is an indication that the holding capacity of the receiver has been reached. Continued operation under this condition may be dangerous and may seriously damage the hermetic unit.

5. As soon as pressure falls to 2 to 5 pounds on the suction gauge, stop the unit and close (front seat) both discharge and suction service valves on compressor. All the Freon is stored in the receiver. Pressures will have started to equalize with the compressor and the gauges will now read some intermediate pressure. However, opening the low side now will result only in a negligible loss of Freon. *NOTE:* Do not permit unit to pump down to a vacuum since air will be admitted if lowside is then opened.

6. Expansion valve, evaporator and check valves are all connected with SAE flare connections and may be quickly removed. To remove thermal bulb of expansion valve, follow same procedure as removing thermostat bulb.

RENEW CONDENSER OR RECEIVER: To remove condenser or receiver from system, the entire charge must be purged from the system to the atmosphere.

E A S T E R N   E N G I N E E R I N G   C O M P A N Y ' S   M O D E L - D - 1 1 - P U M P :

The Eastern Engineering Company's Model D-11 pump is used to circulate cooled water from the cooler through car piping. Its purpose is to provide even temperature water at all faucets.

It consists of a fractional horsepower motor, furnished in various A.C. or D.C. voltages, with a close coupled direct drive pump. The entire unit is mounted on a bed plate and located in the same locker as the water cooler.

M O T O R : The motors used on the cars in this lot are General Electric Company's. However, various makes will be found and due to the frame dimensions of the motors, various lengths of shaft extensions and pump mounting housings are used. See Figure 167.

P U M P : The pump is of the close coupled direct-drive type, with open vane impeller mounted directly on the motor shaft extension, eliminating need for bearings in the pump proper.

The seal shown Figure 168 consists of a stainless steel retainer with a carbon seal face, which maintains its seal by coming in contact with a lapped surface on the rear of the pump impeller. Initial contact is actuated by flat spring type washers. Contact under pressure is maintained by means of a hydraulic balance obtained by the machining of the seal surfaces. The back seal between the stainless steel retainer and pump housing is accomplished by means of a synthetic rubber ring. The spring pressure is maintained by means of a stop fitted in the pump housing and locked by a set screw. Spring pressure can be varied by sliding stop along shaft.

R E N E W   S E A L :

1. Remove six cover screws and cover.

2. Hold shaft at "A" - unscrew impeller by turning clockwise (note shaft extension has left-hand thread at both ends). With the impeller removed pump body may be removed from adapter by sliding it off shaft.

3. Remove adapter, unscrew nuts from motor rods. Entire seal assembly may be removed from inside of pump body.

C A U T I O N : Before reassembly:

a. Check shaft extension for eccentricity using a pencil as an indicator - tap the shaft extension with hammer handle as required to straighten it.

b. Check inside of stuffing box for smoothness.

c. If motor is sleeve bearing type, check for end play, end play of 1/8" or more will cause seal to leak.

d. Inspect lapped surface on impeller and carbon seal face. If carbon surface is not worn down to metal retainer and the impeller is not scored or damaged it is still fit for further service. Inspect the back seal (synthetic rubber) ring around the feather edge for wear or damage, as a small nick or cut will cause leaks.

4. Be sure that the parts are in relation to one another as shown Figure 168.

C A U T I O N : Since the seal does not rotate be sure the locking lugs are engaged one on the sliding stop and the other in the stainless steel retainer. To assure this, twist the seal on insertion until it can no longer be turned.

5. Wipe lapped faces clean and apply impeller.

6. Replace gasket and screws.

7. Test. These pumps can be tested for seal tightness under any water pressure available. Slight leakage may occur during first five minutes of operations as the new parts are seated in.

GENERAL ELECTRIC RAILWAY WATER COOLERS

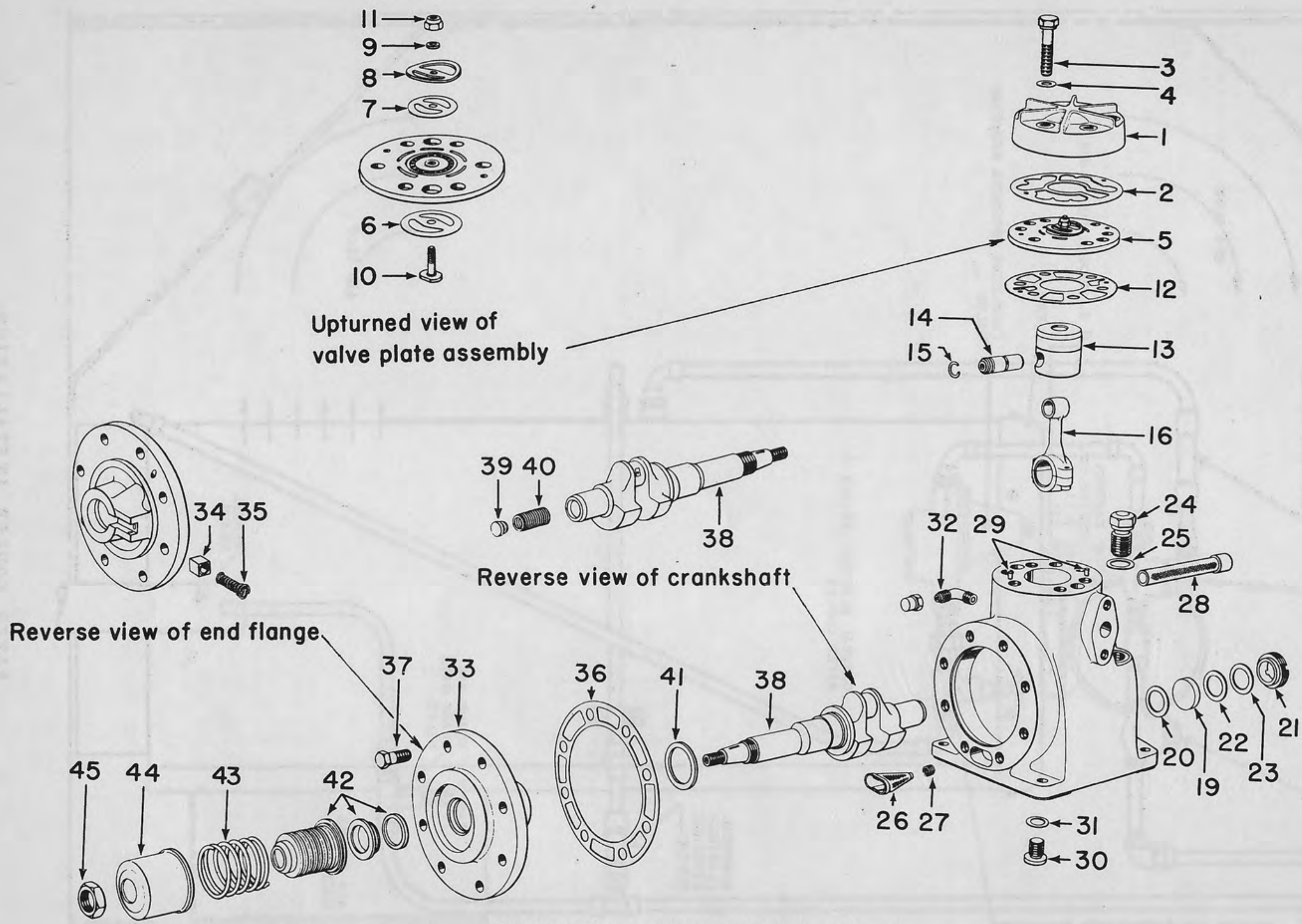
Renewal Parts - Type RW675 A

Cat. No.	Description
	Motor Model No. 5BC44AB183X for RW675A3 (32 V. DC)
CW2AR1	Compressor
	Renewal Unit Parts
C13A623	Liquid Receiver
M4B409	Expansion Valve
M15B422	Expansion Valve Insulator
B6A153	Cooling Unit Assembly
B20A38	Nut for Expansion Valve Connection to Cooling Unit
C20A671	Washer for Expansion Valve Connection to Cooling Unit (2 Req.)
C13A629	Condenser
B20A343	Heat Interchanger
C1A17	Liquid Line Valve
C17A1	Valve Cap
C20A14	Valve Cap Gasket
C20B94	Condensing Unit Rubber Mounting (4 Req.)
246750	Compressor Pulley Key
C20B54	Compressor Pulley Nut
C20B55	Compressor Pulley Nut Lock Washer
C20B106	Motor Hinge, Pin and Retaining Ring
M4B402	Control for RW675A3 (32 V. DC)
C5B423	Compressor Pulley
	Renewal Cabinet Parts
B7A177	Cabinet Top
B7A242	Top Plate
B7A179	Condensing Unit Compartment Guard
B7A184	Removable Panel
B20A38	Water Inlet Fitting Nut (on back of cabinet)
B20A39	Water Inlet Fitting Washer (on back of cabinet)
B20A38	Cooling Unit Drain Fitting Nut (on back of cabinet)
C20A671	Cooling Unit Drain Fitting Washer (on back of cabinet)
Compressor Parts	Suction and Discharge Service Valve
C1A125	Suction Service Valve
C17A377	Valve Cap
C11A347	Valve Cap Gasket
C11A116	Suction Service Valve Gasket
C20B78	Suction Service Valve Cap Screw
C1A130	Discharge Service Valve
C17A377	Valve Cap
C11A347	Valve Cap Gasket
C11A116	Discharge Service Valve Gasket
C20B78	Discharge Service Valve Cap Screw (2 Req.)

CW-2 COMPRESSOR ASSEMBLY

Renewal Parts

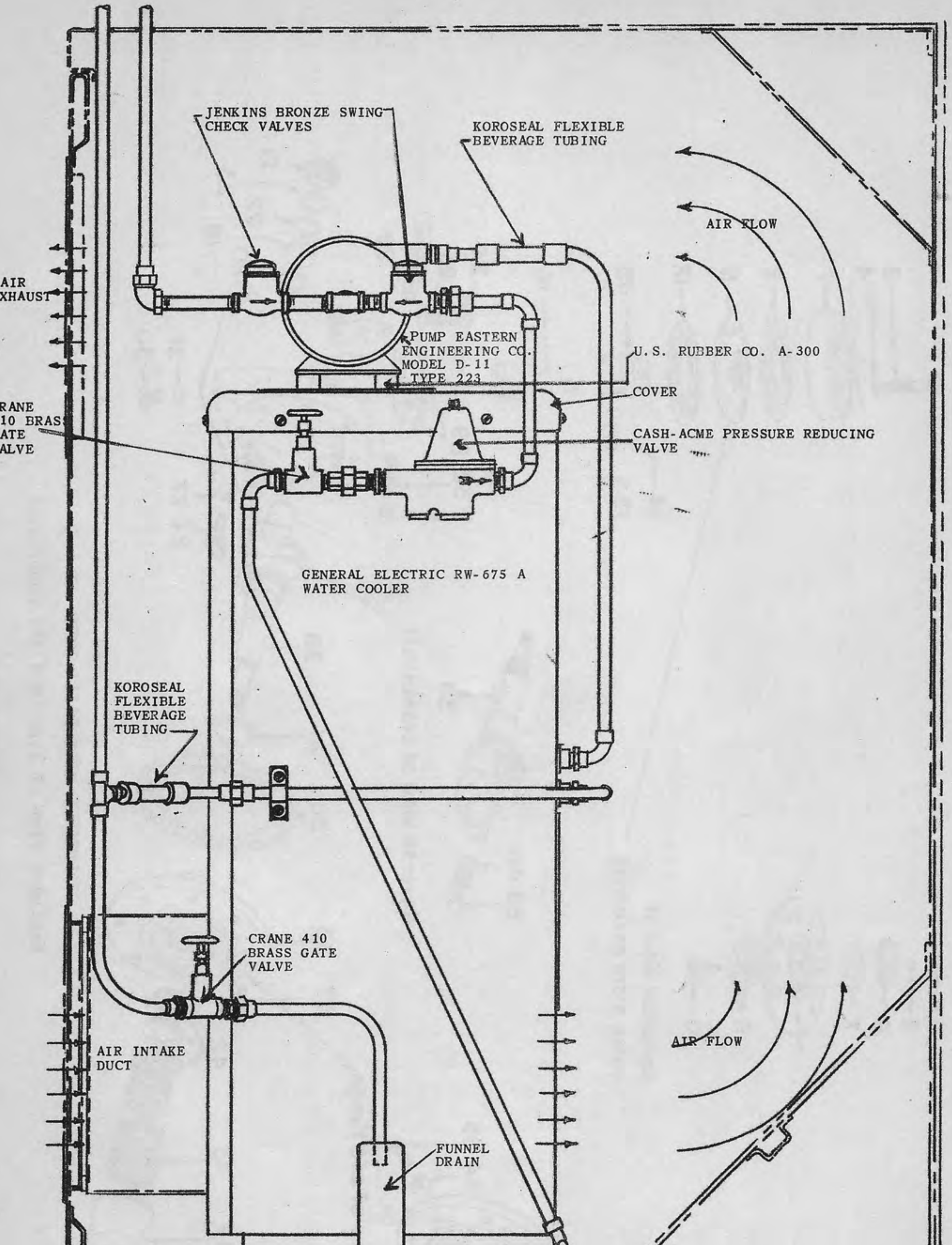
Ref. No	Part No.	Description
1	C8A191	Cylinder Head
	C17A5	Cylinder Head Control Connection Elbow
2	C11A359	Cylinder Head Gasket
3	C20A630	Cylinder Head Cap Screw
4	C11A264	Cylinder Head Cap Screw Gasket
5	C10A343	Valve Plate Assembly
6	C10A338	Intake Valve
7	C10A335	Discharge Valve
8	C10A336	Discharge Valve Retainer
9	C10A337	Discharge Valve Spacer
10	C20B33	Valve Retainer Screw
11	C20B34	Valve Retainer Screw Nut
12	C11A360	Valve Plate Gasket (.010" thick)
12	C11A361	Valve Plate Gasket (.015" thick)
	C9A245	Piston Pin Complete with Piston Pin and Snap Ring
13	C9A242	Piston Only
14	C9A243	Piston Pin
15	C20B37	Snap Ring
16	C9A241	Connecting Rod Assembly
	C20B117	Cap Bolt
	C20B116	Cap Bolt Washer
19	C20A573	Crankcase Oil Sight Glass
20	C11A254	Crankcase Oil Sight Glass Gasket
21	C20A572	Crankcase Oil Sight Glass Retainer
22	C20A867	Crankcase Oil Sight Glass Washer (Composition)
23	C20A574	Crankcase Oil Sight Glass Washer (Steel)
24	A19A417	Crankcase Oil Fill and Oil Drain Plugs
25	C11A141	Crankcase Oil Fill and Oil Drain Plugs Gasket
26	C14A63	Crankcase Oil Filter
27	C20B45	Crankcase Oil Filter Spring
28	C14A62	Crankcase Suction Port Strainer
29	C20B67	Crankcase Dowel Pin
30	C20B44	Crankcase Assembly Plug
31	C11A369	Crankcase Assembly Plug Gasket
32	C17A5	Crankcase Control Connection Elbow
		Crankcase Control Connection Union
46		Crankcase Bottom Plate
47		Crankcase Bottom Plate Gasket
48		Crankcase Bottom Plate Cap Screw
33	C16A203	End Flange Assembly
34	C20B38	Oil Pump Vane
35	C20B39	Oil Pump Spring
36	C11A351	End Flange Gasket
37	C20A334	End Flange Cap Screw
38	C9A259	Crankshaft Assembly
39	C20B41	End Plug
40	C20B42	End Plug Spring
41	C20B43	Crankshaft Thrust Washer
42	C16A206	Shaft Seal Replacement Kit
43	C20B68	Shaft Seal Spring
44	C20B69	Sealing Cup
45	C20B40	Shaft Seal Nut



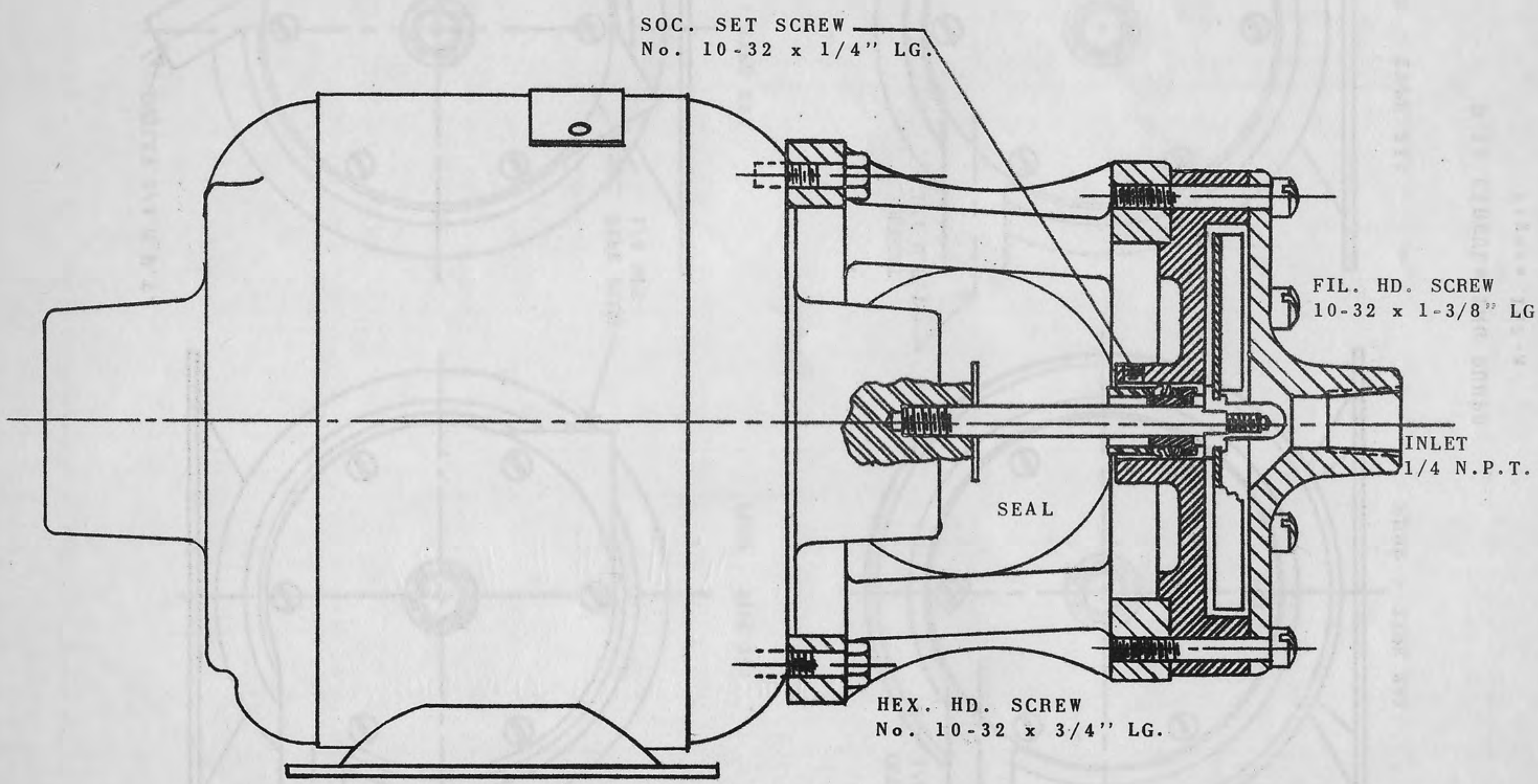
COMPRESSOR ASSEMBLIES TYPE CW - 2

Exploded View of Type CW-2 AR1 Compressor

Figure 165

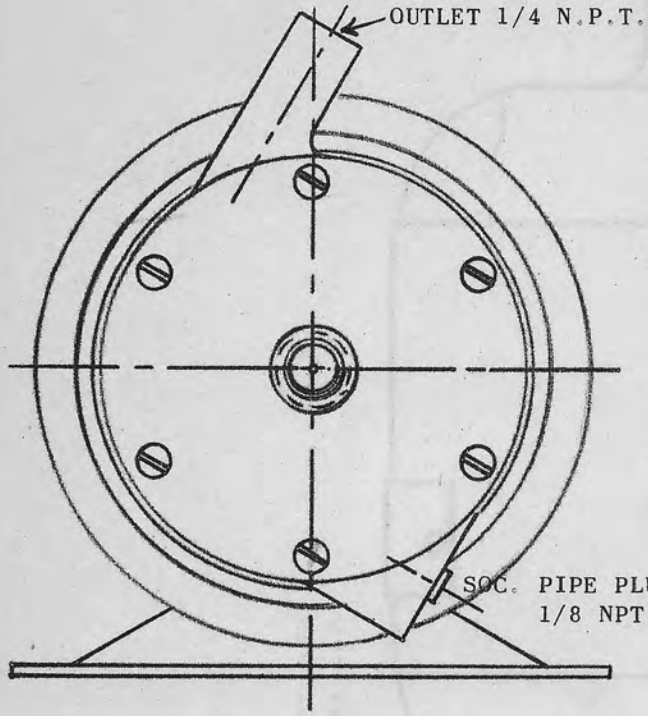


WATER COOLER INSTALLATION
Figure 166

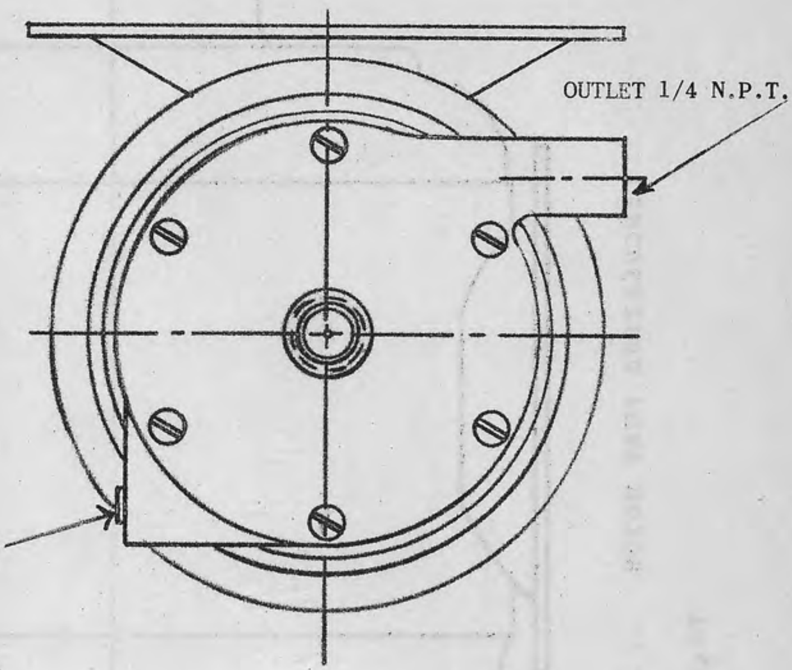


CIRCULATING PUMP MOTOR - 32 VOLT D.C. - 1/6 H.P. - 1725 RPM

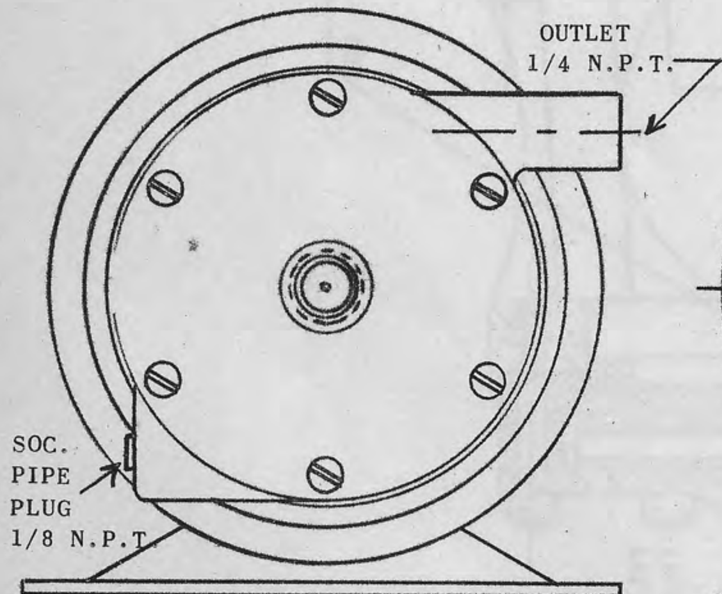
Figure 167



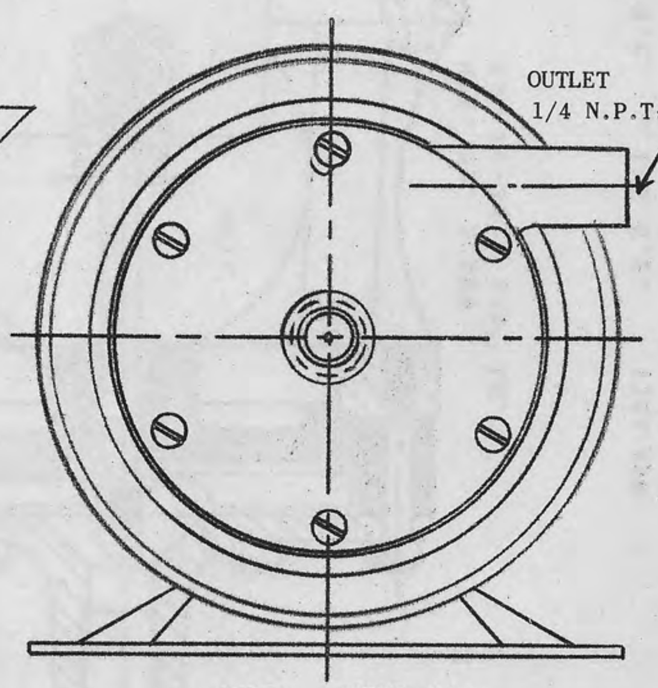
PUMP - TYPE 237



PUMP - TYPE 240



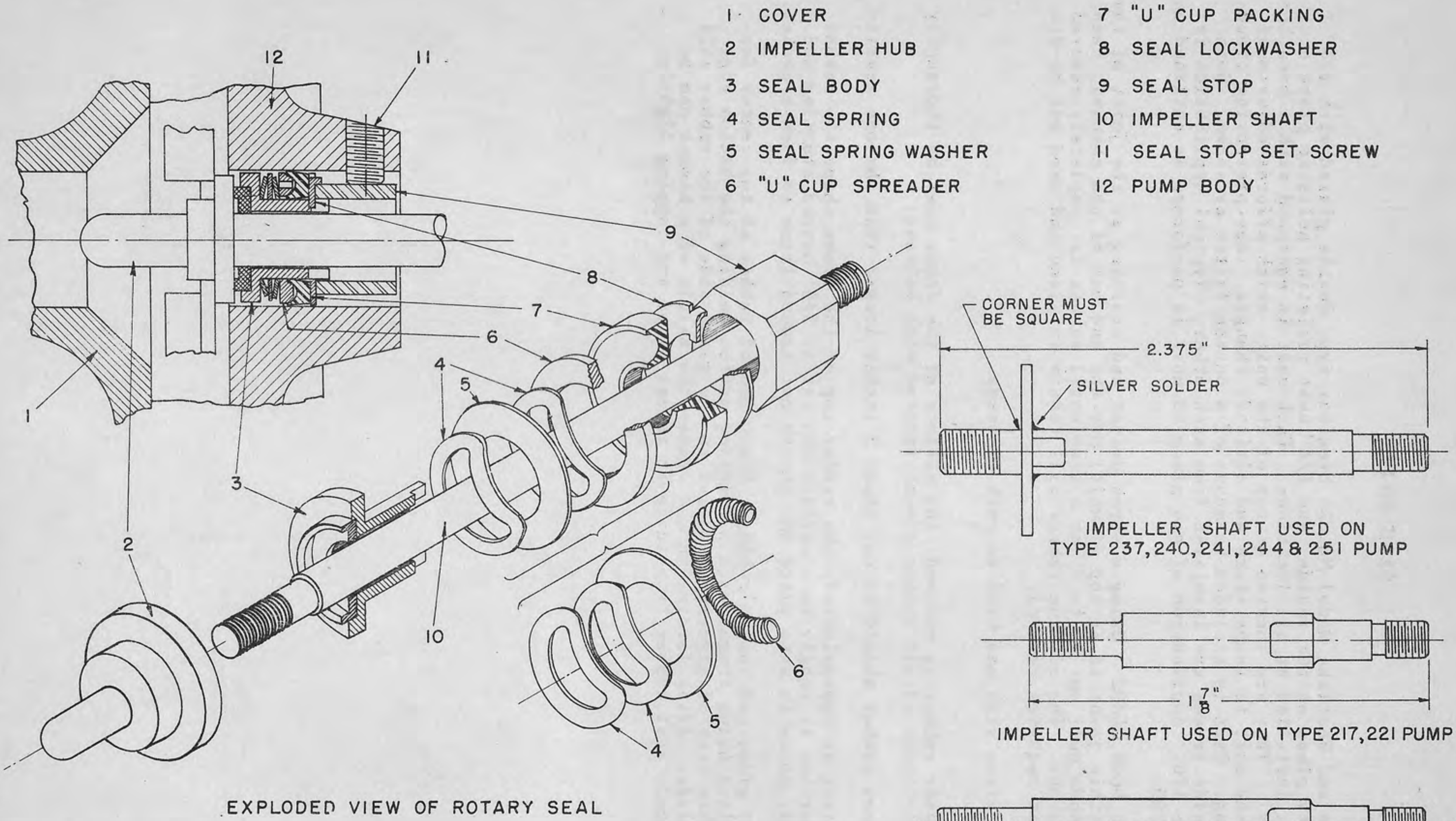
PUMP - TYPE 251



PUMP - TYPE 241

D-11 CIRCULATING PUMPS

Figure 167-A



ROTARY SEAL ASSEMBLY

Figure 168

SASH UNITS

Adams and Westlake Model No. 36 breather type double glazed with 1/4" laminated safety glass on the inside, and 1/4" heat resisting polished plate on the outside are installed at all locations. Each unit is equipped with a breather, (See Figure 169). They are located at top of the unit, which affords adjustment of air within the unit to temperature and altitude changes, thus preventing clouding and frosting. Dirt is excluded by means of a cotton filter as shown. Both inside and outside frames are insulated from each other. Typical application is shown in Figure 170. Application of new glass to unit is performed as outlined on pages 279 and 280.

RENEW VESTIBULE DOOR GLASS: Using a screw driver and starting at the joint of the inside rubber (this joint is at top of unit) pry the end out of the channel, then working with hands pull out 3" to 4" at a time until rubber is completely removed. Then lift glass out. The outside rubber will remain in place and need not be disturbed unless it requires renewal.

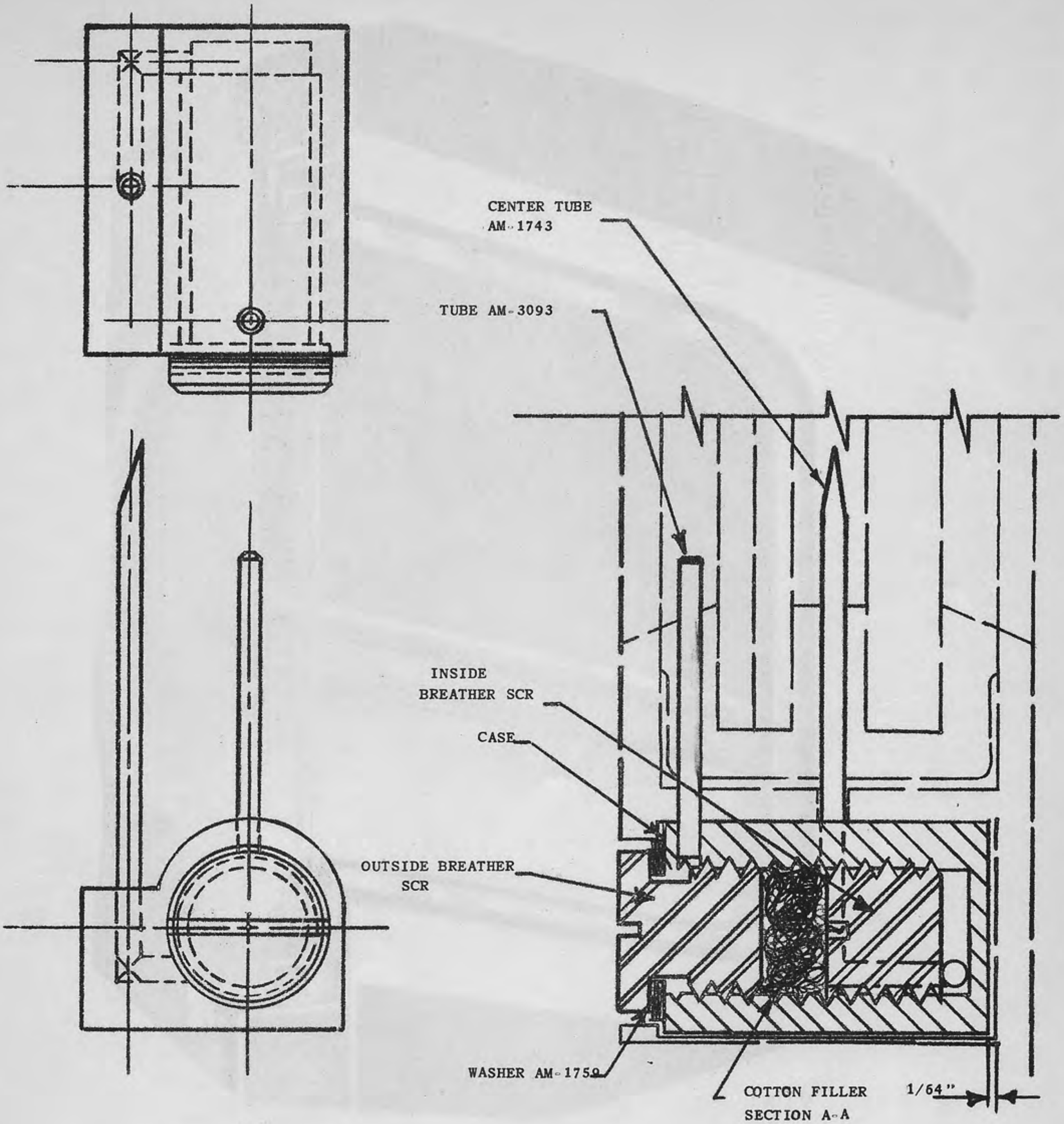
CAUTION: Hold glass with one hand as work proceeds.

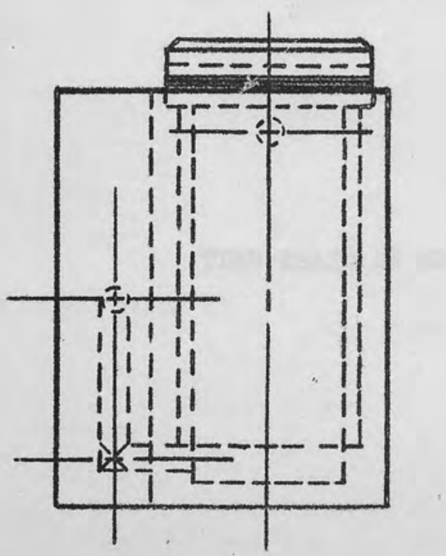
If outer rubber is renewed, the surface of the frame must be thoroughly cleaned and all traces of old rubber cement removed with solvent.

The new rubber should be cut about 3 inches longer than the one removed.

Starting at approximately the center top of the frame shape the rubber around frame forcing it snugly into corners and cut it 3/8" beyond starting end. Then cement end, force it into place and smooth out around frame to form a gasket.

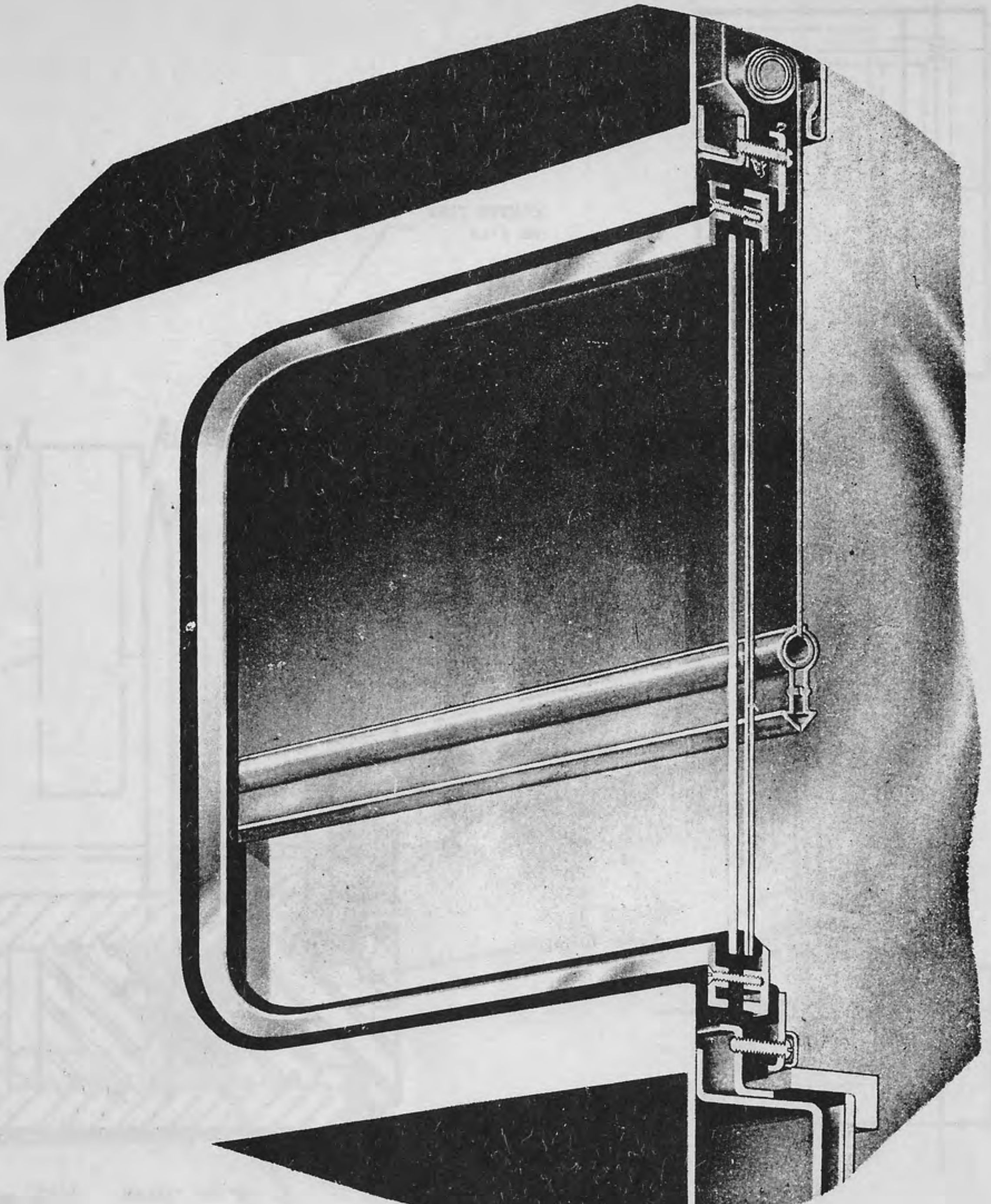
Apply glass and inside rubber. Start end of rubber at top center forcing it into place using thumbs with a twisting motion holding the bottom edge out. A very thin coat of glycerine applied to the glass side of the rubber will help make it slide. After forcing in the rubber the handle of a hammer can be used to completely seat rubber by sliding it across glass and tapping lightly.





MODEL 28 BREATHER UNIT - A & W SASH

Figure 169



TYPICAL APPLICATION OF ADAMS & WESTLAKE MODEL 36 GLASS UNIT

Figure 170

GLASS APPLICATION

Due to the fact that after the glass has been installed in the ADLAKE Model 36 double glazed sash unit it is not possible to do further cleaning on the two inside faces, it is desirable that care be taken to see they are perfectly clean before being assembled. Experience has shown that it is well to watch the following:

A. That the table or bench on which the glass is to be cleaned is free from particles of metal or other substances which may scratch it. A piece of clean cloth or felt will serve the purpose.

B. The cleaning compound should be of such a nature that it will not scratch or mar the glass, such as whiting.

C. The cloths used for cleaning should be clean and free from dirt or particles that may scratch the surface of the glass.

D. The glass should be cleaned on both sides in order to be sure the inside face is perfectly clean before it is assembled into the unit.

E. Set the glass on edge and carefully inspect to be sure it is free from fingermarks, streaks, smudge-spots, etc. If any show up remove them before assembly into the unit. Be careful to handle the glass in such a way that it will not become finger-marked after cleaning. With this in mind proceed with the following:

1. Remove unit from opening in car.

2. Lay flat on table or bench with face of unit showing screw heads on upper side. (See Figure 171)

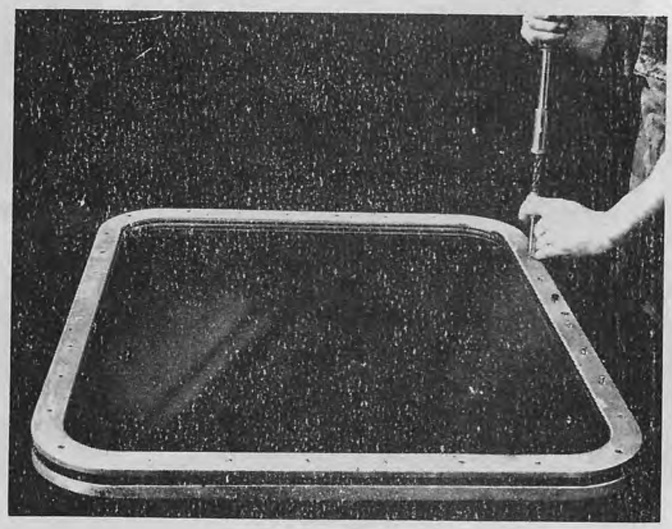


Figure 171

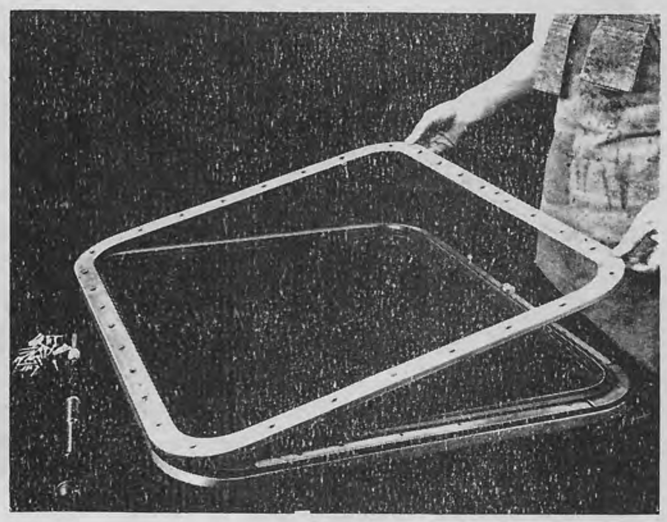


Figure 172

3. Remove all screws except the screw cap of the breather

4. Lift off upper half of frame. (See Figure 172.)

5. Remove glass assembly (glass, rubber and breather) from lower half of frame. (See Figure 1

6. If one of the lights of glass is undamaged mark it with crayon or chalk to show point at which breather is applied.

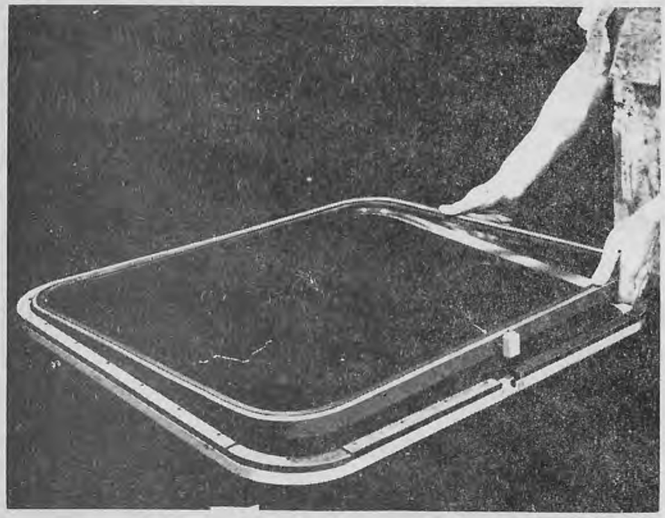


Figure 173

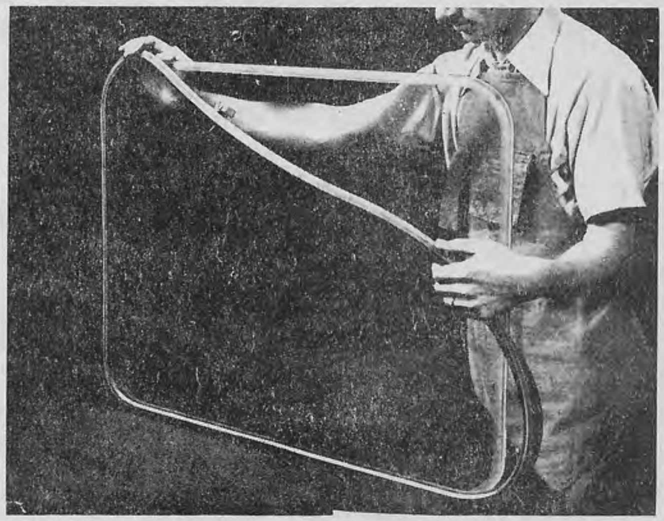


Figure 174

7. Remove rubber from glass but do not remove breather from rubber. (See Figure 175

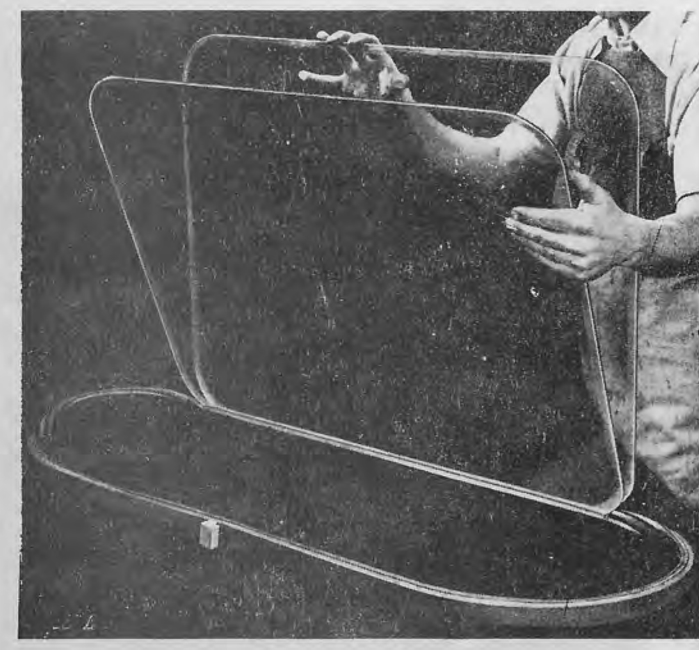


Figure 175

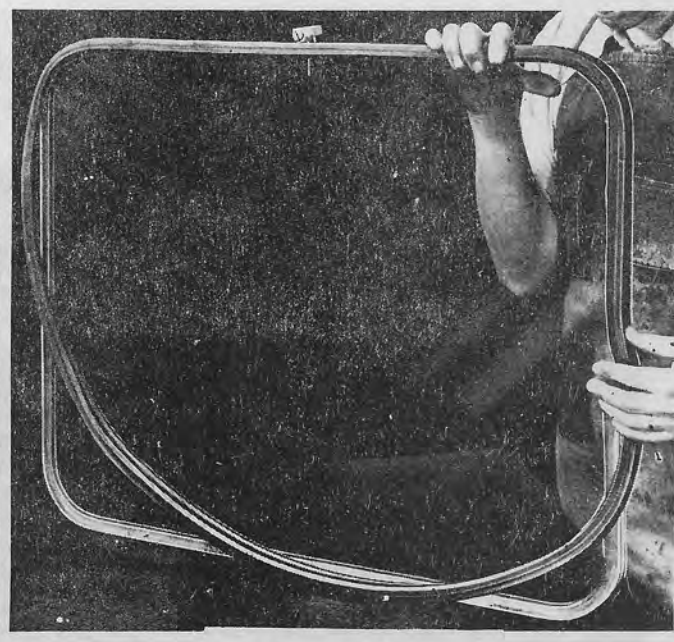


Figure 176

8. Clean both lights of glass, particularly on the faces that go toward each other Be sure no lint, dust, finger-marks or smudge-spots are left on glass, for when sealed in unit they can not be removed.

9. Clean rubber to be sure no dirt has adhered to it. If the rubber shows any damage or is torn replace it with a new one.

10. Stand the two lights of glass on edge with cleaned faces toward each other and with spot marked for breather location on upper edge. (See Figure 175

11. Apply rubber to glass, placing breather at point marked on glass. (See Figure 176 Caution: It is important that the replacement glass has the same dimensions (length, width & thickness) as the piece it replaces or a loose seal will result. Glass should be without sharp edges to avoid cutting rubber. Be sure the breather screw-cap will face toward the inside of the car. Start to apply at breather and work both ways across top, then down both sides, after which reverse position of glass and complete across bottom. Go over again to make sure rubber is all the way on.

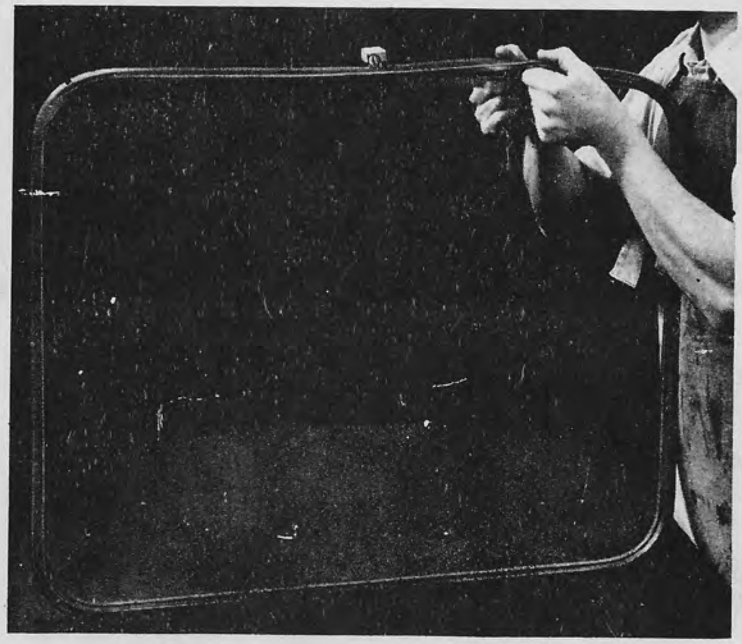


Figure 177

12. After rubber is applied check to see that breather is correctly located. If not lift rubber from top edge of glass and firmly pull until it is. (See Figure 177 Then work rubber down sides and across bottom to make even application.

13. Place glass and rubber assembly back in metal frame. (See Figure 172 See that breather is located in center of notch cut in frame. It is important there be no binding of breather and that it is free on all sides.

14. Replace upper half of metal frame.

15. Replace all screws and tighten so there is equal pressure on all four sides of unit. Go around two or three times to be sure all screws are turned up tight. (See Figure 175

16 When placing unit in the car opening see that it is so set that breather is located at the top with the screw-cap toward the inside of the car and the tube toward the outside.

17. If a hose is used to test the water tightness of the unit after application to car, see that the breather tube is covered so as to prevent water being forced into it.

Mirrors are 1/4" plain glass of sizes and locations as follows:

16" x 22" - Over washstand in Bedroom and Compartment Annex.

4" x 26 1/2" - Open Sections.

14" x 16" - Over washstands in upper Roomette.

27" x 27" - Cross partition in lower Roomettes.

36" x 38" - Cross partition in Women's Dressing Room.

10 3/4" x 48" - Sliding door upper Roomette.

31" x 22" - Cross partitions in Roomettes.

11" x 49" - Roomette, Bedroom and Compartment entrance doors.

16" x 30" - General toilet, Porter's section, and Men's & Women's dressing rooms.

MISCELLANEOUS GLASS: Adams & Westlake Company's No. 36 with 3 1/8" radius corners outside heat absorbing, inside laminated plate used in sizes and location as follows with 4" radius corners:

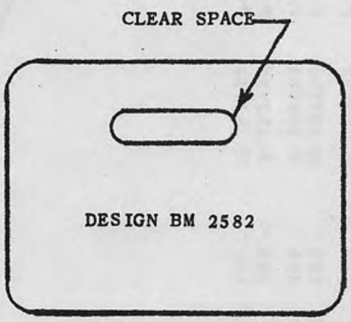
39 1/8" x 20 7/8" Heat Absorbing)
39 1/8" x 20 7/8" Laminated Plate) Hinged Room E in Plans 4180 and 4181.

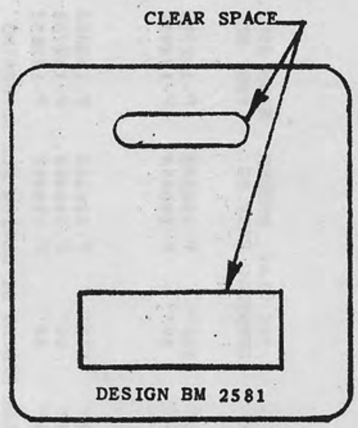
23 1/2" x 23 3/4" Heat Absorbing)
23 1/2" x 23 3/4" Laminated "Sandblasted" Plate) General Toilet

UNIT SIZE	SASH RADIUS CORNERS	GLASS SIZE	GLASS RADIUS CORNERS	R-255 RUBBER GLAZ. LENGTH	LOCATION
41 1/8" x 22 7/8"	5 1/16"	39 1/8" x 20 7/8"	3 1/8"	107"	Hinged 4180 Room D 4181 Room A
25 1/2" x 25 3/4"	4 1/8"	23 1/2" x 23 3/4"	3 1/8"	84"	Sandblasted BM 2851 Gen. Toilet
17"x 22 3/8"	Single Laminated Plate				End Door
37" x 25 3/4"	4 1/8"	35" x 23 3/4"	3 1/8"	105"	Upper & Lower DRW Room & Roomettes
44" x 25 3/4"	4 1/8"	42" x 23 3/4"	3 1/8"	118"	Obs. Lounge Rmt.- Compt. Open Sec. Bdm. & Pass.
25 1/2" x 25 3/4"	4 1/8"	23 1/2" x 23 3/4"	3 1/8"	84"	Porter's Section
20 7/8" x 29 7/8"	Single Laminated Plate		2 1/4		Vest. Side Door
31" x 25 3/4"	4 1/8"	29" x 23 3/4"	3 1/8"	94"	Men's & Women's Dressing Room - BM2581 - Sandblasted
13" x 8"	Libbey Owens - Sq. Corners - Heat Absorbing Lam. Plate				Upper Berth Section
28 1/8" x 22 7/8"	5 1/16"	26 1/8" x 20 7/8"	3 1/8"	83"	Hinged Room A - 4108A

(cont.d)

UNIT SIZE	SASH RADIUS CORNERS	GLASS SIZE	GLASS RADIUS CORNERS	R-255 RUBBER GLAZ. LENGTH	LOCATION
31" x 25 3/4"	4 1/8"	29" x 23 3/4"	3 1/8"	94"	4109A-4108 Bedrooms
25 1/2" x 17 3/4"	4 1/8"	23 1/2" x 15 3/4"	3 1/8"	69"	Obs. Car 6878-4109A 8M2582 Buffet



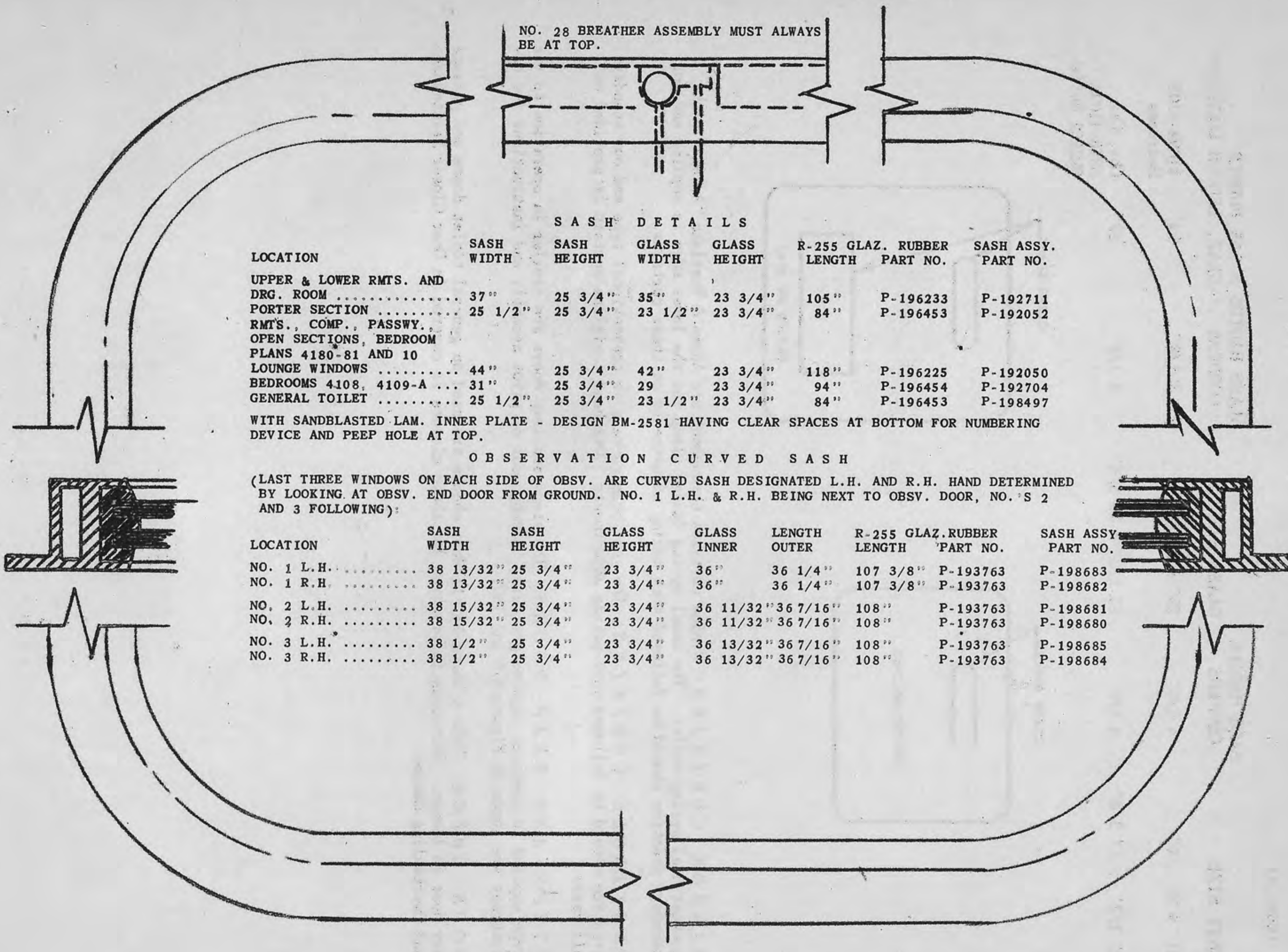


WINDOW CURTAINS: Window curtains throughout are Adams & Westlake."Adlake" with conventional spring roller. The usual spring loaded clamp for the lower edge is applied and our standard practice should be followed when making adjustments on these curtains.

VESTIBULE CURTAINS: The vestibule curtain is conventional type and our standard practice should be followed when making adjustments. Overhead trainline curtain is provided on all cars.

STEPS AND TRAP DOORS: The steps and trap doors are similar in operation to the type applied to previous lightweight cars. Arrangement of pivot assembly and instructions for adjustment are shown in Figures 179 and 180.

DOOR CHECK: Yale & Towne No. 11 door checks are used on general toilet doors and passageway door to lounge. Servicing information for these closers is covered in Door Closer Maintenance and Overhauling Manual.



S A S H   D E T A I L S

LOCATION	SASH WIDTH	SASH HEIGHT	GLASS WIDTH	GLASS HEIGHT	R-255 GLAZ. RUBBER LENGTH	PART NO.	SASH ASSY. PART NO.
UPPER & LOWER RMTS. AND DRG. ROOM	37"	25 3/4"	35"	23 3/4"	105"	P-196233	P-192711
PORTER SECTION	25 1/2"	25 3/4"	23 1/2"	23 3/4"	84"	P-196453	P-192052
RMTS., COMP., PASSWY., OPEN SECTIONS, BEDROOM PLANS 4180-81 AND 10 LOUNGE WINDOWS	44"	25 3/4"	42"	23 3/4"	118"	P-196225	P-192050
BEDROOMS 4108, 4109-A ...	31"	25 3/4"	29	23 3/4"	94"	P-196454	P-192704
GENERAL TOILET	25 1/2"	25 3/4"	23 1/2"	23 3/4"	84"	P-196453	P-198497

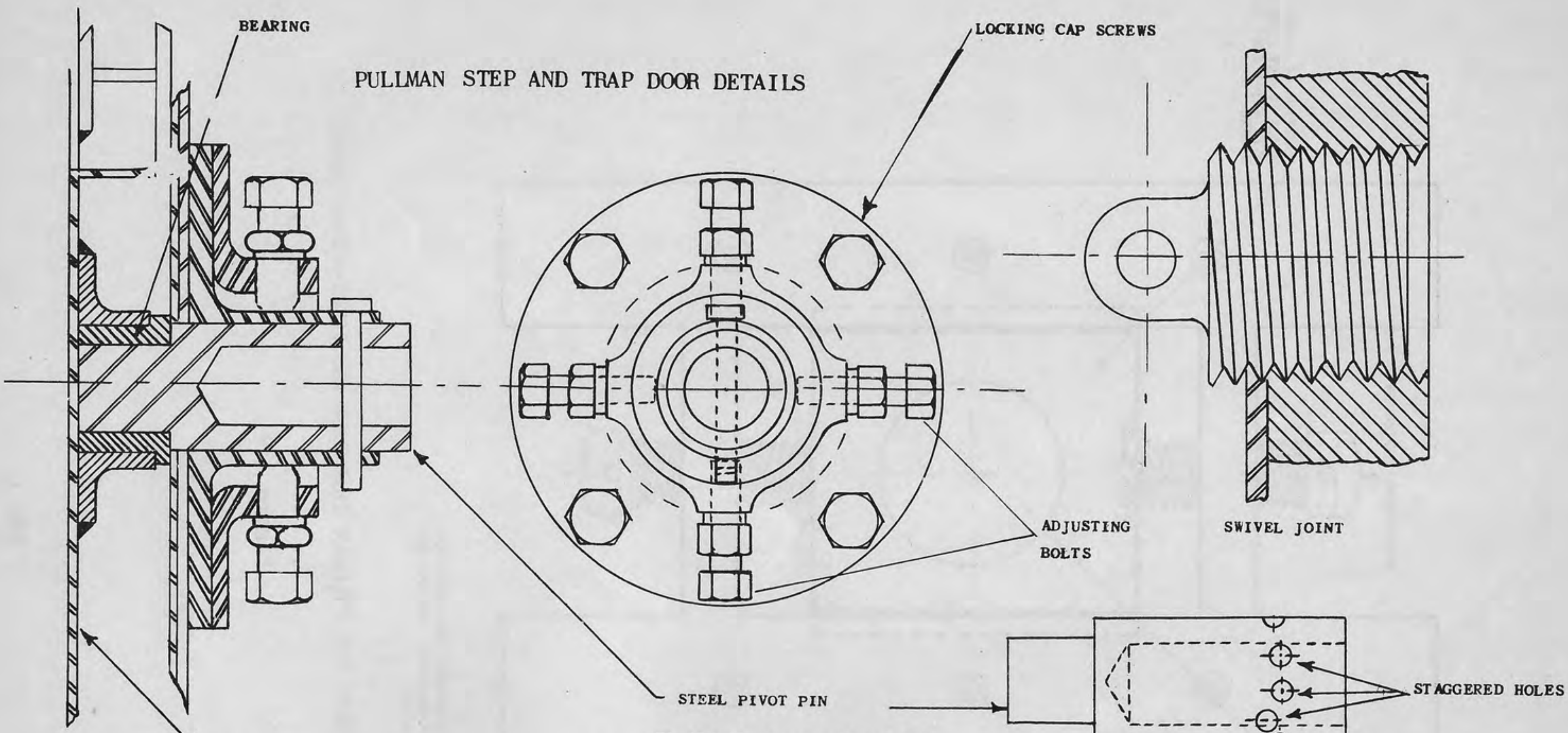
WITH SANDBLASTED LAM. INNER PLATE - DESIGN BM-2581 HAVING CLEAR SPACES AT BOTTOM FOR NUMBERING DEVICE AND PEEP HOLE AT TOP.

O B S E R V A T I O N   C U R V E D   S A S H

(LAST THREE WINDOWS ON EACH SIDE OF OBSV. ARE CURVED SASH DESIGNATED L.H. AND R.H. HAND DETERMINED BY LOOKING AT OBSV. END DOOR FROM GROUND. NO. 1 L.H. & R.H. BEING NEXT TO OBSV. DOOR, NO.'S 2 AND 3 FOLLOWING):

LOCATION	SASH WIDTH	SASH HEIGHT	GLASS HEIGHT	GLASS INNER	LENGTH OUTER	R-255 GLAZ. RUBBER LENGTH	PART NO.	SASH ASSY PART NO.
NO. 1 L.H.	38 13/32"	25 3/4"	23 3/4"	36"	36 1/4"	107 3/8"	P-193763	P-198683
NO. 1 R.H.	38 13/32"	25 3/4"	23 3/4"	36"	36 1/4"	107 3/8"	P-193763	P-198682
NO. 2 L.H.	38 15/32"	25 3/4"	23 3/4"	36 11/32"	36 7/16"	108"	P-193763	P-198681
NO. 2 R.H.	38 15/32"	25 3/4"	23 3/4"	36 11/32"	36 7/16"	108"	P-193763	P-198680
NO. 3 L.H.	38 1/2"	25 3/4"	23 3/4"	36 13/32"	36 7/16"	108"	P-193763	P-198685
NO. 3 R.H.	38 1/2"	25 3/4"	23 3/4"	36 13/32"	36 7/16"	108"	P-193763	P-198684

PULLMAN STEP AND TRAP DOOR DETAILS



TO ADJUST STEPS & TRAP DOOR:

1. DISCONNECT OPERATING ARM BETWEEN STEP AND TRAP DOOR AT TRAP DOOR.

2. LOOSEN LOCKING CAP SCREWS.

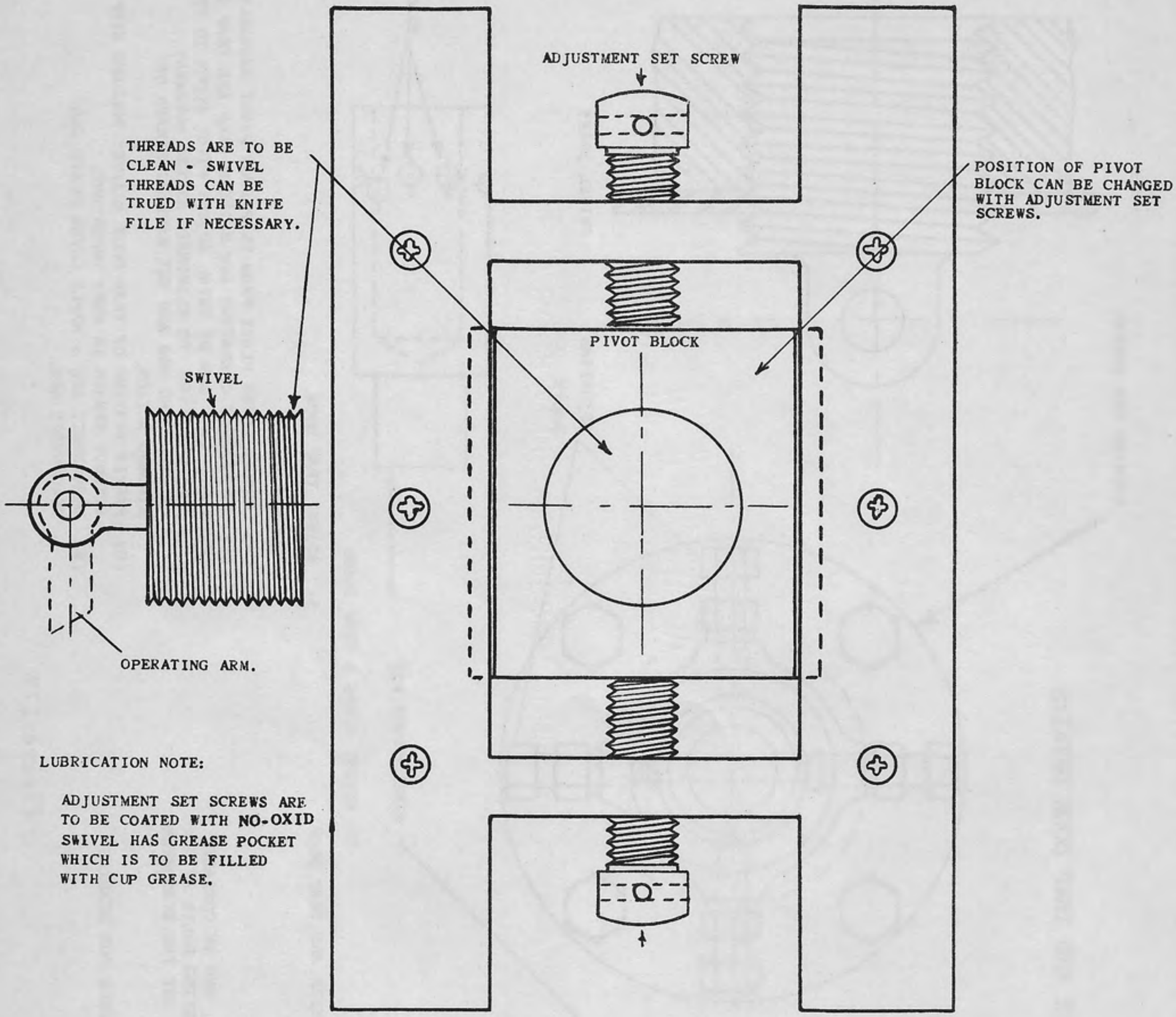
3. ADJUST STEP FLUSH WITH SIDE SKIRT, AND IN CONTACT WITH TRAP DOOR WITH THE FOUR ADJUSTING BOLTS AT EACH PIVOT. FOR LATERAL MOVEMENT USE THE STAGGERED HOLES IN STEEL PIVOT PIN.

4. ROCK STEPS IN ALL DIRECTIONS TO CHECK FOR BEARING WEAR.

5. ADJUST TRAP DOOR

(A) REMOVE COVER PLATE FROM TRAP DOOR PIVOT ASSEMBLY.
(B) RE-CONNECT OPERATING ARM BETWEEN STEP AND TRAP DOOR.
(C) S FIG. 180 AND BY TRIAL ADJUST PIVOT BLOCK TO PROPER POSITION TO ELIMINATE EXCESS MOVEMENT OF OPERATING ARM AND YET HAVE NO STRAIN OR BINDING ACTION.
(D) PROPER SEATING OF TRAP DOOR AGAINST FOLDING STEP WITHOUT STRAIN IS VERY IMPORTANT.
(E) DISCONNECT ARM - APPLY COVER PLATE AND RE-CONNECT ARM.

Figure 179



NOTE: STEP PIVOTS ARE ADJUSTABLE FOR ELEVATION BY ADJUSTMENT BOLTS ON PIVOT CASTING(SEE FIGURE 282 FOR DETAILS)

ADJUSTMENT ARRANGEMENT FOR PULLMAN TRAP DOOR AND FOLDING STEP LEVER

Figure 180

NOTES

VENETIAN BLINDS

Ajax-Consolidated Company's "DA-LITE" blinds are used instead of window curtains at certain locations, such as lounge and observation rooms. This blind differs from the household type as it does not have cord arrangements to raise, lower or adjust slat angularity. Blind is raised or lowered by depressing brake control buttons on bottom bar, moving bar to desired location. Movement is aided by spring roller at top of blind, connected to bottom bar with nylon tape.

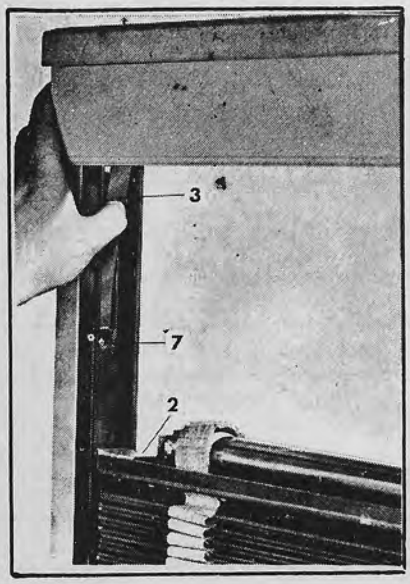


Figure 181

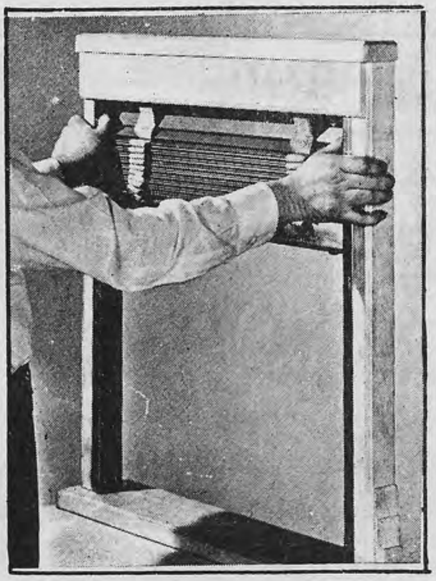


Figure 182

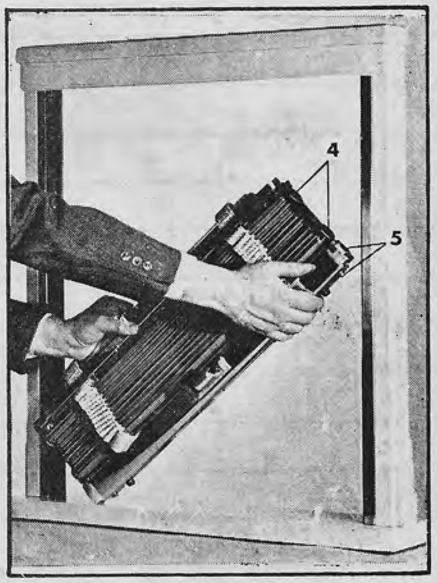


Figure 183

Top of ladder rests on the spring roller, as the roller rotates, it pulls either the front or back tape, tilting the slats. Entire blind can be removed by depressing lever springs #3, allowing top aluminum bar to be lowered, resting on top of slats, see Figures 181 and 182.

NOTE: To relieve roller spring tension, blind should be raised near the top of window before removal. Blind can then be removed as shown in Figure 182.

The top bar can be adjusted to compensate for sash irregularities by loosening the locking screws and moving the end section. The bottom bar has similar adjustments to overcome - loose or tight fit of the brake mechanism in the rubber lined side channels. If the bottom bar has excess lateral movement, convert as follows:
See Figure 183.

1. Raise blind to top, leave bottom bar and slats in side channels.

2. Loosen end block adjustment screws No. 6029.

3. Move end blocks in or our as desired.

4. End rollers No. 6008 should have approximately 1/16" overall lateral play in side channels.

5. After proper adjustment of both end blocks, tighten both screws No. 6029.

End blocks No. 6025 and No. 6026 are not attached to brake plunger No. 6058, stabilizer assembly is attached to the end blocks. The stabilizer assembly has no separate adjustment, being regulated by the end block adjustment. Brakes are independent of the end blocks and require separate adjustments after end blocks are located. To adjust brakes refer

1. Remove bottom bar from side channels.

2. Loosen set screw No. 6035 Allen No. 10 headless set screw.

3. Turn brake plunger to move stabilizer wheel No. 6071 in or out. Wheel No. 6071 in turn locates brake shoe No. 6099.

4. Face of wheel 6071 should extend about 1/16" beyond end rollers No. 6008. (Make sure that wheel No. 6071 fits into brake shoe yoke No. 6099 holding it in captive position).

5. Equalize both brake shoes.

6. After adjustments tighten set screws No. 6035, re-install bottom bar in side channels.

7. Check brake operation.

TO REPLACE WOOD SLATS:

1. Remove bottom bar and all slats. Do not remove top bar.

2. Break out damaged slat.

3. Cut a slit in the new slat from the router holes to the front edge with a hack saw.

4. Install new slat. Be sure slits are toward front of blind.

5. Slip lifting tapes through slits into router holes.

6. Press small metal clips over slit for re-inforcement. The front ladder tape will conceal clip.

7. Re-install slats and bottom bar into side channels.

CLEANING PROCEDURE: Adhere to previous instructions outlined in Superintendent of Yards memorandum "Interior Gang Cleaning - Standard and Lightweight Cars", November 20, 1946.

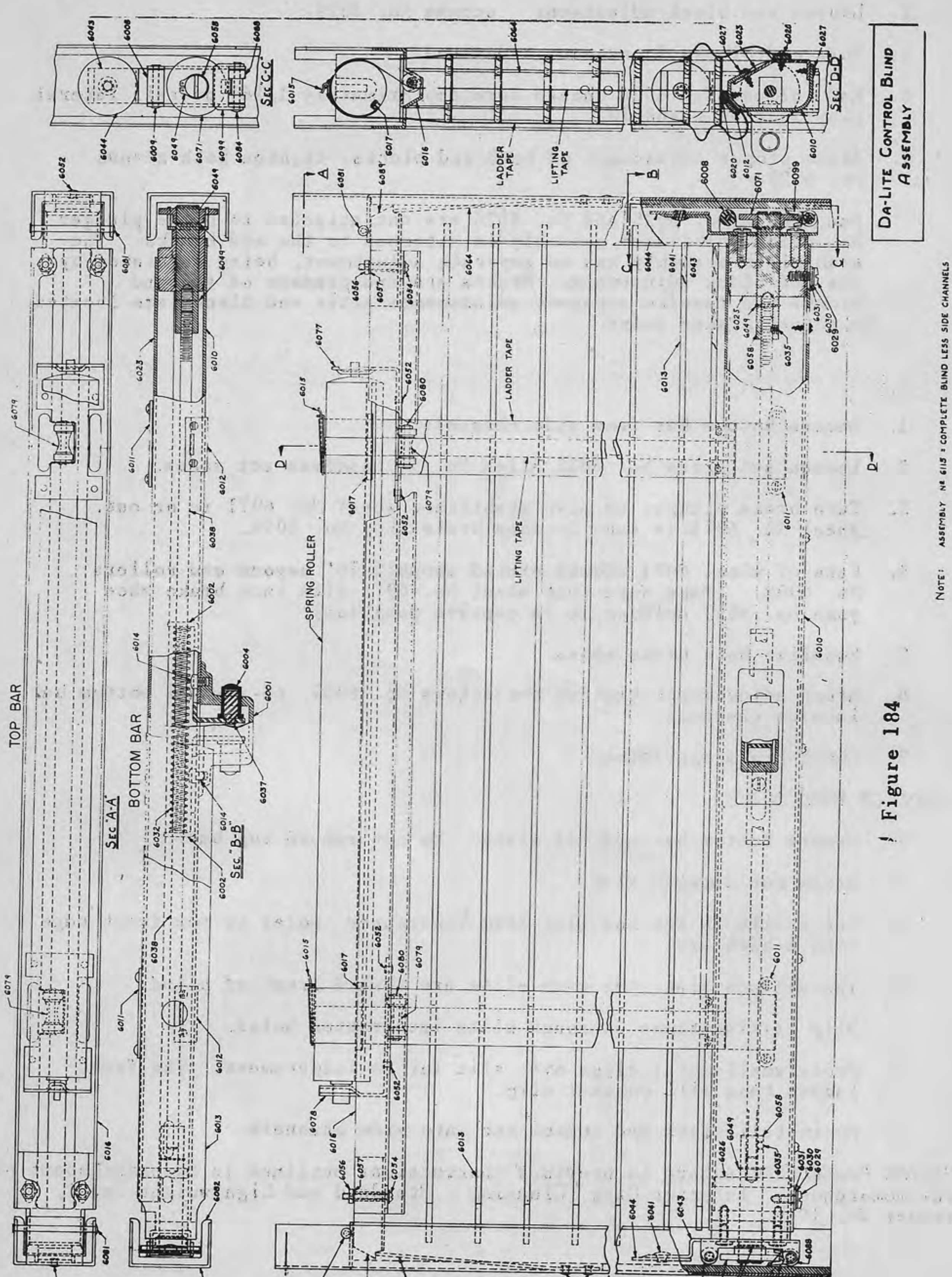

TOP BAR
BOTTOM BAR
SEC "A-A"
SEC "B-B"
SEC "C-C"
SEC "D-D"
SPRING ROLLER
LADDER TAPE
LIFTING TAPE
DA-LITE CONTROL BLIND ASSEMBLY
NOTE: ASSEMBLY No 6115 = COMPLETE BLIND LESS SIDE CHANNELS

Figure 184

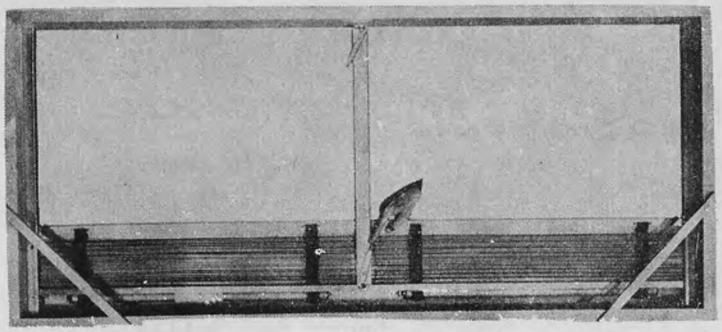


Figure 185

At large windows double blinds are sometimes used. These blinds employ the use of a centerpost guide which must be removed before taking out blinds. To remove: See Figure 185.

1. **Raise both blinds to top of window.**

2. **Open bottom and top latches in rear of centerpost.**

3. **Lift post about 1" to release bottom holding pins; then bring bottom part of post out from sill.**

4. **Ease post downward and at the same time compress brake buttons of one blind to relieve pressure of brakes.**

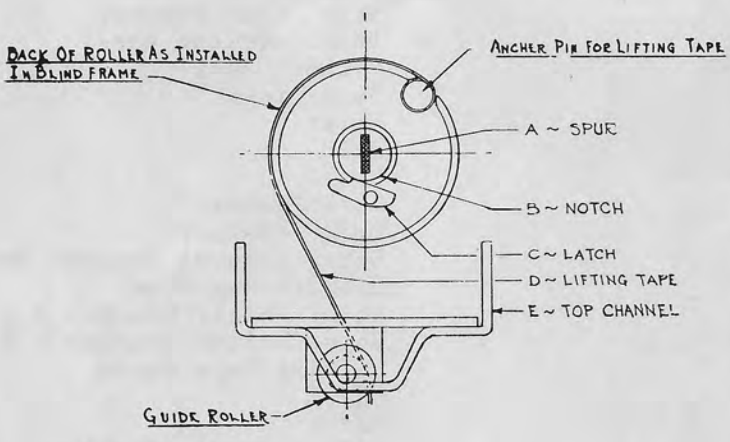


Figure 186

The roller spring at the top of blind is similar to the ordinary curtain roller except it is metal and the ratchet latch is placed on the bottom to permit engagement only during installation - see Figure 186 Spring is wound correct number of turns for proper operation. Number of turns is marked on label of each roller. Note that nylon tape reels off back of roller. If nylon tape unwinds unevenly cocking the blind, move the bottom bar up and down several times, which will even the tapes.

PARTS LIST " DA-LITE " CONTROL VENETIAN BLINDS

PARTS NO.	PARTS NAME
6001	Button Housing
6002	Control Bracket
6004	Control Button
6008	Upper End Roller
6009	Upper End Roller Rivet
6010	Bottom Bar Front
6011	Ladder Tape Anchor - Back
6012	Ladder Tape Anchor - Front
6013	Wood Slat
6014	Button Housing Screw
6015	Ladder Tape Joining Pin
6016	Top Channel (Deep Side Channel)
6017	Lifting Tape Attaching Clip
6020	Ladder Tape Anchor Screw
6023	Bottom Bar Back (D. S. Channel)
6025	Bottom Bar End Block R.H.
6026	Bottom Bar End Block L.H.
6027	Assembly Screw
6029	Binder Head Screw
6030	Lock Washer
6031	Plain Washer
6032	Control Button Spring
6035	Set Screw
6037	Push Button Stud
6038	Tie Rod
6041	Disc Roller Rivet
6043	Stabilizer Bracket
6044	StabilizerDisc Wheel
6047	Roller Label
6049	Snap Rings
6052	Rivet
6054	Bolt
6056	Nut
6057	Lock Washer
6058	Brake Plunger
6064	Upper Channel Support Spring
6071	Stabilizing Wheel
6077	Motor Roller Bracket R.H.
6078	Motor Roller Bracket L.H.
6079	Lifting Tape Guide
6080	Rivet
6081	Rivet
6083	Side Channel (Deep)
6084	Lower End Roller Rivet
6088	Lower End Roller
6089	Top Channel End Bracket
6099	Brake, Lock

UPPER CROSSWISE BED (BC): The upper bed in drawing room and bedrooms with bed crosswise (BC) as shown in Figure 187 has a counterbalance arrangement concealed in a casing below bunk. It consists of turnbuckles connected to opposing helical springs that connect to wire cables, which run over pulleys and are attached to bracket on berth as shown in Figure 188. When replacing a spring or adjusting the bed for tension, an access plate can be removed in center of casing below bunk.

UPPER LENGTHWISE BED (BL) (See Figure 189) is a "straight lift" cable type, the upper bed is stored in ceiling above the lower folding bed. When latch is released (See Figure 191) with berth key the bed lowers on four cables, one on each corner. In addition, the bed is guided by two adjustable rollers which operate in channels on each side of the lower bed pocket. When bed is fully lowered, a tapered bed rest pivot enters a socket provided on outside wall panel to hold berth stationary and support that corner. On room side of bed, a hold down rod is engaged from bed corner to bracket provided on ceiling. This rod supports this corner.

The balance arrangement is accomplished by means of two separately mounted torsion spring assemblies which have the shafts joined together by means of a universal joint, see Figure 190. These assemblies are installed in tandem above the ceiling panels, which are provided with access plates. At opposite ends of shaft are two cable drums to which the cables are fastened. Cables from room side of bed reel off drums directly to bed casing. Cables for window side of bed reel horizontally off drums to an idler pulley, located on end partitions, then vertically to corners of bed casing. Figure 192.

The shaft of each tension assembly is fitted with two self aligning ball bearings. The outer races of bearings are supported by the spring anchor at one end and the support bracket at opposite end. The fixed end of the helical coil spring is fastened in slot of stationary spring anchor at one end of assembly and the other end is set in slot of spring anchor which is keyed to shaft. The cable drums are keyed to the shafts and held in place by locknuts.

The cables are 1/8" in diameter stranded steel nylon covered (-7strands, 19 wires per strand-). Length of cables in compartments are 6' 10" long for rear cables and 4' 6" long for front cables. Cables are fastened to the drums on the counter-balance spring arrangement with two machine screws and a clamp and to bed corners with a dull type clamp fastener using four machine screws to hold clamp tops to base; Figure 192 shows cable diagram.

Springs are arranged so when bed is lowered both springs wind in same direction. All parts except shafts are interchangeable. Approximate tension is set as follows: 9½ full turns on helical coil spring at head end of bed and 8½ full turns on spring at folding partition end. Both adjustments are made with bed in night position. A pawl and ratchet gear, shown on Figure 190 is provided to hold tension while winding. Final adjustment to counter-balance springs are made with a fully loaded bed. When the night position latches are released, spring tension should pull the bed up to within eight (8) inches of the fully closed day position. On release of bed from night position, the counter-balance mechanism can be damaged if spring tension is set too high and the room is prepared for single occupancy with mattress removed from upper berth.

STANDARD ROOMETTE BED.

The bed pivots are held in a pivot rocker assembly as shown in Figure 193. Note that the rocker is held to a pivot plate with two 3/8" cap screws which provide for alignment of the bed as shown in Figure 193. The pivot rocker adapters are mounted to the partition with four 3/8" cap screws. The bed can be removed (after disconnecting counter balance mechanism) by removing the four screws that fasten rocker assembly to partition.

The counter-balancing mechanism consists of four coil springs, located under the bed in the bed alcove. One end of the springs are fastened to a saddle arrangement that is pivoted to the bed, the other end is fastened to a bracket that is welded to the car floor plate in bed alcove.

Locking arrangement is the same general design as that of pre-war lightweight cars except the latches are located at top and window side of the bed alcove.

Upper Roomette Folding Bed)	
Lower Roomette Sliding Bed)	Our standard arrangement and the present practice
Open Sections Upper and Lower)	should be followed.
Berth)	

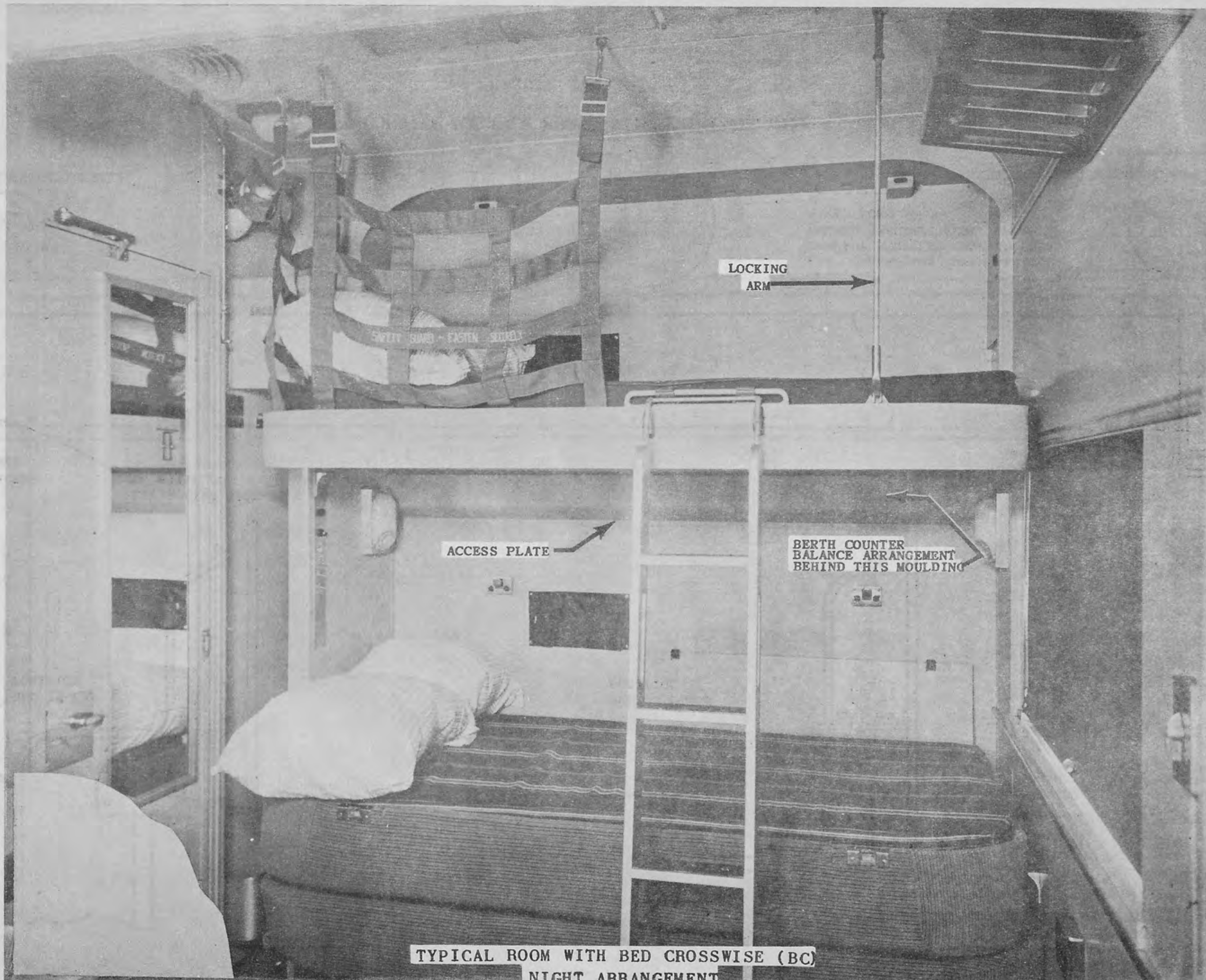
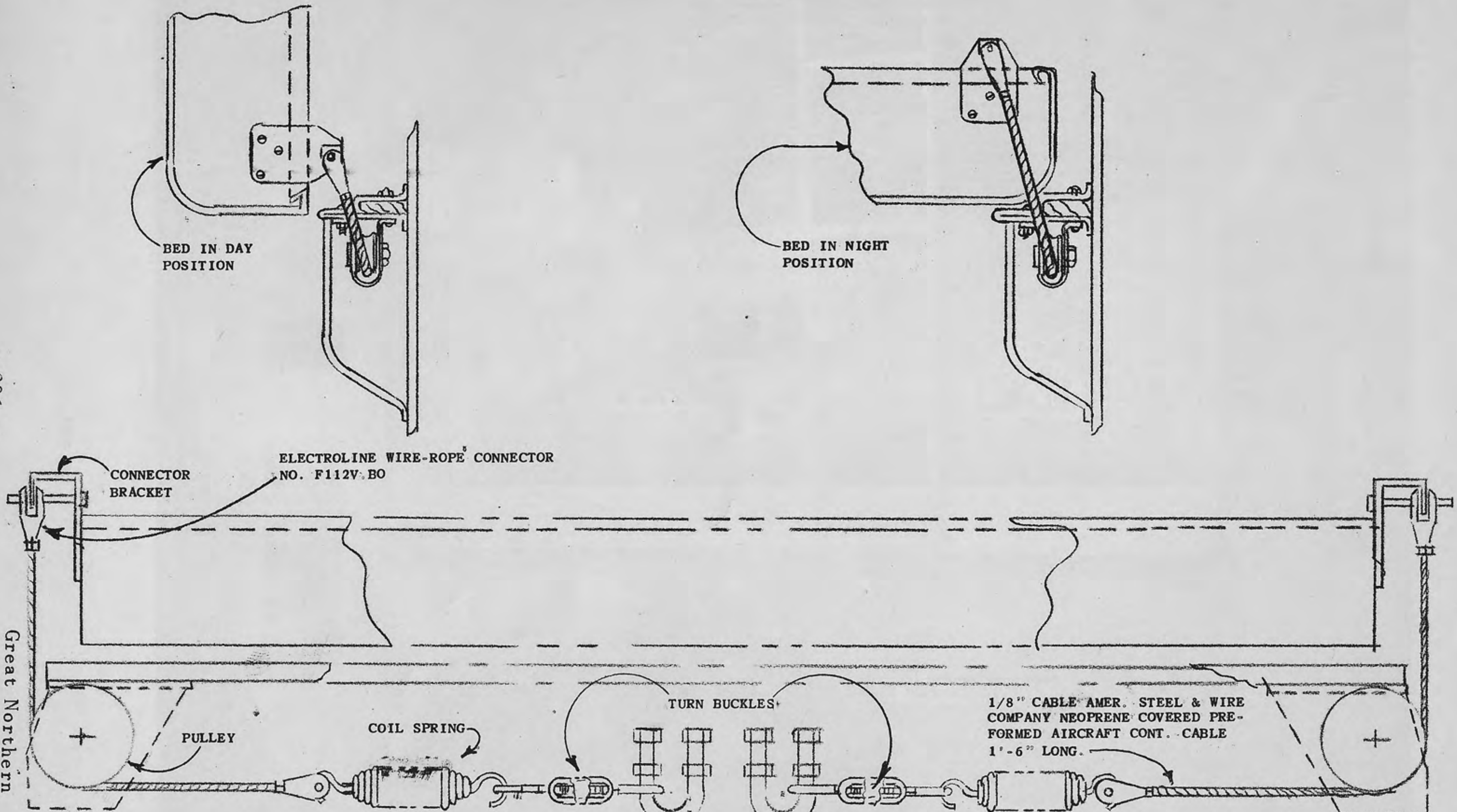
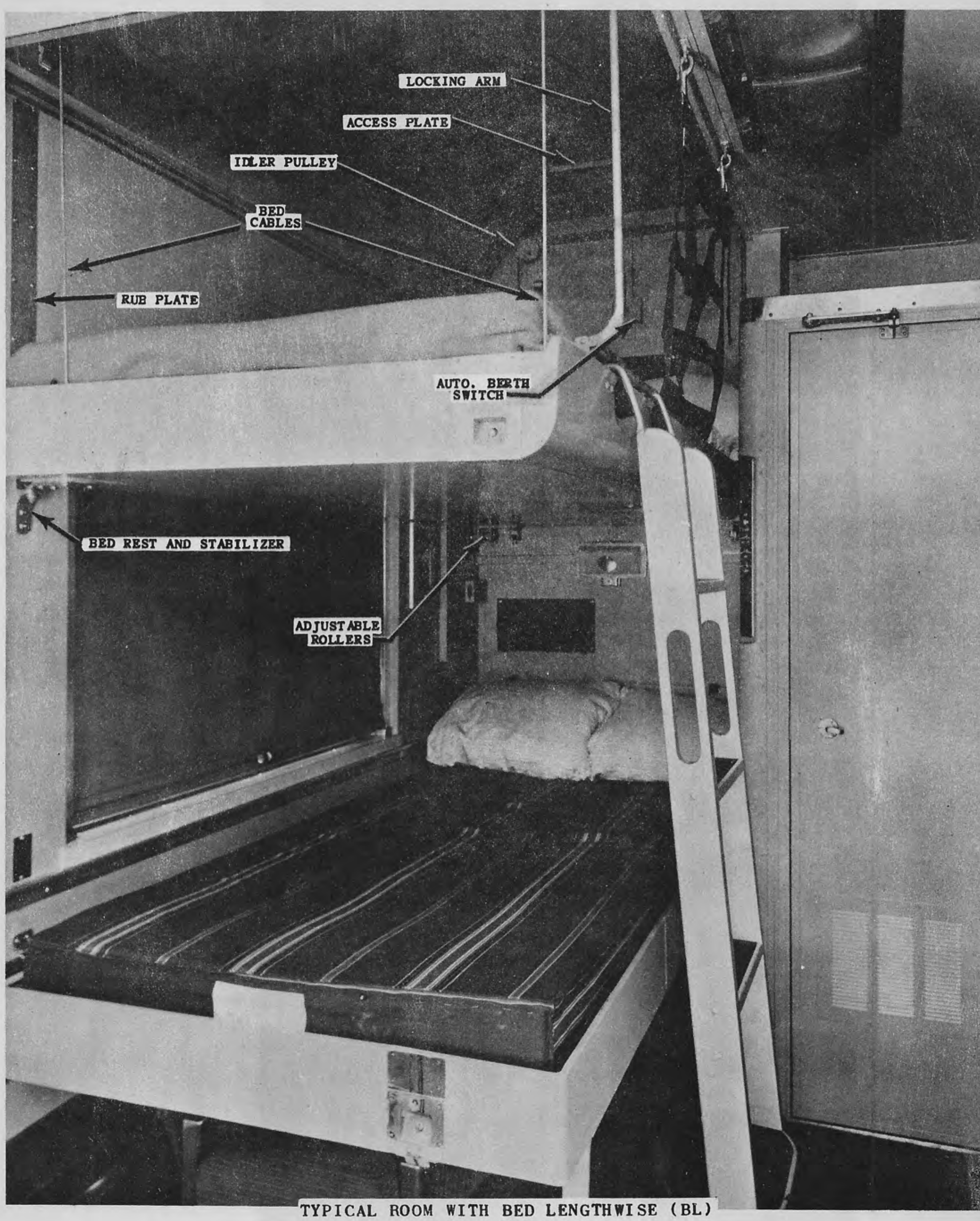

LOCKING
ARM
ACCESS PLATE
BERTH COUNTER
BALANCE ARRANGEMENT
BEHIND THIS MOULDING
TYPICAL ROOM WITH BED CROSSWISE (BC)
NIGHT ARRANGEMENT

Figure 187



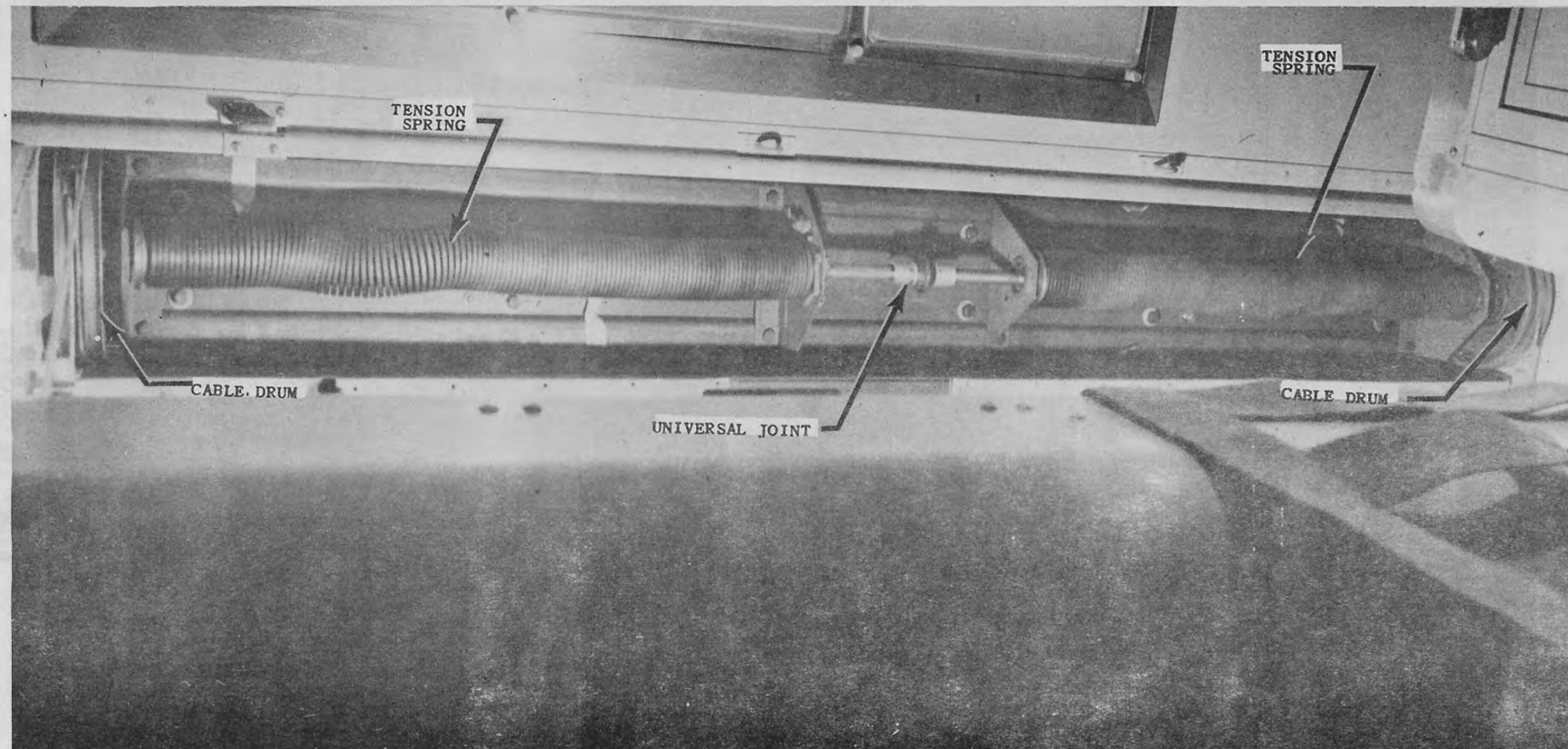
BERTH COUNTER-BALANCE ROOMS WITH BED CROSSWISE

Figure 188



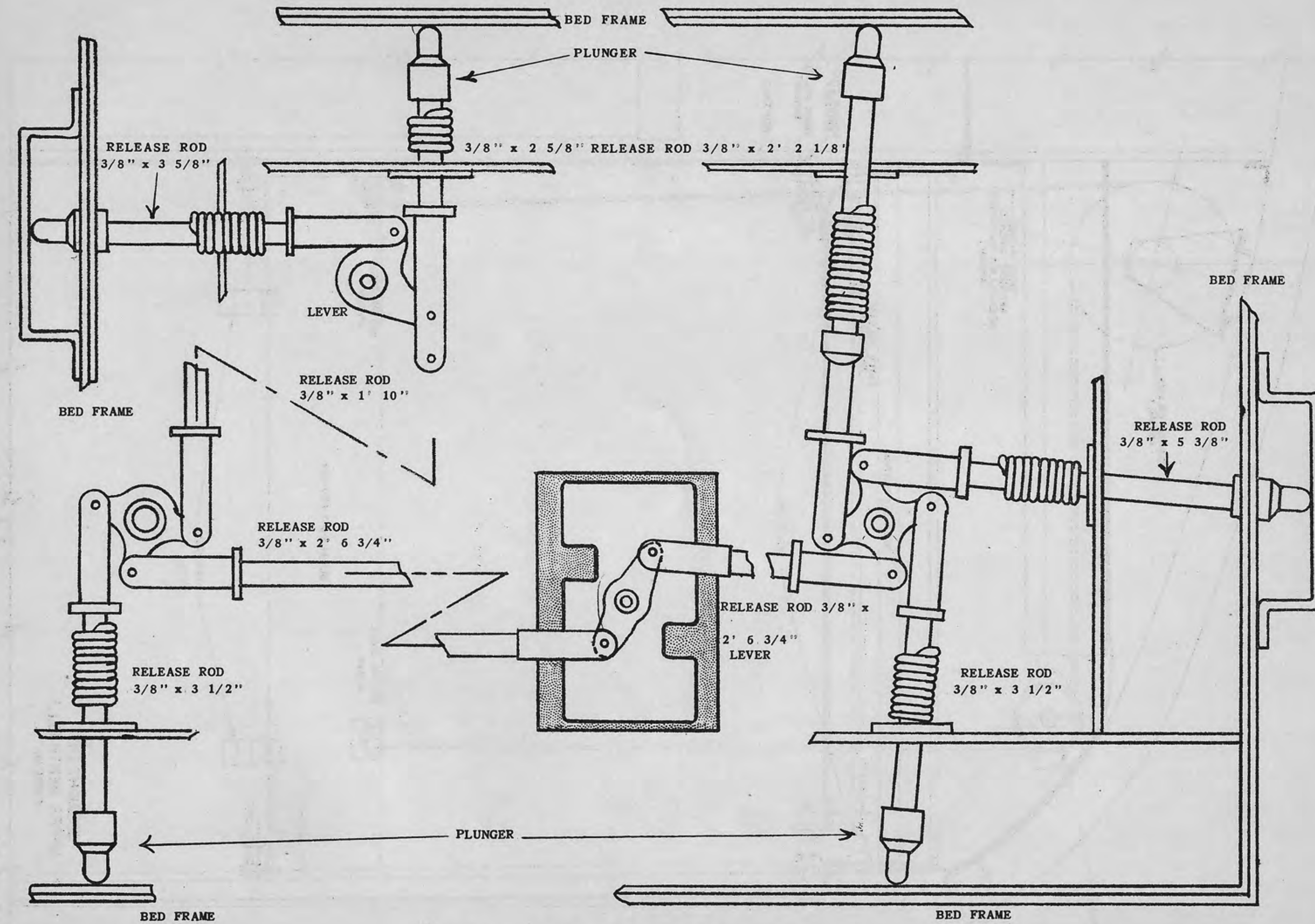
TYPICAL ROOM WITH BED LENGTHWISE (BL)
NIGHT ARRANGEMENT

Figure 189



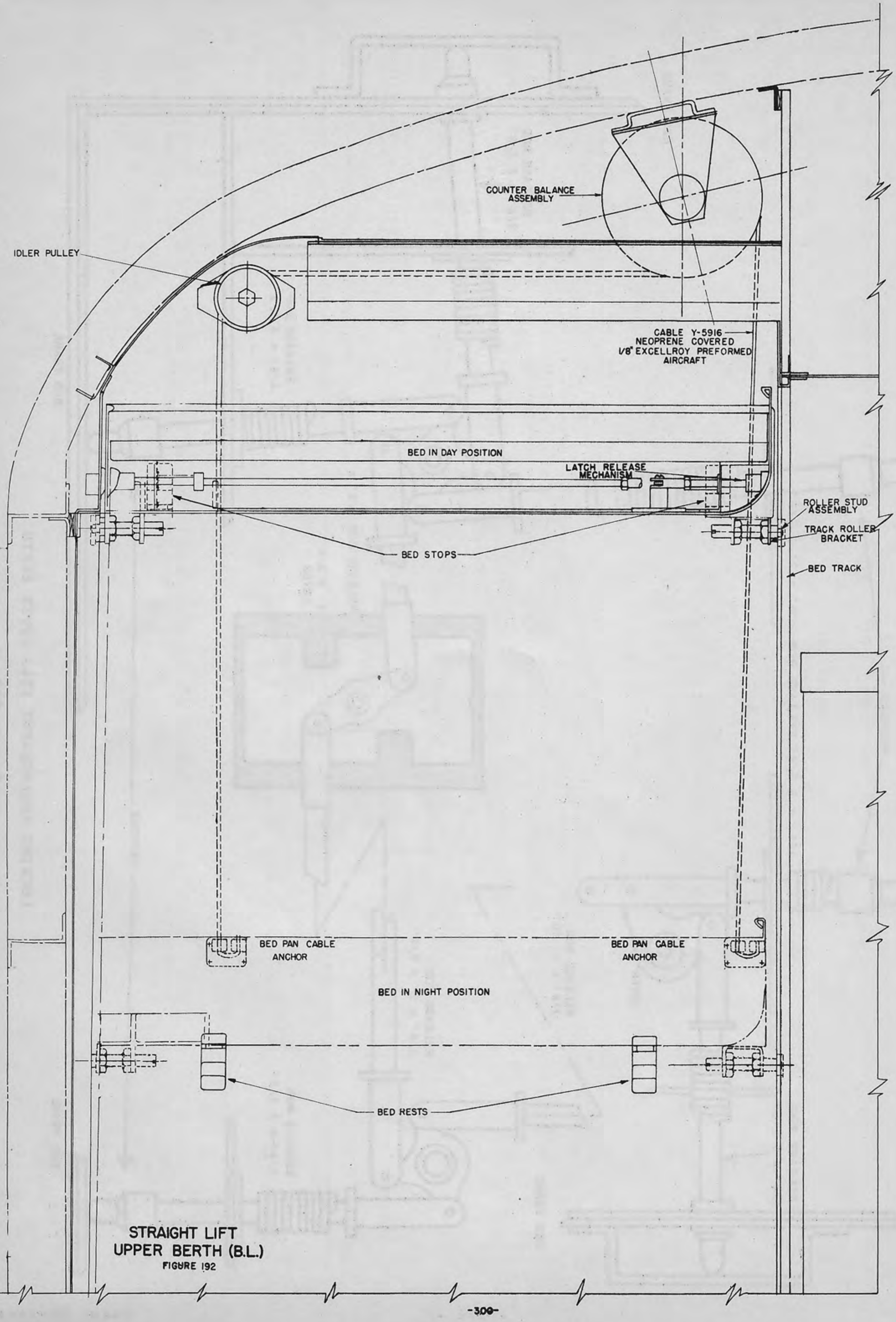
COUNTER BALANCE ARRANGEMENT FOR
LENGTHWISE UPPER BERTH
(Viewed from below)

Figure 190



LOCKING ARRANGEMENT (BL) UPPER BERTH

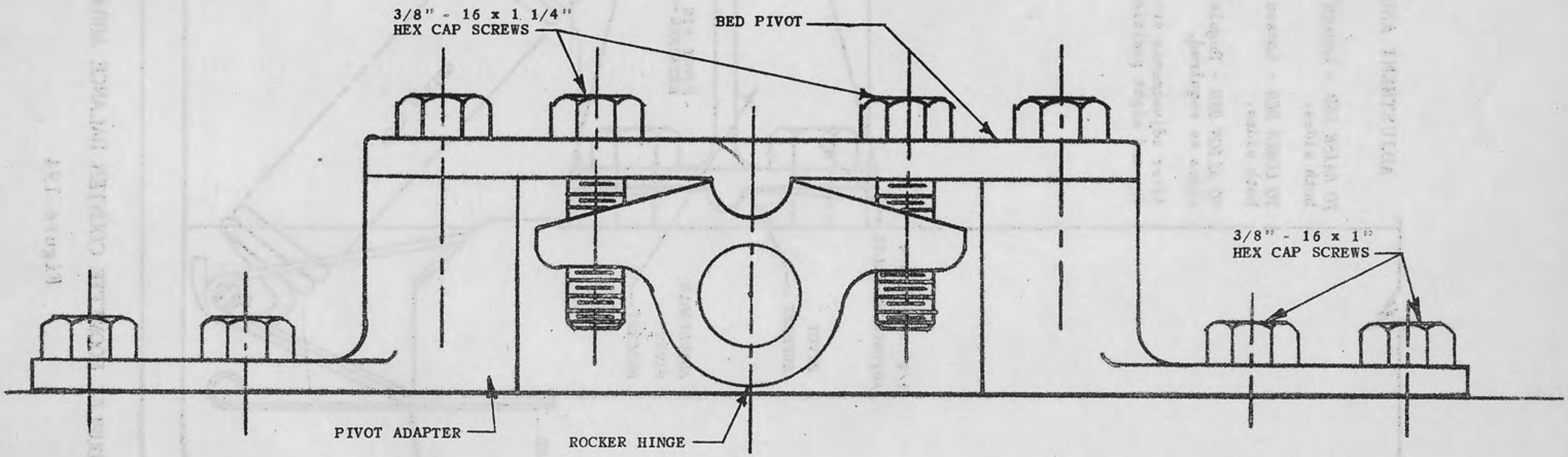
Figure 191



STRAIGHT LIFT
UPPER BERTH (B.L.)
FIGURE 192

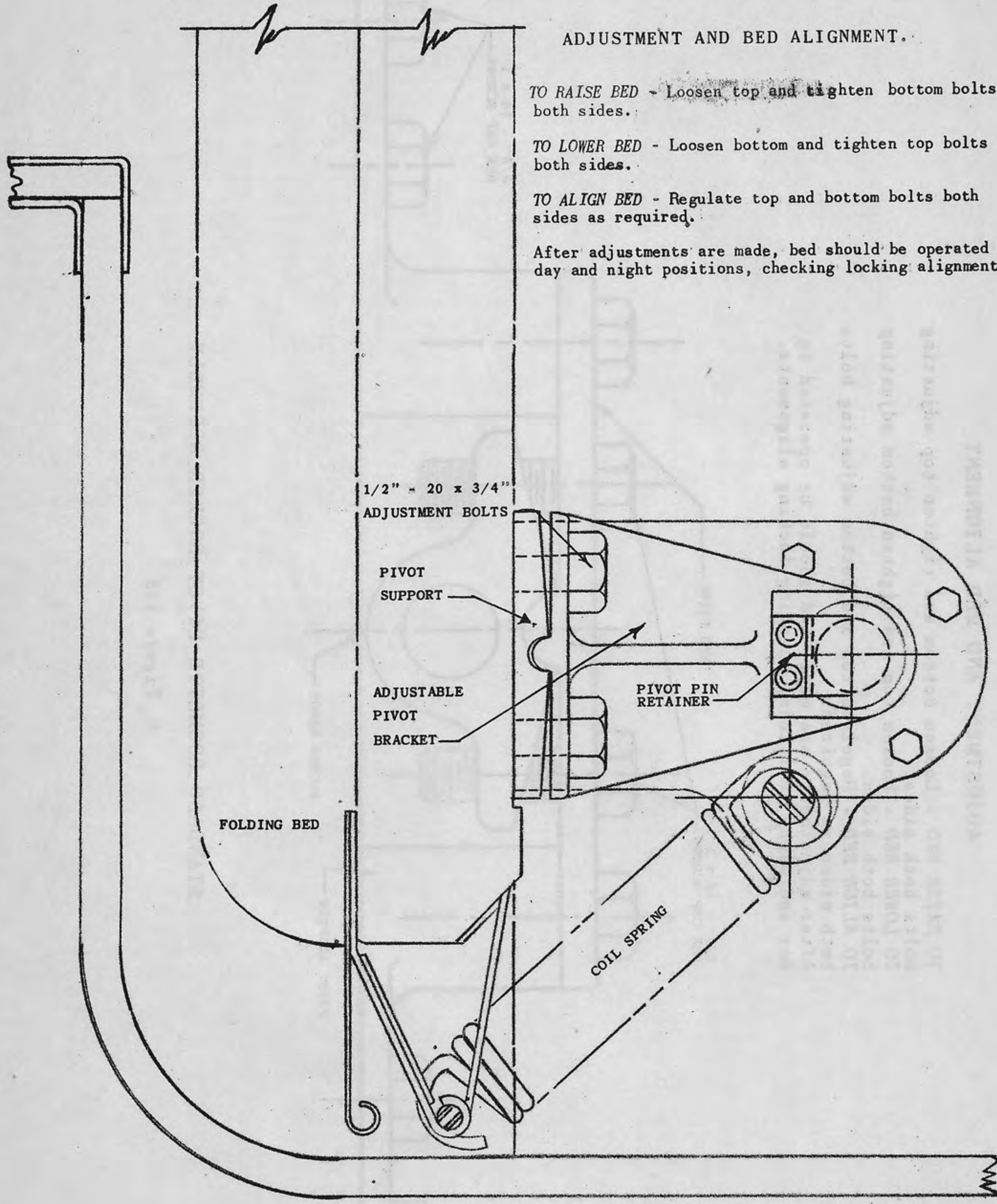
ADJUSTMENT AND BED ALIGNMENT

TO RAISE BED - Loosen bottom and tighten top adjusting bolts both sides.
TO LOWER BED - Loosen top and tighten bottom adjusting bolts both sides.
TO ALIGN BED - Regulate top and bottom adjusting bolts both sides as required.
After adjustments are made, bed should be operated in day and night positions, checking locking alignments.



STANDARD ROOMETTE PIVOT ROCKER ASSEMBLY

Figure 193



ADJUSTMENT AND BED ALIGNMENT.

TO RAISE BED - Loosen top and tighten bottom bolts both sides.

TO LOWER BED - Loosen bottom and tighten top bolts both sides.

TO ALIGN BED - Regulate top and bottom bolts both sides as required.

After adjustments are made, bed should be operated in day and night positions, checking locking alignments.

UPPER DUPLEX ROOMETTE COUNTER BALANCE ARRANGEMENT

Figure 194

NATIONAL PNEUMATIC ELECTRIC DOOR CLOSER

DESCRIPTION OF EQUIPMENT: The equipment consists of an operator engine, pressure and exhaust electromagnetic valves, time delay relay, door reversing switch, door reversing cut-out switch, door latch switch, porter's door switch and emergency door closing cylinder.

On these cars there are three types of National Pneumatic Electric Door closers. All parts on these closers are interchangeable with the exception of the mounting base and the gear segments. Because of this a complete unit is not interchangeable with a unit of a different model number.

The door is attached to two short shafts, one at the top and one at the bottom. The bottom shaft is pivoted in a bearing and it merely guides the door. The top shaft by which the door is hung extends into the compartment above the door. The engine is connected to the top shaft through gear segments and the movement of the engine piston rotates the door through an arc of about 90° to open and close.

OPERATOR ENGINE OPERATION: The piston assembly of the operator engine has two different diameters, and fits into piston chambers of corresponding size. See Figure 195. As the pistons have different areas, when air pressure is present in both chambers the piston with the larger area exerts the greater force and overcomes the lesser opposing force of the smaller piston. Therefore the piston assembly moves outward, closing the door.

When the control circuit energizes the exhaust type magnet valve of the door operator this magnet valve exhausts the air pressure from the larger cylinder of the operator engine. With the larger cylinder open to exhaust, the constant pressure entering the engine at the center port moves the piston assembly inward, thus opening the door.

To prevent the door from slamming open, a cushioning device is incorporated in the engine. As the door opens, the piston moves repidly inward until the seal on the end of the cushioning plunger contacts the end of the large cylinder and closes the free exhaust port. The remainder of the air pressure in the cylinder is then exhausted through a small orifice in the cushioning plug. As the piston continues its stroke an "AIR CUSHION", is built up which retards the engine speed and cushions the final movement of the door.

The door operator engine incorporates a constant speed feature. If the door is obstructed or held while opening, air continues exhausting from the large cylinder of the engine. To replenish the air leaving the large cylinder and thus maintain an air cushion so that the door, when released, will open at normal speed, compressed air from the center port of the engine flows constantly into the plunger assembly and passes out into the large cylinder chamber through openings in the cushioning plunger.

To close the door, the control circuit de-energizes the exhaust type magnet valve of the door operator which then admits air pressure to the large cylinder of the operator engine. This causes the piston assembly in the engine to move outward forcing the constant line pressure present in the small piston chamber back into the air supply line. Just before the piston assembly reaches the end of the stroke in this direction, the air pressure, which builds up in the smaller cylinder retards this piston movement and cushions the final movement of the door, Figure 196 shows relation of operator engine to emergency cylinder.

SETTING UP THE DOOR FOR AUTOMATIC OPERATION: With the porter's switch in the "AUTOMATIC" position a circuit is completed to the coil of the pressure magnet valve; which valves air pressure to and through the exhaust magnet valve, into the end port of the engine to the center port of the engine, and to the emergency cylinder, making the equipment operative. The door is closed and the piston of the emergency cylinder is held inward where it does not affect the automatic operation of the door.

The wiring as shown on Figures under HOW IT OPERATES are only for explanatory purposes. Wiring diagrams for these cars are shown on Figures 197 and 198. Reducing valve shown in Figure 199 operates the same as the reducing portion of the A 1 A governor reducer valve explained in the water system.

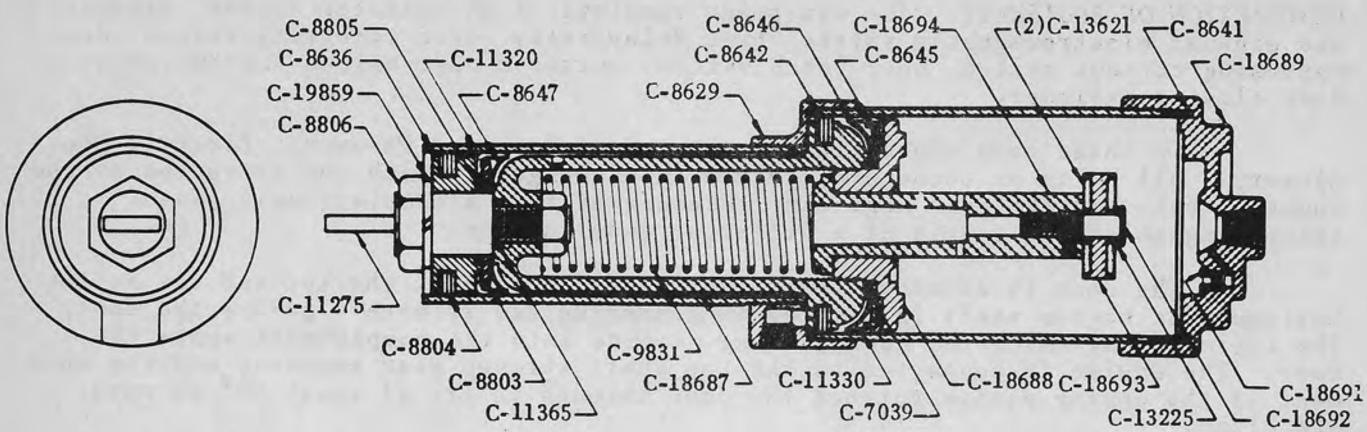


Figure 195

END DOOR OPERATOR ENGINE

PART LIST

C-7039	Gasket	C-8804	Felt Lubricating Ring	C-13621	Cushion Seal
C-8629	Cylinder	C-8805	Gasket	C-18687	Piston
C-8636	Piston Center	C-8806	Lock Nut	C-18688	Follower
C-8641	Gasket	C-9831	Plunger Spring	C-18689	Cylinder Cap
C-8642	Felt Lubricating Ring	C-11275	Stud	C-18691	Cushion Plug
C-8645	Cup Follower	C-11320	Cup	C-18692	Screw
C-8646	Cup Expander	C-11330	Cup	C-18693	Seal Retainer
C-8647	Cup Expander	C-11365	Gasket	C-18694	Cushioning Plunger
C-8803	Cup Washer	C-13225	Bushing	C-19859	Washer

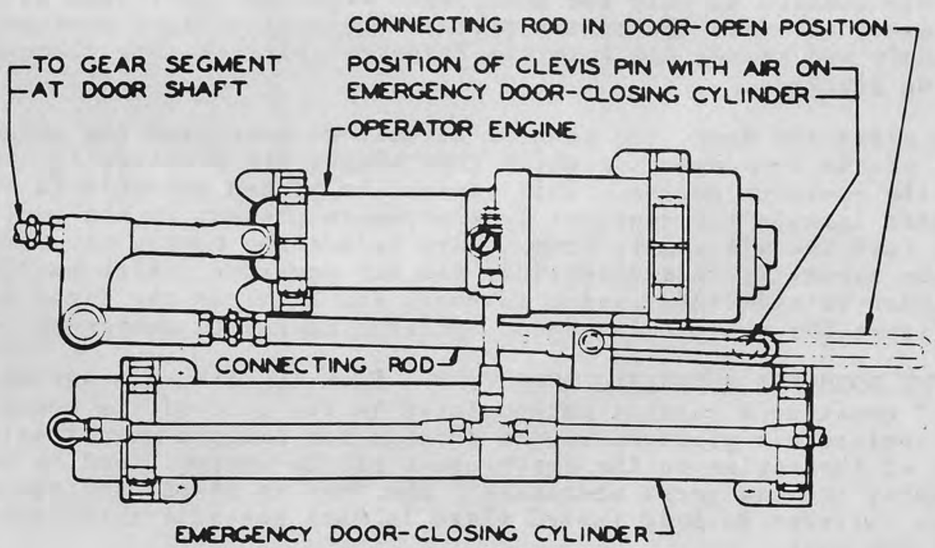


Figure 196

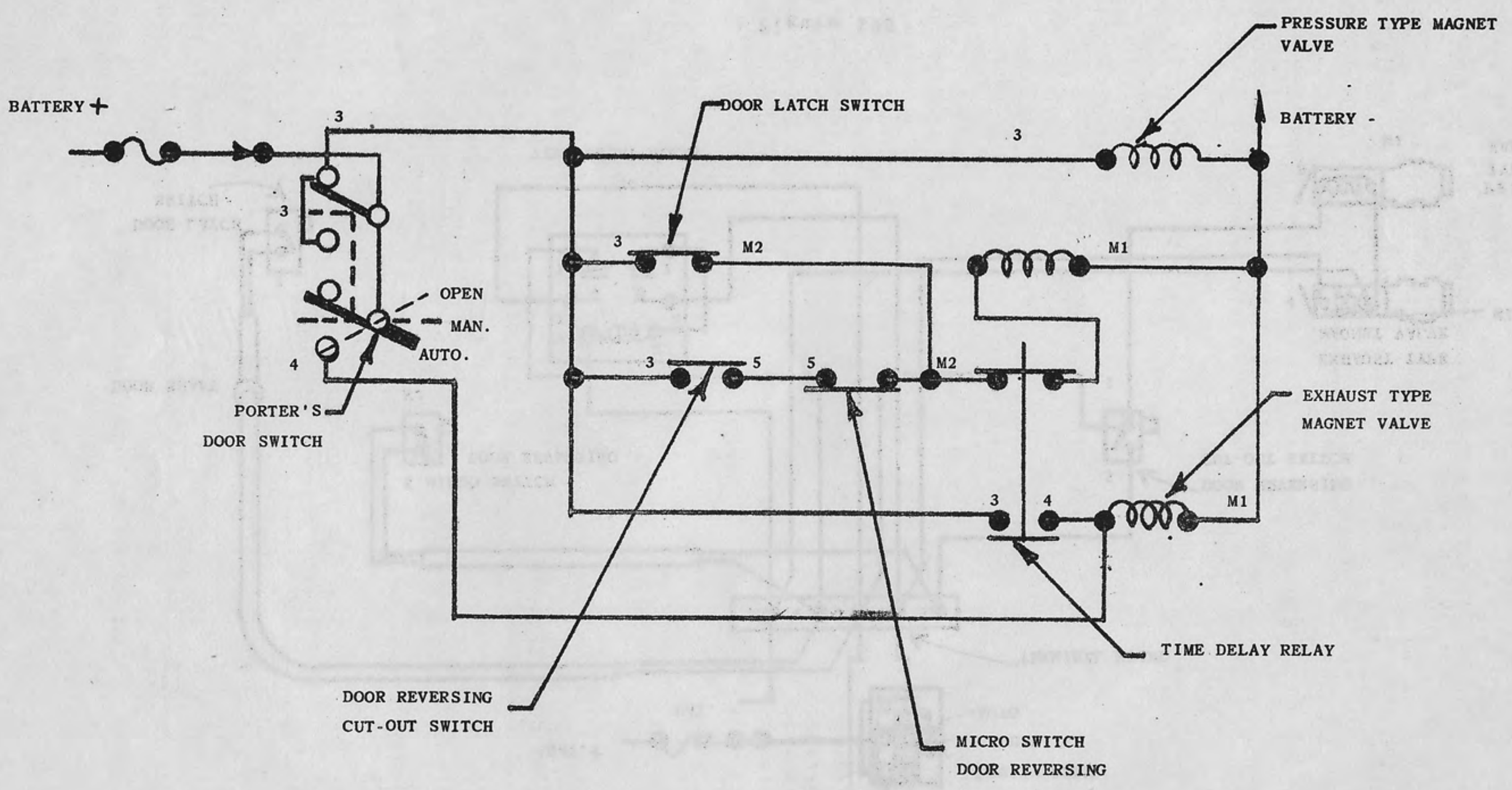

BATTERY +
3
3
OPEN
MAN.
AUTO.
4
PORTER'S
DOOR SWITCH
DOOR LATCH SWITCH
3
M2
3
5
5
M2
3
PRESSURE TYPE MAGNET
VALVE
BATTERY -
M1
EXHAUST TYPE
MAGNET VALVE
3
4
M1
TIME DELAY RELAY
DOOR REVERSING
CUT-OUT SWITCH
MICRO SWITCH
DOOR REVERSING

Figure 197

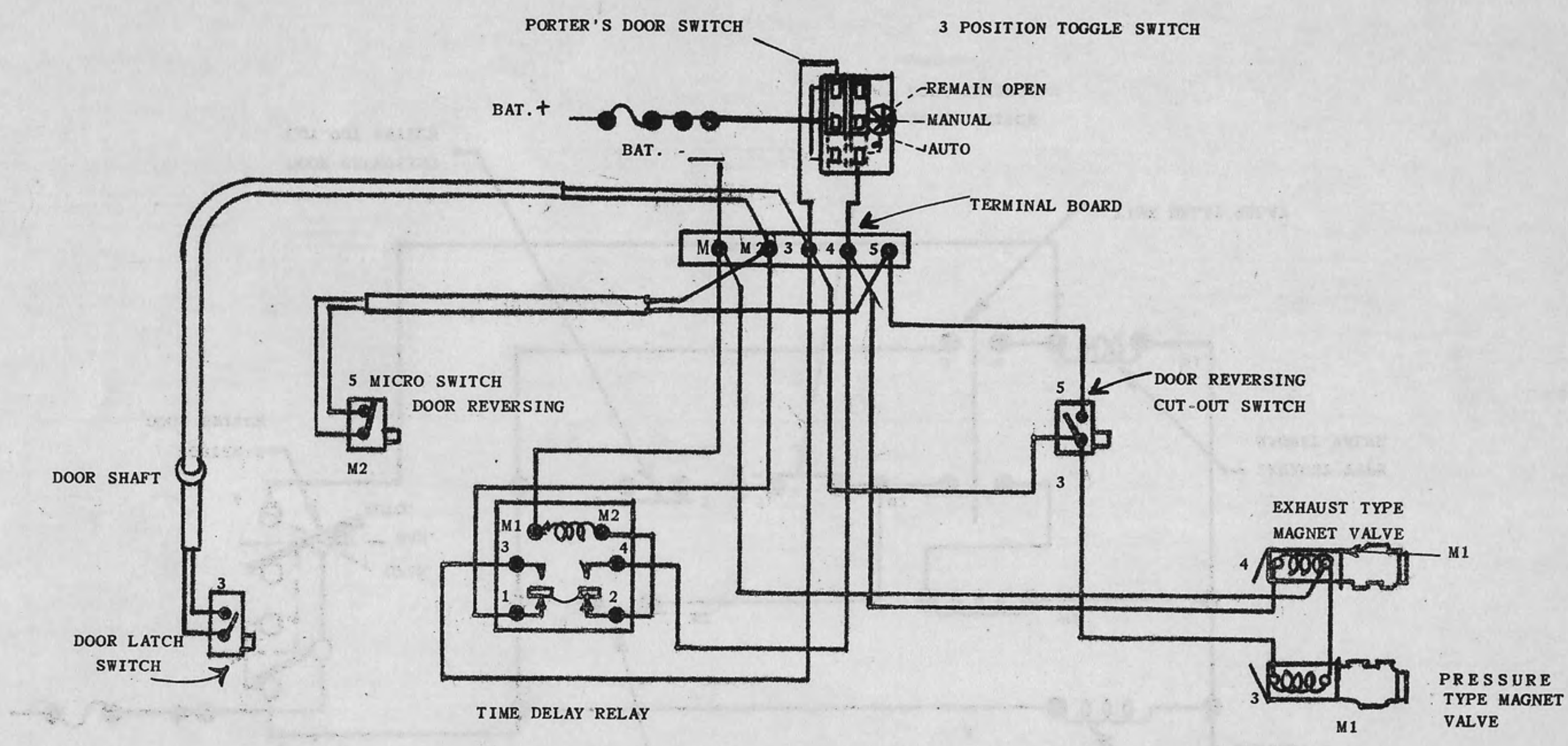

PORTER'S DOOR SWITCH
3 POSITION TOGGLE SWITCH
BAT. +
BAT. -
REMAIN OPEN
MANUAL
AUTO
TERMINAL BOARD
M
M2
3
4
5
5 MICRO SWITCH
DOOR REVERSING
M2
DOOR REVERSING
CUT-OUT SWITCH
5
3
DOOR SHAFT
M1
M2
3
4
1
2
EXHAUST TYPE
MAGNET VALVE
4
M1
DOOR LATCH
SWITCH
3
TIME DELAY RELAY
PRESSURE
TYPE MAGNET
VALVE
3
M1

Figure 198

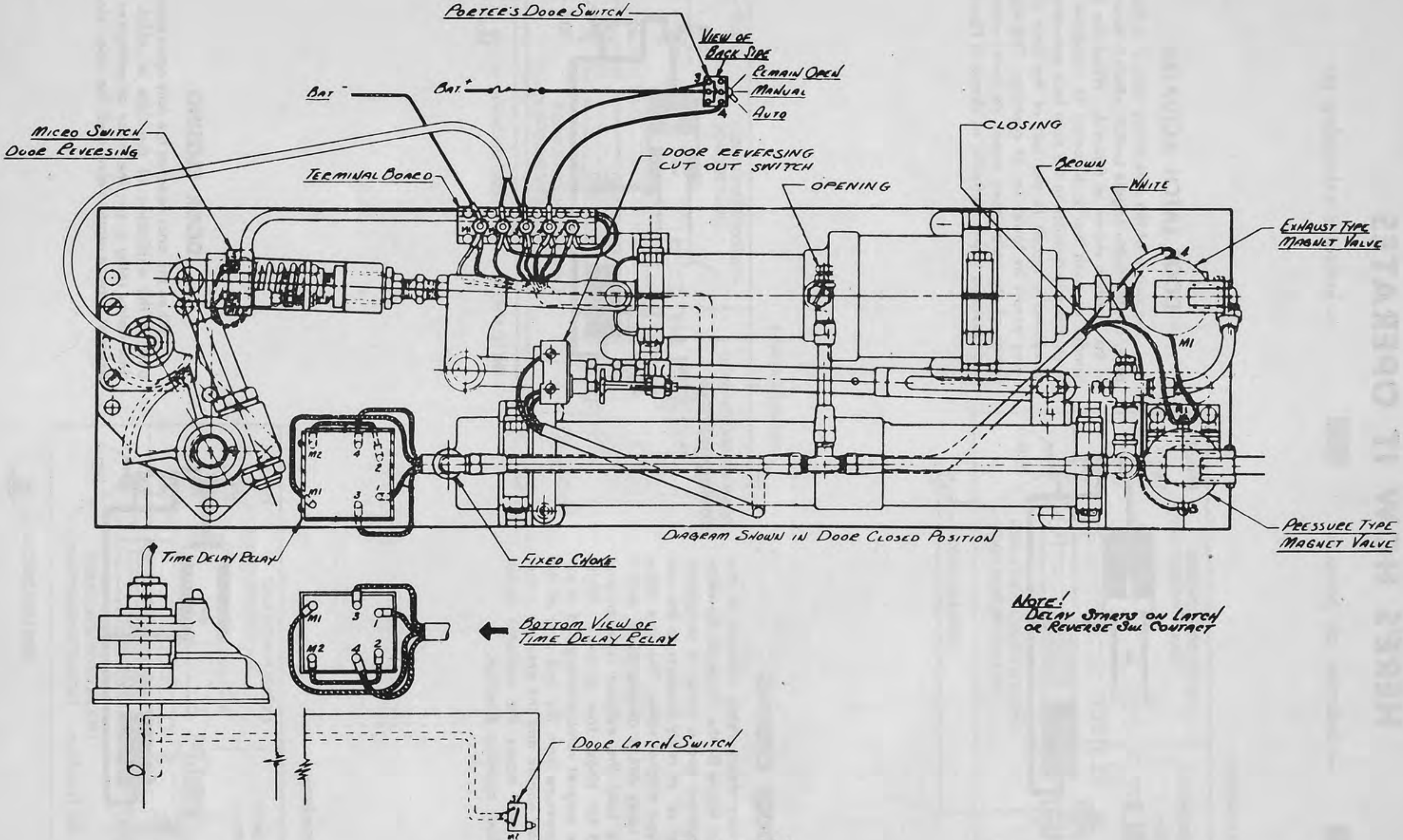
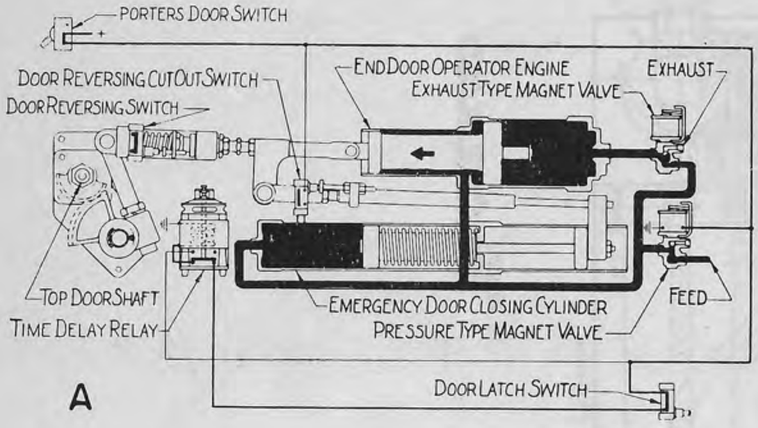


Figure 199

PIPING AND WIRING DIAGRAM
END DOOR OPERATOR

HERE'S HOW IT OPERATES

— indicates air pressure — indicates exhausting air



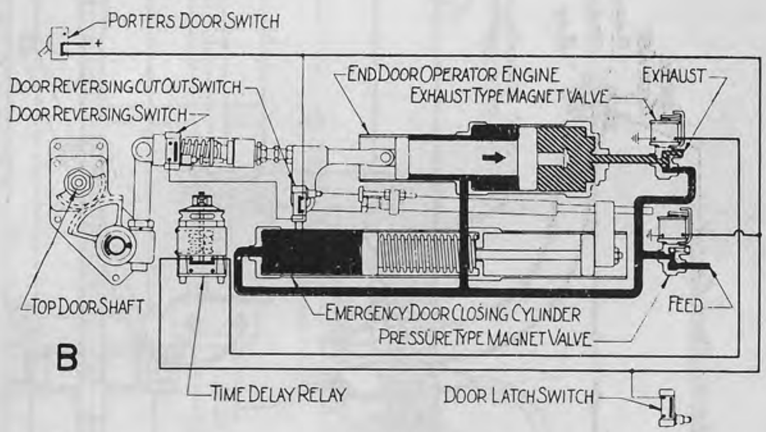
A

DOOR LATCH ACTUATED

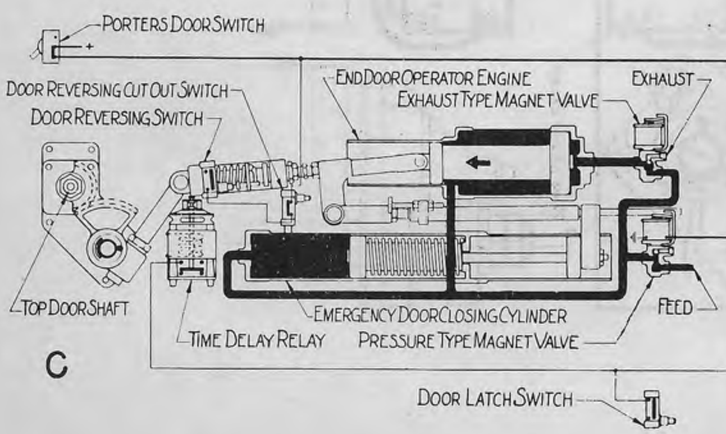
The switch of the time delay relay is a double pole, double throw toggle switch, which is normally in the position shown in figure **A**. When the door handle or push bar is actuated to withdraw the latch, the micro switch in the door lock momentarily completes a circuit to the coil of the time delay relay across its lower set of contacts. The toggle switch of the relay then opens its lower contacts and closes its upper contacts, as shown in figure **B**.

DOOR OPENING

With the time delay relay contacts in the position shown in figure **B**, the circuit to the relay coil has been opened and a circuit is completed across the upper set of relay contacts to the coil of the exhaust type magnet valve. The time delay starts when the relay coil is de-energized, and it is usually set to hold the exhaust type magnet valve energized for about four seconds. While the exhaust type magnet valve is energized, it exhausts the air pressure from the end port of the end door operator engine and the pressure entering the center port moves the operator piston inward in the door opening direction.



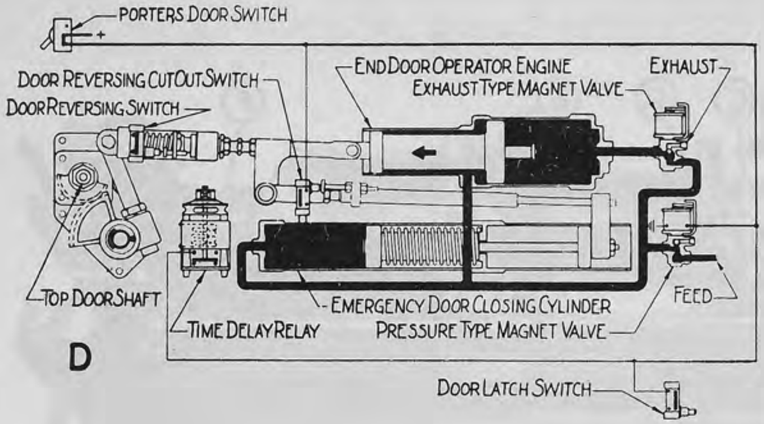
B



C

DOOR CLOSING

When the door reaches the fully open position and at the expiration of the time at which the time delay relay is set, the relay de-energizes the exhaust type magnet valve and the door closes.



D

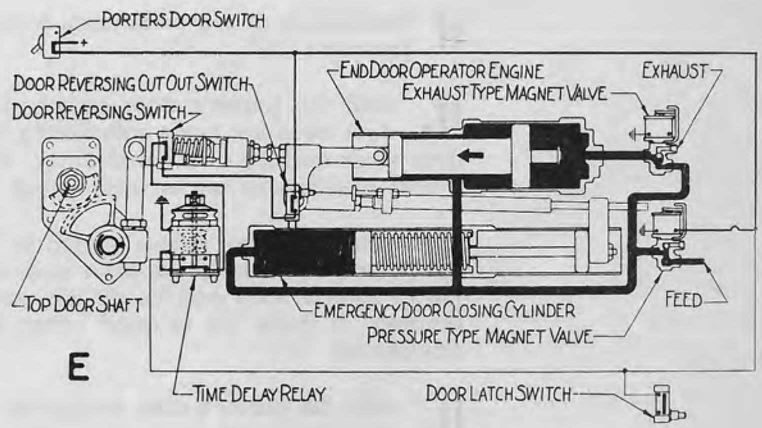
DOOR CLOSED

Air pressure valved into the end port of the end door operator engine by the exhaust type magnet valve moves the engine piston completely out to the door closed position.

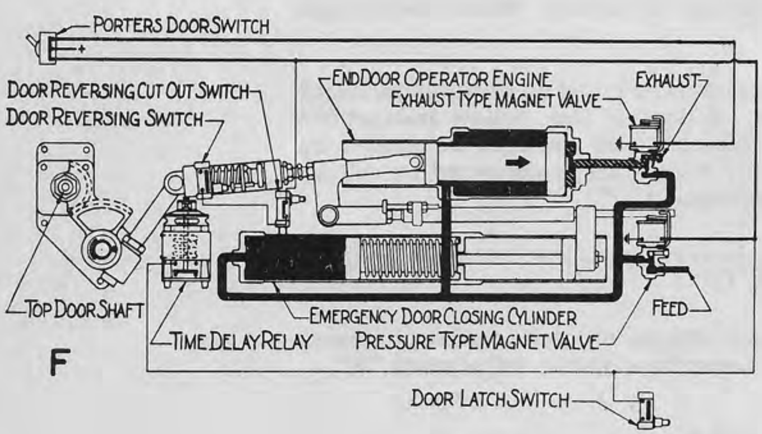
The door reversing cut-out switch opens the circuit to the door reversing switch when the door enters the door jam, which cuts out the reversing feature. The full power of the end door operator engine is then available to completely and positively close the door.

DOOR REVERSES

If the door is obstructed while closing, the end door operator engine builds up a pressure of 12 to 15 pounds at the door against the obstruction, which compresses a spring in the operator connecting rod and momentarily closes the door reversing switch. The door reversing switch momentarily completes a circuit to the coil of the time delay relay across its lower set of contacts, causing the toggle switch of the relay to open its lower contacts and close its upper contacts, completing a circuit to the exhaust type magnet valve. The door then re-opens and the sequence shown by figures B, C and D is repeated.



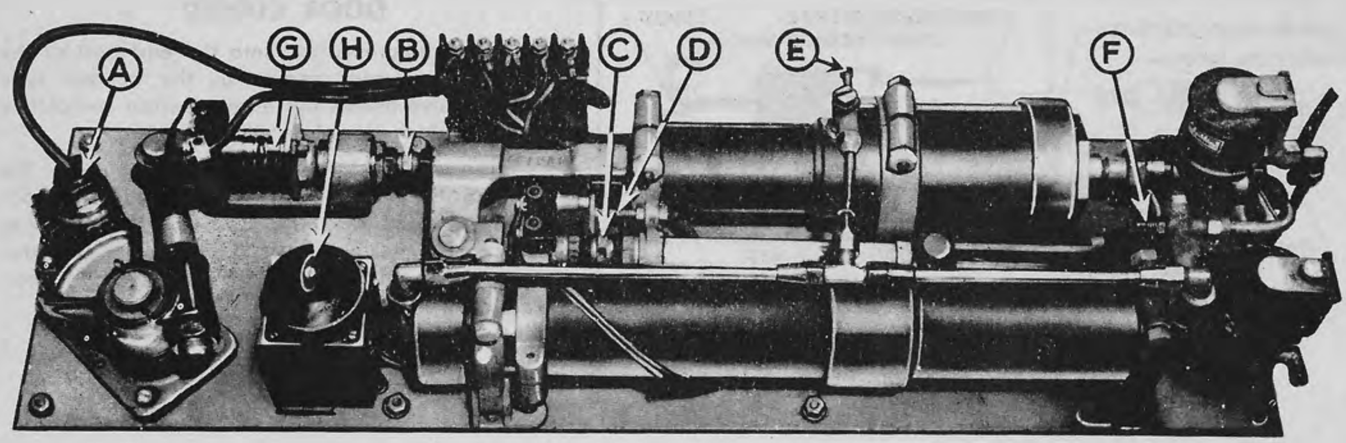
E



F

SETTING THE DOOR TO REMAIN OPEN

By setting the Porter's Door Switch in the "remain open" position, the exhaust type magnet valve is energized, which exhausts air pressure from the end port of the end door operator engine, opening the door. The exhaust type magnet valve remains energized and the door remains open until the setting of the porter's door switch is changed.



Adjustment Check List

If door binds at top or bottom, follow instructions under adjustment "A".

If, with the porter's door switch in "manual" position, the door does not close completely, check the door latch, the door seals and the door for binding. If these are in good order, follow instructions under adjustment "C".

If, with the porter's door switch in "automatic" position, the door reverses at the door jam, check the latch for sticking or interference and check the weather seals and door for binding. If these are in good order, follow instructions under adjustment "D".

If, with the porter's door switch in "automatic" position, the door does not open promptly when latch is actuated, check position of latch and keeper and make adjustments in accordance with lock instructions, which can be obtained from the lock manufacturer.

If door opens too quickly or too slowly, follow instructions under adjustment "E".

If door closes too quickly or too slowly, follow instructions under adjustment "F".

If door reverses without coming against an obstruction, check the door for binding. If door is free, follow instructions under adjustment "G". This condition can also be caused by the door closing too quickly which can be corrected by following instructions under adjustment "F".

If obstructed door fails to reverse, follow instructions under adjustment "D" and "G".

If timing of the door from release of latch to start of closing is incorrect, follow instructions under adjustment "H".

Mechanical Adjustments A-B-C
Air Adjustments E-F
Electrical Adjustments D-G-H

Adjustment Instructions

A Door Shaft Nuts

The two jam nuts at the top of the top door shaft must be adjusted to raise or lower the door until there is adequate clearance at both the top and bottom of the door, after which the jam nuts must be pulled tight to maintain the adjustment.

B Operator Connecting Rods

Before making adjustment "B", back striker "D" as far from micro switch as possible. With air on and porter's door switch in automatic position, adjust operator connecting rod with turnbuckle "B" so the nut on the operator piston is flush with the end of the cylinder as shown in figure G. Then re-adjust striker in accordance with instruction "D".

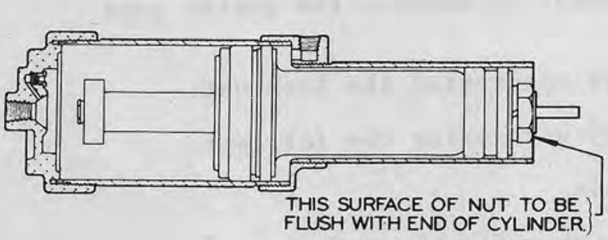


Figure G

C Emergency Door Closing Cylinder Connecting Rod

Before making adjustment "C", back striker "D" as far from micro switch as possible. With air on and porter's door switch in the "remain open" position, adjust turnbuckle "C" so the clevis pin just touches the end of the clevis slot. Then shorten the connecting rod by 1½ turns of turnbuckle "C". Re-adjust striker in accordance with instruction "D".

D Door Reversing Cut-Out Switch

With air on and porter's door switch in the "automatic" position, screw striker "D" toward the micro switch until the switch plunger is compressed about ⅛". Then open the door, hold a pencil or small screw driver blade across the inside frame of the door opening as shown in figure H, and permit the door to close against this object. Back striker "D" slowly away from the micro switch until the door reverses from this position.

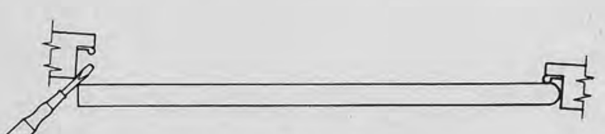


Figure H

★As the adjustment of the Door Opening and Door Closing Control Fittings is interdependent, the door opening fitting should always be adjusted before attempting to adjust the door closing fitting. When combined governors and pressure regulators are in the air feed line to the end door operators, adjustments can be made at any train line pressure exceeding the pressure at which the regulator is set. When combined governors and pressure regulators are not in the air feed line, all adjustments must be made at the service train line pressure. *(Above 100 lbs. with battery fully charged or generator operating).*

E Door Opening Control Fitting ★

With the door closed and latched, place the porter's door switch in the "remain open" position. After about five seconds, release the door latch. If the door has a tendency to slam open, loosen the jam nut and turn the adjusting screw into the door opening control fitting. If the door opens too slowly, back the adjusting screw out of the fitting until the proper speed is obtained. Then lock the adjusting screw in position with the jam nuts. The door opening speed is 3 to 3½ seconds.

F Door Closing Control Fitting ★

Place the porter's door switch in the "remain open" position. Allow the door to remain open for about five seconds, and then quickly place the porter's switch in the "automatic" position. If the door has a tendency to slam closed, loosen the jam nut and turn the adjusting screw into the door closing fitting. If the door closes too slowly, back the adjusting screw out of the fitting until the proper speed is obtained. Then lock the adjusting screw in position with the jam nut. The minimum door closing speed is 4 seconds.

G Door Reversing Switch Striker

Adjust the switch striker so that with the door in the closed position, and the porter's door switch in the "manual" position, there is 1/16" clearance between the switch striker and the micro switch plunger.

H Time Delay Relay

Rotate the adjusting screw clockwise to increase the delay and counterclockwise to decrease the delay. The setting *should be* four to five seconds from the time the latch is actuated until the door starts to close.

OPERATOR ENGINE - SHOP REPAIR

Remove the operator engine from the base plate as follows:

1. Disconnect the union which joins the air line between the port on the large cylinder end cap and the exhaust type Magnet Valve.
2. Disconnect the air line leading to the door opening control fitting at the center port of the operator engine.
3. Disconnect the main connecting rod between the door shaft and the engine.
4. Remove the two bolts from the clamps holding the operator engine fastened to the base plate.

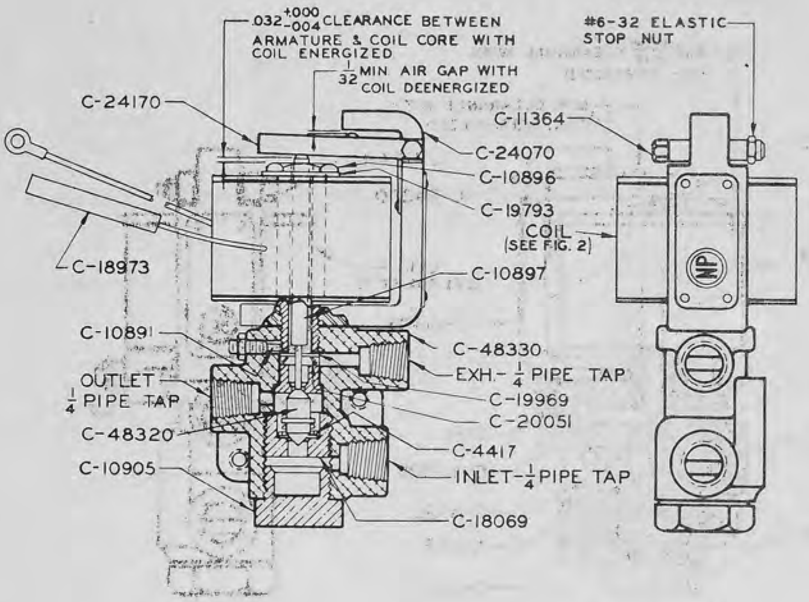
To dis-assemble the operator engine:

1. Place it in a bench vise and remove the end cap.
2. Take out the entire piston assembly to examine the piston cups and lubricating rings.
3. The piston cap can be removed by unscrewing the lock nut.
4. The piston cup can be removed by unscrewing the follower.
5. Replace piston cups with new ones.
6. Inspect the felt lubricating rings and replace them.
7. Clean all metal parts in solvent and apply fresh grease to the piston cups and to the cylinder walls.
8. Saturate the two felt lubricating rings with SAE 30 oil.
9. Before re-assembling the operator engine, replace all gaskets.
10. Then install the re-assembled engine on the base plate and clamp it firmly in position.
11. Attach the main connecting rod and connect the air line piping to the center port door-opening control fitting.
12. Complete the installation, connect the piping between the cylinder end cap and the exhaust type Magnet Valve.

For valve grinding instructions see Figures 200 and 201.

M A G N E T   V A L V E

(HEAVY DUTY EXHAUST TYPE)



UPPER VALVE HOLDER

LOWER VALVE HOLDER

Figure 200

UPPER VALVE GUIDE

PART LIST

C-4417	Spring	C-19793	Spring Washer
C-10891	Plug	C-19969	Disc (Silencer)
C-10896	Coil Core	C-20051	Spring (Silencer Disc)
C-10897	Push Rod	C-24070	Bracket & Spring
C-10905	Cap Nut	C-24170	Armature Lever
C-11364	Pivot Screw	C-48320	Valve
C-18069	Valve Seat	C-48330	Body
C-18973	Sleeve	Coil - -	See table.

VOLTAGE	COIL NUMBER	MAGNET VALVE COMPLETE WITHOUT BRACKET
32	C-48340	C-48370
64	C-48350	C-48380
120	C-48360	C-48390

VALVE GRINDING

Use valve holder C-21300 for grinding the lower valve. Unscrew cap nut and the lower valve seat from the magnet valve body and remove the armature lever and push rod. Apply a small quantity of grinding compound to the lower face of the valve and replace it in the magnet valve housing, together with the spring and lower valve seat. The valve holder is then placed in the hole in the center of the coil so that the slotted end of the valve holder will fit over the stem of the valve. Rotate the valve holder and valve until the valve face is smooth.

The tool for grinding the upper valve face consists of a valve holder C-21290 and a guide C-13622. To grind the upper valve face, unscrew cap nut and remove the lower valve seat, spring, and valve from the magnet valve housing. The lower end of the valve is then placed in the end of the valve holder and the valve holder is pushed part way through the guide. A small quantity of grinding compound is now applied to the upper face of the valve. The valve holder guide, with the valve holder and valve, is then placed in the bottom of the magnet valve. The end of the valve holder which projects through the magnet valve is rotated until all scores disappear from the upper valve face.

After either valve has been ground, the valve faces should be thoroughly washed with solvent and all air passages in the magnet valve should be blown out with compressed air to make certain that no particles of grinding compound remain in the magnet valve.

After re-assembling the magnet valve, make sure that the top of the push rod projects .032" plus .000" or minus .004" from the face of the coil core, when the coil is energized. If the push rod projects less than .028" it should be replaced.

The magnet valve may be tested for leakage with an air pressure gauge, or by applying soap and water solution to the ports. With the magnet valve energized, or with the armature lever depressed manually, no indication of pressure should be obtained at the outlet connection. With the valve de-energized, no pressure should be obtained at the exhaust connection.

Magnet valves require no lubrication.

M A G N E T V A L V E

(PRESSURE - TYPE)

PART LIST

C-4417 Spring
C-8920 Valve & Stem
C-10891 Plug
C-10896 Coil Core
C-10903 Push Rod
C-10905 Cap Nut
C-11364 Pivot Screw
C-24070 Bracket & Spring
C-24170 Armature Lever
C-44220 Valve Body & Seats

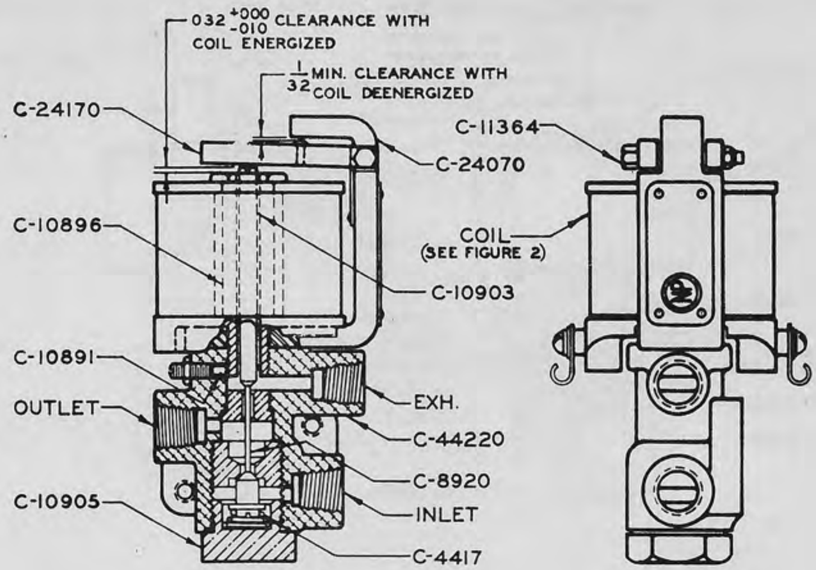


Figure 201

VOLTAGE	COIL NUMBER	MAGNET VALVE COMPLETE WITHOUT BRACKET
32	C-16630	C-43720
55-75	C-31670	C-43730
120	C-41950	C-43670

VALVE GRINDING

To grind the lower valve remove cap nut, spring, and valve. Then apply a small quantity of grinding compound to the face of the valve. Replace it in the magnet valve and rotate it with a screw driver until the valve face is smooth.

To grind the upper valve, remove the armature lever and push rod. Apply a small quantity of the grinding compound to the valve face of the push rod and replace it in the magnet valve. Rotate the push rod with a screw driver until all scores disappear from the valve face.

After the valves have been ground, the valve faces should be thoroughly washed in solvent and all air passages in the magnet valve should be blown out with compressed air to make certain that no particles of grinding compound remain in the magnet valve.

When the magnet valve has been re-assembled, make sure that the top of the push rod projects .032" plus .000" or minus .010" from the face of the coil core. If the push rod projects less than .022", it should be replaced with a new one.

The magnet valve may be tested for leakage with an air pressure gauge, or by applying soap and water solution to the ports. With the magnet valve coil energized, or with the armature lever depressed manually, no indication of pressure should be obtained at the outlet connection With the magnet valve coil de-energized, no pressure should be obtained at the exhaust connection.

Magnet valves require no lubrication.

EMERGENCY DOOR CLOSING CYLINDER - SHOP REPAIRS:

Remove the emergency cylinder from the base plate as follows:

1. Remove the bolts from the mounting brackets holding the emergency cylinder in position on the base plate.

2. Take the pin out of the clevis jaw. The emergency cylinder can now be removed from the base plate for disassembling.

CAUTION: The spring in the emergency cylinder exerts a pressure of about 90 pounds against the coupling. Therefore, before attempting to dismantle the emergency cylinder it is the best to be equipped with a spring releasing device like the one shown in Figure 202.

Disassemble the emergency cylinder as follows:

1. Place it in a bench vise in a vertical position, held by the cylinder cap port projection.

2. Remove the nut and washer from the end of the piston rod and detach the connecting rod jaw.

3. Using a spanner wrench, unscrew the slotted rear cylinder from the coupling, holding the coupling with a strap wrench to prevent it from turning.

4. Then lift the cup guide from the end of the piston rod.

5. The coupling should now be unscrewed from the main cylinder. Before doing this however, screw a 12 inch extension rod (see Figure 204) to the threaded end of the piston rod to serve as a guide for the spring as it is being released from the cylinder.

6. Then place the spacer (shown in Figure 204) over the extension rod and on top of the inner flange of the coupling.

7. Place the slotted section of the spring-releasing lever over the extension rod and against the top of the spacer. (See Figure 204).

8. Using a strap wrench, start unscrewing the coupling from the main cylinder, which must be held with another strap wrench to prevent it from turning in the cylinder end cap. When the coupling is almost fully unscrewed from the cylinder, be sure to hold the slotted spring, releasing lever firmly against the spacer so as to release the spring slowly.

9. With the coupling off, unscrew the main cylinder from the end cap which is still held in the vise.

10. Then remove the spring, the piston rod and piston assembly from the cylinder. NOTE: To insure correct re-assembly, mark the end of the main cylinder which was attached to the end cap.

11. Renew the piston cup and felt lubricating strip.

12. Remove the piston cup, unscrew the lock screw and follower washer and remove the expander and washer.

13. Clean all metal parts in solvent and apply fresh grease to the piston cup, the spring, and to the interior walls of the main cylinder.

14. Saturate the lubricating strip with SAE-30 oil.

15. Re-assemble the piston assembly as shown in Figure 205.

Re-assemble the emergency cylinder as follows:

1. Insert the piston rod and piston assembly through the end of the main cylinder which was previously marked for correct attachment to the end cap.

2. Replace the gasket in the end cap.

3. Then replace the end cap port projection in the vise and screw the main cylinder into the end cap and tighten.

4. Screw the extension rod to the end of the piston rod, see Figure 202 and drop the spring into the cylinder.

5. Place the coupling over the piston rod extension with the recessed end of the coupling against the end of the spring.

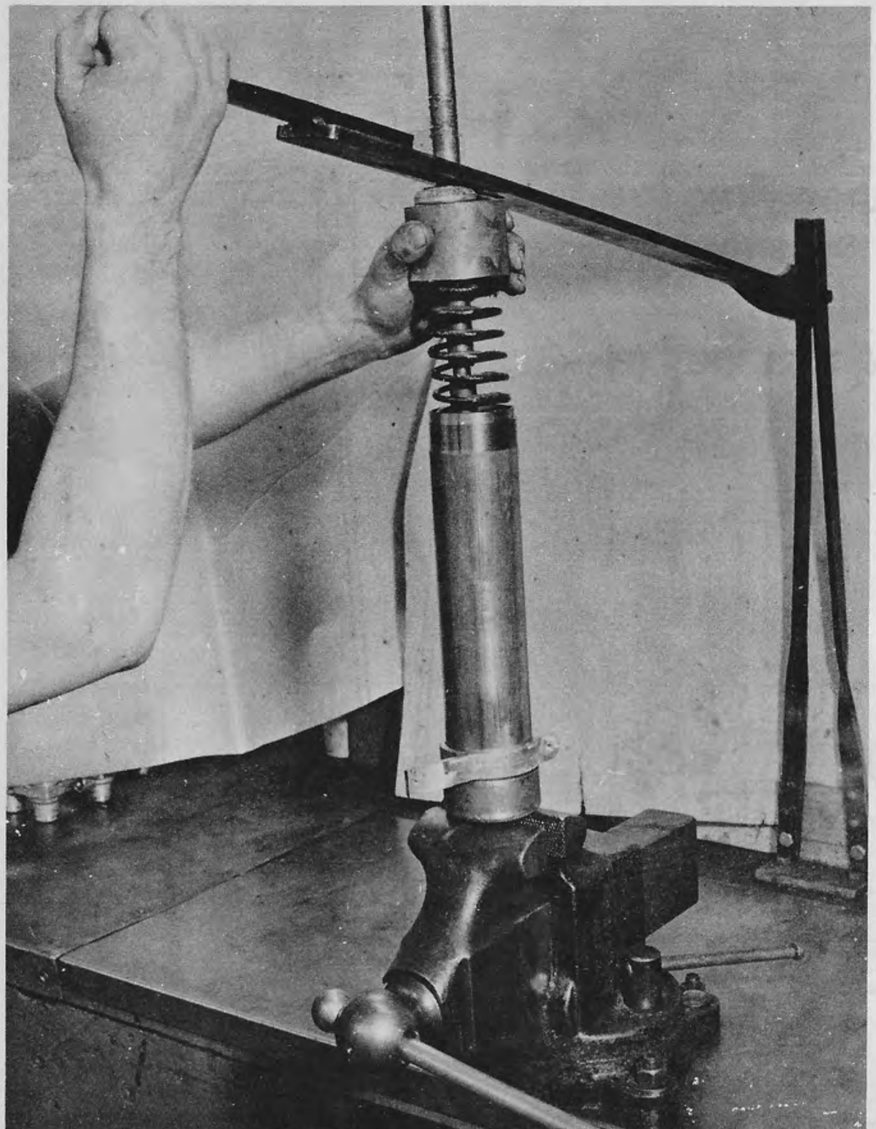
6. Place the slotted section of the spring-releasing lever over the piston rod extension and press the lever down on top of the spacer against the pressure of the spring until the threads of the coupling and the cylinder make contact. Screw the coupling to the cylinder and tighten with a strap wrench.

7. Remove the spacer and extension rod and place the cup guide on the piston rod as shown in Figure 204.

8. Screw the rear cylinder into the coupling, using a spanner wrench. Make certain that when tightened, the slotted side of the rear cylinder is exactly at right angles to the end cap port and on the correct side.

9. Apply a thin film of grease to the interior walls of the rear cylinder and to the edges of the slot in this cylinder.

10. Place the connecting rod jaw on the end of the piston rod and fasten it with the lockwasher and lock nut. The emergency cylinder can now be attached to the base plate.



EMERGENCY CYLINDER SPRING DEVICE

Figure 202

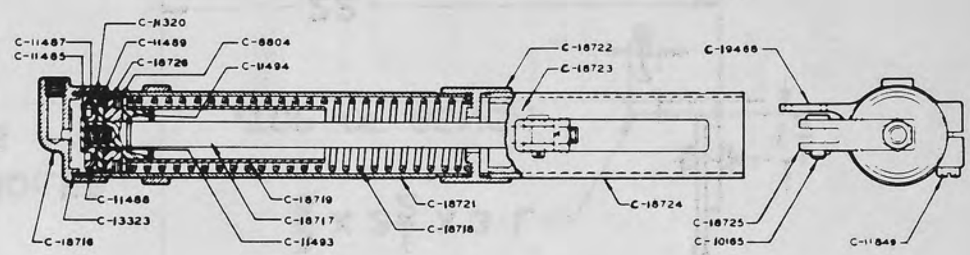


Figure 203

EMERGENCY CYLINDER

PART LIST

C-8804	Lubricating Strip	C-18716	Cap
C-10165	Pin for Jaw	C-18717	Plunger (Rod)
C-11320	Cup Assembly	C-18718	Spring
C-11485	Lock Screw	C-18719	Spring Guide
C-11487	Follower Washer	C-18721	Cylinder
C-11488	Expander	C-18722	Coupling
C-11489	Washer	C-18723	Cup Guide
C-11493	Plunger Gasket	C-18724	Rear Cylinder
C-11494	Lubricator Retainer	C-18725	Connecting Rod Jaw
C-11849	Screw	C-18726	Piston Center
C-13323	Gasket	C-19468	Bracket for Micro-switch

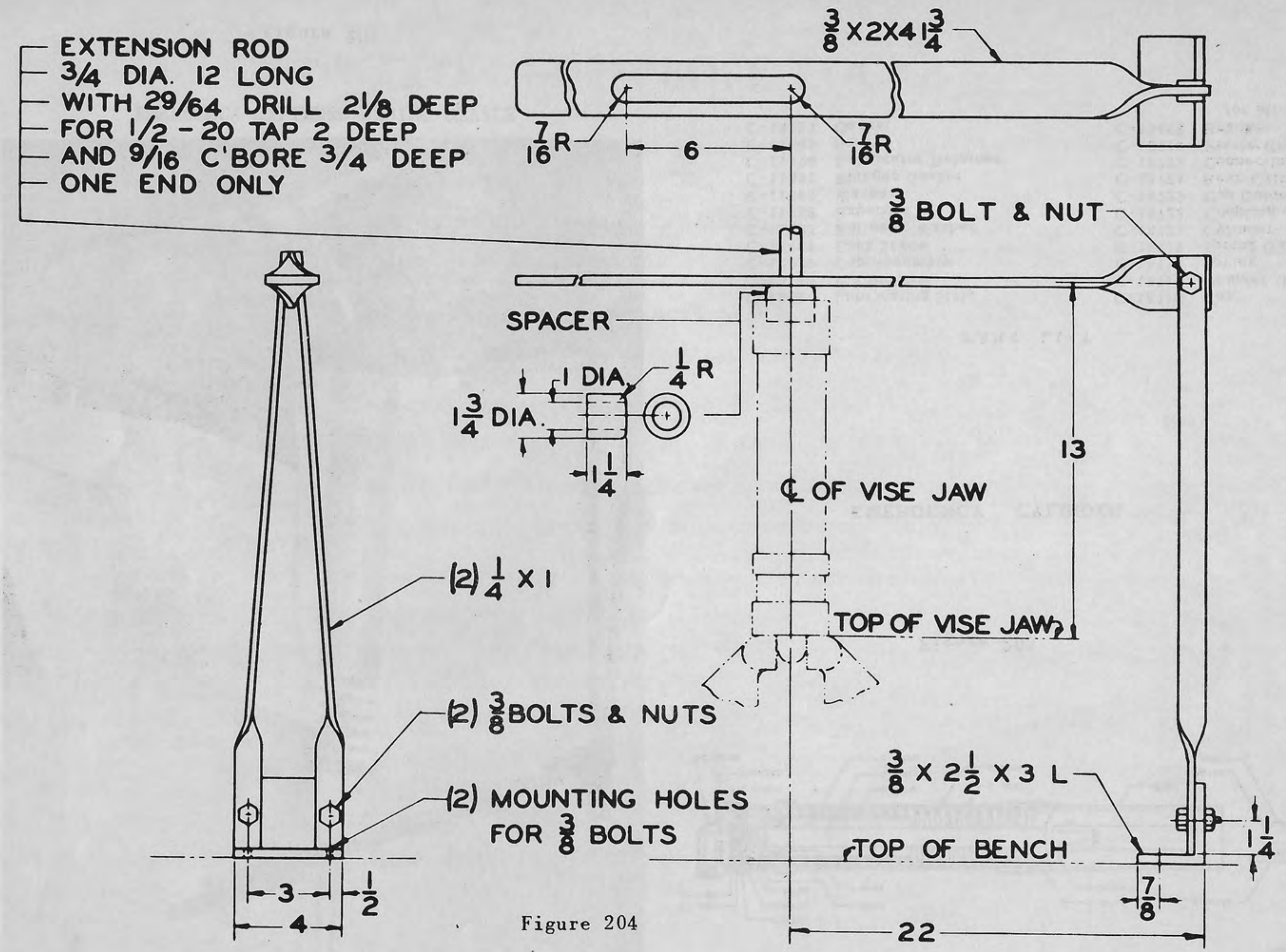
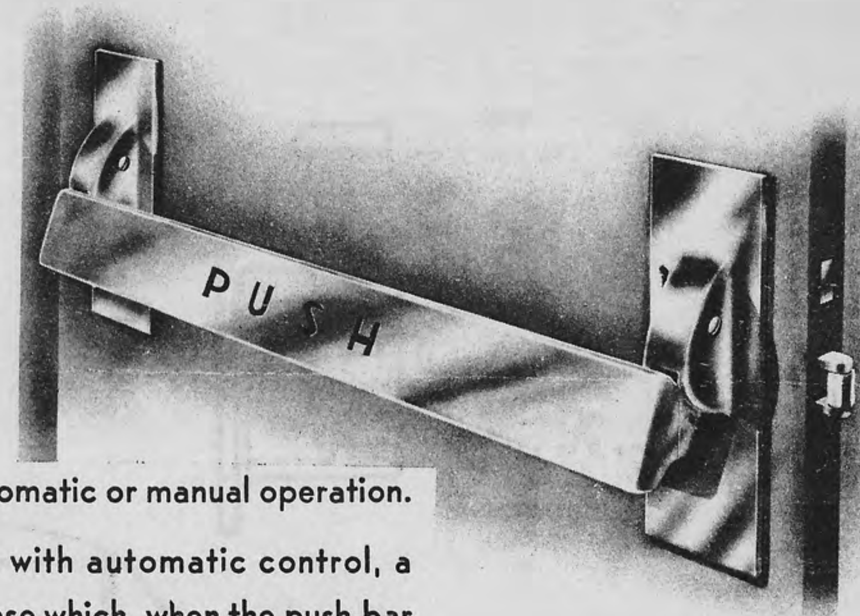


Figure 204

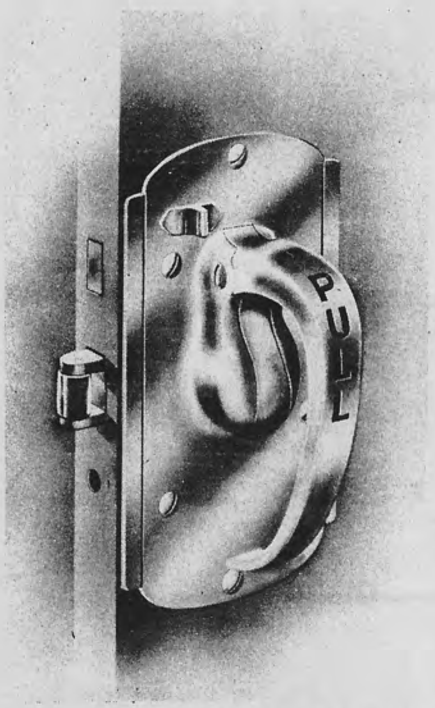
EMERGENCY CYLINDER SPRING DEVICE



These locks are of sturdy construction for half mortise installation.

Furnished in aluminum with satin anodized finish.

All working parts are of hard bronze, except rollers and pins which are of Monel Metal.



Can be installed for either automatic or manual operation.

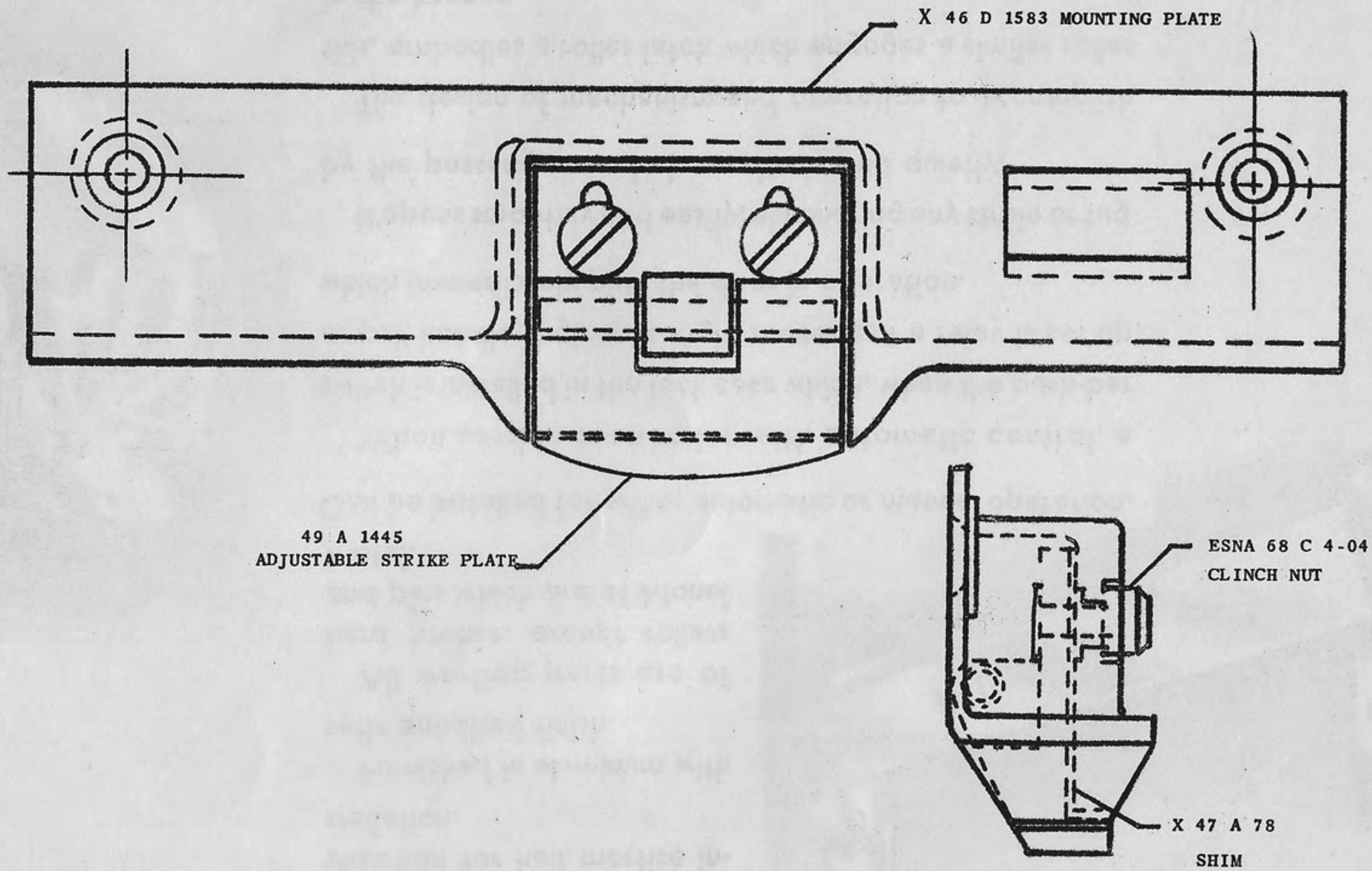
When used in connection with automatic control, a switch is installed in the lock case which, when the push-bar or pull handle is given a slight movement a relay is set up which immediately puts the door in operation.

It opens smoothly and easily, eliminating any strain or tug by the passenger, and closes slowly and quietly.

The design of mechanism and operation to accomplish this, embodies a roller latch which engages a similar roller in the keeper.

No. 1392 Lock with 22 ½" Push Bar Fitted to Pullman barrel key on outside and thumb piece inside.

DAYTON PUSH-PULL LOCKS



KEEPER ASSEMBLY

Figure 205

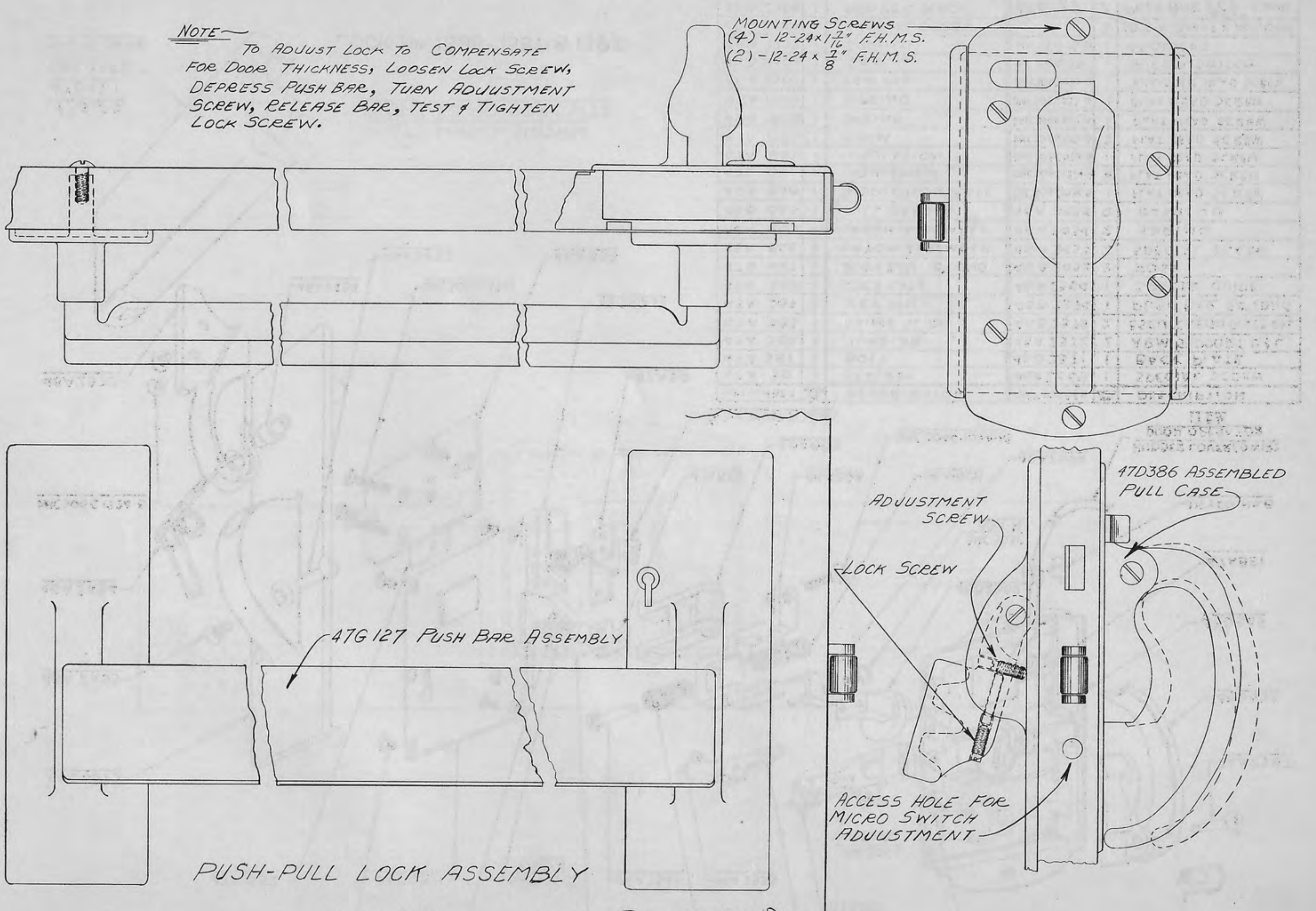
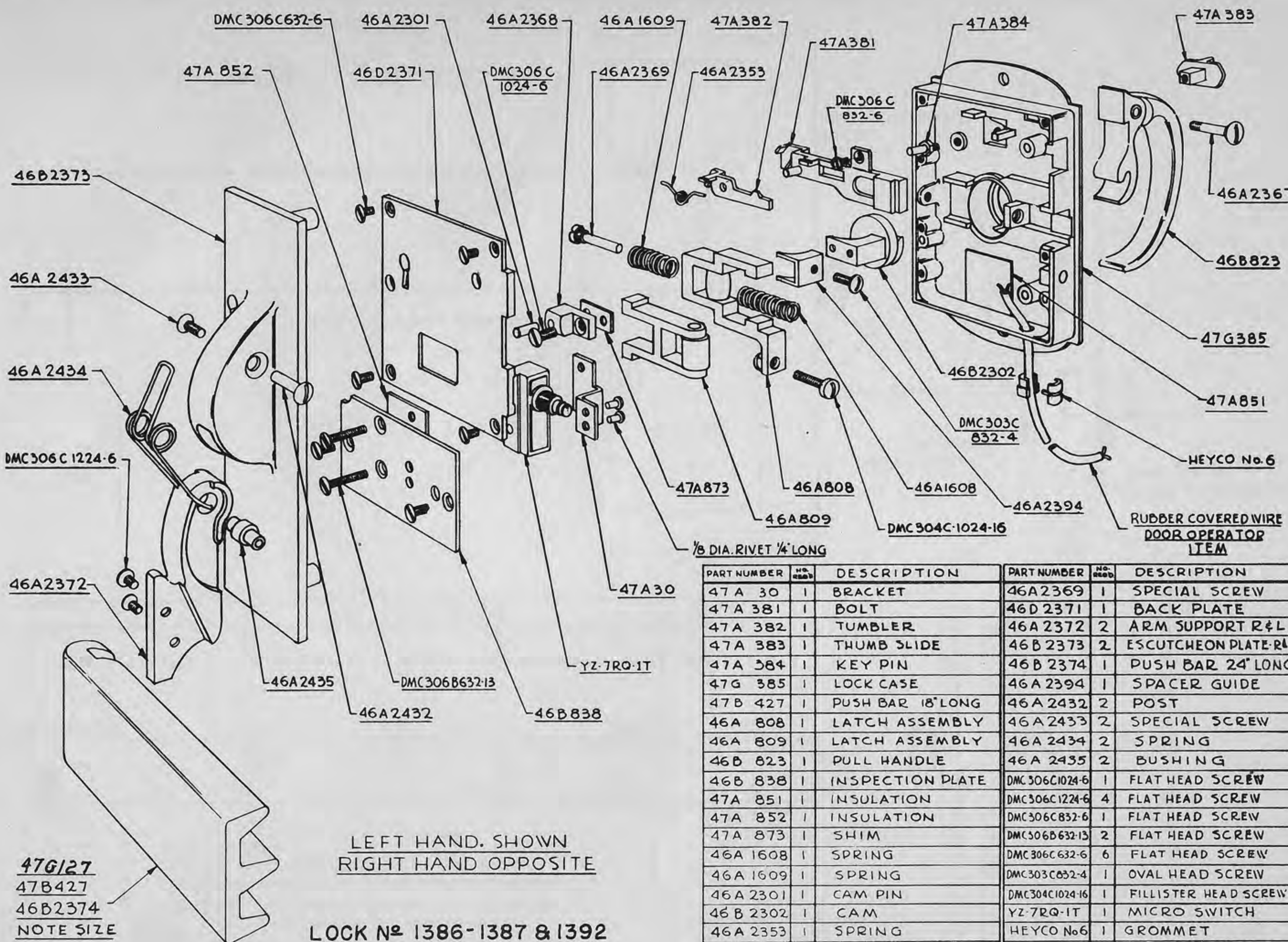

NOTE—
TO ADJUST LOCK TO COMPENSATE FOR DOOR THICKNESS, LOOSEN LOCK SCREW, DEPRESS PUSH BAR, TURN ADJUSTMENT SCREW, RELEASE BAR, TEST & TIGHTEN LOCK SCREW.
MOUNTING SCREWS
(4) - 12-24 x 1 7/16" F.H.M.S.
(2) - 12-24 x 7/8" F.H.M.S.
47D386 ASSEMBLED PULL CASE
ADJUSTMENT SCREW
LOCK SCREW
ACCESS HOLE FOR MICRO SWITCH ADJUSTMENT
47G 127 PUSH BAR ASSEMBLY
PUSH-PULL LOCK ASSEMBLY

Figure 206



LEFT HAND. SHOWN
RIGHT HAND OPPOSITE

LOCK No 1386-1387 & 1392

PART NUMBER	NO. REQ'D	DESCRIPTION	PART NUMBER	NO. REQ'D	DESCRIPTION
47A 30	1	BRACKET	46A2369	1	SPECIAL SCREW
47A 381	1	BOLT	46D 2371	1	BACK PLATE
47A 382	1	TUMBLER	46A 2372	2	ARM SUPPORT R&L.
47A 383	1	THUMB SLIDE	46B 2373	2	ESCUTCHEON PLATE-R&L.
47A 384	1	KEY PIN	46B 2374	1	PUSH BAR 24" LONG
47G 385	1	LOCK CASE	46A 2394	1	SPACER GUIDE
47B 427	1	PUSH BAR 18" LONG	46A 2432	2	POST
46A 808	1	LATCH ASSEMBLY	46A 2433	2	SPECIAL SCREW
46A 809	1	LATCH ASSEMBLY	46A 2434	2	SPRING
46B 823	1	PULL HANDLE	46A 2435	2	BUSHING
46B 838	1	INSPECTION PLATE	DMC306C1024-6	1	FLAT HEAD SCREW
47A 851	1	INSULATION	DMC306C1224-6	4	FLAT HEAD SCREW
47A 852	1	INSULATION	DMC306C832-6	1	FLAT HEAD SCREW
47A 873	1	SHIM	DMC306B632-13	2	FLAT HEAD SCREW
46A 1608	1	SPRING	DMC306C632-6	6	FLAT HEAD SCREW
46A 1609	1	SPRING	DMC303C832-4	1	OVAL HEAD SCREW
46A 2301	1	CAM PIN	DMC304C1024-16	1	FILLISTER HEAD SCREW
46B 2302	1	CAM	YZ-7RQ-1T	1	MICRO SWITCH
46A 2353	1	SPRING	HEYCO No6	1	GROMMET
46A 2367	1	SPECIAL SCREW		2	1/8" DIA. RIVET x 1/4" LONG
46A 2368	1	BUMPER BLOCK	47G127	1	PUSH BAR $22\frac{1}{2}$" LONG

Figure 207

I N D E X

AIR CONDITIONING (Frigidaire)

Air Conditioning Unit, Description of........ 121
Air Distribution........ 156
    Filters. - Fresh and Recirculating Air........ 156
Compressor Motor Unit, Description of........ 111
Compressor Motor Control Panel, Description of........ 146
    Operation of Compressor Motor Control Panel........ 146
Condenser Unit, Description of........ 114
    Condenser Fan........ 114
    High-Low Pressure Switch........ 114
    Liquid Receiver........ 114
    Spray Assembly........ 114
    Water System........ 114
Frigidaire Modulex Refrigerant Control Valve........ 127
Low Voltage Relay, Testing of........ 153
Service Operations........ 131
    Adding F-12........ 135
    Adding Oil........ 132
    Adjusting Compressor Belt Tension........ 131
    Adjustment of Switches........ 135
    Air Filters - Condenser........ 138
    Checking F-12 Level........ 135
    Condenser Fan Wheels........ 136
    Eliminators........ 136
    Exchanging Compressor........ 132
    Float Valve........ 138
    Flushing of Tank........ 136
    Leaking shut-off Valves........ 135
    Oil charge........ 132
    Pressure cut-out and Safety Switch........ 135
    Pump. - KRVS Condenser........ 138
    Pumping down of System........ 138
    Receiver........ 136
    Removal and Cleaning of Strainer........ 138
    Removing Oil........ 135
    Renew Seal - KRVS Pump........ 138
    Replacing Compressor Belts........ 131
    Replacing Compressor Seal........ 131
    Seasonal Draining........ 138
    Servicing the Expansion Valve........ 135
    Spray Nozzles........ 136
    Strainer. - Water supply........ 138
    Use of Pressure Gauges........ 131
    Water Level........ 136

AIR CONDITIONING CONTROL (VAPOR)

A.C. Control, Description of........ 195
Cooling Tubes........ 197
Floor Heat, General Toilet........ 198
Floor Heat, Passageway........ 198
Floor Heat, Rooms........ 198
Layover Heat Tube........ 198
Panel, Description of........ 195
Resistor Table........ 205
Temperature Selector Switch........ 195
Thermostat Meter Test........ 198

BUFFET REFRIGERATION:

Description of Equipment 232
Diagnosing Service Complaints 239
Electrical Controls 238
Expansion Valve, Description of 232
Motor 1/2 H.P. Condensing Unit 239
Service Operations 232
- Adding Oil 234
- Adding Refrigerant 234
- Attaching High Pressure Gauge 233
- Attaching Low Pressure Gauge 233
- Changing the Compressor 235
- Checking Head Pressure on Idle and Operating Condensing Units 237
- Checking Oil 236
- Evacuating the Cooling Unit, Liquid and Suction Lines, (Removing Refrigerant) 233
- Purging Air from Condensing Unit 233
- Purging Air from the Cooling Unit 233
- Renew Compressor Seal 236
- Testing for Freon Leaks 234

Starting and Adjusting of Storage Cabinet Units 238
Trouble and Diagnosis of Service Problems 242

DRIVE EQUIPMENT:

Axle Mounting Assembly 2
Clutch, Description of 22
Clutch, Automatic, Shop Repairs to (Mechanic's Shop) 28
Clutch, Automatic, Yard Repairs to 22
Clutch Lubrication 22
Description of Drive 1
Drive Shaft, Description of 18
Drive Shaft, Yard Shop Repairs to 22
Gear Unit Assembly 2

ELECTRICAL SYSTEM:

Batteries 207
Battery Disconnect Switch 211
Battery Trainline Connectors 211
Battery Trainline Receptacles 211
Branch Circuit Breakers 211
Branch Circuit Fused 211
Call Bell System 212
Charging Receptacles 211
Direct Current, 32 Volt 211
Exhaust Fans 207
Fans 207
Fluorescent Lighting 212
Fluorescent Lighting Trouble Diagnosis and Correction of 223
Inspection Light 211
Inspection Procedure 212
Lamping Specifications 214
Main Light Switch 211
Main Switchboard 211
Trainline Switch 211

ENGINATOR, WAUKESHA, DIESEL:

Air Cleaner and Intake Manifold, Description of 54
American Bosch Fuel Pump, Description of 62
    Operation of American Bosch Fuel Pump 63
Control Box, Inspector's, Description of 54
Control Cabinet 83
Cranking Motor 54
Cylinder Head and Inserts 51
Cylinder Sleeves 51
    Cylinder Sleeves, Removal of 51
Data Sheet, Engine - Generator 94
Enginator Control and Operation (D.C. Unit) 83
        Control Selector Switch, Position "A" 88
        Control Selector Switch, Position "A" with "AA" Type
        Operation Enginator and Axle Generator 88
        Control Selector Switch, Position "B" 88
        Control Selector Switch, Position "C" 92
Enginator Protective Devices 55
Enginator, Waukesha Diesel, Description of 47
Engine Cooling System 52
    Engine Radiator Cooling System, Cleaning of 52
Fluid Coupling 83
Fuel Injectors 67
Fuel Oil Tank, Diesel 57
    Fuel Oil Tank, Servicing of 62
    Fuel Oil Tank, Steam Heat for 62
Fuel Pump Control Rod Solenoid 57
    Fuel Pump Control Rod Solenoid, Adjustment of 57
Generator .... 37 & 47
General Service Instructions 92
    Care of Ball Bearings 92
    Enginator Storage 93
    Generator Brush Data 92
    Fluid Coupling 93
Hydraulic Nozzle Tester, Use of 68
    Testing for Leakage 68
Klixon Switch, Thermostatic 37
Master Governor - Gear Driven 55
Mechanical Overspeed Governor 55
    Master Governor and Overspeed Governor, Adjustment of 55
Nozzle Tester, Operating of 69
    Adjusting injection Pressure 69
    Assemble injector to Engine 71
    Disassemble and Clean Nozzle and Nozzle Holder 69
    Disassembly, Cleaning and Reassembly of Nozzle Holder 69
    Lapping Valve Seat to Nozzle 69
    Reassembly of Nozzle to Holder 71
    Timing Fuel Injection Pump to Engine 71
Nozzle Troubles and Remedies 71/72
Oil Pump and Controlled Lubrication 51
Pistons, Connecting Rods and Crankshaft 51
Primary or Transfer Pump 62
Train Line Operation 92
Two-Speed Operation 83
Voltage Regulator and reverse current relay (D.C. Unit) 83

GENERATING EQUIPMENT: (Axle Driven) (Safety Genemotor)

Armature, Description of ... 38
Brush Boxes, Description of ... 41
Frame, Description of ... 38
Fuses ... 41
Genemotor, Description of ... 37
Generator Relay (Automatic Switch), adjustment of ... 41
Generator Regulator, Description of ... 41
Generator Regulator - Current and Voltage Settings ... 42
Klixon Switch ... 37
Polarity ... 41
Ventilation ... 41

GENERATING EQUIPMENT: (Diesel Driven) (Waukesha)

Description of ... 37 & 47
Enginator Control and Operation (D. C. Unit) ... 83
    Control Selector Switch, Position "A" and "AA" ... 88
Generator Brush Data ... 92
Klixon Switch, Thermostatic ... 37
Voltage Regulator and Reverse Current Relay ... 83

HEATING SYSTEM:

Description of Equipment ... 157
End Valves and Metallic Conduit ... 187
Radiation ... 171
Regulator ... 157
Repairs and Testing ... 183
    Check for Cause of Steam Blowing at Regulator ... 183
    Shop Test of Vapor Regulators ... 184
Replace Valve Solenoid Coil (Floor Valve) ... 185
Replacing Orifice Seats in Valve Bodies ... 185
Replacing 1671-EE Bellows in Valve Body ... 185
Replacing Solenoid Manual Control Arm Assembly (Floor Valve) ... 185
Replacing Solenoid Needle Valve Assembly (Floor Valve) ... 185
Solenoid Admission Valves ... 170
Steam Trainline ... 187
Thermostatic Bellows ... 185
Water Heating and Protection Loop ... 187

MECHANICAL SECTION:

BED MECHANISM:

Adjustment and Bed Alignment - Standard Roomette Pivot Rocker Assembly ... 301
Adjustment and Bed Alignment - Upper Duplex Roomette Counter Balance Arrangement ... 302
Bed Mechanism, Description of ... 293
Upper Lengthwise Bed (BL) ... 293
Upper Crosswise Bed (BC) ... 293
Standard Roomette Bed ... 294

DOOR CLOSER:

Cause and Correction of Improper Operation ... 310
Description of Equipment ... 303
Emergency Door Cylinder - Shop Repairs ... 315
How it operates ... 308
Magnet Valve - Exhaust Type ... 313
Magnet Valve - Pressure Type ... 314
Operator Engine Operation ... 303
Operator Engine - Shop Repair ... 312
Setting Up the Door for Automatic Operation ... 303
Valve Grinding ... 313

MECHANICAL SECTION (Cont'd).

MISCELLANEOUS:

Door Check........ 283
Glass Application........ 279
Miscellaneous Glass........ 282
Renew Vestibule Door Glass........ 276
Sash, Description of........ 276
Steps and Trap Doors........ 283
Step and Trap Door Details........ 285
Vestibule Curtains........ 283
Window Curtains........ 283

VENETIAN BLINDS:

Cleaning Procedure........ 289
Replacing Wood Slats........ 289
Venetian Blinds, Description of........ 288

WATER SYSTEM:

Description of System........ 253
Draining Car, Procedure of........ 257
Governor and Reducing Valve........ 257
Hoppers........ 258
Piping........ 253
To prepare a drained car for Service........ 258
Vacuum Breakers........ 258
Washstands........ 258
Water Filling Valve........ 253
Water Tank........ 253

WATER COOLER:

Attaching High Pressure Gauge........ 266
Common Causes of improper performance of Refrigeration Cycles and Their Correction........ 268
- Adjust new Control........ 269
- Air in System........ 268
- By-pass........ 269
- Check Control........ 269
- Faulty Check Valve........ 269
- Faulty expansion Valve Operations........ 268
- Loss of Refrigerant........ 268
- Moisture in System........ 268
- Overcharge of Refrigerant........ 268
- Purging........ 268
- Renew Condenser or Receiver........ 270
- Renew Control........ 269
- Renew Expansion Valve, Evaporator, or Check Valve (Low Side)........ 270
- Thermostat Control........ 269

Compressor........ 265
Description of Equipment........ 265
Eastern Engineering Co.'s Model D-11 Pump........ 271
- Motor........ 271
- Pump........ 271
- Renew Seal........ 271

General Capacity Data........ 266
Refrigeration Service........ 265
Temperature of Liquid and Suction Lines........ 266
Trouble Shooting Chart........ 267