Form 2699D-8-51
Printed in U.S.A.

OPERATION AND CARE OF SAFETY ELECTRICAL EQUIPMENT

for

Railroad Car Lighting

and

Air Conditioning

THE SAFETY CAR HEATING AND LIGHTING COMPANY INC.

NEW YORK • CHICAGO • PHILADELPHIA • ST. LOUIS • NEW HAVEN • SAN FRANCISCO • MONTREAL

This manual has been prepared to provide fundamental maintenance information for the Safety Car Heating and Lighting Company's standard line of generator and genemotor equipment. Information such as wiring diagrams, tools available for dismantling and reassembly of equipment and maintenance procedure has been included to assist the maintenance forces in the proper care of Safety equipment.

Since Safety equipment is widely used, it is realized that maintenance procedures and shop practices based on actual operating experience have already been established. These instructions, therefore, need not always be followed implicitly. It is hoped that the contents of this manual will add to established procedures and practices.

When supplemental information concerning generator or genemotor equipment is required, it can be readily obtained from any of our district offices.

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OPERATION, CARE AND ADJUSTMENT OF SAFETY GENERATOR AND GENEMOTOR EQUIPMENT USED TO SUPPLY POWER FOR RAILROAD PASSENGER, BAGGAGE, EXPRESS AND POSTAL CARS AND CABOOSES

STANDARDS

Every Safety generator or genemotor is thoroughly tested for compliance with specifications for "Car Electrical Equipment of the Association of American Railroads" before shipment. These specifications require that the generator or genemotor be operated at its rated voltage and current with the covers arranged as in summer service; three hours for enclosed machines and five hours for open machines, at 1.25 times rated full load speed. At the conclusion of this test the temperature rise of the parts must not exceed the values shown in the following table:

Part	Insulation AIEE Classification	Method	Max. Temperature Rise Ventilated Machines	Max. Temperature Rise Totally Enclosed Machines
Armature Winding	Class B	Resistance	105	115
Field Winding	Class A	Resistance	85	95
Field Winding	Class B	Resistance	120	115
Commutator	Class B	Thermometer	95	105

Since armature windings of all Safety generators and genemotors are wound with Class B insulation, temperature rise values for Class A insulated armatures are not shown in the table.

Each machine is calibrated for brush position to assure performance in either direction of rotation. This is accomplished by measuring the field current in each direction and then shifting the head (complete with brush gear) to a position where the current values are the same in either direction of rotation. The head is then pinned in position with a dowel. Thereafter the brush position is fixed.

Each generator and genemotor is then thoroughly tested at maximum operating speed in each direction of rotation and the commutation is checked.

MAGNET FRAME

The magnet frame of all large generators is fabricated of rolled steel with mounting or suspension lugs of ample proportions, welded in place. Some of the smaller generators have frames of cast steel. The heads are cast iron. They are located by accurately machined rabbets or pilots assuring accurate alignment of the bearings and centering of the armature. The heads are provided with tappings for draw-off bolts. An easily removed hand-hole cover at the commutator end and large openings in the frame facilitate inspection of the brushes, commutator and internal parts of the machine.

POLES

The poles are of the laminated type, securely bolted to the magnet frame.

FIELD COILS

The field coil windings are thoroughly impregnated with an oil and moistureproof compound by the vacuum process. Flexible leads of ample capacity are soldered to the ends of the coil windings. After applying the coil insulators the assembly is taped. The coils are then treated with insulating varnish, which provides added oil and moisture protection.

To avoid improper application, the coils are plainly marked with the catalog number and adjacent to each lead is stenciled either "O" or "I" designating the outer or inner lead. These "O" and "I" designations shown in wiring diagrams, Fig. 1 through 10, provide a positive yet easy way of identifying field coil connections.

All flexible coil leads are connected to the coil at least six inches from where they are brought out through the insulating tapes. This provides for holding the lead firmly in place and prevents any pull or strain on the coil winding connections.

ARMATURES

The armature core is built up of high grade electrical sheet steel and each stamping is insulated with core varnish. The stampings are assembled under heavy pressure between core plates at each end.

The armature is form wound with conductors having Class B insulation. The slot cell insulators are also Class B. The coils are securely held in the core slots by laminated phenolic or glass-melamine wedges. Band wires are used at the ends, outside the armature core to prevent flaring of the coil ends due to centrifugal force and to provide locations for balancing weights.

After assembly, the armatures are dipped in varnish and baked. This process is repeated several times to assure complete sealing of all windings. A high grade baking varnish is used and baking temperatures are very accurately controlled.

COMMUTATOR

The commutator bars are of hard drawn silver bearing copper with liberal wearing depth and ample area to carry the maximum output of the generator. The bar insulation is made of the best grade amber mica. The bars and mica are assembled as a complete unit under pressure and accurately machined for the tapered V rings and insulators. The assembly is then made on a bronze hub and the entire unit is tightened and seasoned under carefully controlled temperatures, pressures and speeds while the commutator is hot.

SHAFT

The shaft is made from high-grade alloy steel accurately ground to size. Generous fillets are used at all shoulders. The shaft extensions are provided with the standard taper and key seat for application of pulley or clutch which is keyed to the shaft and locked with a castellated nut and cotter.

BEARINGS

Bearings of the highest quality and generous size are used. Ball bearings are used throughout on generators. A roller bearing is used at the drive end and a ball bearing at the commutator end of genemotors. Bearings are mounted on accurately ground seats on the shafts.

LUBRICATION

Grease is used as a lubricant in all generators and genemotors. Ample space is provided around the bearing for liberal grease capacity. Grease seals prevent grease loss and the entrance of dirt into the generator or bearings. It should not be necessary to add grease between shopping periods.

Although there are many grades of grease which will give satisfactory operating performance, we have standardized on Safety No. 900255 for generators up to 5kw capacity and on Safety No. 900254 for larger capacity generators.

All generator and genemotor bearings are packed with Safety grease before leaving the plant. New grease need not be applied before placing the machine in use.

As a service to our customers, we have grease Safety No. 900255 and No. 900254 available in 5 and 10 pound containers. The purchase of grease in this manner assures the use of the correct lubricant. When stocked in convenient 5 and 10 pound containers there is little possibility of the grease becoming contaminated with foreign matter.

If for reasons of standardization, the customer wishes to use lubricant other than Safety grease, it can be tested by our Engineering Department and proper lubricating instructions will be recommended.

BALANCE

All rotating parts such as armatures, rotors, pulleys and fans are dynamically balanced individually before application to the shaft. This assures full interchangeability.

POLARITY CHANGERS

On generators without interpoles, the direction of generator current is kept unidirectional by automatically rotating the brushes by means of a rocking polarity changer through an angle of 90 degrees whenever the direction of armature rotation is changed.

On generators or genemotors with interpoles, switch type polarity changers are used to obtain correct polarity, depending on the rotation of the armature. Refer to Table A, page 3, for generator polarity changer figure numbers, and to Table B, page 11, for genemotor polarity changer figure numbers.

GENERATOR INSTALLATION

Generators should be protected from all drips. It is advisable not to locate them at the kitchen end of a dining car for this reason.

MOTORING THE GENERATOR

As a routine check in the yards for defective bearings and to be assured of satisfactory operation, the generator can be operated as a motor. This operation is a "must" after any electrical connections have been disturbed. This operation is commonly referred to by the maintenance groups as "motoring".

Motoring a generator is a simple operation and is easily accomplished. If the drive is by belt or belts the generator must be pulled forward to relieve the belt tension and to remove the belt or belts from the generator pulley. Where generator is used with positive drive or V-belt and gear drive with only a safety clutch, the propeller shaft or the V-belts must be removed. The armature and pulley should turn freely by hand without drag from the belts. With drives using the automatic clutch with generators and genemotors, the automatic clutch disconnects the drive when the car is at a standstill or the genemotor is not operating on stand-by power. The armature can then be turned freely by hand. The polarity changer should then be set in its correct position for either direction of operation.

The generator is now ready to be motored. Go to the locker where the regulator and reverse current relay are located. Grasp the lever arm under the voltage coil firmly with one hand and hold down to compress the carbons tightly. The reverse current relay is then closed manually with the other hand. The first rush of current upon closing the relay will cause a heavy rush current to the generator. It will exert a strong pull upward on the lever arms. When the reverse current relay has been closed it remains closed and hand may be removed. Care must be taken or the fingers of the hand holding the regulator arm will be pinched.

As the generator picks up speed, the pull of the current will die down and the lever may be moved up gradually. This will reduce the pressure on the field carbons and thus introduce resistance into the field circuit which will speed up the generator, now operating as a motor.

Do not raise the lever arms sufficiently to break open the generator regulator pile, thus opening the field circuit. This will cause the motor to operate at a dangerously high speed. Do not operate the generator as a motor at speeds higher than in normal operation, as this will tend to damage the armature. With the generator turning over at a reasonable speed, pull the lever arms down and then release. The reverse current relay should open, automatically close and then open again. This is a sure test that the generator will operate on the road.

The polarity changer may then be set to operate the generator as a motor in the opposite direction and the same procedure followed as above. It is best to perform these operations with the inspection covers in place for then assurance is given that no flexible polarity changer leads are pinched under the cover and that the polarity changer will throw over when the armature is rotated as in normal operation.

Since a genemotor can be checked readily by operating the machine by its AC motor, it is not necessary to motor a genemotor.

GENERATORS

General Information

Table A contains general generator information.

* Denotes generators up to 10kw capacity, having the rocking type brush rigging polarity changer.

• Denotes generators 15kw capacity and upward, having interpoles and switch type polarity changers.

TABLE A

Generator Type	Fig. No.	Volts	Amps.	Minimum Commutator Diameter	Wiring Diagram Fig. No.	Polarity Changer Fig. No.
*AA1500	11	15	67	4⅜"	1	—
*B15425	11	40	37.5	5⅜"	2	—
*B3750	11	40	75	5⅜"	2	—
*C2400	11	40	50	5⅜"	2	—
*C3450	11	40	75	5⅜"	2	—
*C4550	11	40	100	5⅜"	2	—
*D5675	11	40	125	5⅜"	3	—
*DA5475	11	40	125	5⅜"	3	—
*GB75450	11	40	187.5	7⅝"	4	—
*GB10550	11	40	250	7⅝"	4	—
*GH75700	11	40	187.5	7⅝"	4	—
*GH10750	11	40	250	7⅝"	4	—
•GF15750	17	150	100	7⅝"	8	18
•GG15750	17	40	375	7¾"	5	19
•GJ15800	17	40	375	7¾"	5	19
•GJ20910	17	40	500	7¾"	6	19
•GJ25825	17	40	625	7¾"	5	19
•GK10750	17	80	125	7⅝"	7	18
•GK20910	17	80	250	7⅝"	7	18
•GL20910	17	40	500	7¾"	6	19

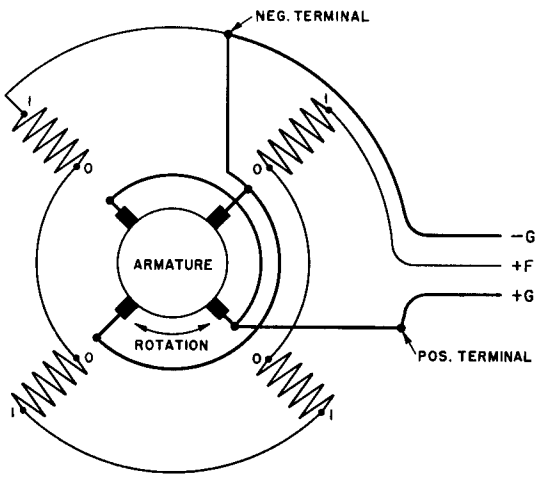


Fig. 1 Wiring Diagram, commutator end of type AA generators

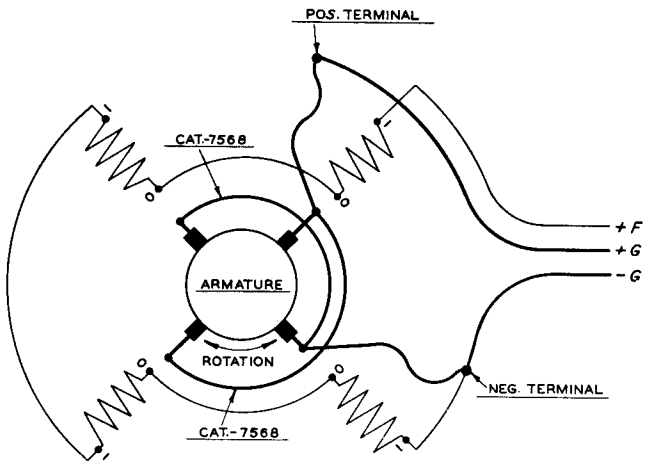


Fig. 2 Wiring Diagram, commutator end of type B and C generators

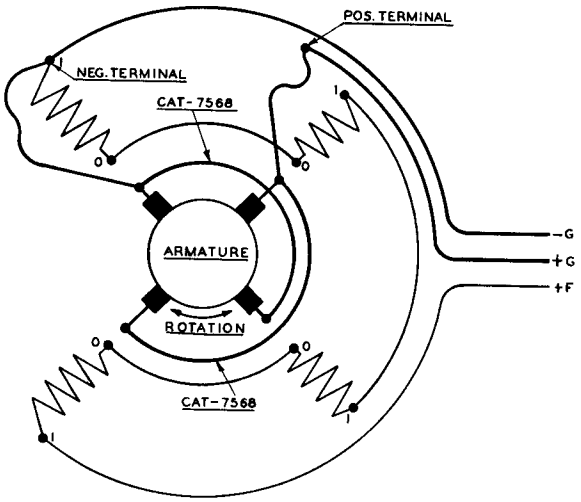


Fig. 3 Wiring Diagram, commutator end of type D and DA generators

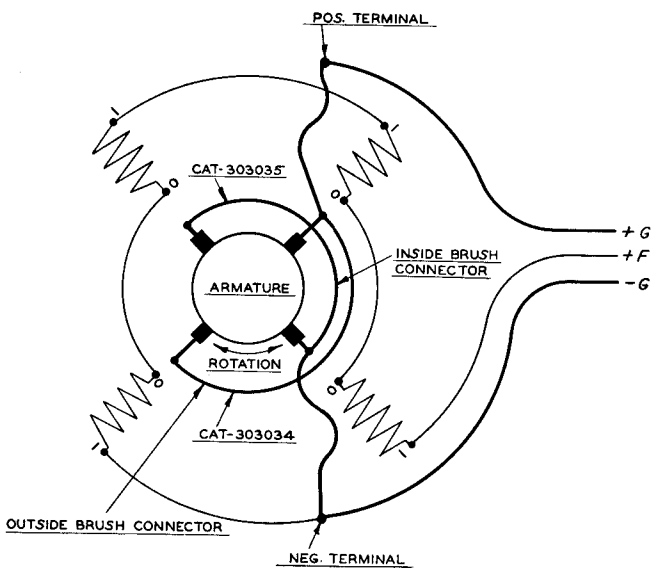


Fig. 4 Wiring Diagram, commutator end of type GB and GH generators

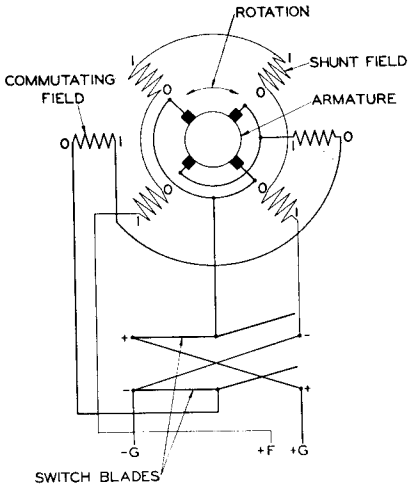


Fig. 5 Wiring diagram for GG, GJ generators and GN genemotors

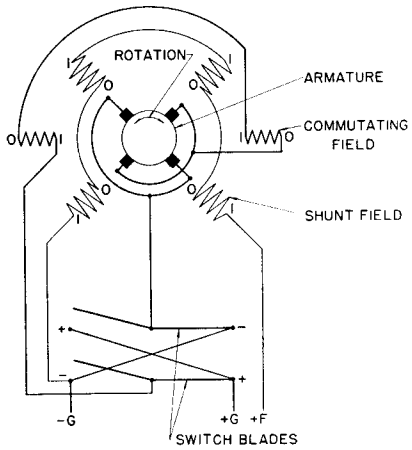


Fig. 6 Wiring diagram for GJ, GL generators and GK, GL genemotors

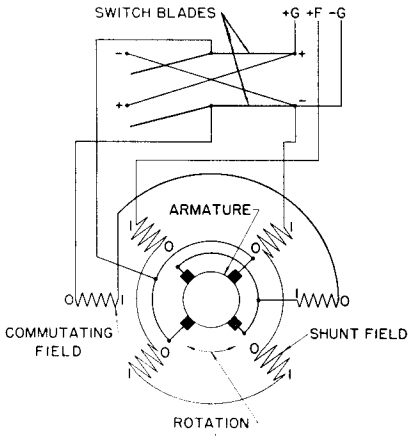


Fig. 7 Wiring diagram for GK generators and GK, GP, HC genemotors

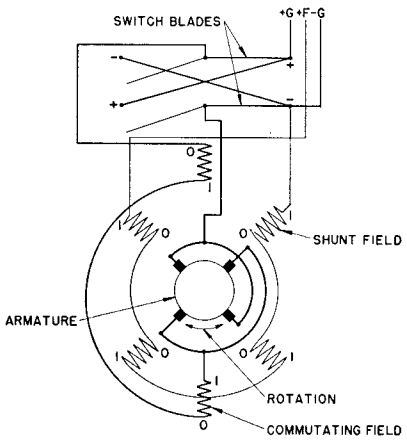


Fig. 8 Wiring diagram for GF generators

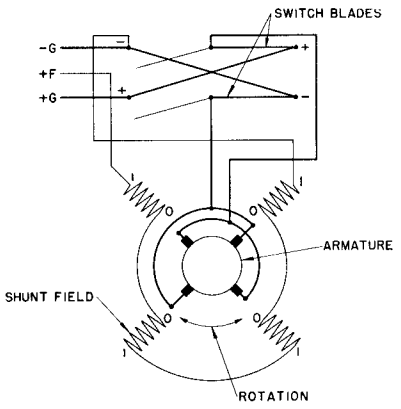


Fig. 9 Wiring diagram for C genemotors

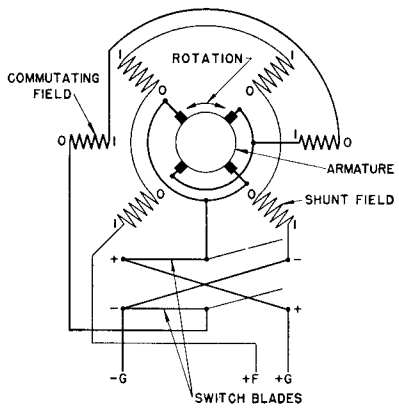


Fig. 10 Wiring diagram for HB genemotors

GENERATORS WITH ROCKING TYPE POLARITY CHANGERS

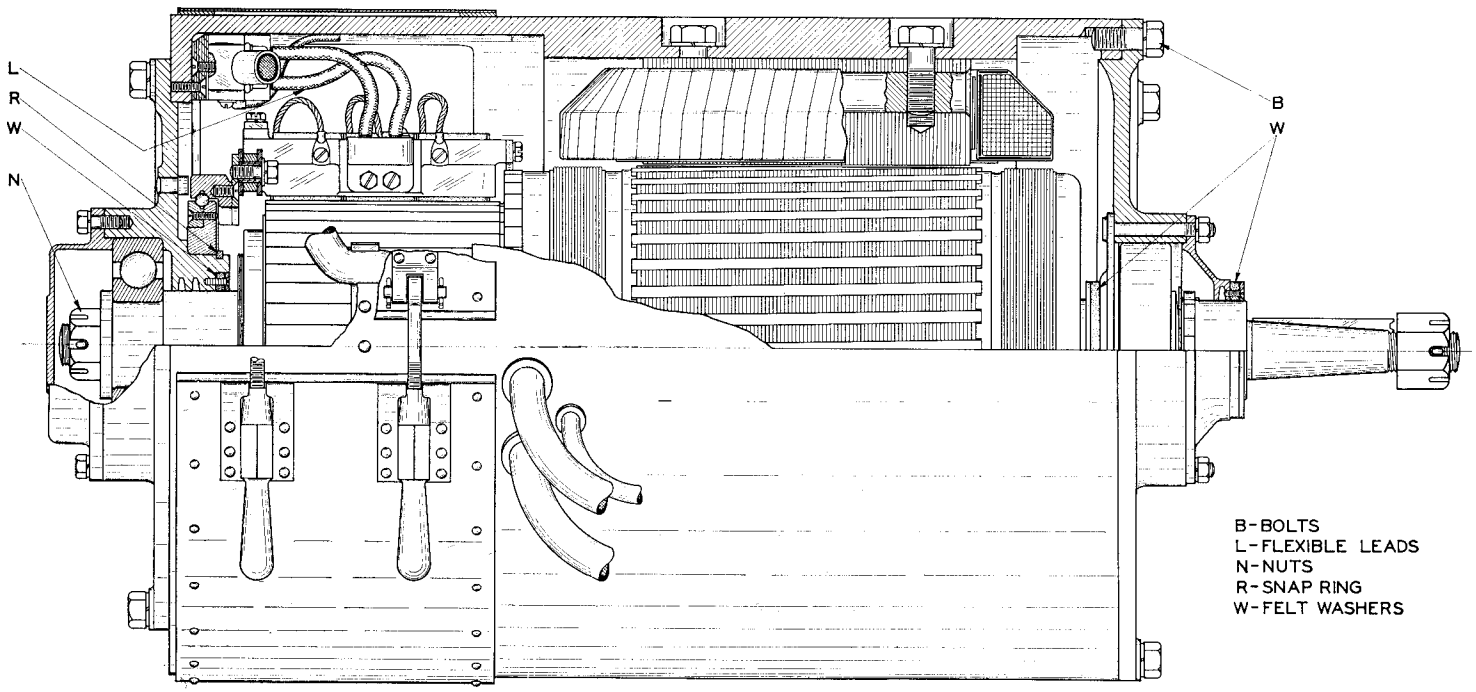


Fig. 11 Generator with rocking type polarity changer, capacity 10kw or less

The construction of the polarity changer raceway in this type of generator is a precision job. The inner raceway forging made of high grade steel (A51-50 Bethlehem Steel Specs.) is machined, hardened and then ground to close tolerances.

The outer raceway consists of 2 ring forgings of high grade alloy steel (A51-50 Bethlehem Steel Specs.). These forgings are machined, with suitable tappings to hold the two parts together, hardened and then ground as a unit to close tolerances. The outer raceway is then separated and approximately sixty 3/8" precision made steel balls are inserted. The outer raceway is clamped together by means of screws and riveted in place on the back side to make a single unit.

The complete bearing unit is held on a pilot of the commutator end head by means of a snap ring in a tapered groove which assures positive locking of the inner raceway to the head.

CARE AND INSPECTION

A thorough cleaning and inspection of the machine should be made once a year or every 100,000 miles, whichever comes first.

Proceed as follows:

Remove the hand hole cover, grease cap at commutator end and bearing retaining nut N, Fig. 11, at end of shaft.

Take off belt, as described under "Belt Application" page 30 and allow the spring to draw the generator back to the vertical position.

Disconnect flexible leads L, Fig. 11, from the brush rigging and after lifting the brushes, take off the commutator end head with its bearing and polarity changer. Two of the bolts removed from the head can be applied in the tapped draw-off holes. This will force the head out of the generator frame. The rocking polarity changer may then be taken off the head by springing out the snap ring R, Fig. 11.

An inspection should be made of the rocking polarity changer to insure freedom of action. The brush box flexible leads L, Fig. 11 and brushes should also be checked for condition at this time.

When blowing out a generator, a clean cloth should be packed around the rocking polarity changer to prevent foreign particles from entering the ball race. After the machine is thoroughly cleaned, the ball race can then be blown out with dry air, as it is rocked back and forth. If the raceway is dirty and sticky, it should be washed in kerosene or "Varsol" and blown out with dry air.

After the ball race is thoroughly cleaned, a few drops of oil should be placed in the raceway. To spread the oil in a thin coat, rock the raceway back and forth. The coat of oil will prevent the formation of rust.

If the raceway becomes rough or pitted due to constant vibrations encountered in service, and does not reverse polarity readily, the unit can, in many cases, be returned to the Safety Car Heating and Lighting Company for regrinding.

To determine whether the raceways should be sent back for regrinding, look for the stampings listed below. Raceways without markings may be sent back since the absence of markings denote that they have never been reground.

a. If the ball race complete Cat. No. 21865 is stamped 7585△ in raised letters, it should not be sent

back to New Haven for regrinding. These are case hardened parts and grinding for a larger sized ball takes all the hard metal off the surface of the ball raceways.

b. Raceways stamped "R" denote first regrinding. using 13/32" balls. These raceways can be reground once more.

c. Raceways stamped "RG" denote second regrinding using 7/16" balls. These raceways should not be sent back to New Haven, as they cannot be reground again.

Fig. 12 Pilot Shaft No. 59557

Take off the pulley locknut and the pulley. Remove bolts B, Fig. 11. The armature with the pulley end head and bearing complete can then be taken out from the pulley end, using bolts in draw-off holes. To facilitate removal of the armature, it is suggested that the pilot shaft, No. 59557, Fig. 12, be used. This shaft is screwed on the thread at the commutator end of the armature shaft. The use of the pilot shaft will make the removal of the armature easier and will prevent damage to the commutator as the armature is removed.

To remove pulley end head from armature, take off the grease cap by removing the nuts on the six holding bolts of the grease cap, after which head can be easily pulled off. The inside grease cap and ball bearing now remain on the shaft.

The ball bearing on the pulley end is pressed on the shaft and should not be taken off. If, for any reason, this bearing must be replaced it can be most easily done by removing the bearing retaining nut and using bearing puller No. 312755, Fig. 13 as follows:

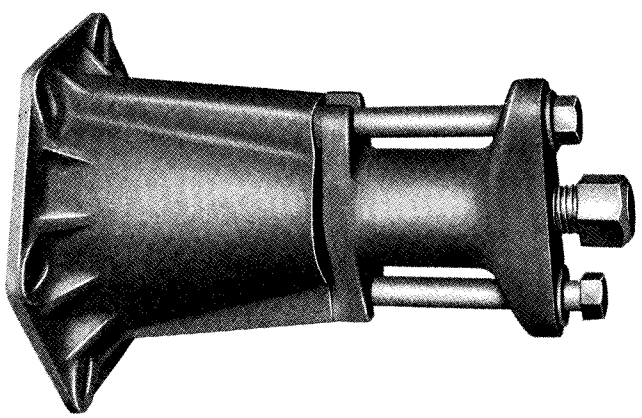


Fig. 13 Combination Pulley, Bearing and Head Puller No. 312755

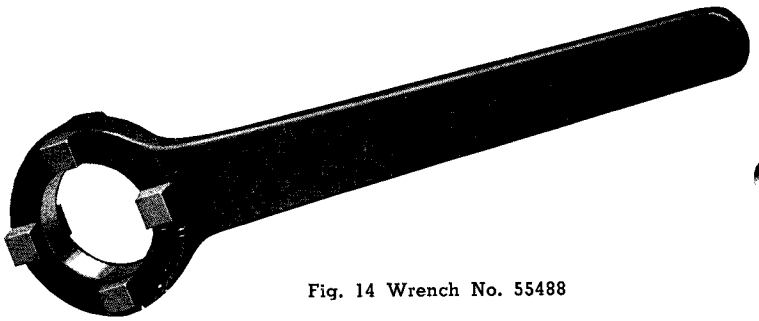


Fig. 14 Wrench No. 55488

Slip bearing puller over the end of the shaft with the flanged end assuming the same position as the grease cap previously removed. Apply the nuts to the inside grease cap studs. The bearing is now ready for removal by turning the hexagonal headed screw at the end of the bearing puller.

Care should be used to prevent dirt from entering the bearings. It is advisable to keep them covered.

To remove or apply the bearing locknut, N, Fig. 11 (if locknut is Nos. 26167, 304914 or 304975) use wrench No. 55488, Fig. 14. For generators using bearing locknut No. 63492 an SKF wrench for N-14 nut is used. For generators using bearing locknut No. 310598, wrench No. 314995, Fig. 15 is used.

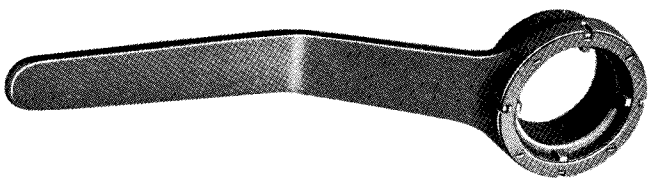


Fig. 15 Wrench No. 314995

The interior of the machine should be thoroughly cleaned and the field coils examined to see that they are in good condition. The pole bolts should be tight.

Carefully inspect and clean heads, bearings, brush riggings and armature, thoroughly washing heads and ball bearings with kerosene. DO NOT USE GASOLINE FOR WASHING BALL BEARINGS. After washing, bearings should be drained, greased and wrapped in a clean cloth until the machine is ready for their application.

The felt washers W, Fig. 11 on the pulley end head, commutator end head and grease cap should be examined and replaced if damaged or worn.

The brushes should be removed from the boxes and the brush rigging wiped off with kerosene.

To reassemble the machine, apply the pulley end head bearing to the armature. This is accomplished by using jack press No. 55886, Fig. 16 or equivalent. Grease the bearing and half fill the grease cap with the proper grease.

The bearings may be reapplied by pressure on the inner race. Be sure the inside and outside of the tube used to apply pressure is clean. Heating the bearing in hot, clean lubricating oil will make application easier.

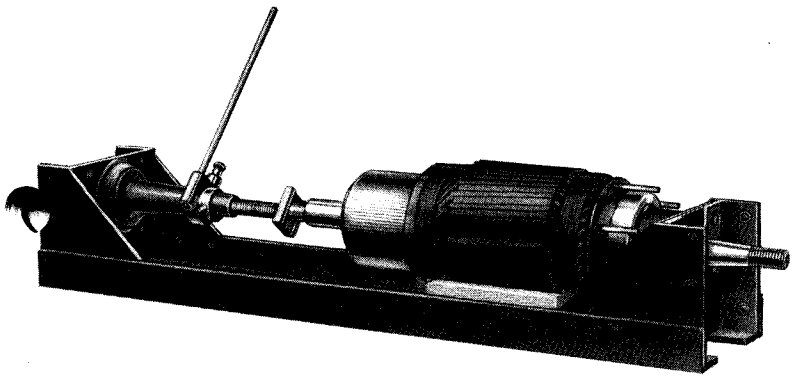


Fig. 16 Jack Press No. 55886

The commutator end head is then applied to the frame. The pilot shaft, No. 59557, Fig. 12 is applied to the commutator end of the armature. Slip the armature, pilot shaft first, through the drive or pulley end of generator. The pilot shaft acts as a guide through the commutator end head and helps prevent damage to the commutator. The pulley end head should then be secured to the frame by applying bolts B, Fig. 11.

Grease the commutator end ball bearing and apply to the commutator end head, locking with nut N, Fig. 11.

It is important that the correct grade of grease be used for ball bearings. The grease must be absolutely neutral with regard to acid or alkaline reaction, and should be of such consistency that it will not separate into oil and soap when subjected to the temperature of the generator and the churning action of the bearing. For further lubrication information see page 2.

Apply the pulley to the armature shaft. Reapply belt in accordance with instructions under the heading "Belt Application" page 30. The locknut N on the commutator end should then be tightened.

The brushes and flexible leads L are next applied, after which it is advisable to check the throw-over action of the polarity changer and motor the generator in both directions (see page 2). Apply hand hole cover.

COMMUTATOR CARE

After the commutator has been in service for a short time it should have a dark burnished appearance. In this condition a commutator will not cut if kept reasonably clean. If the commutator is rough, a fine grade of sandpaper may be used for buffing, but in no case should emery cloth be used. The commutator should be kept free from oil.

If brushes work freely in the holders and the commutator is kept clean, it is not necessary to use sandpaper. The brushes should be renewed when they are worn to one inch in length.

When new brushes have been placed in the holder, a piece of sandpaper should be wrapped around the commutator, between the brushes and the commutator, with the sand side next to the brush. The armature should then be rotated until the brushes fit.

Before turning the commutator, undercut the mica between bars when necessary. Then proceed as follows:

Set up armature in lathe, with steady rest on bearing seats. Turn the commutator using a T04 carbide tool and light cut. For finishing cut, use a .003 feed at 400 to 500 RPM. Remove burrs from undercutting, bevel bar edges and polish with No. 7 Garnet paper. The commutator should not be turned to a diameter less than that shown in Table A, page 3.

BRUSH HOLDER SPRINGS

The brush holder springs are set at the factory for the proper pressure, which is stamped on the side of the spring holder in pounds. All the springs are set for a pressure of two pounds on all generators up to 5kw capacity. Three pounds pressure is used on generators of 7.5kw and 10kw capacity. If, for any reason, springs fail to give these pressures, apply a complete new spring and holder.

GENERATORS WITH SWITCH TYPE POLARITY CHANGERS

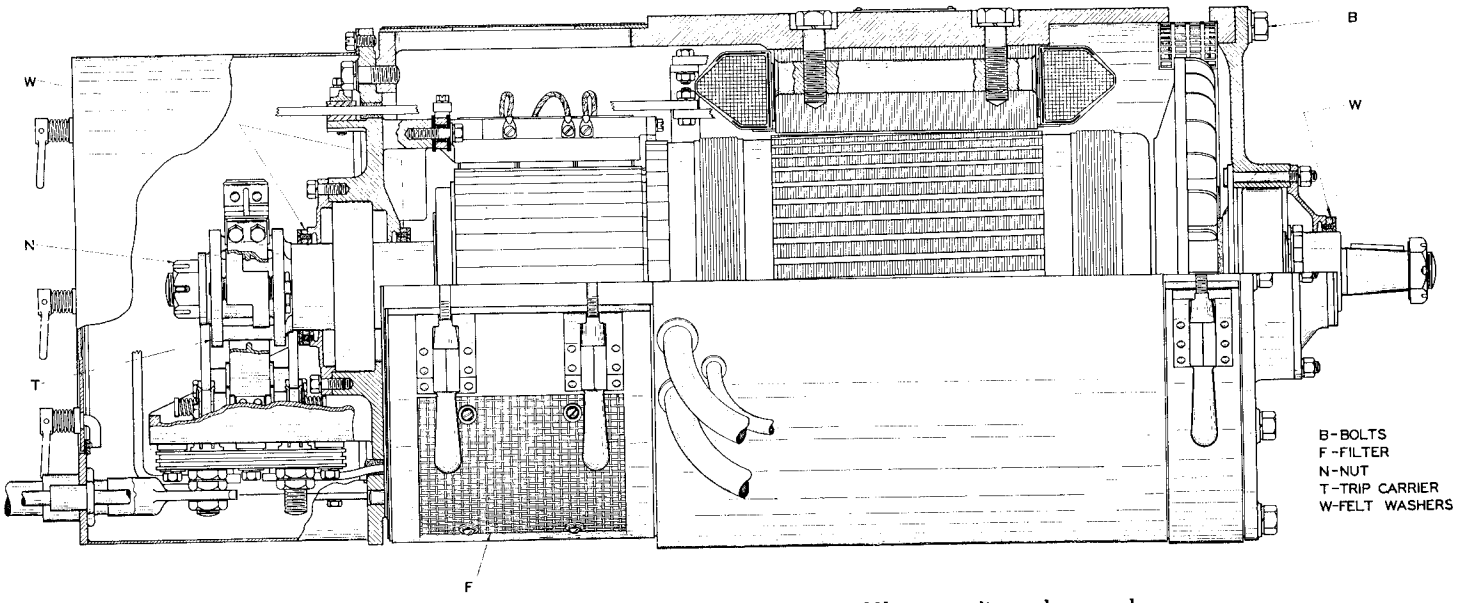


Fig. 17 Generator with switch type polarity changer, 10kw capacity and upward

Generators of 10kw capacity and upward, Fig. 17 are equipped with interpoles and switch type polarity changers, shown in Fig. 18 and 19. (Note: 10kw generators 80 and 150 volts are equipped with interpoles. The 10kw, 40 volt generators are not.)

For polarity changer switch used with the various types of generators refer to Table A, page 3.

CARE AND INSPECTION

The care and the inspection of these larger capacity generators is essentially the same as for the smaller generators (see pages 5 to 7). In addition to the monthly procedure followed on the smaller generators it is necessary to:

Thoroughly clean switch and remove all dirt from the generator and all air passages.

Wipe switch blades thoroughly with a clean cloth and apply a thin coating of grease or vaseline to the switch blades.

Check nuts fastening the busses or leads to the switch to be sure they are tight.

Inspect the throw-over mechanism of the switch to assure its satisfactory operation.

Inspect the trip carrier to be certain that the trips are free on pins P, Fig. 18 and 19.

A thorough inspection of the machine should be made once a year or every 100,000 miles, whichever comes first. At this time the following work should be done:

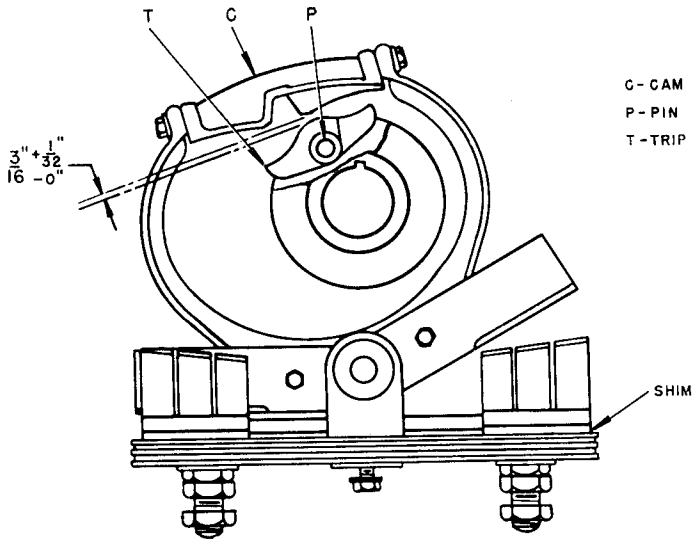


Fig. 18 Polarity Changer Switch

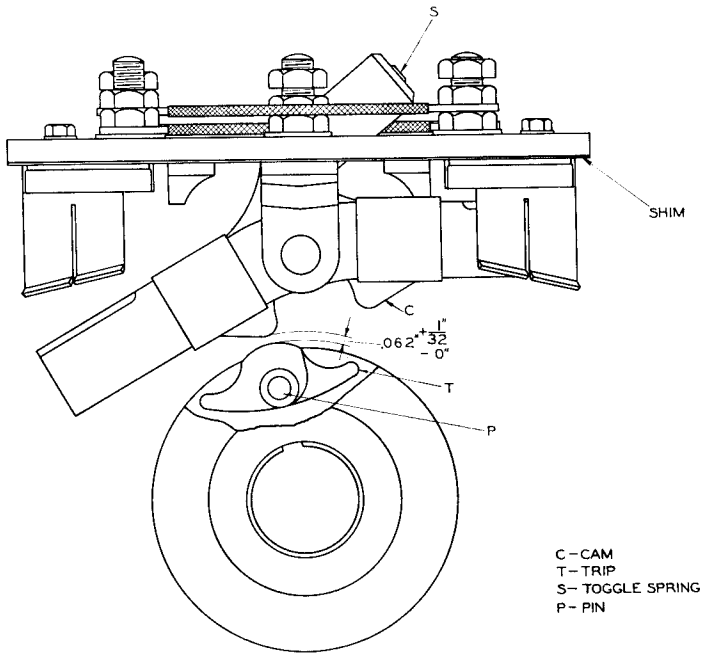


Fig. 19 Polarity Changer Switch

GENERATORS WITH SWITCH TYPE POLARITY CHANGERS

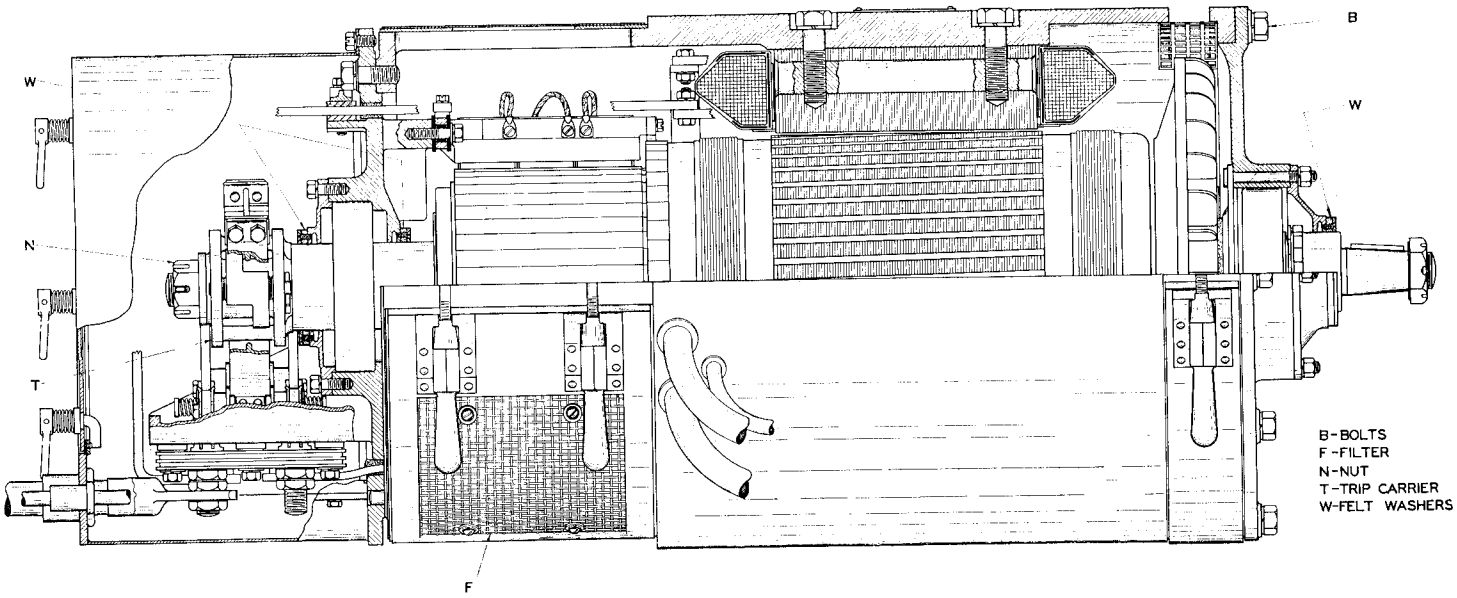


Fig. 17 Generator with switch type polarity changer, 10kw capacity and upward

Generators of 10kw capacity and upward, Fig. 17 are equipped with interpoles and switch type polarity changers, shown in Fig. 18 and 19. (Note: 10kw generators 80 and 150 volts are equipped with interpoles. The 10kw, 40 volt generators are not.)

For polarity changer switch used with the various types of generators refer to Table A, page 3.

CARE AND INSPECTION

The care and the inspection of these larger capacity generators is essentially the same as for the smaller generators (see pages 5 to 7). In addition to the monthly procedure followed on the smaller generators it is necessary to:

Thoroughly clean switch and remove all dirt from the generator and all air passages.

Wipe switch blades thoroughly with a clean cloth and apply a thin coating of grease or vaseline to the switch blades.

Check nuts fastening the busses or leads to the switch to be sure they are tight.

Inspect the throw-over mechanism of the switch to assure its satisfactory operation.

Inspect the trip carrier to be certain that the trips are free on pins P, Fig. 18 and 19.

A thorough inspection of the machine should be made once a year or every 100,000 miles, whichever comes first. At this time the following work should be done:

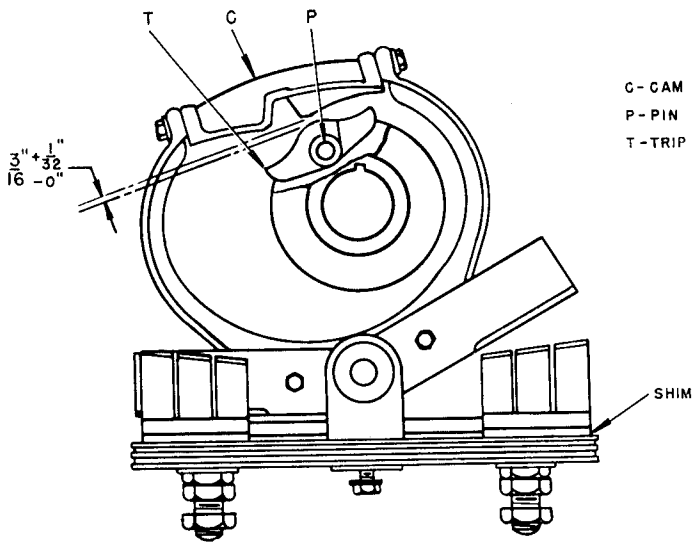


Fig. 18 Polarity Changer Switch

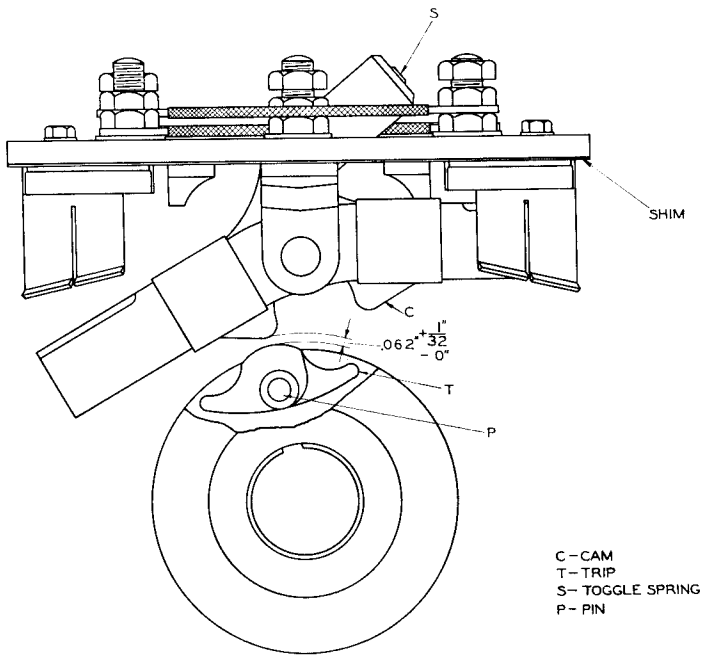


Fig. 19 Polarity Changer Switch

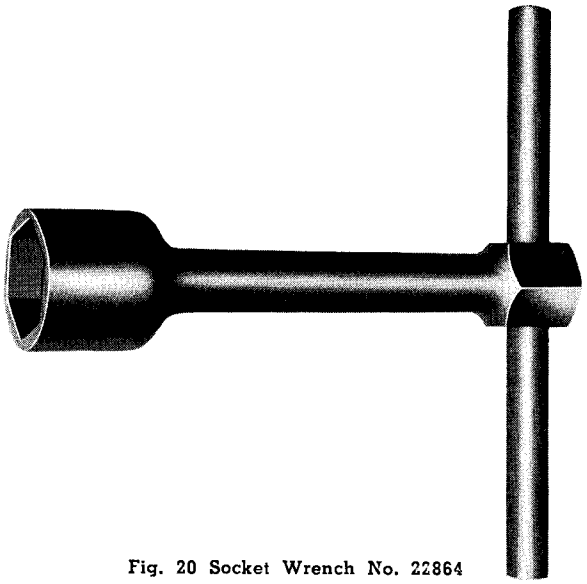


Fig. 20 Socket Wrench No. 22864

Remove the polarity changer and commutator opening covers. Remove nut N, Fig. 17 holding the trip carrier T, Fig. 17, using socket wrench No. 22864, Fig. 20. Remove the belts or disconnect the propeller shaft and remove flange from shaft. If the generator is fitted with a safety or automatic clutch, this part should be removed, by use of puller No. 312757, Fig. 21 or Spicer No. 55223X.

The armature is removed as follows:

Lift the brushes. The bolts, B, Fig. 17, in the head on the drive end are then removed. Two of these bolts should be applied to the threaded holes in the head and used to draw the drive end head with armature out of magnet frame. Pilot shaft No. 59557, Fig. 12, should be used and is screwed on the threads at the commutator end of the armature shaft. The use of the pilot shaft will facilitate the removal of the armature and prevent damage to the commutator, as the armature is being removed. The armature complete with the drive end head and bearing is removed through the drive end of the generator.

The outside grease cap and the drive end head may be taken off by removing the nuts on the six holding bolts, leaving the inside grease cap and the ball bearing on the shaft.

The bearing on the drive end is pressed on the shaft and normally should not be taken off. If, for any reason, this bearing must be removed, use Bearing Puller No. 312755, Fig. 13, after bearing locknut has been taken off.

To remove or apply the bearing locknut use wrench No. 55488, Fig. 14 if locknut is No. 26167, 304914 or 304975. For generators using bearing locknut No. 63492 an SKF wrench for N-14 nut is used. For generators using bearing locknut No. 310598 wrench No. 314995, Fig. 15 is used.

Care should be taken to prevent dirt from entering the bearings. Bearings should be covered at all times when out of a machine. Thoroughly clean interior of the machine and examine field coils to see that they are in good condition. The pole bolts should be tight.

Remove commutator end head and bearing, polarity changer and brush rigging and carefully clean and inspect. The heads and ball bearings should be thoroughly washed with kerosene. DO NOT USE GASOLINE FOR WASHING BALL BEARINGS. The bearings should then be drained, greased and wrapped in a clean cloth until the machine is ready for their application.

Remove brushes from the holders and wipe brush rigging with kerosene.

Examine felt washers W, Fig. 17 on the drive end grease cap, drive end head, commutator end grease cap and commutator end head and replace if worn or damaged.

When the generator fan is damaged or worn, it is necessary to remove it from the armature shaft. This is accomplished as follows: Remove the four bolts holding fan to shaft collar. Apply heat to aluminum fan. This will cause the fan to expand and it then will be easy to remove.

To reassemble the machine apply the drive end head to the armature. Grease the bearing and half fill the grease cap with the proper grease.

Grease and apply commutator end bearing to the commutator end head, and apply outside grease cap to prevent dirt from entering the bearing.

It is important that the correct grade of grease be used for ball bearings. The grease must be absolutely neutral with regard to acid or alkaline reaction, and should be of such consistency that it will not separate into oil and soap when subjected to the temperature of the generator and the churning action of the bearing. For further lubricant information see "Lubrication", page 2.

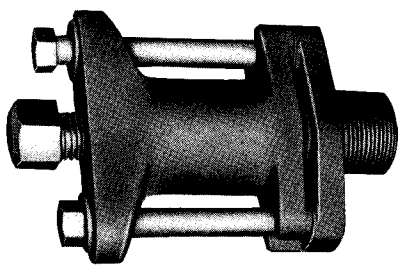


Fig. 21 Clutch puller No. 312757

The drive end bearing may be reapplied by pressure on the inner race. This is most readily accomplished by using a steel tube of sufficient internal diameter to slip over the shaft.

The pilot shaft No. 59557, Fig. 12 is then applied to the commutator end of the armature. Slip the armature, pilot shaft first, through the drive end of the generator. The pilot shaft acts as a guide through the commutator end bearing and helps prevent damage to the commutator. Tighten drive end bolts B, Fig. 17.

Apply the trip carrier T and trip carrier nut N, Fig. 17. The final tightening of nut N should take place after the drive shaft is applied to prevent the armature from turning as the nut is tightened.

On generators with automatic clutches it will be necessary to hold the shaft when performing this operation.

Replace the brushes in the brush boxes.

Check the operation of the trip and switch by slowly rotating the armature first in one direction, then in the other. The switch should trip positively. If it does not, check the clearance between the trip T and the cam C on the polarity changer switch, Figs. 18 and 19. The surfaces of the trip and cam should engage sufficiently to cause the trip to be carried past center, at which point the toggle springs will throw it positively into the switch clips. If this action is not obtained it will be necessary to remove or add sufficient shims under the switch base to obtain the correct action.

Check to be sure the counterweight part of trip T, Fig. 18 and 19, which levels out as the machine speed increases, does not hit cam C, Fig. 18 and 19, as the armature is rotated. The position of the trip is then as in Fig. 18 and 19 and the clearance between it and the cam surface is as indicated in these polarity changer switch diagrams.

Be certain that the armature is disconnected from the drive, then motor the generator in both directions (see page 2 for instructions).

Apply the polarity changer, making sure all connections are tightly made. Apply the hand hole covers, clutch and propeller shaft.

COMMUTATOR CARE

The care of a commutator for generators with switch type polarity changers is the same as for generators with rocking type polarity changers as covered on page 7. However, we are repeating these instructions for your convenience:

After the commutator has been in service for a short time, it should have a dark burnished appearance. In this condition a commutator will not cut if kept reasonably clean. If the commutator is rough, a fine grade sandpaper may be employed for buffing, but in no case should emery cloth be used. The commutator should be kept free from grease or oil.

If the brushes work freely in the holders and the commutator is kept clean, there will be no necessity for the use of sandpaper. The brushes should be renewed when they are worn to one inch in length.

When new brushes have been placed in the holders, a piece of sandpaper should be wrapped around the commutator between the brushes and the commutator, with the sand side next to the brush. The armature should then be rotated until the brushes fit the commutator. Before turning the commutator, undercut the mica between bars when necessary. Then proceed as follows:

Set up armature in lathe, with steady rest on bearing seats. Turn the commutator using T04 carbide tool and light cut. For finishing cut, use a .003 feed at 400 to 500 RPM. Remove burrs from undercutting. Bevel bar edges. Polish with No. 7 Garnet paper. The commutator should not be turned to a diameter less than that shown in Table A, page 3.

BRUSH HOLDER SPRINGS

The brush holder springs are set at the factory for the proper pressure. The correct pressure of the spring on a new brush is stamped on the side of the spring holder in pounds. If for any reason, springs fail to give this pressure, a new spring complete with its holder should be applied.

The brush boxes and brushes should be cleaned monthly.

GENERAL INFORMATION

Table B contains general genemotor information. General instructions covering the adjustment, operation and care of generators apply also to genemotors having similar type designation and the same type of polarity changer switch. Instructions applying to genemotor care only appear on the following pages.

TABLE B

Generator Type	Fig. No.	Volts	Amps.	Minimum Commutator Diameter	Wiring Diagram Fig. No.	Polarity Changer Fig. No.
C5700	22	40	125	5⅜"	9	18
GK10750	22	80	125	7⅝"	7	18
GK10750	22	140	71.5	7⅝"	7	18
GK20910	22	80	250	7⅝"	7	18
GK20910	22	140	143	7⅝"	6	18
GL10750	22	40	250	7¾"	6	19
GL20910	22	40	500	7¾"	6	19
GN25825	22	40	625	8⅛"	5	19
GP25825	22	80	312.5	7⅝"	7	18
GP25825	22	140	178.5	7⅝"	7	18
HB30725	22	40	750	9⅜"	10	19
HB30725	22	80	375	9⅜"	10	19
HC30725	22	140	214	9⅜"	7	18

CARE AND INSPECTION

The genemotor armature removal procedure differs from a generator armature removal. In standard genemotor equipment the drive end bearing is constructed with the roller retainer integral with the outer race. For all such standard genemotors the armature is removed as follows:

The reference numbers mentioned in the following paragraphs refer to Fig. 22.

Remove covers from polarity changer and hand hole. Remove nut holding the trip carrier, using socket wrench No. 22864, Fig. 20, and then remove trip carrier. Remove grease cap at commutator end. Lift brushes for clearance. Pilot shaft No. 318429 which is similar to the one shown in Fig. 12 is then screwed on the threads at the commutator end of the armature shaft. The use of the pilot shaft makes the armature removal easier and prevents damage to the commutator as the armature is being removed.

Remove eight bolts, 2. Draw stator and motor frame over end of the shaft, thus removing frame, head, outer raceway and roller bearing assembly.

The motor stator is locked in position by the set screws, 3. When necessary to remove the stator from motor frame remove these set screws, 3, and pull the leads through the outlet bushings. The stator may then be pressed out of the frame. When sliding stator out of frame be careful not to damage the stator windings. Apply pressure to area, 4, Fig. 22 outside the windings. This prevents distortion of the stator.

The armature is now ready for removal. Suspend armature until it is in a "floating" position and then draw out of genemotor frame.

There are many machines in service equipped with the drive end roller bearing built with the roller retainer integral with the inner race and for these machines the process for armature removal is as follows:

Remove grease cap and then bearing locknut, 5, using Spanner wrench No. 314995, Fig. 15. Remove draw-off bolts, 1, Fig. 22. By applying draw-off bolts to threaded holes in head or by using bearing puller 312755, Fig. 13, pressure is applied and the drive end bearing may be removed.

Remove eight bolts, 2. Draw stator and motor frame over end of the shaft.

The motor stator is locked in position by the set screws, 3. When necessary to remove the stator from motor frame remove these set screws, 3, and pull the leads through the outlet bushings. The stator may then be pressed out of the frame. When sliding stator out of frame be careful not to damage the stator windings. Apply pressure to area 4, Fig. 22 outside the windings. This prevents distortion of the stator.

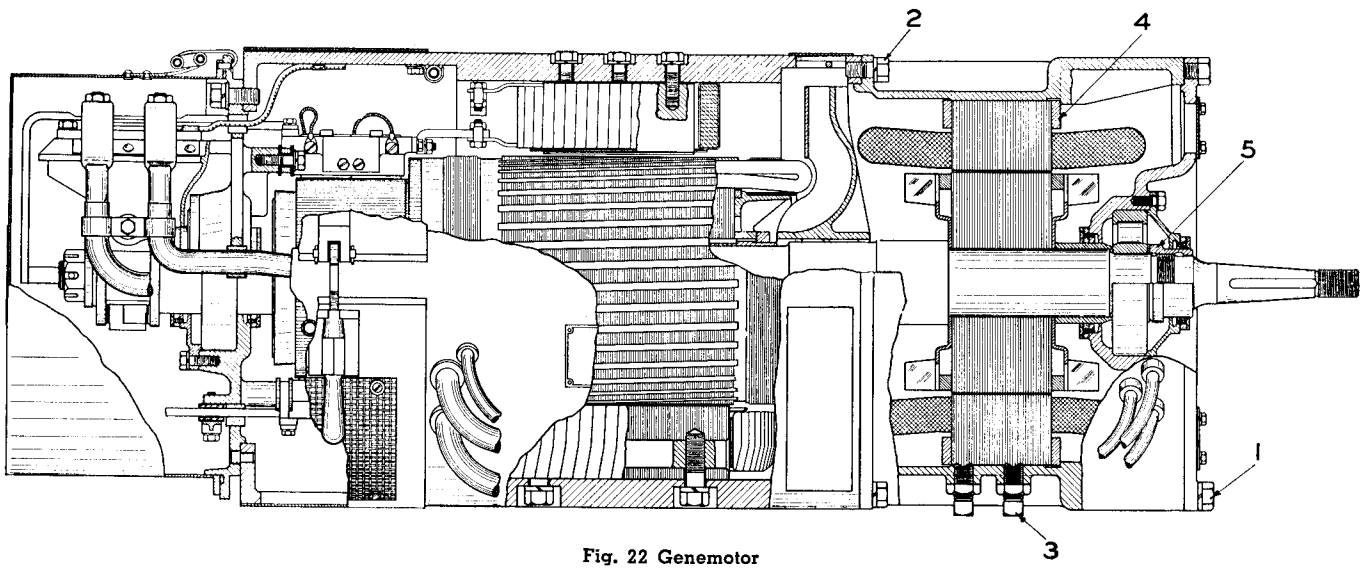


Fig. 22 Genemotor

Remove the polarity changer cover and hand hole cover. Remove nut holding the trip carrier using socket wrench No. 22864, Fig. 20 and then remove trip carrier. Remove grease cap at commutator end. Lift brushes for clearance. Pilot shaft No. 318429 which is similar to the one shown in Fig. 12, is then screwed on the threads at the commutator end of the armature shaft. The use of the pilot shaft makes the armature removal easier and prevents damage to the commutator as the armature is being removed. Suspend armature until it is in a "floating" position and draw out of genemotor frame.

Remove the drive-end head with outer race and roller cage of the bearing. Drive outer bearing race out of head by using Bearing Remover No. 317648, Fig. 23 as follows:

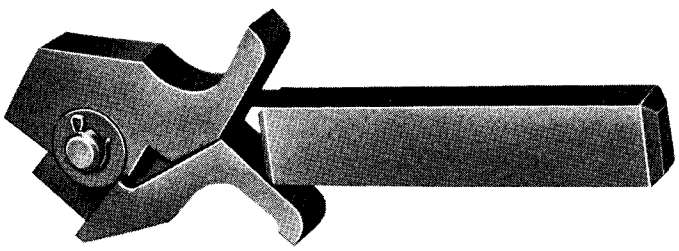


Fig. 23A Bearing Remover, Cat. No. 317648 wings folded for passing through the bearing

Apply the bearing remover as shown in Fig. 23A, the two wings down on the retaining loop of the handle, folded together so that they can be passed through the bearing within the head and beyond the bearing raceway. The wings can then be pulled back through the bearing and spread as shown in Fig. 23B,

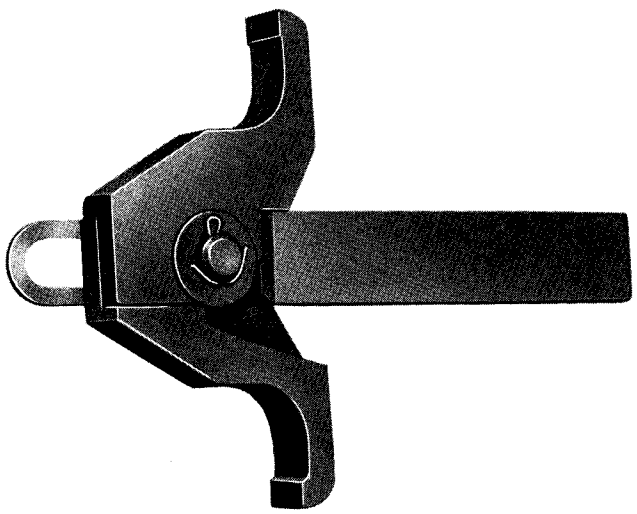


Fig. 23B Bearing Remover, Cat. No. 317648 wings spread for removing the bearing

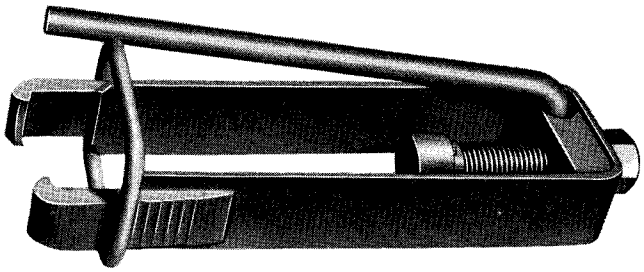


Fig. 24 Bearing Puller No. 317226

so that the tips can engage the outer raceway between the clearance space in the head and the inside face of the bearing raceway. With the wings in this position, the handle with the retaining loop is slipped down into the recess portion developed by spreading the wings. This operation locks the handle in place. Strike the end of the handle with a hammer in a direction to remove the outer race of the bearing from the head.

When the bearing seems exceptionally tight, some heat may be applied to the head. Before this heat has had a chance to travel into the bearing, the expansion should relieve the fit so that no trouble will be encountered.

To remove the inner race of the bearing, use Bearing Puller No. 317226, Fig. 24 as follows:

Fit the bearing puller jaws over the inner raceway of the roller bearing. Drive the clamp ring over notches to secure clamping position. With a suitable wrench, screw in the hexagonal headed bearing puller bolt.

The bearing puller handle is furnished to keep the unit from turning. Do not place a bar between the bearing puller and shaft as this will tend to damage the taper finish and destroy the fit between the shaft and clutch.

Genemotor assembly is made in reverse order. However, it is best to remove the bearing from the motor head before applying the head. When applying the drive end bearing, be careful not to scratch the rollers.

COMMUTATOR CARE

Genemotor commutator care is similar to generator commutator care. Refer to page 10 for further information. For minimum commutator diameter refer to Table B, page 11.

BRUSH HOLDER SPRINGS

Generator brush holder spring information is equally applicable to genemotors. Please refer to page 10.

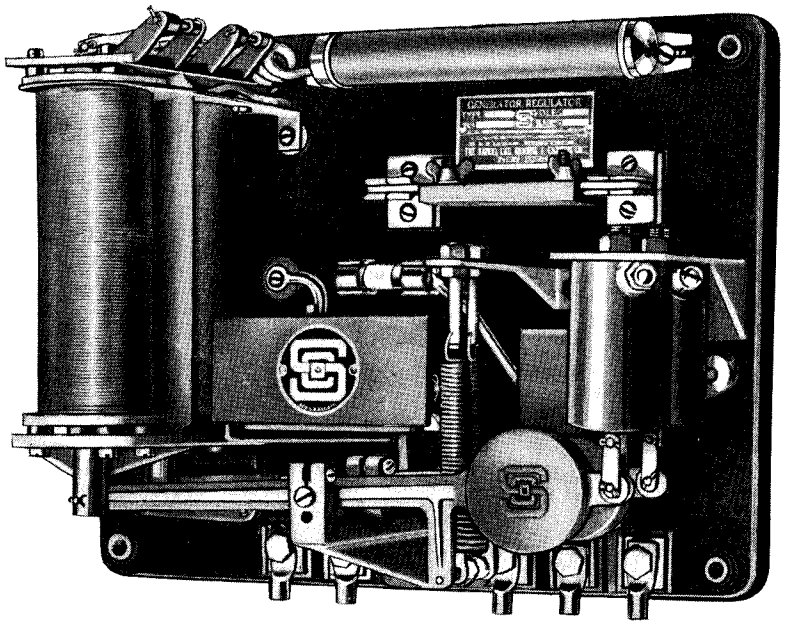


Fig. 25 Safety Generator Regulator

GENERAL INFORMATION

Safety regulators are assembled on panels formed from heavy sheet steel. The edges of the panel are turned down to give rigidity and to provide space for the necessary back connections.

The four holes for mounting are provided with insulated bushings for insulating the panel from the mounting supports.

All terminals for connections or for mounting parts which must be insulated from the panel are set in molded plastic bushings except those which are subjected to the heat of the carbons. These are insulated with mica.

The terminals for external connections to the regulator are designed for front connected installations.

All connections and parts subject to adjustment and repair are accessible from the front of the panel and can be removed without disturbing insulation or back connections.

All parts of the regulator are mechanically balanced, the regulation being accomplished by springs. This gives constant and close regulation unaffected by jars or vibrations. The dashpots used are of the inverted air type with graphite plungers. The action of these dashpots is constant regardless of temperature change and they do not become clogged with the dust of service.

A resistance having a zero temperature coefficient is in series with all voltage coils to compensate for changes in voltage due to the heating of the coils.

OPERATION OF SAFETY TYPE S-75-EA, S-150-EA, S-225-EA, SM-75-EA, SM-150-EA AND SM-225-EA GENERATOR REGULATORS

The operating mechanism of all generator regulators is identical. The difference in type designation is due to the difference in the wattage and current capacity of the regulators. For example, the generator regulator as shown in Fig. 25 is a type S-75-EA. The letter "S" denotes current capacity up to and including 125 amperes. The letters "SM" denote current capacity exceeding 125 amperes. The numerals "75, 150, and 225" denote the wattage capacity and that the regulators have one, two or three 75 watt carbon piles respectively. The letter "E" denotes voltage regulation and the letter "A" current regulation, thus an "EA" regulator is one having both voltage and current regulation.

The voltage is regulated by controlling the field current by the resistance of the generator regulator carbon pile, which is connected in series with the generator field. The resistance of the carbon pile is governed by the pressure exerted on it by levers, which are operated by the plungers of current and voltage magnets. The windings of the series coil carry the current output of the generator. If the current output tends to rise above that which the regulator is set to maintain, the plunger of the series coil, through its lever changes the pressure of the carbon pile, thereby reducing the field strength and holding the generator maximum current to its proper value. If the voltage tends to rise above that which the regulator is set to maintain, the plunger of the voltage coil

through its lever reduces the pressure on the carbon pile and holds the voltage to its proper value, thereby insuring reliable battery protection and adequate load supply.

The series coil is set to hold the current at the rated output of the generator.

The wiring diagram of the generator regulator is shown in Fig. 26.

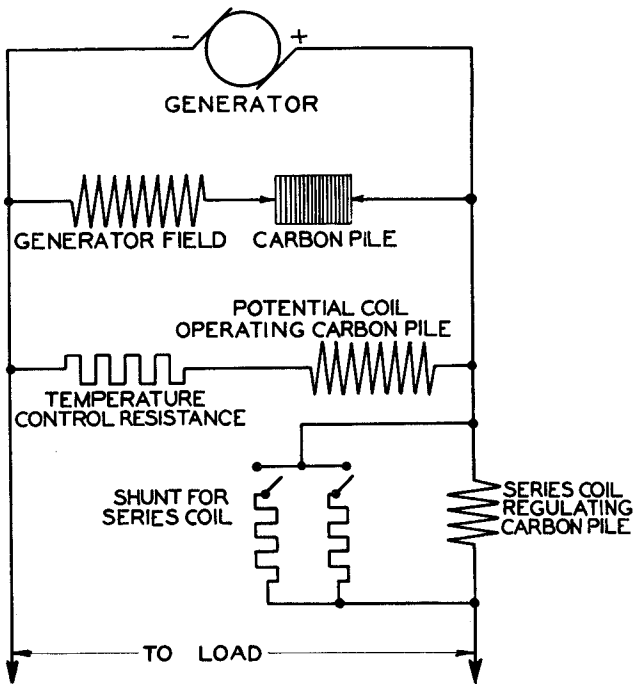


Fig. 26 Wiring diagram of generator regulator voltage and current control

As the output of the generator is held to rated capacity by the series coil, the generator cannot be overloaded either by the connected load or by charging an exhausted battery. At the same time the full output of the generator is available for the battery or the connected load whenever it is needed.

Each generator regulator is made so that it can be used for several values of generator current output without the necessity of changing any of the regulating coils.

This is accomplished by the use of a shunt on the back of the regulator having a terminal at the side or bottom of the current coil. The current coil itself is of proper size to regulate the lowest amount of current to which the regulator is to be set. Shunts are provided which can be thrown in parallel with this regulating coil, increasing the generator output to the point desired.

Regulators are made in five sizes, one of which normally operates without a shunt at 25 amperes, the second at 75 amperes, the third at 187.5 amperes, the fourth at 375 amperes, the fifth at 500 amperes. The 25 ampere regulator may be set at either 37.5 or 50 amperes. The 75 ampere regulator may be set at 100 or 125 amperes. The 187.5 ampere regulator may be set at 250 amperes. The 375 ampere regulator may be set at 500 amperes, and the 500 ampere regulator may be set at 625 or 750 amperes.

OPERATION OF SAFETY TYPE SM-75-EAB, SM-150-EAB, SM-225-EAB REGULATORS USED WITH GENEMOTORS

The operation and construction of the generator regulator used with genemotors is similar to other generator regulators of the same type except that a bias coil is included as indicated by the suffix "B" added to the type designation. The bias coil consists of a potential winding inside the current coil. When the genemotor is being operated by the motor the bias coil is connected across the battery through an interlock on the AC starter panel. When this coil circuit is closed it influences the current coil arm, exerting a stronger pull on the current coil plunger.

The bias coil is used on the generator regulator. With this regulator it is possible to obtain full generator output when the genemotor is being driven from the car axle. Then when operating from AC standby the generator output is limited to the capacity of the AC motor or AC line. This is accomplished as follows:

When the AC power plug is inserted the AC starting contactor closes and at the same time the normally open interlock to which the bias coil is connected is also closed, thereby putting this coil directly across the battery. This exerts a certain amount of pull on the current coil plunger even when the current in the current coil is zero. To this pull is added the pull of the current winding when the generator builds up. The result is that the regulator becomes operative at a lower current value than when the bias coil is not in the circuit.

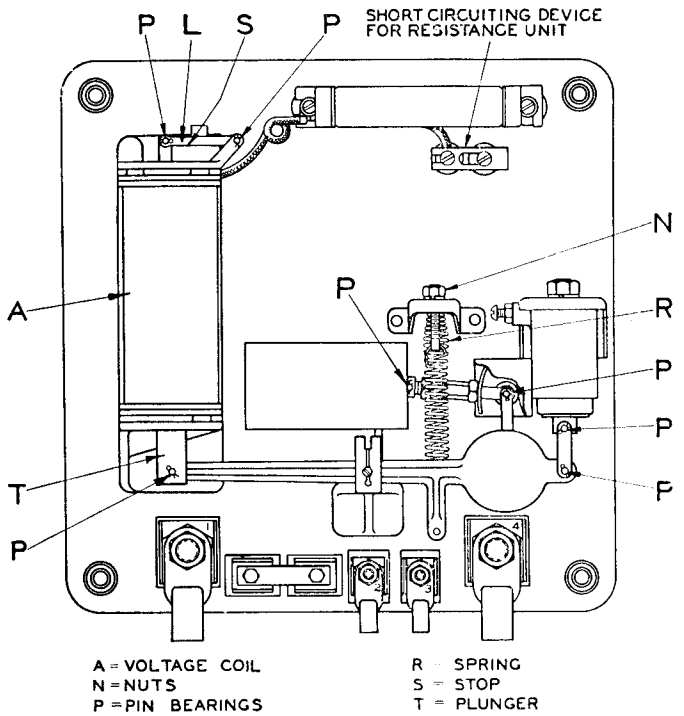


Fig. 27 Generator Regulator Panel

CARE AND ADJUSTMENT

Thoroughly clean regulator pin bearings P, Fig. 27. Reamers No. 61965 (long) and No. 61966 (short) with holder No. 61964 provide the best means for cleaning the holes. The pins can be readily cleaned with fine sandpaper or emery paper.

If the generator regulator is out of adjustment, clean the carbon pile before resetting. To accomplish this, release the pressure on the carbons by lifting plunger T, Fig. 27, and blow out with a blast of air, or move the carbons up and down on the supporting rods by hand.

The voltage coil is set at the factory to maintain the voltage listed in the following table:

VOLTAGE COIL SETTING TABLE

Generator Nominal Volt Rating	Voltage Coil Setting Lead Battery	Voltage Coil Setting Nickel Iron Battery
40	38	45
80	76	90
140	132	159

The setting for nickel iron batteries is made with the short circuiting link on the resistance in series with the voltage coil open. This device is on the upper right hand corner of the regulator panel, Fig. 27, and is marked in accordance with the voltage settings given in the preceding "Voltage Coil Setting Table".

The Safety Dynamotor Set provides the best means of checking the setting of the voltage coil A, Fig. 27.

Dynamotor Set No. 301585, Fig. 28, is used to set 40 volt equipment. Dynamotor Set No. 301585 with auxiliary panel No. 301562, Fig. 29, is used for setting 80 volt equipment. Dynamotor Set No. 301585 with auxiliary panel No. 314224, Fig. 29, is used for setting 140 volt equipment. The instructions for using the dynamotor set are as follows:

Generator Regulator Setting—40 volt equipment:

Open the battery and the main light switches on the switchboard.

Remove the positive generator lead from the regulator panel.

Remove the field carbons.

Turn the double pole, double throw switch of the set to the No. 2 position, Fig. 28.

Insert the plug in the "regulator" receptacle of the set. Connect the red covered flexible lead from this receptacle to the positive generator terminal on the regulator panel and the black covered lead to the negative generator terminal on the regulator panel.

Place the handle of the rheostat in the start position.

Insert the plug into the "battery" receptacle of the set. Connect the red covered flexible lead from this receptacle to the live positive side of the battery and black flexible lead to the live negative side of the battery.

Increase the voltage of the set by moving the rheostat handle away from the start position until it reaches the voltage at which the regulator is to hold the generator voltage.

With the voltage of the set held at this value, adjust the spring tension of the spring R, Fig. 27, which is connected to the rear of the voltage coil lever, until the small guide lever L, Fig. 27, which is on top of the voltage coil, stays in its horizontal position after it is placed there by hand. Lowering the voltage

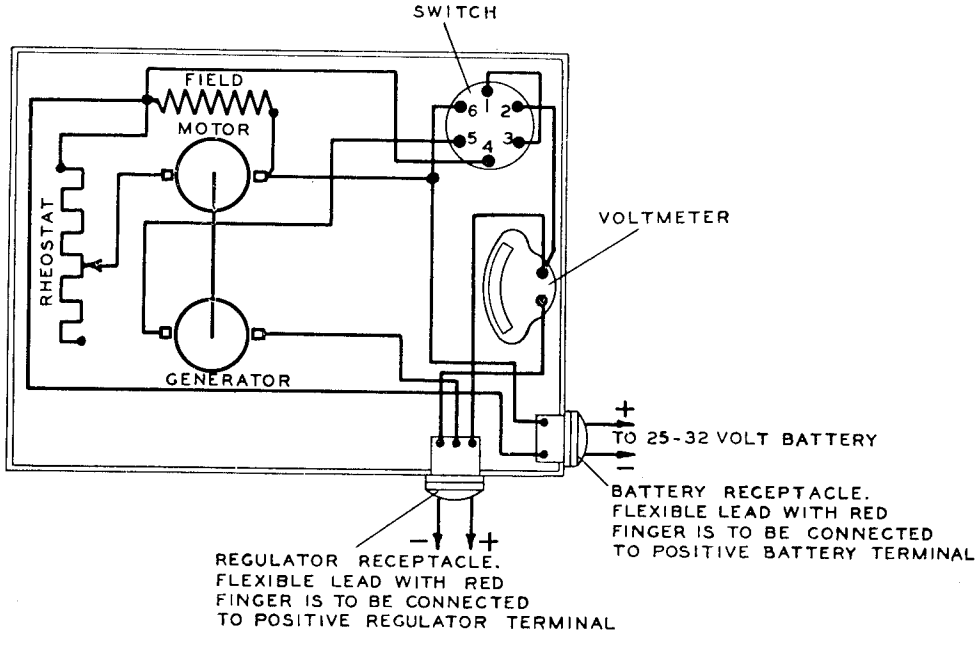


Fig. 28 Wiring diagram of dynamotor set

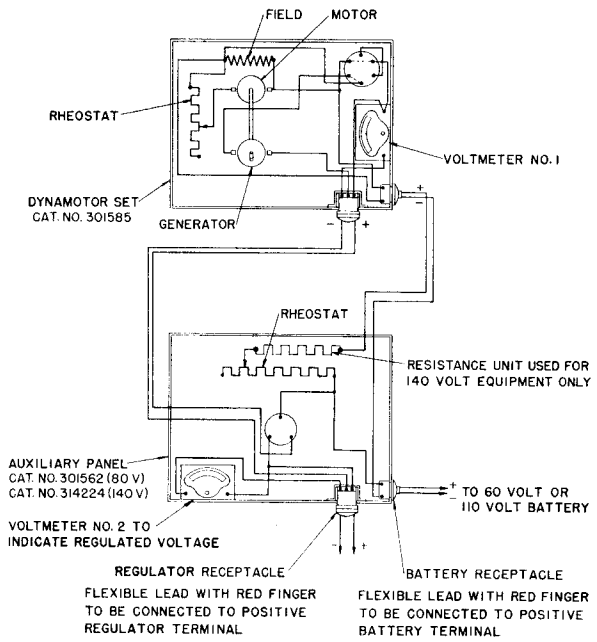


Fig. 29 Wiring diagram of dynamotor set with auxiliary panel

one volt should cause this lever to lower from its horizontal position, and increasing the voltage one volt should cause this lever to rise from this position. If more than one volt variation is required to move this lever, there is undue friction which should be located and eliminated.

To remove the set, move the rheostat handle to the start position, disconnect the positive and the negative "battery" leads from the battery, and disconnect the positive and the negative "regulator" leads from the regulator. Then replace the positive generator lead, the field carbons, and close all of the battery switches which may have been opened.

Generator Regulator Setting—80 volt equipment:

In order to set the voltage coil on regulators used with 80 volt equipment it is necessary to use the auxiliary panel Cat. No. 301562, see Fig. 29 for connections, follow the instructions below:

Turn the double pole, double throw switch in the dynamotor set to No. 2 position.

Open the battery and the main light switches on the switchboard.

Remove the positive generator lead from the regulator panel.

Remove the field carbons.

Insert the plug into the "regulator" receptacle of the auxiliary panel. Connect the red covered flexible lead from this receptacle to the positive generator terminal on the generator regulator, and the black covered flexible lead to the negative generator terminal on the regulator. Insert the plugs connected to the auxiliary panel into the receptacles of the dynamotor set.

Place the handle of the rheostat on the dynamotor set in the start position (at the voltmeter side of box).

Insert the plug in the "battery" receptacle of the auxiliary panel. Connect the red covered flexible lead from this receptacle to the live position side of the battery switch, and the black covered flexible lead to live negative side of the battery.

Increase the voltage of the set by moving the rheostat handle away from the start position until it reaches the voltage at which the regulator is to hold the generator voltage.

With the voltage of the set held at this value, adjust the spring tension of the spring R, Fig. 27, on the voltage lever until the small guide lever L on the top of the voltage coil stays in its horizontal position after it is placed there by hand. Lowering the voltage two volts should cause this lever to lower from its horizontal position, and increasing the voltage two volts should cause this lever to rise from this position. If more than two volts variation is required to move this lever, there is undue friction, which should be located and eliminated.

To remove the set, move the rheostat handle to the start position, disconnect the positive and the negative "battery" leads from the battery and then disconnect the positive and the negative "regulator" leads from the regulator. Replace the positive generator lead, field carbons and close the battery switch.

If for any reason it is desired to obtain less than 70 volts with a 70 volt battery turn the switch of the dynamotor set and that on the auxiliary panel to position No. 1, Fig. 28.

Generator Regulator Setting—140 volt equipment:

To set the voltage coil on 140 volt equipment follow the same procedure as for the 80 volt equipment. It is necessary, however, to use auxiliary panel No. 314224. See Fig. 29 for connections.

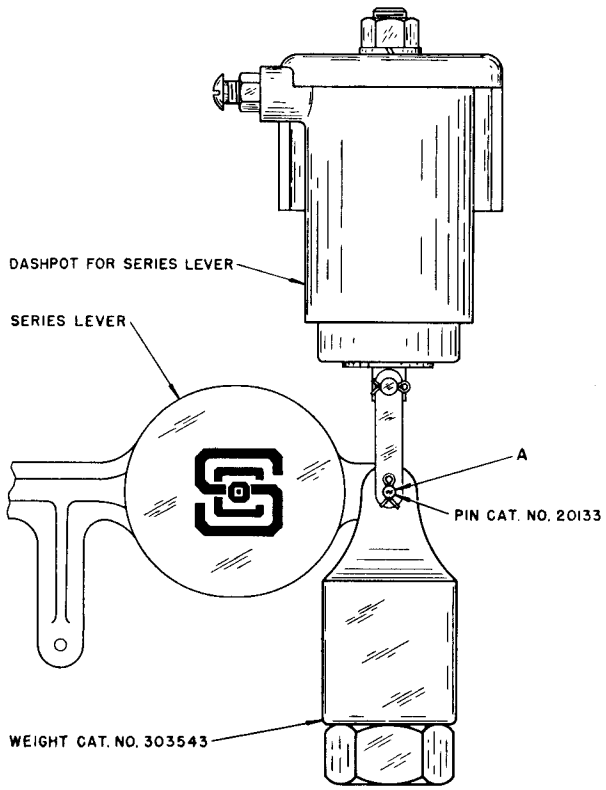


Fig. 30 Weight No. 303543

Generator Regulator Setting—Without Dynamotor Set

If no dynamotor set is available it is possible to check the setting of the voltage coil by riding the car.

This is accomplished as follows:

Make certain that the voltage coil A, Fig. 27, is hot and that current is not passing through the current coil. The latter can be accomplished by placing a sheet of insulating material between the contacts of the reverse current relay. Under these conditions and with the car running at a speed of 35 mph or more, the voltage across the No. 1 and No. 5 terminals on the type S regulator and the No. 2 and No. 4 terminals on the type SM regulator should be as given in the "Voltage Coil Setting Table", page 15, for the voltage of the equipment involved. If the voltage is not correct, it should be adjusted by the spring R, Fig. 27, connected to the rear or voltage coil lever by screwing nuts N, Fig. 27 down to raise the voltage and up to lower the voltage.

The setting of the current coil can be made while the car is in the yards by using weight No. 303543, Fig. 30, proceeding as follows:

To check the current coil setting apply the weight to the dash pot end of the current coil lever, as shown at point A in Fig. 30. Remove pin No. 7202 and substitute pin No. 20133 which is supplied with the weight.

The dash pot vent should then be fully opened and the voltage lever raised to its highest position at the coil end. Next, adjust the current coil spring so that the current coil lever is in balance; the guide lever on top of the current coil, should remain in a horizontal position.

The hexagonal threaded weight should be removed from the bottom of the weight when setting regulators of a capacity of 125 amperes or less.

After the setting has been made, the dash pot vent should be adjusted by means of the adjusting screw.

The most satisfactory adjustment of the dash pot is one which will allow the voltage lever to fall from its uppermost position to its lowest position in from 3 to 5 seconds. This can be checked by raising the lever by hand and allowing it to fall.

Adjustment of Carbon Pile

The adjustment of the carbon pile is covered by the following instructions:

This adjustment of the carbon pile need only be made when regulators are overhauled or when renewing the carbons.

The number of field carbons should be such that when the car is standing or when no voltage is on the regulator and the carbons are tightly compressed by the spring of the voltage coil, the face of the terminal lever 1, Fig. 31, is in a vertical position.

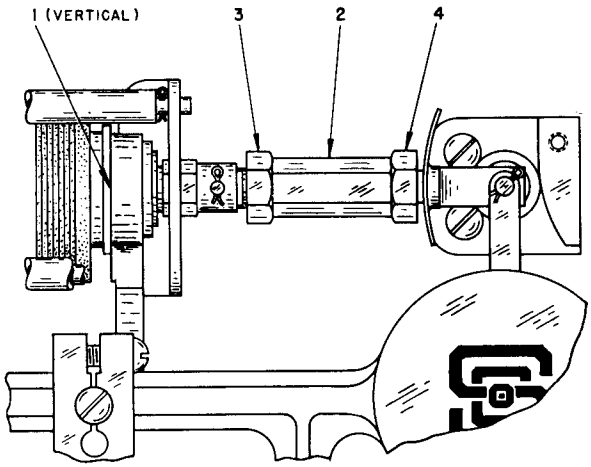


Fig. 31 Diagram for carbon pile adjustment

If the regulator is hot, as would be the case after two hours of operation, the adjusting nut, 2, Fig. 31 should be adjusted so that the cam follower linkage is horizontal. With this adjustment the guide lever on top of the voltage coil should just barely come down to the coil supporting bracket.

Attention is called to the fact that locknut 4, Fig. 31 has a right hand thread and locknut 3, Fig. 31 has a left hand thread.

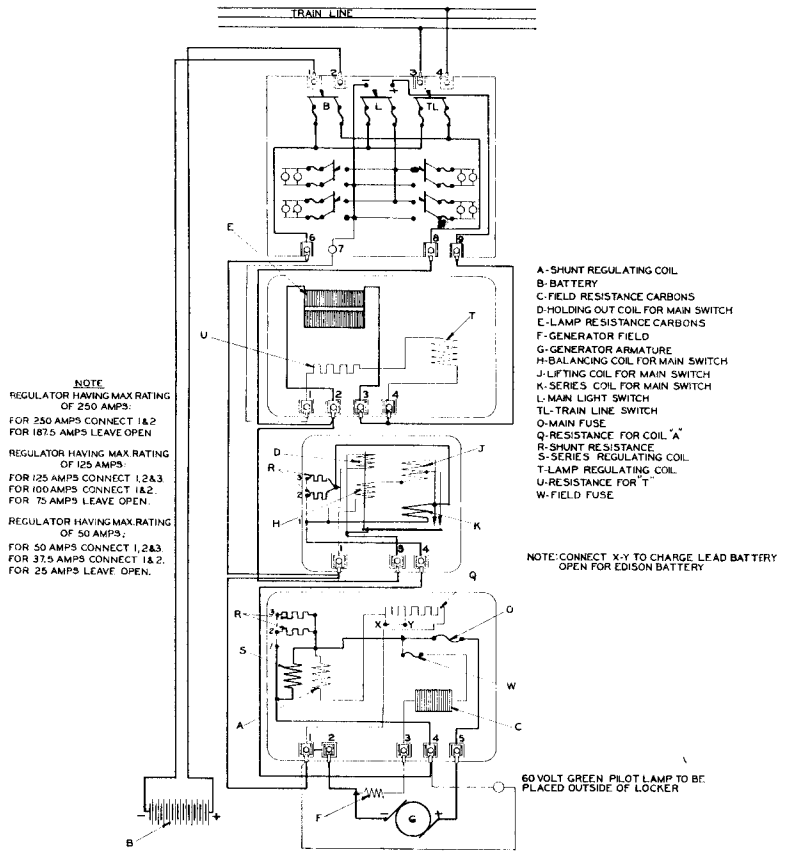


Fig. 32 Wiring diagram of type S panels and type C switchboards

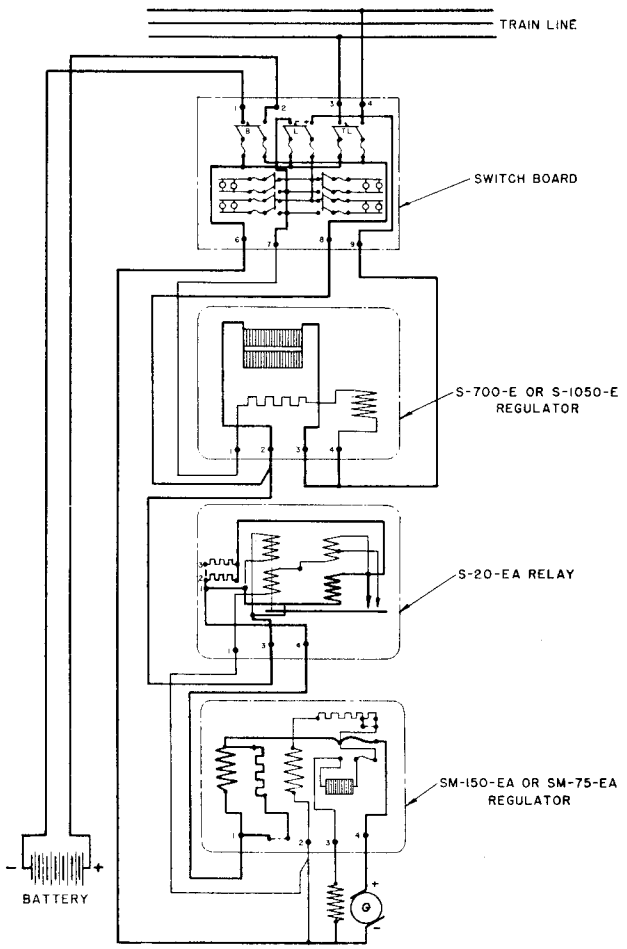


Fig. 33 Wiring diagram of type SM panels and type C switchboards

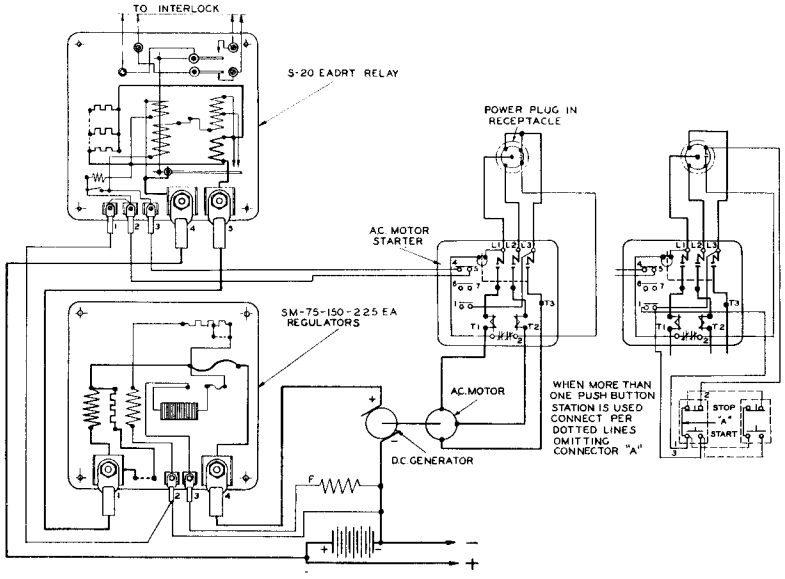


Fig. 34 Wiring diagram of genemotor equipment using SM-75-EA, SM-150-EA, or SM-225-EA regulators and S-20-EADRT relay

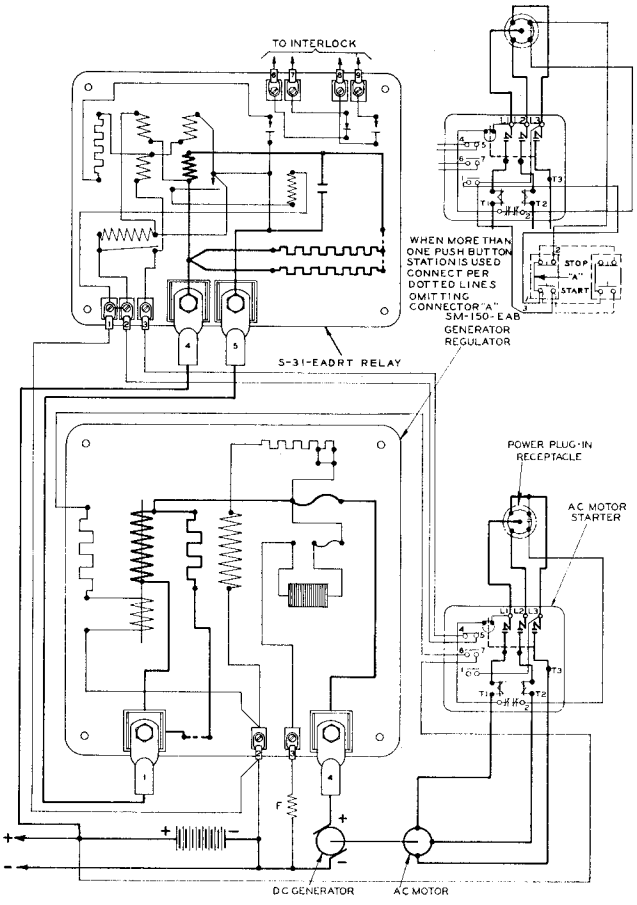


Fig. 35 Wiring diagram of genemotor equipment using SM-150-EAB regulator and S-31-EADRT relay

GENERAL INFORMATION

The Safety type S reverse current relays are made in three panel sizes with maximum current capacities as shown in the following table:

Type	Max. Amperes
S-10	50 and 125
S-20	250 and 375
S-30	500
S-31	750

The S-31 relay supersedes the S-30 and is used for either 500 or 750 ampere equipments. The internal and external connections are the same.

The suffix EA in the type designation indicates the relay has voltage and current coils. DR indicates that interlock auxiliary contacts are provided and a T indicates a time delay relay is included on the panel. The time delay relay is used with genemotor equipment to prevent the reverse current relay from closing until after the AC motor has had time to come up to normal speed.

The reverse current relay is furnished on a steel panel as a separate and complete unit. The recommended connections when the S-10-EA reverse current relay is used are shown in Fig. 32 and the connection for the S-20-EA in Fig. 33. The typical connections recommended for the S-20-EADRT and the S-31-EADRT relays are shown in Fig. 34 and Fig. 35 respectively.

S-10 AND S-20 RELAYS

The S-10 and S-20 reverse current relays are of the closed magnetic circuit type with pivoted armature. They have three voltage coils and one series coil, so arranged that when the generator voltage equals that of the battery the armature is lifted and the circuit closed. The coil D, Fig. 36, is connected across the contacts of the relay so that the voltage impressed across it is the difference between battery voltage and generator voltage, and if the generator is not operating the full battery potential is available. The pull of this coil on its plunger locks the relay in an open position. At this time the current from the battery which energizes this coil also serves to energize the field of the generator so that it will always build up in the proper direction. The coils J and H, Fig. 36, are in series across the generator so that as the generator builds up, coil J tends to close the relay while coil H serves to replace coil D which becomes inoperative as the generator voltage approaches that of the battery. The design of these coils is such that correct balance is obtained at any battery voltage encountered in service. Consequently when the armature is set with the proper gap the relay closes when the generator voltage is slightly above battery voltage. The series coil K serves to lock the relay closed when the generator is charging the battery and also serves to neutralize coil J when the battery attempts to discharge through the generator. The tap from coil J brought out to the auxiliary contact on the relay serves to reduce the strength of the coil J so that a very small

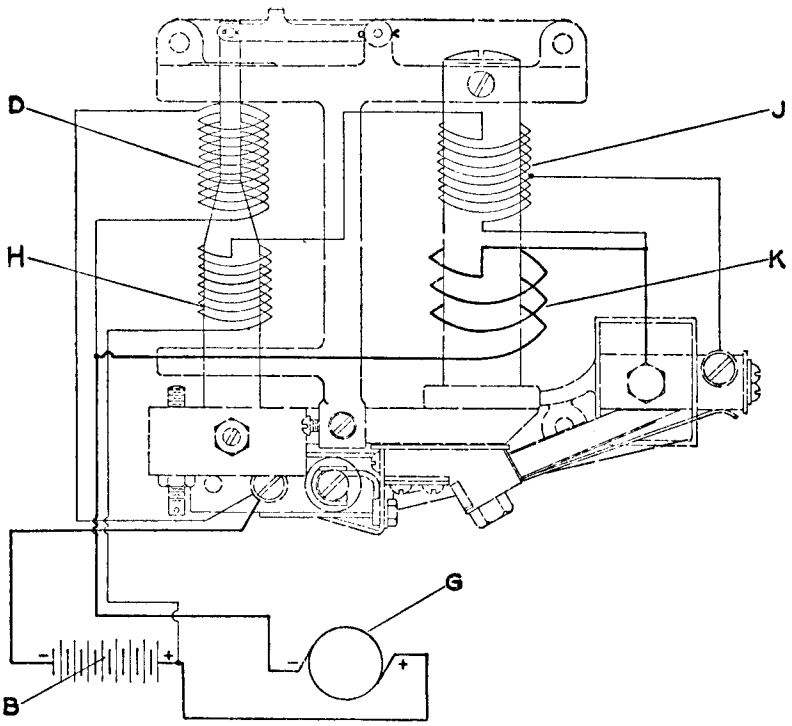


Fig. 36 Diagram for S-10 and S-20 reverse current relay

discharge from the battery will open the switch. Due to the fact that the operation of this relay depends upon the balancing of the voltage coils D, H and J, Fig. 36, the effects of the temperature changes in the coils cancel each other. It is therefore, not necessary to place resistance with zero temperature coefficients in series with the coils to obtain the same operation under various changes in temperature.

The S-10 and S-20 reverse current relays are set at the factory to close ½ volt above the voltage of the battery on 40, 1 volt on 80 and 1¾ on 140 volt equipment, and should not require any adjustment in service.

In case adjustment is required the dynamotor set provides the best means of accomplishing this adjustment.

Adjustment of 40 Volt Relays

Open all of the switches to the lamp regulator so that its coil is inoperative.

Remove the positive generator lead from the bottom of the reverse current relay panel.

Turn the double pole double throw switch in the set to the No. 1 position. See Fig. 28.

Place a piece of paper or some other insulating material over the brush of the reverse current relay so that the set will be insulated from the battery when the main contact of the relay closes.

Insert the plug into the "regulator" receptacle of the set. For setting reverse current relays with the time delay relay, as indicated by "T" in the type designation, connect the red covered flexible lead from the "regulator" receptacle to the number 5 terminal on the reverse current relay panel. For relays which do not have the time delay relay, connect the red covered flexible lead to the number 4 terminal.

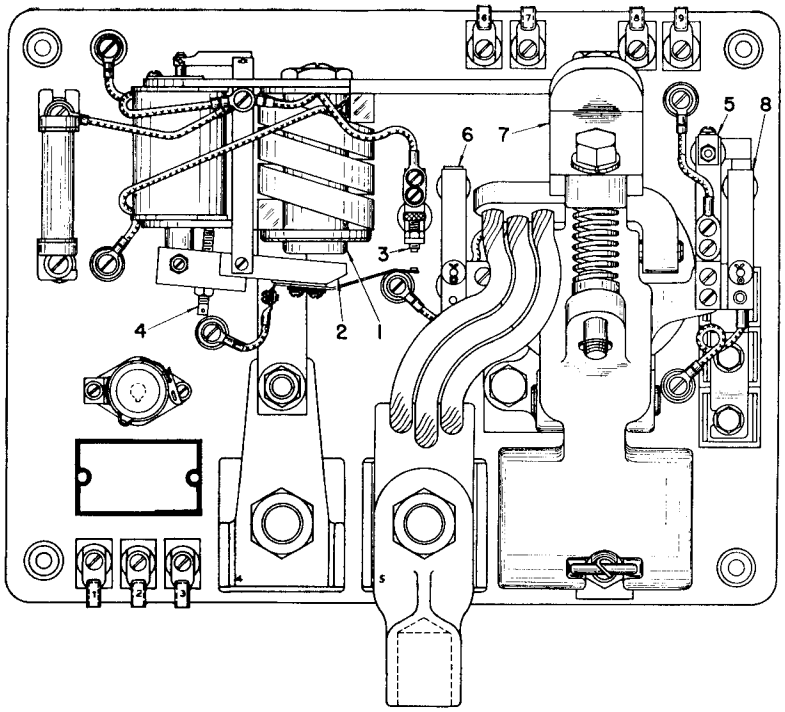


Fig. 37 Safety type S-31-EADRT Relay

The black covered lead is connected to terminal number 1 on the reverse current relay panel.

Place the handle of the rheostat in the start position, away from the cover side of the box.

Insert the plug into the "battery" receptacle of the set. Connect the red covered flexible lead from this receptacle to the live positive side of the battery and the black covered flexible lead to the live negative side of the battery.

Increase the voltage of the set to the cutting-in voltage of the reverse current relay by moving the rheostat handle away from the starting position.

Set the main switch.

To remove the set, move the rheostat handle to the start position, disconnect the positive and the negative "battery" leads, from the battery and then disconnect the positive and the negative "regulator" leads from the reverse current relay panel. Replace the positive generator lead.

Adjustment of 80 Volt Relays

For relays used with 80 volt equipments auxiliary panel No. 301562 is used with dynamotor set, and the instructions to be followed are:

Turn the double pole, double throw switch in the dynamotor set to the No. 1 position. See Fig. 28.

Open all of the switches so that the lamp regulating coil is inoperative.

Remove the positive generator lead from the bottom of the generator regulator panel so that the generator is disconnected.

Place a piece of paper or some other insulating material over the brush of the relay so that the set will be insulated from the battery when the relay contact closes.

Insert the plug into the "regulator" receptacle of the set.

For setting reverse current relays with the time delay relay, as indicated by "T" in the type designation, connect the red covered flexible lead from the "regulator" receptacle to the number 5 terminal on the reverse current relay panel. For relays which do not have the time delay relay,, connect the red covered flexible lead to the number 4 terminal. The black covered lead is connected to the terminal number 1 on the reverse current relay panel.

Place the handle of the rheostat of the dynamotor set in the start position, away from cover side of the box. Place the handle of the rheostat on the auxiliary panel in the start position at the voltmeter side of the box.

Insert the plug into the "battery" receptacle of the auxiliary panel. Connect the red covered flexible lead from this receptacle to the positive battery terminal and the black covered flexible lead to the negative battery terminal on the generator regulator, lamp regulator, or switchboard.

Increase the voltage of the set to the cutting-in voltage of the reverse current relay by moving the handles of the rheostats away from the start position. Move the handle of the dynamotor set rheostat before moving the handle of the rheostat on the auxiliary panel.

Set the reverse current relay. If sufficient voltage cannot be obtained to set the relay, disconnect the voltage regulating coil of the generator regulator by removing one side of the resistance unit connected in series with the voltage or shunt coil. This will relieve the generator of the load taken by the coil and will allow the set to develop a higher voltage.

To remove the set, move the rheostat handle to the start position, disconnect the positive and the negative "battery" flexible leads and then disconnect the two "regulator" leads from the batteries. Replace the positive generator lead and other connections previously opened.

Adjustment of 140 Volt Relays

The procedure for adjusting 140 volt relays is the same as for 80 volt relays. However, auxiliary panel No. 314224 is used with the dynamotor set.

S-30 AND S-31 RELAYS

The S-30-EADR, S-31-EADR and S-31-EADRT relays consist of a small reverse current relay having characteristics similar to the type S-10-EA relay, and a large contactor whose coil is energized through the contact of the small reverse current relay. The large contactor connects the generator to the battery and the load.

The electrical connections, operation and adjustments of these relays are similar to those of the S-10-EA relay. The core 1 of the reverse current relay, Fig. 37, should be adjusted so that the armature 2 is horizontal when it touches the stop pin in the face of the core and the relay is closed. The main contact adjusting screw, 3, should be adjusted so that the relay opens on a reverse current of not more than 22 amperes. A slight wiping action between the contacts should be obtained when the relay closes. The armature stop screw, 4, is adjusted so that the relay closes at one half volt above the battery voltage.

On the S-30-EADR, the reverse current relay is equipped with an interlock contact at the top, which should be adjusted to close when the armature has completely dropped out. An adjustment which permits the making of this contact before the armature has fully dropped out may result in chattering. This interlock contact, 5, Fig. 37, is located on the main contactor on the S-31-EADR and S-31-EADRT.

Interlocks, 6 and 8, Fig. 37, on the main contactor, should be adjusted so that the gap is approximately 1/16" when the main contactor is open. Contact 7 of the contactor requires no adjustment, as the coil is designed to close at any voltage from 25 to 45 as soon as the main contact of the reverse current relay closes. It is necessary to be certain that contact is made on the silver inserts.

The instructions covering adjustment and maintenance of the type S-10-EA and S-20-EA relays apply also to the S-30-EADR, S-31-EADR and S-31-EADRT relays.

The reverse current relay on the S30 and S-31 are set at the factory to close at 1.5 to 2 volts above the voltage of the battery on 40 volt equipments.

SAFETY TYPE S LOAD REGULATORS

GENERAL INFORMATION

Safety type S load regulators are made in three capacities, and are designated type S-350-E, type S-700-E and type S-1050-E. They are capable of dissipating 350, 700 and 1050 watts in the carbon pile, respectively. They are shown in Figs. 38, 39 and 40.

Regulators consist of one, two or three piles of carbon discs in series with the load; the two or three piles may be either in series or parallel. The pressure on these carbons, and therefore their resistance, is governed by the armature of a magnet, the winding of which receives the voltage of the load to be regulated. The magnet and lever is designed so that a high degree of accuracy in voltage regulation is accomplished without the use of any auxiliary control.

The carbons are compressed by an adjustable spring connected to a link acting through a lever connection. The pull of the spring is opposed by the pull of the electro-magnet, which is connected directly across the load mains and is so designed that the armature will stay in any position throughout its stroke when the load voltage is right. When the load voltage is high, the magnet becomes stronger and pulls the armature down against the pull of the spring and reduces the pressure upon the carbons, increasing their resistance and bringing the load voltage back to normal. If the load voltage is low, the magnet becomes weakened, the spring pulls the armature back and through the lever connection, exerts enough pressure on the carbon piles to decrease their resistance and bring the load voltage back to normal. As will be noted from the wiring diagrams, Figs. 32 and 33, the load regulator coil is connected so that it is controlled by the light switch.

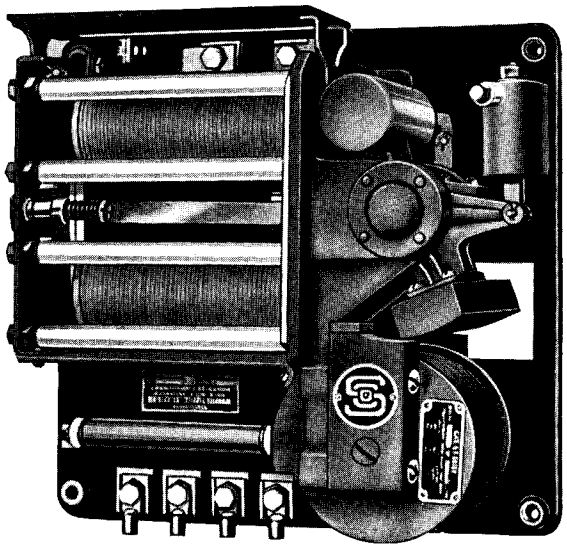


Fig. 39 Safety type S-700-E lamp regulator

CARE AND ADJUSTMENT

To obtain the best operation from any equipment proper maintenance is essential. Therefore, the regulators should be checked periodically. This inspection consists of cleaning the carbons, pivot pins, and the removal of any friction in the pins or supports.

In the following instructions the points identified by letters are shown in Fig. 41 for the S-350-E, Fig. 42 for the S-700-E and Fig. 43 for the S-1050-E.

The cleaning of carbons may be accomplished by releasing the pressure on the carbons and then blowing out the dirt by means of an air hose, or moving the carbons up and down on their support rods by hand. The pressure on the carbons is released by drawing armature A down to stop S.

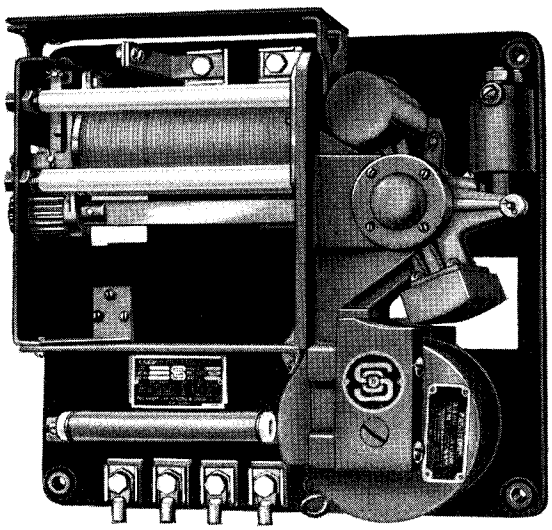


Fig. 38 Safety type S-350-E lamp regulator

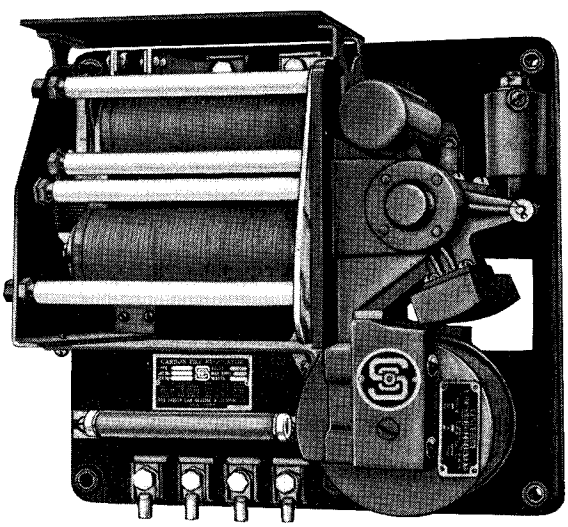


Fig. 40 Safety type S-1050-E lamp regulator

The pins to be cleaned are shown at P. The pins may be readily cleaned by polishing with very fine emery paper and the pin holes by using reamer, No. 61967 with holder No. 61964. The pressure plate guide rods B, Fig. 42, should be cleaned and inspected to assure absence of any binding.

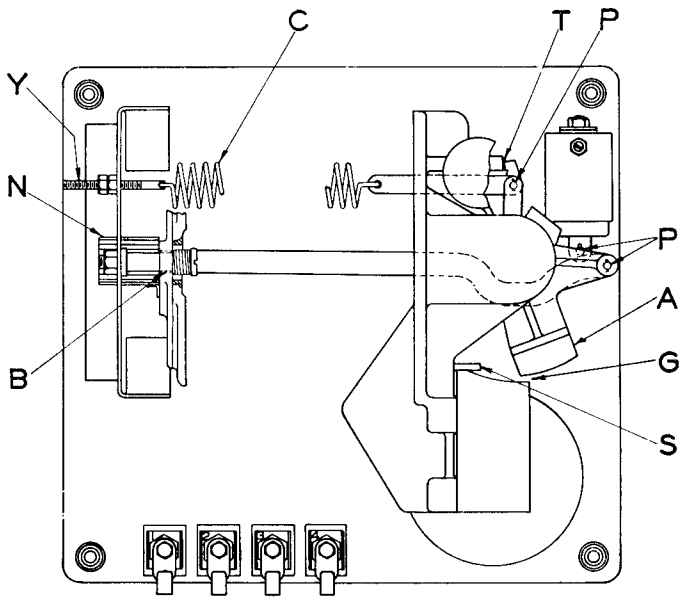
Thickness of Disc	Required per Pile
1/8	48
1/16	96
1/32	192 approx.

Check operation after regulator has been thoroughly cleaned. To do this, it is first necessary to be certain that the pressure on the carbon pile is correct. This should be done when the carbons are hot. Proceed as follows:

Disconnect the operating coil and pull the armature A against the stop S. Upon releasing armature A, the spring should pull the armature against stop T. With the proper pressure, the carbons will be snug when attempting to move them by hand. If the armature A does not return to the stop T the pressure is incorrect and the knurled nut N should be turned toward the regulator panel until the armature A just barely goes back to the stop T. The nut should then be loosened one-third of a turn.

To set the regulator for voltage, the following procedure may be followed. From the forepart of these instructions it will be noted that the spring C is balanced by a magnetic pull and the setting of the voltage is made by adjustment of this spring only.

To adjust the spring tension, which is done with the regulator hot, short circuit the carbon pile across terminals 2 and 3. Have voltage which it is desired



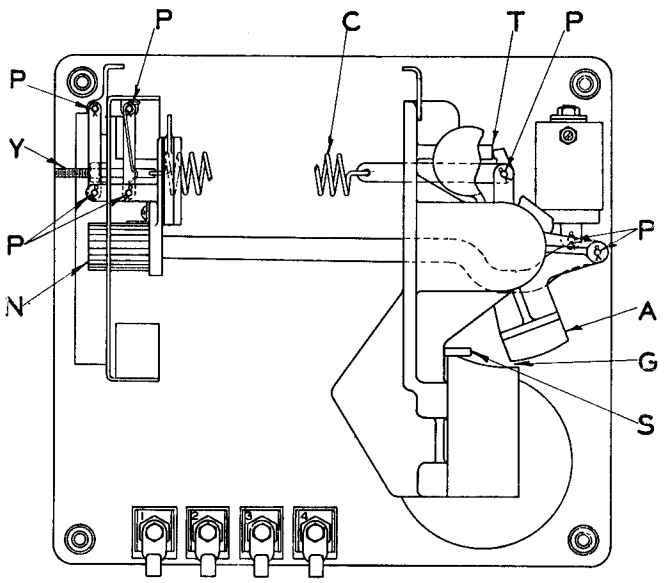
A = ARMATURE
B = GUIDE RODS
C = SPRING
G = AIR GAP
N = KNURLED NUT
P = PIVOT PINS
S = STOP
T = STOP
Y = ADJUSTING SCREW

Fig. 42 Adjustment Diagram for Safety Regulator type S-700-E

to maintain across the load mains, from terminals 1 to 4. The voltage settings usually used are 31, 62 or 110 volts. Now adjust the spring tension by turning the spring adjusting screw Y until the armature will remain in any position throughout its stroke. Remove the short circuit from terminals 2 and 3 and the regulator is ready to operate.

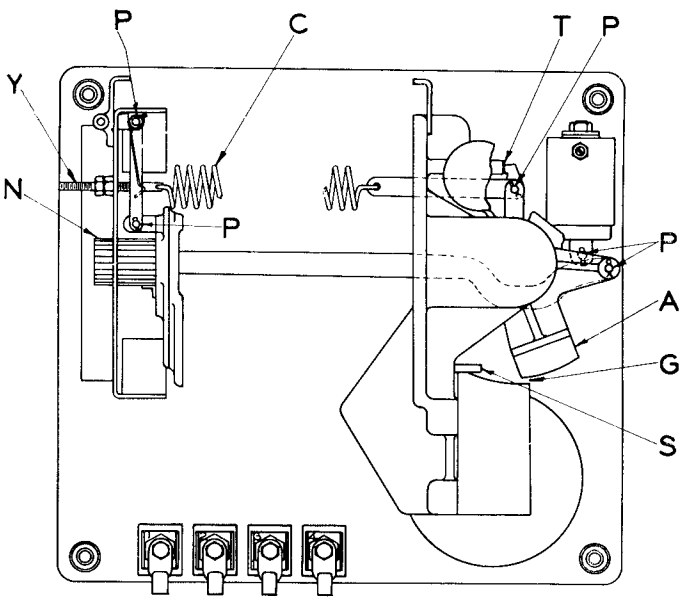
The air vent of the dashpot should be set to prevent any tendency to hunt.

By periodically following these instructions the service rendered by the regulators will be improved



A = ARMATURE
C = SPRING
G = AIR GAP
N = KNURLED NUT
P = PIVOT PINS
S = STOP
T = STOP
Y = ADJUSTING SCREW

Fig. 41 Adjustment Diagram for Safety Regulator type S-350-E



A = ARMATURE
C = SPRING
G = AIR GAP
N = KNURLED NUT
P = PIVOT PINS
S = STOP
T = STOP
Y = ADJUSTING SCREW

Fig. 43 Adjustment Diagram for Safety Regulator type S-1050-E

and greater satisfaction will be obtained from the equipment, the voltage of which is controlled by these regulators.

Do not overlook the following:

The armature of the regulator is mounted on ball bearings to which it is not necessary to add grease.

It is advisable to inspect the bearing yearly. At this time a small amount of Petrolatum should be applied if they are dry.

Bearings should not be packed with any lubricant.

It is inadvisable to oil the pivot pins because the accumulation of dirt in the oil will cause the regulator to operate sluggishly.

Instructions for Setting Type S Load Regulators with Dynamotor Set 301585, Fig. 28

For 40 volt equipment use dynamotor set 301585, Fig. 28 and proceed as follows:

Open the battery and the main light switches on the switchboard.

Short circuit the carbon pile across the No. 2 and No. 3 terminals and then disconnect the dashpot by removing the nut on top.

Turn the double pole, double throw switch of the set to the No. 2 position (see Fig. 28).

Insert the plug into the "regulator" receptacle of the set. Connect the red covered flexible lead of this receptacle to the No. 4 terminal on the regulator and connect the black covered lead of the receptacle to the No. 1 terminal on the regulator.

Place the handle of the rheostat in the start position. Insert the plug into the "battery" receptacle of the set. Connect the red covered flexible lead from this receptacle to the live positive side of the battery switch and the black covered flexible lead of the receptacle to the live negative side of the battery switch on the switchboard.

Increase the voltage of the set to that which it is desired to maintain across the lamp mains that is, from terminal No. 1 to terminal No. 4.

Adjust the spring tension by turning the spring adjusting screw until the armature will remain in any position throughout the stroke.

Replace the dashpot and remove the short circuit from the No. 2 and No. 3 terminals.

To remove the set, move rheostat handle to the start position, disconnect the positive and the negative "battery" leads from the battery switch and then disconnect the positive and the negative "regulator" leads from the regulator. Close the battery and the main light switches on the switchboard.

For 80 volt equipment, auxiliary panel 301562, Fig. 29, is used with dynamotor set 301585, Fig. 28.

Open the battery in the main light switches on the switchboard.

Short circuit the carbon pile across the No. 2 and No. 3 terminals and disconnect the dashpot by removing the nut on top.

Turn the double pole, double throw switch in the dynamotor set to the No. 2 position. Turn the switch on the auxiliary panel to the No. 2 position.

Insert the plug into the "regulator" receptacle of the set. Connect the red covered flexible lead from this receptacle to the No. 4 terminal on the regulator terminal on the regulator.

Place the handle of the rheostat in the start position. Insert the plug into the "battery" receptacle of the set. Connect the red covered flexible lead from this receptacle to the live positive side of the battery switch and the black covered flexible lead to the live negative side of the battery switch on the switchboard.

Increase the voltage of the set to that which it is desired to maintain across the lamp mains, that is, from terminal No. 1 to terminal No. 4.

Adjust the spring tension by turning the spring adjusting screw until the armature will remain in any position throughout its stroke.

Replace the dashpot and remove the short circuit from the No. 2 and No. 3 terminals.

To remove the set, move the rheostat handle to the start position, disconnect the positive and the negative "battery" leads from the battery switch and then disconnect the positive and the negative "regulator" leads from the regulator. Close the battery and the main light switches on the switchboard.

For 140 volt equipment, auxiliary panel 314224, Fig. 29, is used with dynamotor set 301585, Fig. 28. The same instructions apply for 140 volt equipment as those for 80 volt equipment.

GENERATOR SUSPENSIONS

GENERAL INFORMATION

The kw capacity of generating equipment has increased with the application of air conditioning equipment and increased lighting and auxiliary load. The means of driving such large capacity generators and genemotors necessarily must be accomplished by other than the flat belt or straight V-belt methods. Head end cars, however, are of relatively low capacity and therefore can be driven by a flat belt or straight V-belt.

Through the years the Safety Company has expended time and effort in the development and improvement of generator suspensions for this type of equipment. This has resulted in a suspension which provides uniform belt tension and long belt life under normal operating conditions.

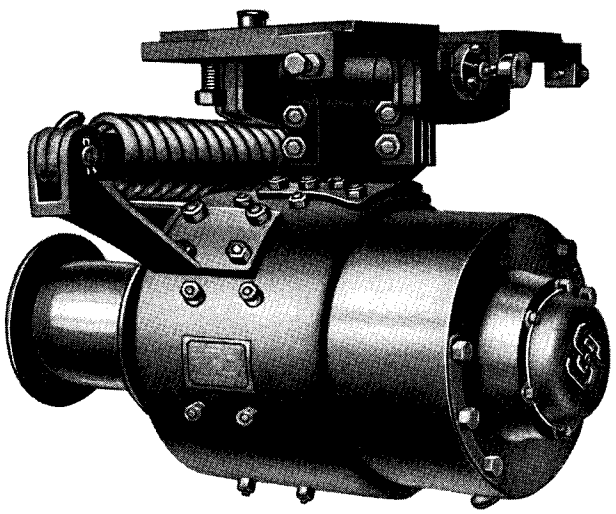


Fig. 44 "Under-Frame" generator and suspension with tension spring

The generator of the Safety "Under-Frame" type of equipment is mounted on the car body and driven from a pulley mounted on the car wheel axle. Such an arrangement removes the weight of the generator from the truck. This arrangement is also superior to truck suspension because of the facility with which the equipment can be inspected.

Suspensions arranged for mounting the generator on the car body, however, have to include certain features for their successful operation. They must be arranged to provide constant tension to eliminate abnormal strain on the belt, which is caused by the change in axle pulley position when rounding curves.

"Under-Frame" suspensions are arranged with a pivot for the generator which should always be properly lubricated to allow the generator to swing freely on its support.

"Under-Frame" types of suspension are shown in Fig. 44 and 45. Uniform belt tension, regardless of the position of the generator, is obtained by the design of the tension spring so that the sum of the tension due to the weight of the generator and that due to the spring is a constant amount. This is accomplished by the belt tension device as follows: (the letters referred to in this description are shown in Figs. 46, 47, 48 and 49).

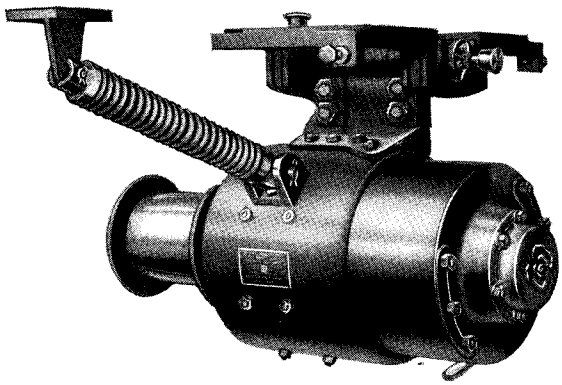


Fig. 45 "Under Frame" generator and suspension with compression spring

The generator is hung from shaft C. The further the generator is pushed towards the truck, the more force is required, since this action makes it necessary to raise the weight of the generator. Thus if no spring were used, the belt tension would depend on the position of the generator, increasing as the generator is pulled by the belt toward the truck.

The same is true if an ordinary compression or tension spring is used—as soon as the belt stretches or the distance between the generator and axle varies, the pull of the spring changes the pull on the belt.

The arrangement of the spring on the Safety "Under-Frame" suspension prevents change of tension due to belt stretch, or due to the change in the distance between the pulley center when the car is on a curve.

The spring is fastened at one end to the generator and at the other end is held stationary by a bracket F attached to the suspension plate or to the center sill of the car. This spring swings the generator away from the truck, as the suspension lugs on the generator act as a lever for the spring to revolve the center of the generator around the suspension shaft C.

The lever arm with which the spring pulls is the distance between the center of the point C and the point X. When the generator hangs vertical as in Figs. 46 and 48 this distance is comparatively large, and the spring exerts considerable force. When the generator swings toward the truck as in Figs. 47 and 49, the distance between C and X becomes smaller, and the force of the spring on the generator is less.

In the latter position, however, the weight of the generator which is converted into belt pull has become greater.

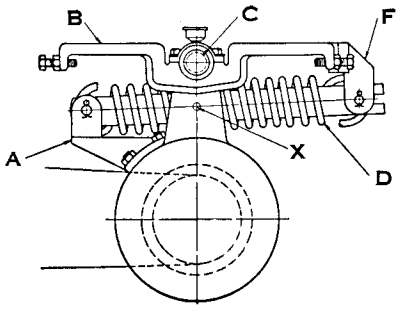


Fig. 46 Position of Generator with tension spring when distance between the axle pulley and suspension frame is shortened

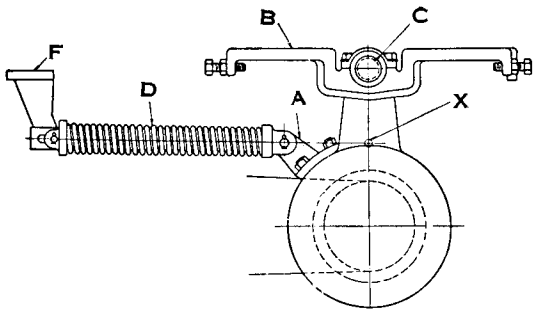


Fig. 48 Position of Generator with compression spring when distance between the axle pulley and suspension frame is shortened

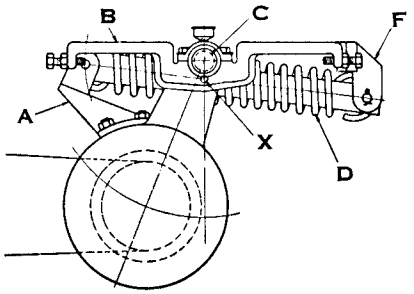


Fig. 47 Position of Generator with tension spring when distance between the axle pulley and suspension is lengthened

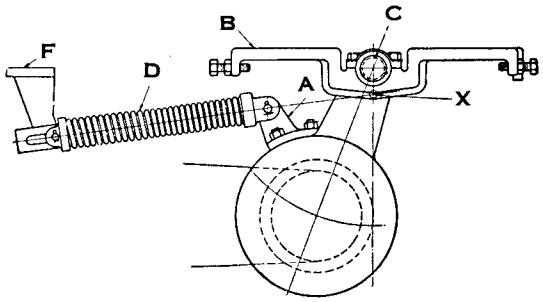


Fig. 49 Position of Generator with compression spring when distance between the axle pulley and suspension frame is lengthened

The strength of the spring and its point of attachment to the generator are so selected that the increase in the belt pull from the weight of the generator as it moves toward the truck, is counter-balanced by the decrease of the force of the spring as its point of application to the generator is changed relative to the center.

In order that the spring may always give proper tension without the necessity of adjustment, it is assembled in a carrier as shown in Figs. 50, 51 and 52, and held on the carrier at the proper initial tension or compression.

The belt should be removed when applying the tension spring to the suspension, and the pins should be inserted in holes G and H in the carrier and the corresponding holes in generator lug A and suspension bracket F.

The suspension arrangement shown in Fig. 45 has the compression spring attached to the generator and to a bracket on the car under-frame.

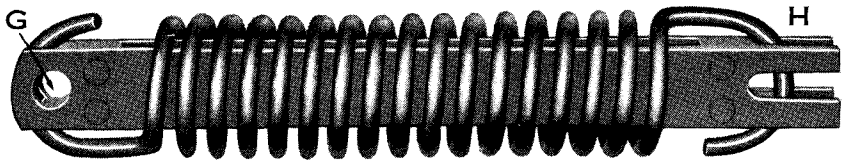


Fig. 50 Tension Spring

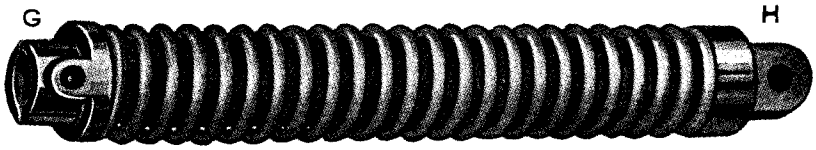


Fig. 51 Compression Spring

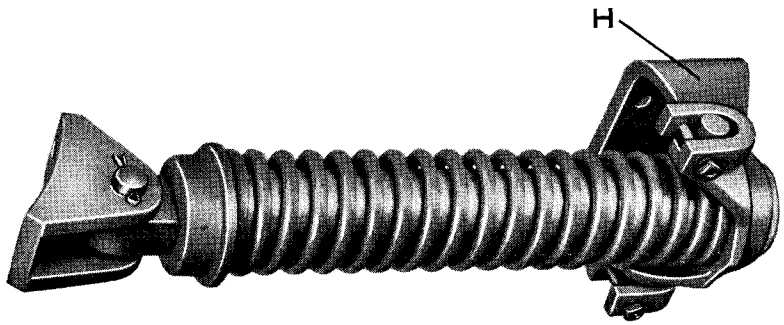


Fig. 52 Suspension Spring

The arrangement shown in Fig. 44 has a tension type spring attached to the generator and to the suspension plate.

The bearings, supporting shafts, bearing caps, grease caps, grease fittings and spring pins, parts most likely to be replaced, are entirely interchangeable.

Suspensions used with generators built in the types B, BB, C, D, DD and E frames (1.5kw to 4kw inclusive) have cast steel supporting frames. These may use either the compression or tension type of spring. They can be arranged for either right hand or left hand application.

Suspensions used with generators larger than 4kw capacity have fabricated supports with self-aligning pivot bearings. These suspensions employ the compression type spring and the right and left hand applications use identical parts. The spring used in this suspension together with brackets is shown in Fig. 52 and suspension supporting members are shown in Fig. 56.

An application or suspension is called right hand when the pulley is on the right of the machine when looking at it from a position at the center of the car.

APPLICATION OF SUSPENSION TO CAR

Drawings showing the application of the generator suspension and the axle pulley to the car, are made from the layouts of the car, truck and under-frame as supplied by the customer. Dimensions required are shown in Fig. 53. These drawings, furnished by the Safety Company for the car builders' use, show the proper mounting for the best clearances possible, and should be closely followed in making the installation.

CLEARANCES

Care must be taken to have proper clearances between the belt and all parts of the truck, car and brake rigging. There must be at least 1½ inches of clearance from the pulley side of the belt above and below it. The clearance from the outside of the belt should be 2¾ inches with Safety fasteners and at least 2 inches with the Crescent type fasteners. There must be ample side clearance for the belt to allow for the swing of the truck on curves.

AXLE PULLEY

Axle pulleys and bushings used with "Under-Frame" equipment are manufactured by the Dodge Manufacturing Corporation. They were selected because of their consistently good service for many years.

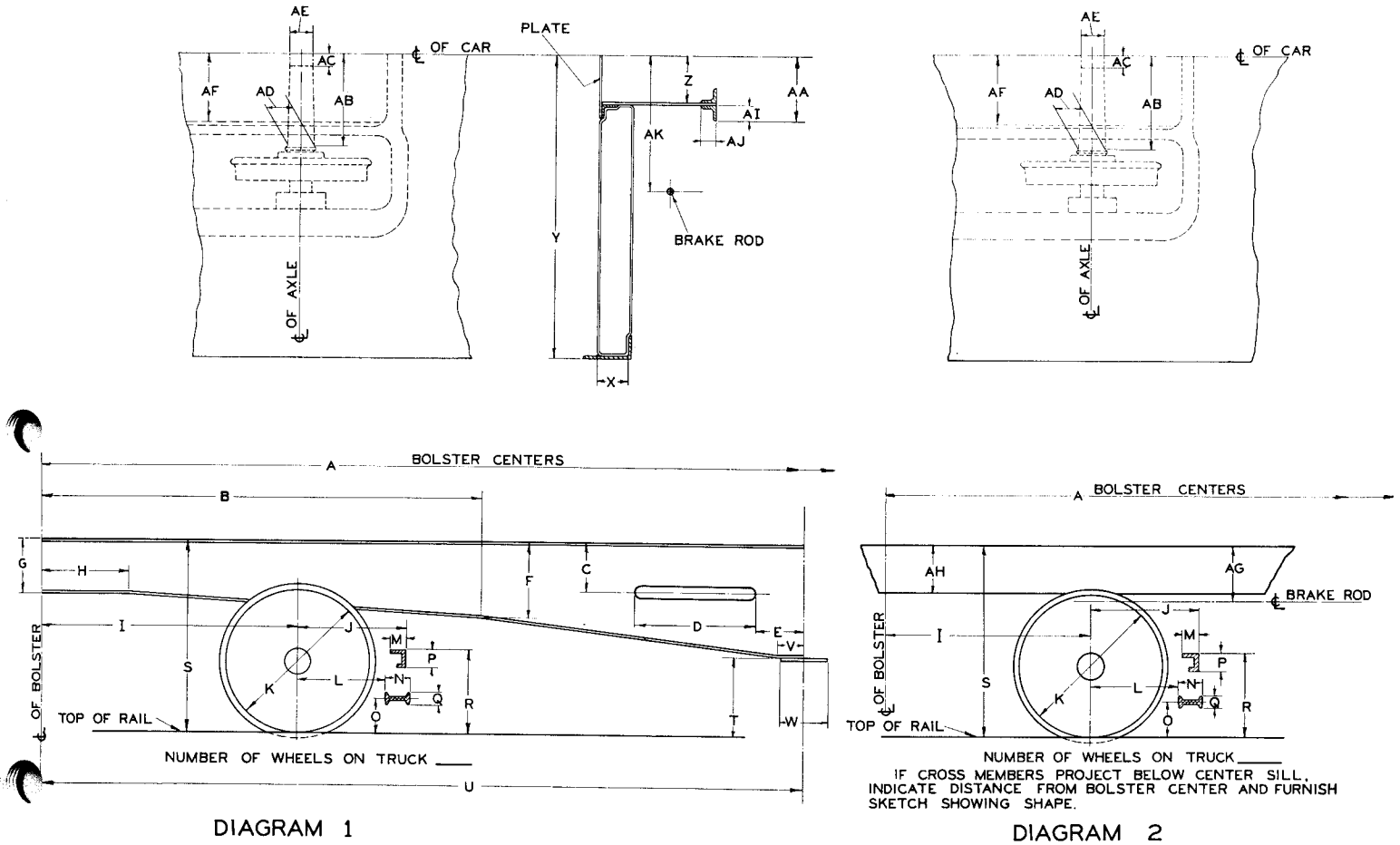


DIAGRAM 1

DIAGRAM 2

Fig. 53 Dimensions required by Safety Company to determine suitable generator suspension and axle pulley application

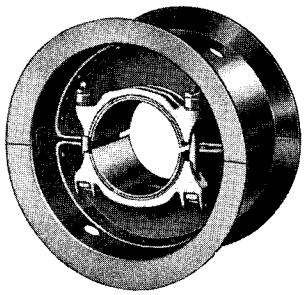


Fig. 54 Axle Pulley

The axle pulley should be placed in position as shown on the drawing furnished. The axle must be turned so that the axle bushing will fit it properly since pulleys which do not run true with the axle cause undue wear on the belts, suspension parts and generator. The bolts securing the pulley should be drawn up evenly so that the pulley will run true with the axle. Nuts should be set up as tight as possible and locked.

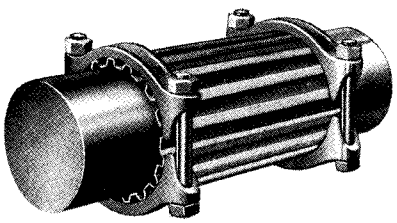


Fig. 55 Axle Pulley Bushing

The axle pulley illustrated in Fig. 54 is of pressed steel with special flanges to allow the belt to take curves. The pulley has a standard A.A.R. bore of 7½ in. diameter and is mounted on a bushing made of corrugated steel formed to fit the taper of the rough turned axle. The bushing is bolted to the axle independent of the pulley and is longer than the pulley hub to allow lateral adjustment of the pulley without moving the bushing.

For application with pulley located over 6 in. from centerline of axle the bushing Fig. 55 is used. For applications with pulley on centerline or as far as 6 in. off centerline of axle, two bushings are used to fit the tapers on either side, the total length of the two bushings being equivalent to that of the single bushing illustrated.

INSTALLATION OF SUSPENSIONS FOR GENERATORS UP TO AND INCLUDING 4KW CAPACITY

The working parts of the "Under-Frame" suspensions are assembled complete with the generator as shown in Figs. 44 and 45. The generator and suspension should be lifted together and secured to the top of two straps of 1 inch by 5 inch steel, which are securely fastened to the car under-frame. These straps should be made up and applied to the car body in accordance with the drawing furnished by the Safety Company. They should be installed so that they are level, and provided with four bolt holes for holding the generator suspension frame to the straps. The dimensions for drilling these four holes are given on suspension drawing.

The center of the generator pulley must be in line with the center of the axle pulley.

The suspension as illustrated in Fig. 44 has the spring integral with the generator and suspension casting. That shown in Fig. 45 necessitates a bracket on the car body to take the end of the spring.

This bracket is attached to a support which is riveted to the center sill of the car.

INSTALLATION OF SUSPENSION FOR GENERATORS LARGER THAN 4KW CAPACITY

Application to the car must be made by dismantling the suspension, removing the sliding frame A and fixed frame B as shown in Fig. 56.

The supporting bolt spreaders C with resilient cushions can then be set in their proper place on the car supporting strap.

The generator with the supporting shaft D clamped rigidly in place is now raised with its lug slightly above the normal running position. The two frames A and B with the bearing clamps slightly loosened are put in place, the bearings E sliding onto the generator supporting shaft.

The generator is then lowered so that frames with mounting cups drop over the resilient mountings. The frames A and B should be approximately vertical before tightening the supporting bolts F.

The sliding frame B can be at either side of the suspension depending on which is more convenient.

After the frames are properly aligned and securely bolted in place, the spherical bearings E should be clamped by tightening the cap bolts G.

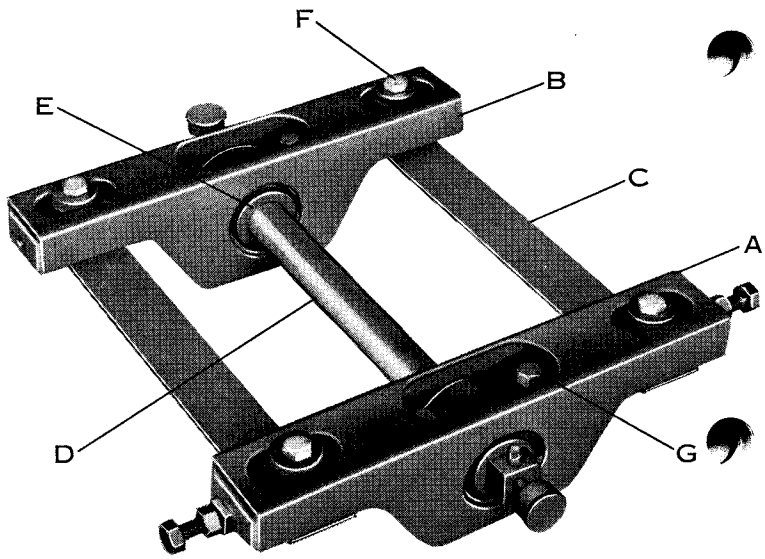


Fig. 56 Suspension

The position and alignment of the car, spring bracket Fig. 52, part H, can now be determined and properly secured to the supporting member of the car. This is important as misalignment of the bracket will cause cramping of the spring holder tube in the bearing of the spring support, and prevent the free action so important for long belt life.

GENERATOR ALIGNMENT

This is accomplished as follows: Be sure car is on a straight and level track.

To determine whether the armature shaft is parallel with top of the rail, place straight-edge across the rails directly under the generator and measure from straight-edge to the center of the armature shaft at the pulley end, and to the center of the grease cap at the commutator end. These two distances should be the same. If not, they may be equalized by the use of washers between the suspension frame and the hangers on the car body.

To get the armature shaft parallel with the center of the axle which carries the pulley, place the straight-edge across the rails against both wheel flanges and mark the position on the rails. Then place the straight-edge on the rails under the generator and by the use of a plumb bob adjust it directly under the center of the armature shaft at the pulley end and the center of the grease cap at the commutator end. The distance between the marks at the wheels and directly under the generator should be the same on both rails. If not, equalize by loosening the bolts which hold the suspension frame to the supporting strap, adjusting the position of the suspension frame by the adjusting screws which are tapped into the suspension frame and bear against the supporting strap. When the adjustment has been properly made by the use of these screws, the bolts which hold the suspension frame in the supporting strap should be securely made up, and the adjusting screws also locked in position.

BELT LENGTH

All "Under-Frame" suspensions give constant belt tension for a generator travel of eight inches, and the belt stretch has no influence on the tension for this travel. Best results are obtained if the generator is kept between 2 inches and 4 inches from vertical. If the belt is so short that the generator is more than 4 inches from the vertical, there is a possibility of its being damaged when rounding a curve. If it is nearer than 2 inches there may be slipping, resulting in damage to the belt and wear of the generator pulley.

MEASURING BELT LENGTH

Have the generator hanging vertical when the car is on a straight and level track. Pass tape over axle pulley and armature pulley to determine the belt length with the generator in the vertical position. Then cut the belt 6 inches shorter than this for Safety fasteners, and 8 inches shorter for the Crescent type of fastener. This will bring the generator 4 inches back from the vertical when belt is applied. When shortening the belt, both ends should be cut off and repunched. If a belt is worn at the fasteners, but in good condition otherwise, a new piece, the length of which should never be less than 18 inches, may be inserted by the use of an extra belt fastener.

SAFETY TYPE BELT FASTENER APPLICATION

Safety belt fasteners are of two types, wedge type shown in Fig. 57 and bolt type shown in Fig. 58. Both employ the same principal for holding the belt. The fasteners form a joining for the ends of the belt without creating a concentrated strain on any part of the belt fabric, as the two ends of the belt are pressed so tightly together that the friction between them takes up the pulling strain of the belt without affecting the fabric around the fastener holes.

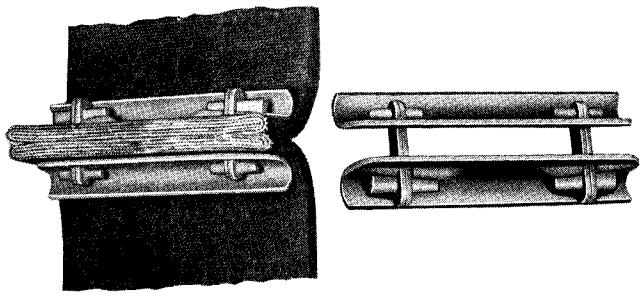


Fig. 57 Wedge type fastener

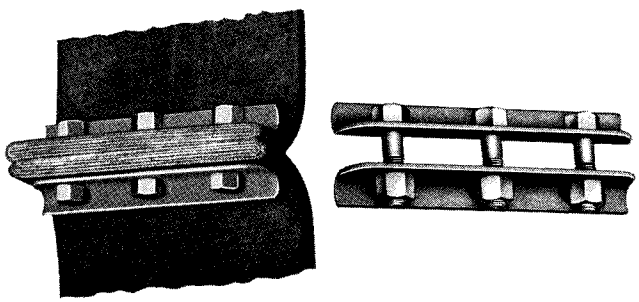


Fig. 58 Bolt type fastener

Safety Wedge Type Belt Fastener

To secure the best service from the Safety wedge type belt fastener the correct size should be determined. Measure the thickness of the belt to the nearest 64th of an inch, and then refer to the following table to determine the catalog number of the belt fastener required.

Belt Thickness in 64ths	Belt Width Inches	Catalog No. Belt Fastener Complete
12	3	301361
12	4	301450
12	5	301454
14	3	300611
14	4	301451
14	5	301455
16	3	301364
16	4	301452
16	5	301456
19	3	301367
19	4	301453
19	5	301457

The method of applying the Safety wedge type belt fastener is as follows:

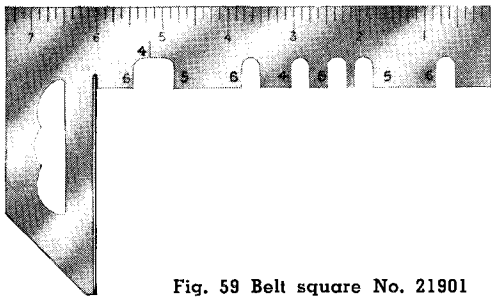


Fig. 59 Belt square No. 21901

Cut the ends of the belt, square across at the proper length. Square No. 21901, Fig. 59 or belt cutter No. 55604, Fig. 60 may be used for this purpose.

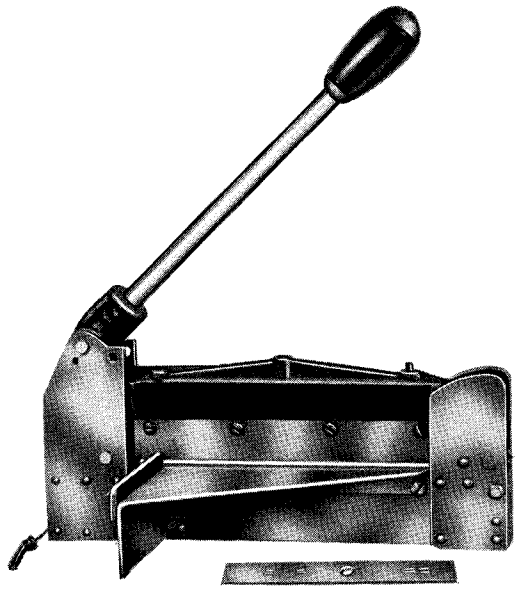


Fig. 60 Belt cutter and template No. 55604

Draw lines square across the belt, 1 inch from each end. Punch holes with belt punch No. 21902, Fig. 61 using as a template either a fastener, template holes provided in square No. 21901 or template furnished with belt cutter No. 55604.

The two ends are then turned up perpendicularly to the run of the belt, the ends held firmly together by plates on each side with the links extending through the holes in the plates and belting. The wedges are then applied to secure the fastening.

Fig. 61 Belt Punch No. 21902 for wedge type belt fastener
Belt Punch No. 301903 for bolt type belt fastener

Safety Bolt Type Fastener

In selecting the proper Safety bolt type fastener, the belt width is the feature to be taken into consideration. The following belt fasteners are carried in stock and are most generally used.

Belt Width Inches	Belt Fastener Complete Cat. No.
4	300878
5	300877
6	301730

The method of applying the Safety bolt type fastener is as follows:

Cut the ends of the belt square across at the proper length. Square No. 303638, Fig. 62 may be used for this purpose.

Draw lines square across the belt, one inch from each end. Punch holes with belt punch No. 301903, Fig. 61 using as a template either a fastener, template holes provided in square No. 303638, Fig. 62 or template furnished with belt cutter 55604, Fig. 60.

The two ends are then turned up perpendicularly to the run of the belt, and held firmly together by plates on each side with the bolts extending through the holes in the plates and belting. The nuts are then applied to secure the fastening.

Application of Crescent Type Belt Fasteners

The ends of the belt must be cut square. Use square No. 21901, Fig. 59 or belt cutter No. 55604, Fig. 60. The ends must be butted together and the rivets well clinched.

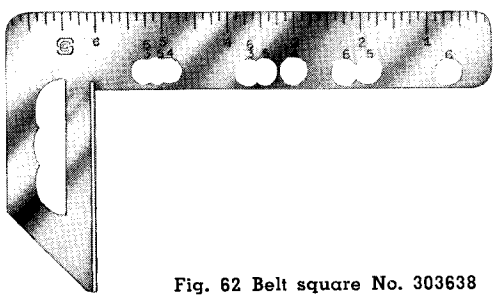


Fig. 62 Belt square No. 303638

BELT APPLICATION

Swing the generator toward the truck with a pry bar and block into position.

When a large number of equipments are maintained, the Safety Company recommends the use of a block and tackle.

Place chain sling at one end, around the axle and the opposite sling around the armature pulley. With the tackle between the slugs, pull the generator to 6 or 7 inches off the centerline.

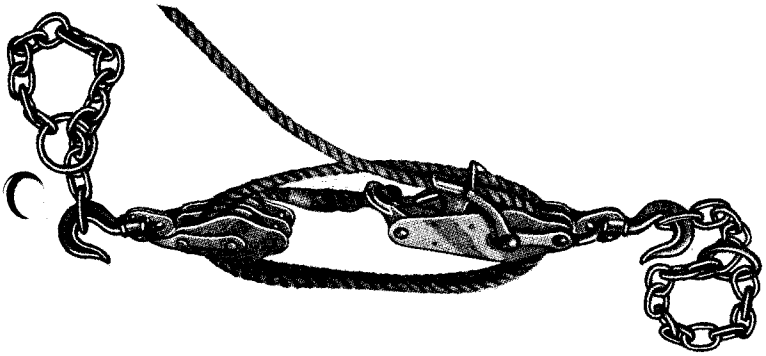


Fig. 63 Block and tackle No. 55614

Block and tackle No. 55614, Fig. 63 is recommended for generators up to type D or for generators used with our standard cast supporting frame. Block and tackle 500001 is similar to 55614 and is recommended for the larger generators using the DA, GB, GF and GH suspensions.

PULLEY CROWN

The armature pulley crown should be 5/16 inches high and should be recrowned when it is worn down to ⅛ inch. Template No. 55730, Fig. 64 is convenient for recrowning. The contour of the rim of the pulleys furnished with "Under-Frame" equipments has been made to give the maximum amount of metal for crowning with a minimum weight.

LUBRICATION AND CARE OF SUSPENSION

The suspension should be properly lubricated to prevent wear of the parts and loss of proper alignment. Ample space for proper lubrication of the generator supporting shaft bearing, Fig. 65 is provided by suitable clearance between the shaft and the bearing. Grease may be forced through this bearing by the use of a compression cup, or may be applied by a grease gun when the proper fittings are applied to the grease cap. When so specified, we will furnish these suspensions with the fittings for either the Alemite, Zerk or Dot systems. If the Alemite system is used, we recommend the industrial slip-on type. As this bearing is not subjected to heating, it is preferable to use petrolatum instead of cup grease. Petrolatum is a pure grease without any admixture of other elements necessary to make it stand high temperatures and it will not harden or cake.

Fig. 64 Template No. 55730

SUSPENSION REMOVAL

The generator supporting shaft B, Fig. 65, is held in the generator lug A by four clamping bolts C at either end of this supporting lug. The supporting shaft turns in the bronze bearings D, and lubrication is supplied to the bearing through the grease grooves G from the grease cups E and grease caps F.

If it is desired to remove the generator from the suspension the generator should be blocked up to take the weight off the suspension shaft. The lock screw C can then be loosened, grease cap F at one end removed and the suspension shaft pulled out of the bearings and lugs by inserting a bolt into the tapped hole in the end of the shaft.

In the extremely unlikely case that the supporting shaft should be stuck in either of the bearings, it can be removed by blocking up the generator and taking off the bearing cap, H.

As the supporting shaft is a free fit in the generator lug, except at the point where it is clamped down by the screws C, there is no likelihood of it ever becoming stuck in the lug.

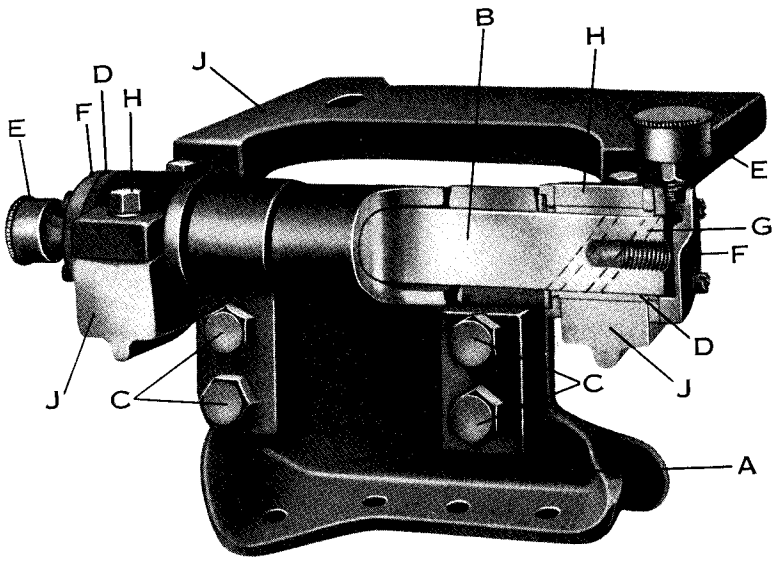


Fig. 65 Supporting shaft and bearing

APPLICATION OF GENERATORS AND GENEMOTORS DRIVEN BY SPICER DRIVE OR SAFETY V-BELT AND GEAR DRIVE

Generators and genemotors driven by Spicer Drive or Safety V-Belt and Gear Drive are usually mounted under the center sill of the car with the center lines of the generator shaft and of the car being parallel. These machines have horizontal mounting brackets.

Generators and genemotors should be supported on resilient mountings as shown in Fig. 66. One mounting is in each arm.

When applying these mountings, the nuts should be pulled snugly against the shoulder on the bolt and the cotter pin inserted. The efficiency of the mounting is reduced if the bolts are made up too loosely or too tightly.

The frames of generators resiliently mounted should be grounded by means of a number ten or larger flexible wire or braid.

A typical application of the Safety V-Belt and Gear Drive is shown in Fig. 68 and a Spicer Drive application is shown in Fig. 67.

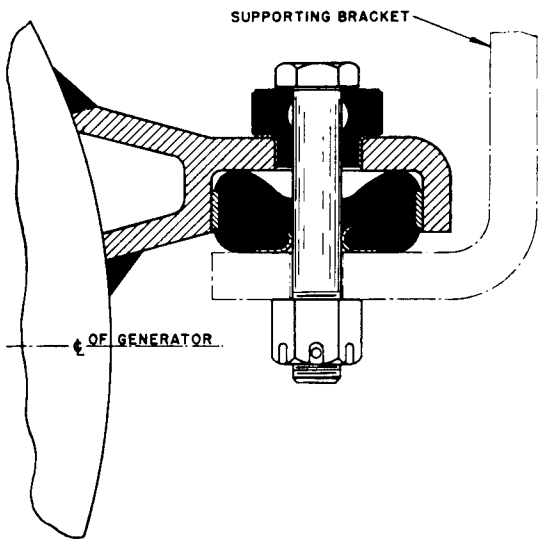
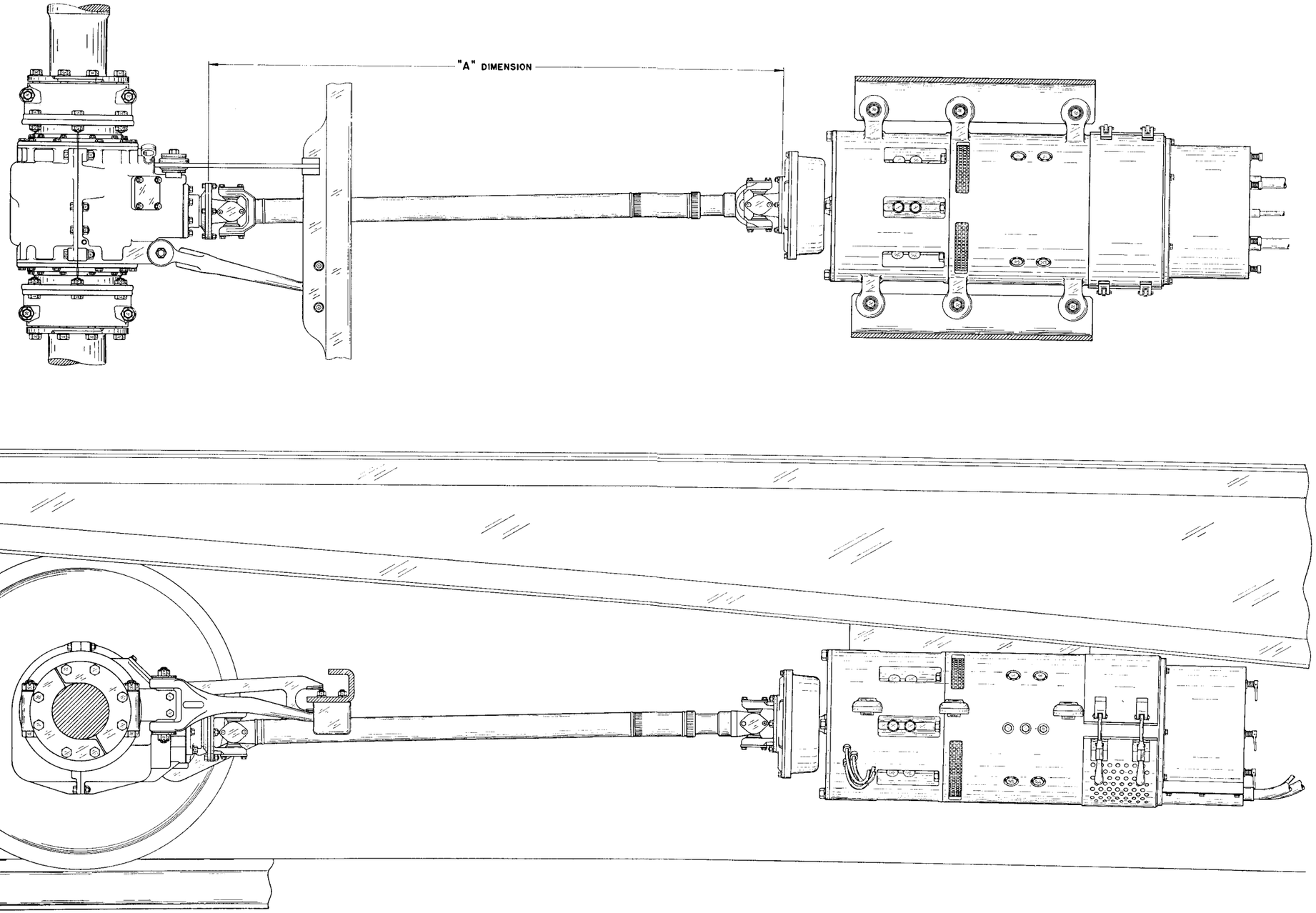
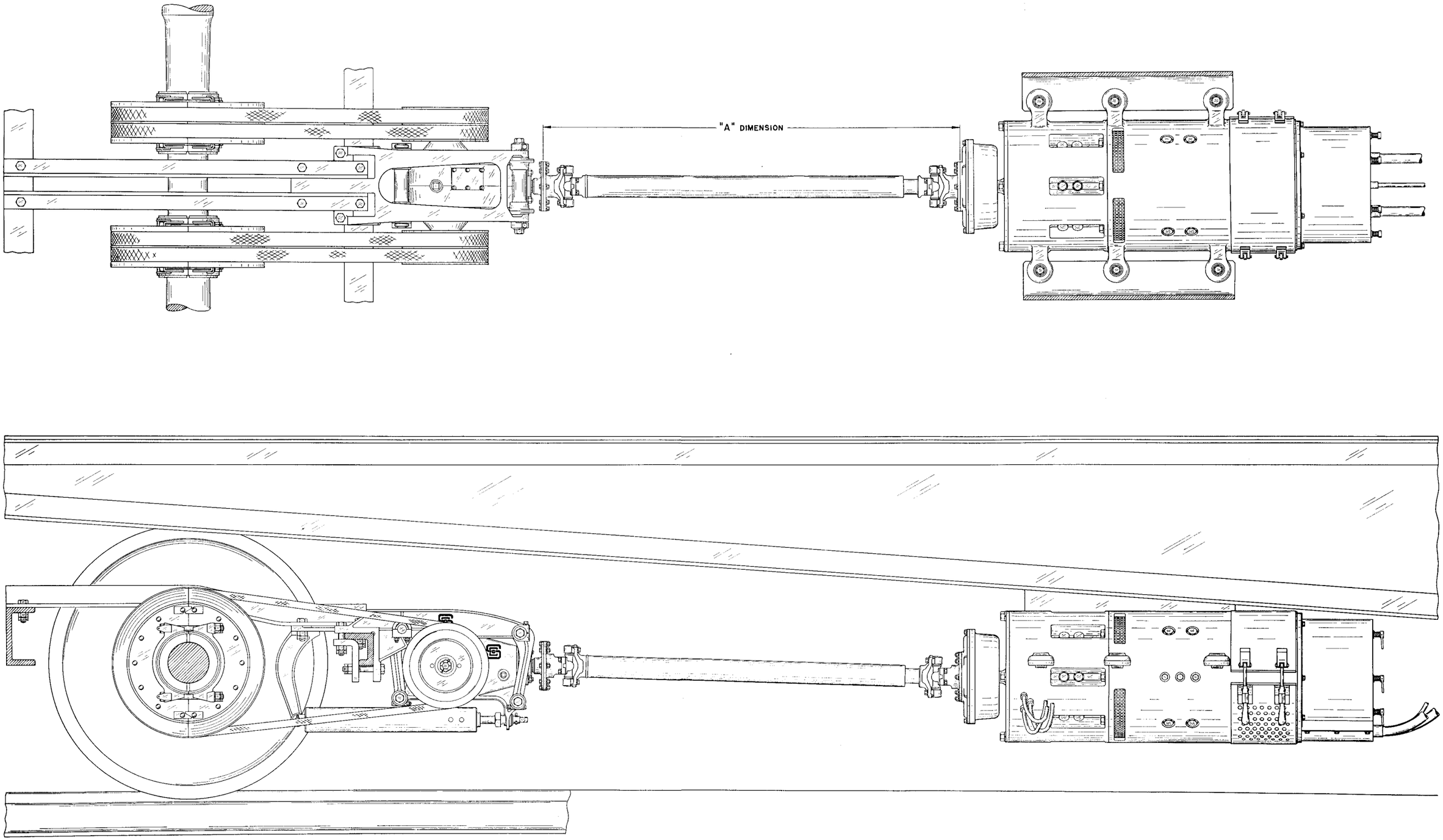


Fig. 66 Resilient mounting



NOTE- FOR "A" DIMENSION SEE SPICER BULLETIN NO. 231
(COMPRESSED LENGTH IS $1\frac{1}{2}$" SHORTER THAN "A" DIMENSION)

Fig. 67 Typical Spicer Drive Application



NOTE- FOR "A" DIMENSION SEE FORM 3749
(COMPRESSED LENGTH IS 2" SHORTER THAN "A" DIMENSION)

Fig. 68 Typical Safety V-Belt and Gear Drive Application