

# Westinghouse

## Small Direct-Connected Turbine-Generator Units

### INSTRUCTION BOOK

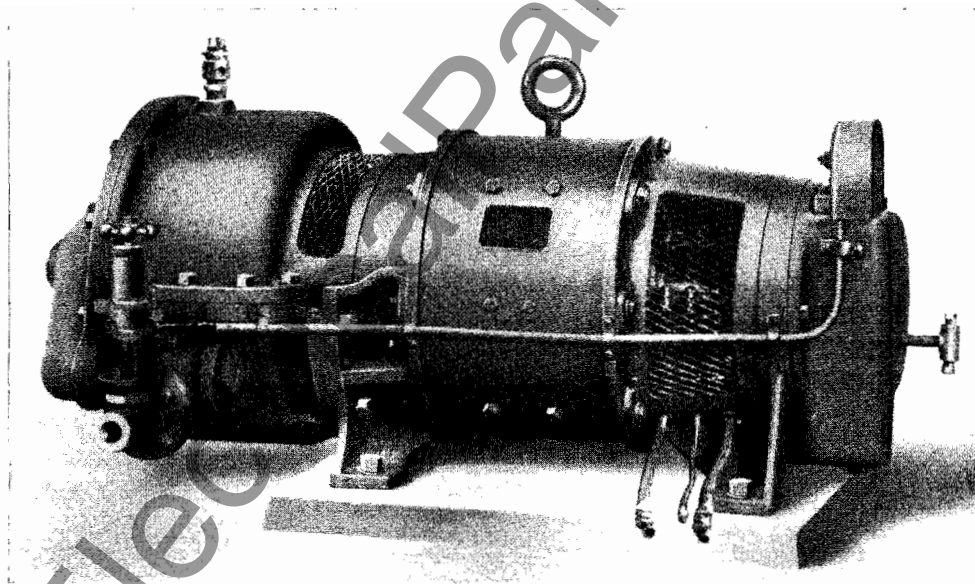


FIG. 1 - SMALL DIRECT-CONNECTED TURBINE-GENERATOR UNIT

IN THE EVENT THAT IT BECOMES NECESSARY TO RETURN ANY PART OF THIS EQUIPMENT TO THE SOUTH PHILADELPHIA WORKS, IT SHOULD BE TAGGED WITH THE SENDER'S NAME AND ADDRESS AND SERIAL NUMBER OF THE UNIT AND SHIPPED BY FREIGHT, EXPRESS OR PARCEL POST TO:

WESTINGHOUSE ELECTRIC & MANUFACTURING CO.  
SOUTH PHILADELPHIA WORKS  
ESSINGTON, PA.

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# Westinghouse

## Small Direct-Connected Turbine-Generator Units

Turbine No. \_\_\_\_\_ Generator No. \_\_\_\_\_

### General Description

This unit consists of a simple impulse turbine directly connected to a direct-current generator. A picture of the complete unit is shown in Fig. 1, while Figures 3, 4 and 5 show transverse sections and the longitudinal section. The generator, which is the supporting member of the unit, is a compound wound machine. There are only two bearings, both of which are of a standard ball type. They are carried in the generator end brackets and are well protected against vapor and heat from the turbine.

The turbine rotor is mounted on the end of the generator shaft. It is keyed to the shaft on a taper fit and further secured by a nut and lock washer. The complete turbine casing is made up of the cylinder base "51", the cylinder cover "97" and the end cover "95". This casing completely encloses the rotor, gland, governor, governor valve and its connecting lever.

### Turbine Rotor

The turbine rotor is of the single wheel, impulse, re-entry type and consists of a disc carrying a single row of blades. As shown in Figure 4, the steam enters through the throttle valve, steam strainer and governor valve into the nozzle. It is expanded in the nozzle, thus transforming the heat energy into velocity energy.

Having reached its maximum velocity at the mouth of the nozzle, the steam impinges against the blades, causing them to move forward, thus revolving the rotor. By the rotation of the rotor the velocity energy of the steam is transformed into work at the turbine rotor shaft. The velocity of the steam at the nozzle mouth is much greater than that of the blades. Consequently, after passing through the blades from the nozzle "53" it becomes advantageous to collect the steam in a reversing chamber "52" which redirects it against the blades a second time thereby adding the energy of another pass through the blades to the rotor shaft before the steam passes into the exhaust. This principle is shown clearly in Figure 2.

### Gland

Since the rotor is overhung on the end of the shaft, only one gland is required to seal against steam leakage along the shaft. This gland is of the labyrinth type, consisting of four packing rings "50" which are carried in grooves cut in the gland case "48". Each ring consists of four segments. A small spring is used back of each segment to hold the segment toward the shaft so that the shoulder on the segment is, at all times, against the corresponding shoulder in its groove. The rings should have approximately .003" clear-

ance sidewise in the grooves. The springs should press the segments firmly against their shoulders and, with the gland assembled, the ends of the segments should just touch. When inserting new rings, their inside diameter should be about .010" less than the shaft diameter, this amount being left to wear off during the first few minutes of operation.

It is of utmost importance to have these packing rings clean and free to move radially in the grooves so that the springs will hold them in their proper position relative to the shaft. If they should become stuck by scale deposits or other foreign matter, they may stand away from the shaft thus allowing excessive steam leakage.

As shown in Figure 5, there is an opening between the second and third packing rings to which a connection can be made from outside the turbine casing. For non-condensing operation, this opening should be connected to an open drain. It then serves as a leak-off for any steam which might leak past the first two rings. For condensing operation, this opening should be connected to a steam supply and steam admitted at about 5 lbs. pressure to seal against influx of air.

### Governor

The governor is of the horizontal fly-ball type and is secured directly to the rotor. The two weights, "85", pivot on knife edges in knife edge blocks "86", and transmit their motion to the governor spindle "69", by means of two governor knife edges, "67". These rest on seats on the toes of the governor weights on one end, and against those in the governor knife edge beam "66", on the other. All of these fulcrum points are hardened.

The governor spindle passes through the governor knife edge beam, the beam acting against a shoulder on the spindle, and thus the movement of the weights is transmitted to the governor spindle and is opposed by the spring "89." Consequently, the speed at which the weights move outward and hence the speed at which the governor holds the turbine is dependent on the compression of this spring. This compression can be changed by the nut "91". One end of the governor

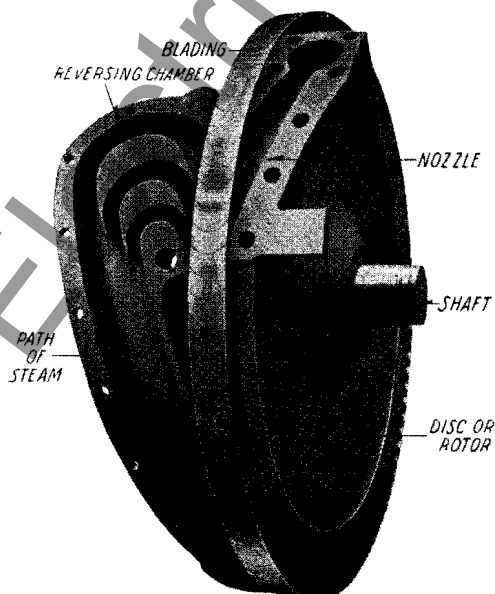


FIG. 2—ROTOR WITH NOZZLE AND REVERSING CHAMBER

spindle is guided in a hole in the end of the generator shaft while the other end is guided by the governor case.

Movement of the governor is transmitted to the governor valve through the lever "62". It will be noted that the governor spindle of course revolves at the same speed as the generator rotor. A special construction is therefore necessary at the governor spindle end, which is in contact with the lever, in order to reduce to a minimum, friction and wear. Either of two types of governor spindle end may be used: namely, the "Ball" type or the "Graphaloid Disc" type, both of which are shown in Figure 5. For non-condensing operation and ordinary steam temperatures, the "Ball" type is used. For condensing operation or unusually high steam temperatures the "Graphaloid Disc" type is used. The construction of each type is shown clearly in the Figure. In the "Ball" type, the ball "76" bears against a hardened pin in the governor lever. The ball is thoroughly insulated, electrically, from the spindle and all parts are held in place by a retainer "77". In the "Graphaloid Disc" type the spindle disc "79" bears against the graphaloid disc "80" which is supported on the governor lever by the pin "82" so that the discs make full surface contact at all times.

#### To Dismantle Governor:

To dismantle the governor, remove the case "88" from the rotor by taking out the four bolts, "65", after which the entire governor can be removed as a unit. If it does not come off readily, the governor body may be tapped with a block of wood or lead or copper mallet. Care should be taken in removing the governor to prevent the spindle from being bent. Before removing the governor spindle nut, "91", measure the distance from the end of the spindle "69", to the top of the spindle nut. This is not absolutely necessary, but it saves a lot of time and labor in restoring the proper adjustment upon re-assembling. The spindle nut should then be removed, after which the spring retainer "90", and the spring "89", can be drawn out. The rest of the parts may then readily be removed. Care should be taken to note the relative position of the various parts so that upon assembling, the same parts may again be placed in the same relative locations, because parts may be slightly worn and if not brought together again as before, may cause trouble.

The governor knife edge blocks "86", are held in place by two pins "87", which have a nice fit in both the block and the governor case "88".

#### To Assemble Governor:

The operation of assembling the governor will be found quite simple if the following procedure is adopted. Hold the governor spindle "69", in a vertical position by clamping the spindle bushing retainer "77", in a block of wood. This retainer is best held by drilling a hole in a piece of wood and then splitting the block on the diameter. Whatever method is used, great care should be taken not to distort the retainer. The governor case "88", should then be slipped over the spindle.

The next move is to hang the two knife edges "67", on the knife edge beam "66", paying special attention to the fact that the bevelled surfaces face inward. It is an easy matter to slip the knife edge beam over the spindle, with the two knife edges hanging in place. One of the governor weights "85", should then be put into its place. It will stay in position because the inside face rests against the case, while the weight of this case is borne by the governor, the load being transmitted through the knife edge block and the whole weight in turn being carried by the knife edge. The other governor weight can then be placed by pulling outward on the one already in position. Pulling this outward will raise the case "88" sufficiently to place the second weight. Holding the second weight, allow the first one to move inward until it is all the way in when both weights should be in their proper position in relation to their adjacent parts. The governor spring "89", should then be placed, followed by the spring retainer "90". The spindle nut "91", should then be screwed down to the position located before dismantling, as mentioned under the heading "to dismantle governor". After the spindle nut is located, the guiding end of the governor spindle must be centralized with the spigot fit of the governor case. If this end is out of center, it will bind in the hole in the end of the generator shaft, thus causing the governor to "hunt", that is; the speed will continually vary even though the load is constant. To center the spindle, place a screw driver or other suitable tool between the spring retainer "90", and the case "88", and push the spindle in the desired direction. It may be necessary to remove

the retainer and to turn the spring a little, but never try to centralize the spindle by tapping it. This method may bend the spindle, making it appear to be central, and trouble is likely to result.

#### To Adjust Governor:

The normal operating speed of the unit is given on the name plate. If, after installing new parts, a speed adjustment is found necessary, proceed as follows:

Remove the complete governor from the rotor.

**To Increase the Speed**, tighten the nut "91", thus increasing the compression of the spring "89".

**To Decrease the Speed**, loosen the nut "91", thus decreasing the compression of the spring "89".

The nut "91" should not be moved more than 1 or 2 turns without again checking the speed.

#### Governor Valve

The governor valve "55" is of the double seated, balanced, poppet type and operates within the cage "56". The cage fits in a counterbore in the cylinder base and is held axially by the guide "57" and guide retainer "58". The valve is pinned to the stem "54" which is guided by the cage "56" at one end and by the guide "57" at the other end.

The valve is practically balanced by the steam flow but the compression spring "59" holds it in the open position until closed by the governor. The lower end of the governor lever "62" forms a yoke which operates against the spool "61" which is threaded on the valve stem. Steam enters the valve cage at both ends and, when the valve is off its seat, passes through the center of the cage into the nozzle.

#### Governor Valve Adjustment:

The valve travel (or lift) is very important and should never be more than  $\frac{1}{8}$ ". In order to check this setting, push the valve stem inward with the hand until the valve has seated. Measure the distance from the contacting surface of the spool to the contacting surface of the governor lever. Then adjust the spool by screwing it backward or forward to give the correct valve travel. As stated above, this travel should never be more than  $\frac{1}{8}$ ", and may be less, depending on the steam conditions. Each unit is tested and the valve travel set correctly before shipment. Therefore, it is recommended that the travel be checked on each new machine when first received and this

travel recorded. Then at any future time, the travel can be set to the original factory figure.

It will be noted that the valve and seats form line contacts and not surface contacts. Therefore this valve cannot be ground in to stop leakage. If it should be necessary to reseal the valve in the field, the inner disc must be faced off maintaining a 90° angle, and the bevel on the outer disc faced back the same amount. The seats in the cage must be bored in the same manner, maintaining a 90° angle at the outer seat and a bevel at the inner seat. If this is not done accurately the areas of the valve discs will be changed, throwing the valve out of balance which will undoubtedly cause hunting of the governor. It is difficult to do this work without proper facilities and, since the parts are relatively inexpensive, it is recommended that new parts be obtained from the factory when such repairs are necessary.

### Throttle Valve

The throttle valve is of the automatic tripping type. Its construction is shown in Figure 4. The stem is in two parts rigidly screwed together. The upper stem "32" is threaded in the slide nut "44" which is kept from turning by the pin "45". The hardened steel washer "46" on the bottom of the nut engages the trip lever "34" to hold the nut in its uppermost position. With this nut latched in its upper position, the valve can be opened or closed by the hand wheel as any ordinary valve. When the latch is pulled outward by the auto stop governor tripping cord, the spring "43" closes the valve tightly on its seat. Resetting is accomplished by turning the hand wheel in the closing direction which screws the nut "44" upward until it is again engaged by the lever "34". The valve can then be opened in the usual manner.

The valve stem packing consists of a series of metallic rings. One complete set of packing includes four pieces of Item 38, packing #1 and three pieces of Item 39, Packing #2. This packing can be tightened to prevent leakage by means of the gland nut "29". After tightening the nut, it is important to test the free working of the stem by tripping the valve by hand. This packing must never be tightened to such an extent as to bind the stem and prevent proper tripping of the valve. The valve disc may be ground on its seat by removing the bonnet and stem.

### Auto-Stop Governor

The function of the auto stop is to shut down the turbine, if for any reason the main governor should fail to operate and allow the turbine to overspeed. It should be set to operate at about 10 per cent above normal speed.

The auto-stop is located on the generator end of the shaft and consists of the weight "3" which operates against the spring "4" which is held in place by the retaining nut "5". The retainer is threaded in the body "2" and secured by lock "6". The center of gravity of the weight "3" is located slightly eccentric to the axis of the revolving shaft. Therefore, when the speed of the unit reaches the predetermined point, the centrifugal force moves the weight outward against the compression of the spring.

The trip mechanism by which the auto-stop is connected to the Throttle Valve consists of the trip cord "17", trip weight "13", trip lever "11" and cam lever "8". The weight "13" is hung on the end of the lever "11" which is fulcrumed on pin "12" and is held in a horizontal position by the latch pin "10" in the cam lever.

The operation of this mechanism is as follows: Referring to Figure 3, when the speed of the unit reaches the tripping speed, the centrifugal force moves the weight "3" outward against the compression of spring "4". The weight in its outer position strikes the cam lever "8" rotating this lever clockwise about the pin "9" which unlatches the lever "11". The lever "11" is then free to rotate counter-clockwise around the pin "12" and the weight "13" therefore drops to the bottom. As the weight "13" strikes the sleeve "20", it moves the sleeve and rod "19" downward. The rod "19" is attached to the Throttle Valve Latch by the cord "17". Therefore downward movement of the rod "19" unlatches the Throttle Valve, allowing it to close.

In order to reset the mechanism, place the weight "13" on the lever "11" and latch this lever in its horizontal position as shown in the Figure. **Caution:** Never operate the unit with the weight "13" in its lower position because in this position, the Auto Stop has no control of the turbine speed. The action of the Tripping Mechanism and the Throttle Valve can be tested by unlatching by hand the lever "11". This however does not test the action of the Auto Stop weight "3". In order to check the speed at which the

weight actually flies out, it is necessary to overspeed the turbine. This can be done by removing the governor lever "62" and operating the unit under control of the throttle valve only.

### Auto-Stop Adjustment:

The speed at which the Auto Stop trips can be changed by changing the thickness of liners "7" between the spring "4" and retainer "5". (Do not place liners between the spring and the foot of the weight.)

To **increase** the tripping speed, increase the thickness of liners "7".

To **decrease** the tripping speed, decrease the thickness of liners "7".

### Generator

The two main bearings "107" and "123" carry the complete rotating element. They are held in position by lock nuts "103" and "124" which are threaded on the shaft and can easily be removed if replacement is necessary. (**Note:** On some of the older units, these bearings were held in position by shrink rings as shown in the detailed view of Figure 5).

The proper method of making the electrical connections is shown in Figures 6 and 7.

Keep electrical machines clean and dry. The generator should be kept free from dust and grit by an occasional blowing out with compressed air or hand bellows.

The brushes "119" of this unit are set in the proper position at the factory and the bracket to which they are attached is doweled in position. This adjustment should not be altered as shifting of the brushes may lead to commutation trouble. New brushes should be of the same make and grade as those shipped with the machine. They should have only sufficient clearance in the brushholders "118" to slide freely, and should be long enough so that the pressure finger does not rest on the brushholder, instead of on the carbon brush.

When putting in new carbon brushes, the faces should be ground to fit the surface of the commutator. This can most easily be accomplished by inserting the brushes one at a time in the brushholders. Place a piece of sand paper, not coarser than No. 0, against the commutator with the sanded side toward the brushes, and allow the brush to ride on the sand paper as the latter is drawn under the brush in the direction of rotation of the armature. The pressure on the brush should be released as the paper is drawn back, care being

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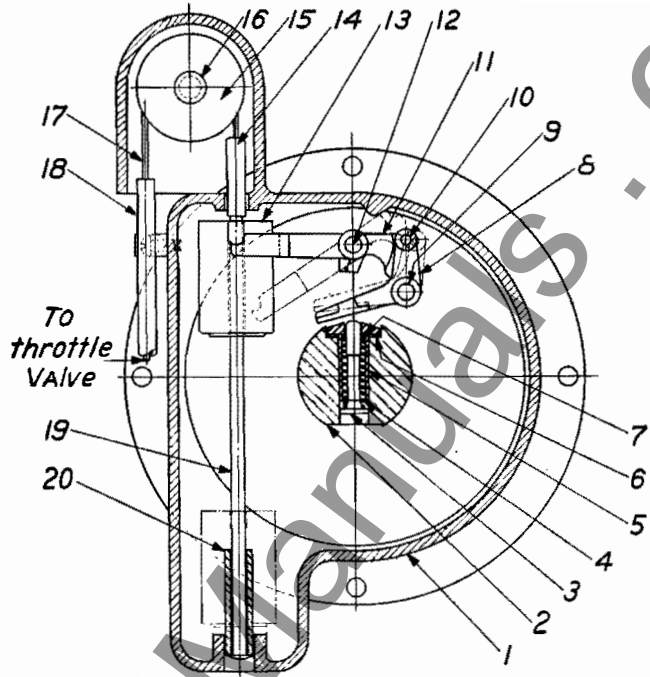


FIG. 3—SECTION THROUGH AUTOMATIC OVERSPEED DEVICE AND TRIP WEIGHT

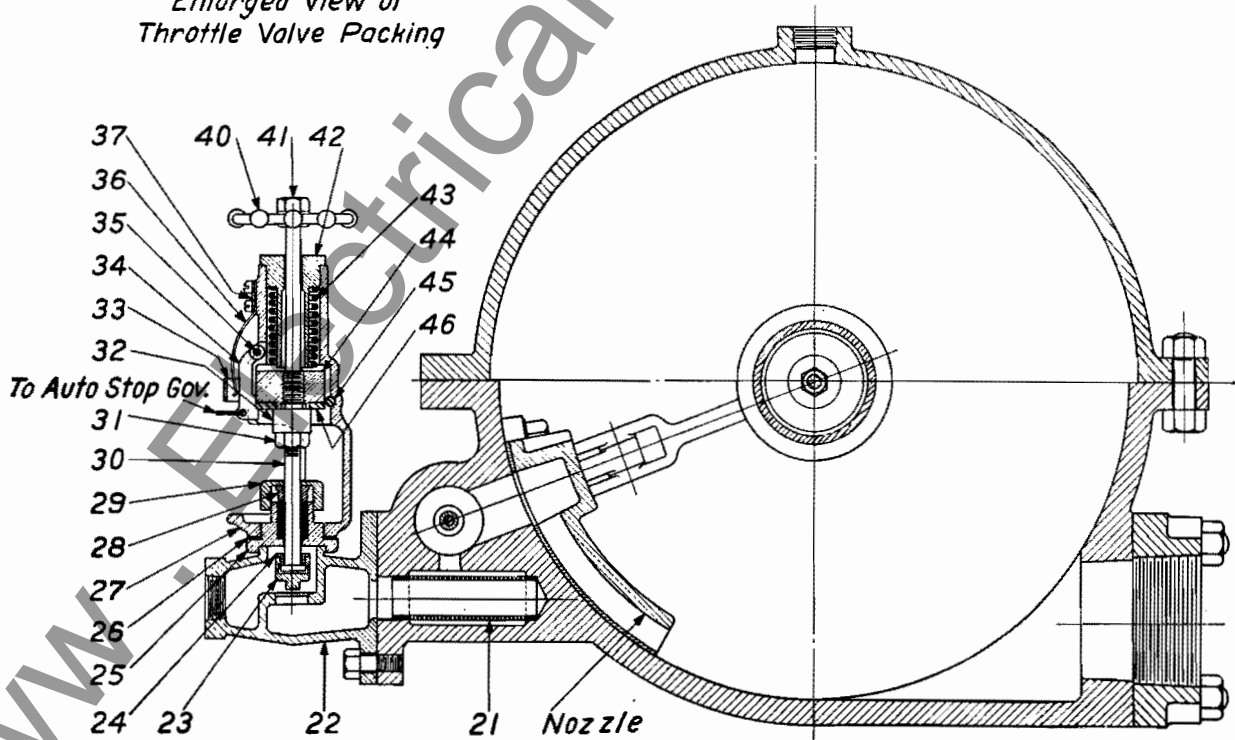
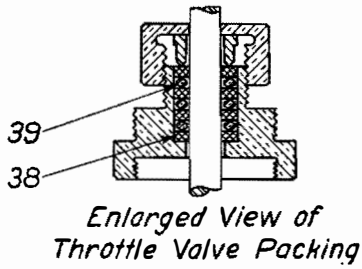


FIG. 4—SECTION THROUGH TURBINE CASING, NOZZLE, GOVERNOR VALVE, STEAM STRAINER AND THROTTLE VALVE

Westinghouse Small Direct-Connected Turbine-Generator Units

Turbine Parts

FIGURE 3

Item No.	Name
1	Auto Stop Gov. Trip Case
2	Auto Stop Gov. Body
3	Auto Stop Gov. Weight
4	Auto Stop Gov. Spring
5	Auto Stop Gov. Spring Retainer
6	Auto Stop Gov. Spring Retainer Lock
7	Auto Stop Gov. Spring Adjusting Liners
8	Auto Stop Gov. Cam Lever
9	Auto Stop Gov. Cam Lever Fulcrum Pin
10	Auto Stop Gov. Cam Lever Latch Pin
11	Auto Stop Gov. Trip Lever
12	Auto Stop Gov. Trip Lever Pin
13	Auto Stop Gov. Trip Weight
14	Auto Stop Gov. Trip Weight Rod End
15	Auto Stop Gov. Trip Pulley
16	Auto Stop Gov. Trip Pulley Pin
17	Auto Stop Gov. Trip Cord
18	Auto Stop Gov. Trip Cord Tube
19	Auto Stop Gov. Trip Weight Rod
20	Auto Stop Gov. Trip Weight Rod Sleeve

FIGURE 4

21	Steam Strainer
22	Throttle Valve Body
23	Throttle Valve
24	Throttle Valve Retainer
25	Throttle Valve Stuffing Box
26	Throttle Valve Yoke Liners
27	Throttle Valve Yoke
28	Throttle Valve Stuffing Box Packing Gland
29	Throttle Valve Stuffing Box Nut
30	Throttle Valve Stem (Lower)
31	Throttle Valve Stem Lock Nut
32	Throttle Valve Stem (Upper)
33	Throttle Valve Trip Lever Stop
34	Throttle Valve Trip Lever
35	Throttle Valve Trip Lever Pin
36	Throttle Valve Trip Lever Spring
37	Throttle Valve Trip Lever Spring Plate
38	Throttle Valve Stuffing Box Packing # 1
39	Throttle Valve Stuffing Box Packing # 2
40	Throttle Valve Handwheel
41	Throttle Valve Handwheel Nut
42	Throttle Valve Spring Retainer
43	Throttle Valve Spring
44	Throttle Valve Slide Nut
45	Throttle Valve Slide Nut Pin
46	Throttle Valve Slide Nut Washer

FIGURE 5

47	Cylinder Bolt (To Generator)
48	Rotor Gland Case (In halves)
49	Rotor Gland Case Tap Bolt
50	Rotor Gland Packing Ring With Springs
51	Cylinder Base
52	Reversing Chamber
53	Nozzle
*54	Governor Valve Stem
*55	Governor Valve
*56	Governor Valve Cage
*57	Governor Valve Stem Guide
58	Governor Valve Stem Guide Retainer
59	Governor Valve Stem Spring
60	Governor Valve Stem Spool Lock Nut
61	Governor Valve Stem Spool
62	Governor Lever
63	Governor Lever Bracket
64	Governor Lever Fulcrum Pin
65	Governor Case Bolt
66	Governor Knife Edge Beam
67	Governor Knife Edge
68	Governor Lever Thrust Pin
*69	Governor Spindle
*70	Governor Spindle Insulating Washer (Inner)

Note: Use Items 69 to 77 inclusive for "Ball" type spindle end.

FIGURE 5 (Continued)

Item No.	Name
*71	Governor Spindle Block
*72	Governor Spindle Bushing Retainer Cotter Wire
*73	Governor Spindle Insulating Bushing
*74	Governor Spindle Bushing
*75	Governor Spindle Insulating Washer (Outer)
*76	Governor Spindle Ball
*77	Governor Spindle Bushing Retainer
Note: Use Items 78 to 84 inclusive for "Graphaloid Disc Type" spindle end.	
*78	Governor Spindle
*79	Governor Spindle Disc
*80	Governor Graphaloid Disc
*81	Governor Graphaloid Disc Cotter Wire
82	Governor Graphaloid Disc Holder Pin
*83	Governor Graphaloid Disc Holder
84	Governor Lever
85	Governor Weight
86	Governor Knife Edge Block
87	Governor Knife Edge Block Pin
88	Governor Case
89	Governor Spring
90	Governor Spring Retainer
91	Governor Spindle Nut
92	Rotor Nut
93	Rotor Nut Lock Washer
94	Rotor Key
95	Cylinder End Cover
96	Cylinder End Cover Gasket
97	Cylinder Cover
98	Relief Valve
99	Rotor Blade Pin
100	Rotor Blade
101	Rotor

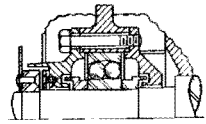
\*Note: Items 54 to 57 inclusive are shipped assembled as one piece.  
Items 69 to 77 inclusive are shipped assembled as one piece.  
Items 78 and 79 are shipped assembled as one piece.  
Items 80, 81 and 83 are shipped assembled as one piece.

Generator Parts

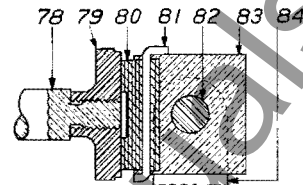
FIGURE 5

102	Blower
103	Bearing Lock Nut (Turbine End)
104	Bearing Lock Nut Lock Spring (Turbine End)
105	Outer Bearing Cap (Complete) (Turbine End)
106	Bearing Bracket (Turbine End)
107	Bearing (Turbine End)
108	Inner Bearing Cap (Turbine End)
109	Bearing Oil Thrower (Turbine End)
110	Housing and Foot (Turbine End)
111	Armature Coil
112	Armature Core
113	Shunt Coil
114	Housing and Foot (Comm. End)
115	Series Coil
116	Bracket Bolt
117	Commutator
118	Brush Holder
119	Brush
120	Brush Rod
121	Brush Rod Insulating Washer.
122	Brush Rod Insulating Tube
123	Bearing (Comm. End)
124	Bearing Lock Nut (Comm. End)
125	Oil Overflow Plug
126	Outer Bearing Cap (Complete) (Comm. End).
127	Bearing Oil Thrower (Comm. End)
128	Inner Bearing Cap (Comm. End)

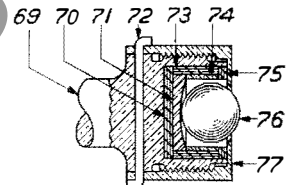
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Turbine End Bearing  
With Shrink Rings



Enlarged View of  
"Grapholoid Disc" Type  
Gov. Spindle End



Enlarged View of  
"Ball" Type  
Gov. Spindle End

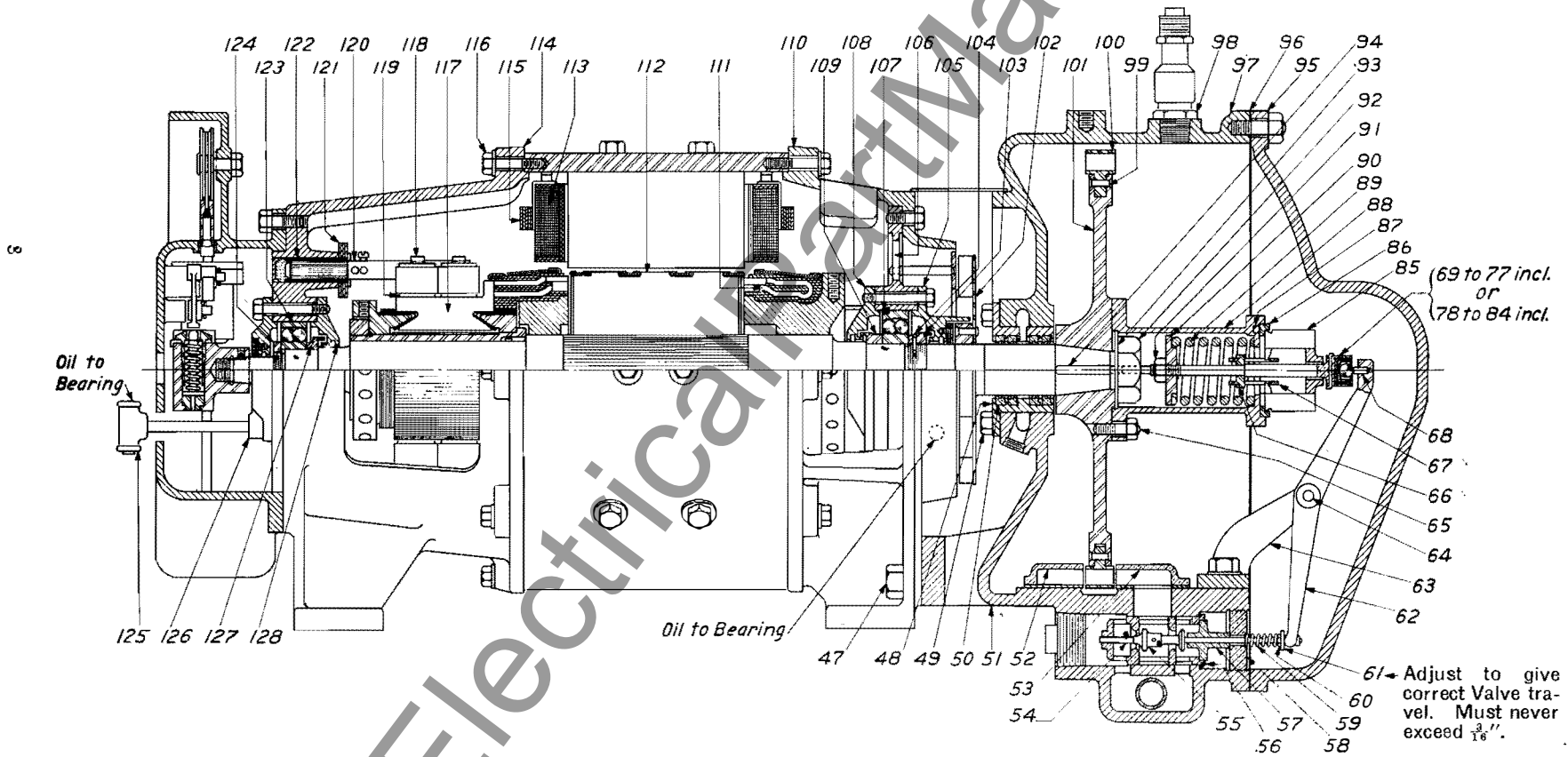


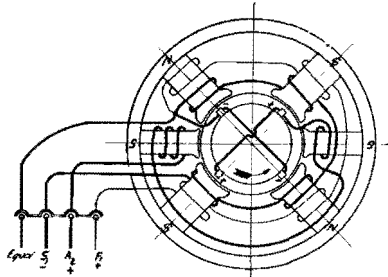
FIG. 5—LONGITUDINAL SECTION THROUGH TURBINE AND GENERATOR

Westinghouse Small Direct-Connected Turbine-Generator Units

DIAGRAMS OF CONNECTIONS

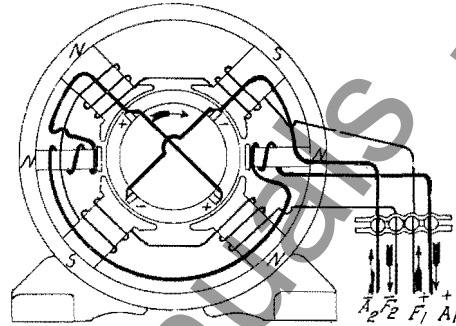
Viewed from Commutator End  
Counter Clockwise Rotation

Fig. 6—Compound-Wound Generator



Connect A2 to + line.  
Connect S1 to --- line.  
Connect F1 to field rheostat and thence to + line.

Fig. 7—Shunt-Wound Generator



Connect A1 and F2 to --- line.  
Connect A2 to + line.  
Connect F1 to field rheostat and thence to + line.

taken to keep the ends of the paper as close to the commutator as possible, thus avoiding rounding the ends of the brush. After the first brush is properly ground, it should be lifted sufficiently to prevent its being forced against the commutator, and the second brush should be ground in the same manner.

The commutator must be kept clean and should be wiped at frequent intervals with a piece of clean canvas cloth free from lint. Apply lubricant sparingly; a piece of paraffin rubbed lightly across the surface when it is very dry and the brushes make a squeaking noise, will furnish sufficient lubrication.

The commutator should always be smooth and polished and have a chocolate color around the brush path. If the commutator should become roughened by excessive sparking or burning, it should be polished with fine sand paper. The brushes should be lifted, and when the machine has reached a normal speed No. 000 sand paper should be moved lightly back and forth across the commutator. Care should be taken to remove all copper dust and sand from the commutator and from the inside of the machine before again operating.

Sparking at the brushes may indicate a defective winding, but before the windings are condemned, the brushes and commutator should be inspected to see that they are in good condition. Sometimes small particles of conducting material become lodged between the copper bars of the commutator causing a short circuit. These particles can be removed by using a thin instrument, care being taken not to burr the copper bars.

Lubrication

The two ball-bearing oil wells (Pipes with T ends) should be filled

with a light oil to within one-eighth inch ( $\frac{1}{8}$ " ) of the top of the tee. One filling should be sufficient for about a week. The bearings may be cleaned occasionally by removing the plugs at the lower ends of the tees, thus draining the oil wells and using kerosene instead of lubricating oil for a few minutes. Do not use graphite or graphite grease in these bearings.

Operation

To Start:

1. See that the circuit breaker and line switch are open.
2. Adjust field rheostat, putting all resistance in the circuit.
3. Make sure that exhaust line is clear and that auto stop trip weight is latched in its upper position.
4. Make sure that cylinder drain is open and keep it open until steam line and cylinder are free of water.
5. Open throttle valve and bring unit up to speed gradually; making sure that the speed is under control of the governor before opening throttle valve wide. This will be shown by the voltmeter.
6. Adjust field rheostat to give proper voltage.
7. Close the line switch and circuit-breaker and apply load.

**Note:** When starting a generator for parallel connection, the voltage of the incoming machine must first be made to agree in direction and strength with that of the bus-bars on the generator already in operation. Then close the equalizer switch, the generator switch and the circuit-breaker. These two

switches are sometimes combined in a three-pole switch. If single-pole equalizer switches are used, the generator must not be connected in parallel until the equalizer circuit is complete. On closing the switch connecting the generator to the bus-bars, adjust the field rheostat again until the incoming machine takes its share of the load, as shown by the ammeters.

To Stop:

1. Adjust field rheostat to reduce the voltage, and consequently the load.
2. Open the circuit breaker and the line switch.
3. Close the throttle valve. The throttle valve should be closed occasionally, if not always, by tripping the weight latch through the small hole at the generator end, which tests the closing action of the overspeed trip. Reset the trip mechanism by turning throttle in closing direction, and lift weight and replace holding lever under it through slot at rear of generator.
4. Close the stop valve in the steam line ahead of the throttle valve and open the cylinder drain.

Maintenance

The construction and adjustments of the various parts have been described above. In addition the following points should be noted:

1. Keep steam strainer clean. This strainer can be removed by removing the throttle valve body.
2. Keep gland free of scale and dirt.
3. Inspect governor valve occasionally and make sure that stem

Westinghouse Small Direct-Connected Turbine-Generator Units

- does not stick or bind in the guides.
4. Inspect governor for excessive wear and see that parts work freely.
  5. Inspect auto stop and see that weight "3" does not stick or bind.
  6. Failure to build up or to generate full voltage may be due to:
    - (1) Slow speed;
    - (2) Open shunt field circuit, caused by faulty connections or a failure in a coil or the rheostat;

- (3) Open armature or series field circuit;
- (4) Incorrect setting of brushes;
- (5) Reversed series or shunt coils;
- (6) Poor brush contact due to dirty commutator or brushes sticking in holders;
- (7) Loss of residual magnetism.

**Renewal Parts**

**Ordering Renewal Parts**—In case renewal parts are required, consult the nearest Sales Office, as shown in

list of this book. In all cases give the following information and give a description of parts. **First**, name plate reading complete. **Second**, normal voltage frequency. **Third**, refer to parts by name as given in illustrations and part list of this book.

**Recommended Stock of Renewal Parts**—In order to obtain uninterrupted service it is recommended that the following items be maintained in the stock of renewal parts:

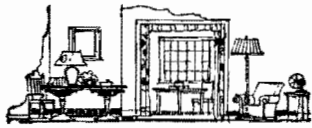
**TURBINE PARTS**

Item No.	Name of Part	No. Per Unit	UNITS IN USE UP TO AND INCLUDING		
			2	5	15
			Quantity Recommended		
23	Throttle Valve	1	0	1	3
24	Throttle Valve Retainer	1	0	1	3
36	Throttle Valve Trip Lever Spring	1	1	2	6
37	Throttle Valve Trip Lever Spring Plate	1	1	2	6
38	Throttle Valve Packing #1	1 set	1 set	2 sets	6 sets
39	Throttle Valve Packing #2				
43	Throttle Valve Spring	1	0	1	2
..	Throttle Valve Complete	1	0	1	2
21	Steam Strainer	1	1	2	6
3	Auto Stop Gov. Weight	1	1	2	6
4	Auto Stop Gov. Spring	1	1	2	6
5	Auto Stop Governor Spring Retainer	1	1	2	6
6	Auto Stop Governor Spring Retainer Lock	1	1	2	6
7	Auto Stop Gov. Spring Liners	1 set	1 set	2 sets	6 sets
14	Auto Stop Gov. Trip Weight Rod End	1	0	1	2
17	Auto Stop Gov. Trip Cord	1	1	2	6
19	Auto Stop Gov. Trip Weight Rod	1	0	1	2
20	Auto Stop Gov. Trip Weight Rod Sleeve	1	0	1	2
54-57	Gov. Valve Complete	1	1	2	6

**TURBINE PARTS (cont'd)**

Item No.	Name of Part	No. Per Unit	UNITS IN USE UP TO AND INCLUDING		
			2	5	15
			Quantity Recommended		
59	Gov. Valve Stem Spring	1	0	1	2
69 or 78	Gov. Spindle Complete	1	1	2	6
85	Governor Weight	2	2	4	12
67	Governor Knife Edge	2	2	4	12
66	Gov. Knife Edge Beam	1	1	2	6
86	Gov. Knife Edge Block	2	2	4	12
87	Gov. Knife Edge Block Pin	4	4	8	24
89	Governor Spring	1	1	1	2
91	Gov. Spindle Nut	1	1	2	6
..	Governor Complete	1	0	1	2
50	Gland Packing Rings and Springs	1 set	1 set	2 sets	6 sets
52	Reversing Chamber	1	0	1	2
53	Nozzle	1	0	1	2
101	Rotor Completely Bladed	1	0	0	1
<b>Generator Parts</b>					
..	Complete Armature	1	0	0	1
111	Armature Coil	1 set	1/3 set	2/3 set	1 set
..	Rewinding Material	1 set	1/3 set	2/3 set	1 set
113	Field Coil-Shunt	4	2	2	4
115	Field Coil-Series	4	2	2	4
..	Field Coil-Commutating	2	1	1	2
119	Brush	1 set	1 set	2 sets	3 sets
118	Brushholder	1 set	1/4 set	1/2 set	1 set
123	Ball-Bearing—Inboard	1	1	1	2
107	Ball-Bearing—Outboard	1	1	1	2

# Westinghouse Products



## Homes—Farms

Air Heaters  
 Auto Engine Heaters  
 Automatic Irons  
 Automatic Percolators  
 Automatic Ranges  
 Cozy Glow Heaters  
 Curling Irons  
 Fans  
 Hot Plates  
 Light and Power Plants  
 Lighting Equipment  
 Mazda Lamps  
 Motors for  
 Buffers and Grinders  
 Ice Cream Freezers  
 Ironers and Washers  
 Refrigerators  
 Sewing Machines  
 Vacuum Cleaners

Newel Posts  
 Panelboards  
 Radio Equipment  
 Rectifying Chargers for  
 Automobiles and  
 Radio Batteries  
 Rectox Trickle Charger  
 Refrigerators, Electrical  
 Safety Switches  
 Solihire Luminaires  
 Sol-Lux Luminaires  
 Solar Glow Heaters  
 Table Stoves  
 Tumbler Water Heaters  
 Turnover Toasters  
 Vacuum Cleaners  
 Wall-Type Heaters  
 Waffle Irons  
 Warming Pads  
 Water Heaters



## Buildings

Arc Welding Equip.  
 Circuit-Breakers  
 Elevators and Control  
 Glue and Solder Pots  
 Instruments and Relays  
 Kitchen Equipment  
 Bake Ovens  
 Hot Plates, Ranges  
 Lighting Equipment  
 Brackets, Newels  
 and Lanterns  
 Reflectors & Lamps  
 Sol-Lux Luminaires  
 Lightning Arresters  
 Micarta Trays  
 Meters  
 Meter Service Switches

Motor Generators  
 Motors and Control for  
 Coal and Ash-Hand-  
 ling Equipment  
 Compressors  
 Elevators  
 Fans and Blowers  
 Laundry Equipment  
 Refrigerating Equip.  
 Vacuum Cleaners  
 Water & Sump Pumps  
 Panelboards  
 Radio Equipment  
 Synchronous Converters  
 Safety Switches  
 Solar Glow Heaters  
 Stokers  
 Switchgear  
 Transformers



## City Improvements

Airport Floodlights  
 Automatic Substations  
 Constant Current Reg-  
 ulators  
 Control Apparatus  
 Elec. Railway Equip.

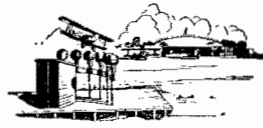
Lighting Units  
 Mazda Lamps  
 Ornamental Standards  
 Parkway Cables  
 Street Brackets  
 Streethoods



## Offices and Stores

Air Heaters  
 Breadbaking Oven  
 Elevators and Control  
 Fans, Desk and Ex-  
 haust  
 Fuses  
 Lighting Equipment  
 Mazda Lamps  
 Meters  
 Micarta Desk Tops  
 Motors for  
 Adding Machines  
 Addressing Machines

Motors for  
 Coffee and Meat  
 Grinders, etc.  
 Dictaphones  
 Envelope Sealers  
 Fans and Blowers  
 Pumps  
 Refrigerating Ma-  
 chines  
 Panelboards  
 Safety Switches  
 Switches  
 Tumbler Water Heaters



## Aviation

Approach, Boundary,  
 Hangar, and Obstruc-  
 tion Lights  
 Arc Welding Equip.  
 Floodlight Projectors  
 Motor-Generators  
 Reflectors  
 Transformers

Mazda Lamps  
 Micarta  
 Cabin-lining Plate  
 Fairleads  
 Hinge Bearings  
 Propellers  
 Pulleys  
 Tailwheels  
 Radio Equipment



## Ships

Circuit-Breakers  
 Condensing Equipment  
 Deck Winch Motors  
 Elec. Heating Appar.  
 Eng. Room Auxiliaries  
 Fans and Blowers  
 Fuses  
 Generating Equipment  
 Instruments  
 Light and Power Plants  
 Lighting Equipment

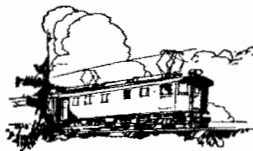
Micarta Trays  
 Motors and Controllers  
 Ovens, Ranges and  
 Galley Equipment  
 Panelboards  
 Propulsion Equipment  
 Diesel-Electric  
 Geared Turbine  
 Turbine Electric  
 Radio Equipment  
 Safety Switches  
 Switchgear



## Electric Railways

Arc Welding Equip.  
 Automatic Substations  
 Babbitt, Solder & Pots  
 Baking Ovens  
 Circuit-Breakers  
 Elec. Trolley Coaches  
 Fans  
 Gas Electric Coaches  
 Gears and Pinions  
 Generators  
 Insulating Material  
 Insulators  
 Lighting Fixtures  
 Lightning Arresters

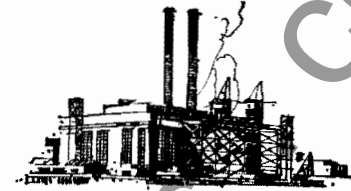
Line Material  
 Manual Substations  
 Mazda Lamps  
 Meters  
 Motors and Control  
 Panelboards  
 Portable Substations  
 Relays  
 Signal Equipment  
 Supervisory Control  
 Switchgear  
 Synchronous Convert's  
 Transformers  
 Trolley Poles



## Railroads

Arc Welding Equipment  
 Automatic Substations  
 Babbitt, Solder & Pots  
 Baking Ovens  
 Battery Charging Equip.  
 Cars—Multiple Unit,  
 Gas-Elec., Oil-Elec.  
 Circuit-Breakers  
 Control Apparatus  
 Elec. Heating Apparatus  
 Fans  
 Gears and Pinions  
 Generators  
 Headlight Equipment  
 Instruments  
 Insulating Materials  
 Insulators  
 Lighting Equipment

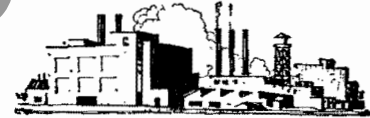
Lightning Arresters  
 Line Material  
 Locomotives—Electric  
 Gas-Elec., Oil-Elec.  
 Manual Substations  
 Mazda Lamps  
 Micarta Gears  
 Motors and Control  
 Outdoor Substations  
 Panelboards  
 Power House Apparatus  
 Radio Equipment  
 Safety Switches  
 Signal Equipment  
 Stokers  
 Supervisory Control  
 Switchgear  
 Transformers  
 Yard Lighting Equip.



## Electric Service Companies

Automatic Switching  
 Equipment  
 Circuit-breakers  
 Condensers  
 Cutouts  
 Fans  
 Frequency-converters  
 Fuses  
 Generators  
 Instruments & Meters  
 Insulating Material  
 Insulators  
 Line Material  
 Lighting Equipment  
 Lightning Arresters  
 Micarta  
 Motors and Control  
 Motor-Generators

Network Protectors  
 Network Transformers  
 Oil Testing and Purify-  
 ing Equipment  
 Outdoor Substations  
 Panelboards  
 Porcelain Insulators  
 Relays  
 Safety Switches  
 Steam Turbines  
 Stokers  
 Supervisory Control  
 Switchgear  
 Synchronous Condens-  
 ers  
 Synchronous Convert-  
 ers  
 Transformers  
 Turbine Generators  
 Voltage Regulator



## Mills and Factories

Arc Welding Equip.  
 Automatic Starters  
 and Controllers  
 Babbitt & Babbitt Pots  
 Capacitors  
 Circuit-Breakers  
 Condensers  
 Fans, Desk and Exhaust  
 Furnaces and Ovens  
 Fuses  
 Generating Equipment  
 Insulating Materials  
 Knife Switches  
 Larry Car Equipment  
 Lighting Equipment  
 Lightning Arresters

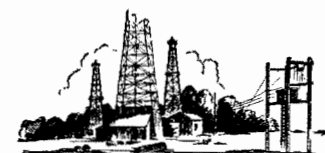
Locomotives—Electric  
 Gas-Elec., Oil Elec.  
 Mazda Lamps  
 Meters and Relays  
 Micarta Gears  
 Motors and Controllers  
 Panelboards  
 Pipe Fittings (Struct'al)  
 Power House Apparatus  
 Safety Switches  
 Solder & Glue Pots  
 Space Heaters  
 Stokers  
 Switchgear  
 Transformers  
 Turbines



## Mines

Arc Welding Equip.  
 Auto. Feeder Equip.  
 Automatic Starters  
 and Controllers  
 Automatic Substations  
 Battery-Charging Equip.  
 Circuit-Breakers  
 Clamps  
 Elec. Heating Apparatus  
 Fans  
 Gears and Pinions  
 Headlights  
 Insulating Materials  
 Insulators  
 Larry Car Equipment  
 Lightning Arresters  
 Line Material

Locomotives  
 Manual Substations  
 Mazda Lamps  
 Meters & Instruments  
 Micarta  
 Motor Generators  
 Motors for Hoists,  
 Pumps, Triples,  
 and Breakers  
 Panelboards  
 Portable Substations  
 Relays  
 Safety Switches  
 Switchgear  
 Synchronous Converters  
 Transformers  
 Ventilating Outfits



## Oil Fields

Arc Welding Equip.  
 Change House Heaters  
 Floodlight Projectors  
 Gear Units  
 Insulators  
 Mazda Lamps  
 Motors and Control

Panelboards  
 Reflectors  
 Rig Lighters  
 Safety Switches  
 Small Light Plants  
 Transformers  
 Vapor Proof Fixtures

# Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

## WESTINGHOUSE SALES OFFICES

ABILENE, KAN., 308 N. Cedar St.  
 AKRON, OHIO, 11 S. Main St.  
 ALBANY, N. Y., 360 Broadway  
 ALLENTOWN, PA., 433 Green St.  
 APPLETON, WIS., 81 Bellaire Court  
 \*ATLANTA, GA., 426 Marietta Sr. N. W.  
 BAKERSFIELD, CALIF., 2224 San Emedio St.  
 BALTIMORE, MD., 118 E. Lombard St.  
 BEAUMONT, TEX., La Salle Hotel  
 BIRMINGHAM, ALA., 2030 Second Ave.  
 BLUEFIELD, W. VA., 208 Bluefield Ave.  
 \*BOSTON, MASS., 10 High St.  
 BRIDGEPORT, CONN., Bruce Ave. and Seymour St.  
 \*BUFFALO, N. Y., 814 Ellicott Square  
 BURLINGTON, IOWA, P. O. 197  
 BURLINGTON, VT., Park Ave.  
 \*BUTTE, MONT., 52 E. Broadway  
 CANTON, OHIO, 120 Tuscarawas St., West  
 \*CHARLOTTE, N. C., 210 E. Sixth St.  
 CHATTANOOGA, TENN., 536 Marker St.  
 \*CHICAGO, ILL., 20 N. Wacker Drive  
 \*CINCINNATI, OHIO, 207 W. Third St.  
 \*CLEVELAND, OHIO, 1216 W. 58th St.  
 COLUMBUS, OHIO, 200 S. Third St.  
 \*DALLAS, TEX., 200 Browder St.  
 DAVENPORT, IOWA, 206 E. Second St.  
 DAYTON, OHIO, 32 N. Main St.  
 \*DENVER, COLO., 910 Fifteenth St.  
 DES MOINES, IOWA, 218 Second St.  
 \*DETROIT, MICH., 5757 Trumbull Ave.  
 DULUTH, MINN., 10 East Superior Street  
 ELMIRA, N. Y., 335 E. Water St.  
 \*EL PASO, TEXAS, 103 N. Oregon St.  
 \*EMERYVILLE, CALIF., 5815 Paladeau St.  
 ERIE, PA., 102 W. 9th St.  
 EVANSVILLE, IND., P. O. Box 457.

FAIRMONT, W. VA., 602 Cleveland Ave.  
 FORT WAYNE, IND., 1010 Packard Ave.  
 FORT WORTH, TEX., 501 Jones St.  
 GARY, IND., 735 Arthur St.  
 GRAND RAPIDS, MICH., 507 Monroe Ave. N.W.  
 GREENVILLE, S. C., West Earle St.  
 HAMMOND, IND., 403 Waltham St.  
 \*HOUSTON, TEX., 608 Fannin St.  
 \*HUNTINGTON, W. VA., 299 Ninth St.  
 INDIANAPOLIS, IND., 530 Madison Ave.  
 ISHPeming, MICH., 433 High St.  
 JACKSON, MICH., 212 W. Michigan Ave.  
 JACKSONVILLE, FLA., 37 S. Hogan St.  
 JOHNSTOWN, PA., 47 Messenger St.  
 \*KANSAS CITY, MO., 2124 Wyandotte St.  
 KNOXVILLE, TENN., 602 Gay St.  
 LITTLE ROCK, ARK., 1115 West Twenty-fourth St.  
 \*LOS ANGELES, CALIF., 420 S. San Pedro St.  
 LOUISVILLE, KY., 322 W. Broadway  
 MADISON, WIS., 508 Edgewood Ave.  
 MEMPHIS, TENN., 130 Madison Ave.  
 MIAMI, FLA., P. O. Box 1168.  
 MILWAUKEE, WIS., 546 N. Broadway  
 \*MINNEAPOLIS, MINN., 2303 Kennedy Sr. N.E.  
 MONROE, LA., 1610 N. Fourth St.  
 NASHVILLE, TENN., 213 N. Second Ave.  
 \*NEWARK, N. J., Haynes Ave. and Lincoln Highway  
 NEW HAVEN, CONN., 240 Cedar St.  
 \*NEW ORLEANS, LA., 333 St. Charles St.  
 NEW YORK, N. Y., 30 Rockefeller Plaza  
 NIAGARA FALLS, N. Y., 205 Falls St.  
 OKLAHOMA CITY, OKLA., 10 E. California St.  
 OMAHA, NEB., 409 S. Seventeenth St.  
 PEORIA, ILL., 104 E. State St.  
 \*PHILADELPHIA, PA., 3001 Walnut St.  
 \*PHOENIX, ARIZ., 11 W. Jefferson St.

\*PITTSBURGH, PA., 435 Seventh Ave.  
 PITTSBURGH, KANSAS, P. O. Box 15  
 PORTLAND, ME., P. O. Box 1797  
 \*PORTLAND, ORE., 309 Southwest Sixth Ave.  
 PROVIDENCE, R. I., 393 Harris Ave.  
 RALEIGH, N. C., 803 N. Person St.  
 RICHMOND, VA., 301 S. Fifth St.  
 ROCHESTER, N. Y., 410 Atlantic Ave.  
 ROCKFORD, ILL., 130 S. Second St.  
 SACRAMENTO, CALIF., 1167 Ninth St.  
 \*SALT LAKE CITY, UTAH, 10 W. First South St.  
 SAN ANTONIO, TEX., 212 East Houston St.  
 SAN DIEGO, CALIF., 861 Sixth St.  
 SAN FRANCISCO, CALIF., 1 Montgomery St.  
 \*SEATTLE, WASH., 603 Stewart St.  
 SIOUX CITY, IOWA, 2111 George St.  
 \*SOUTH BEND, IND., 216 E. Wayne St.  
 SPOKANE, WASH., 152 S. Monroe St.  
 SPRINGFIELD, ILL., 130 S. Sixth St.  
 SPRINGFIELD, MASS., 305 Liberty St.  
 \*ST. LOUIS, MO., 411 N. Seventh St.  
 SYRACUSE, N. Y., 420 N. Geddes St.  
 TACOMA, WASH., 1021 Pacific Ave.  
 TAMPA, FLA., 417 Ellanna Ave.  
 TOLEDO, OHIO, 245 Summit St.  
 TULSA, OKLA., 303 E. Brady St.  
 \*UTICA, N. Y., 113 N. Genesee St.  
 WASHINGTON, D.C., 1434 New York Ave. N.W.  
 WATERLOO, IOWA, 325 Jefferson St.  
 WICHITA, KAN., 400 South Emporia St.  
 WILKES-BARRE, PA., 267 N. Pennsylvania Ave.  
 WORCESTER, MASS., 32 Southbridge St.  
 YORK, PA., 143 S. George St.  
 The HAWAIIAN ELECTRIC CO., Ltd., Honolulu, T. H.—Agent

\*Warehouses located in these cities.

## WESTINGHOUSE AGENT-JOBBERS

ABILENE, KAN., Union Electric Co.  
 AKRON, OHIO, The Mook Elec. Supply Co.  
 ALBANY, N. Y., Westinghouse Elec. Sup. Co., Inc.  
 ALLENTOWN, PA., Westinghouse Elec. Sup. Co.  
 ATLANTA, GA., Westinghouse Elec. Sup. Co.  
 AUGUSTA, ME., Westmore-Savage Elec. Supply Co.  
 BALTIMORE, MD., Westinghouse Electric Supply Co.  
 BANGOR, ME., Westmore-Savage Elec. Sup. Co.  
 BINGHAMTON, N. Y., Westinghouse Electric Supply Co., Inc.  
 BIRMINGHAM, ALA., Moore-Handley Hdw. Co.  
 BLUEFIELD, W. VA., Superior-Sreling Co.  
 BOSTON, MASS., Westmore-Savage Elec. Sup. Co.  
 BUFFALO, N. Y., McCarthy Bros. & Ford  
 BURLINGTON, VT., Westinghouse Elec. Sup. Co.  
 BUTTE, MONT., Westinghouse Elec. Sup. Co.  
 CANTON, OHIO, The Mook Elec. Supply Co.  
 CHARLOTTE, N. C., Westinghouse Elec. Sup. Co.  
 CHATTANOOGA, TENN., Mills & Lupton Sup. Co.  
 CHICAGO, ILL., Hyland Elec. Supply Co.  
 CHICAGO, ILL., Westinghouse Elec. Sup. Co., Inc.  
 CINCINNATI, O., The Johnson Elec. Sup. Co.  
 CLEVELAND, O., Westinghouse Elec. Sup. Co.  
 COLUMBIA, S. C., Westinghouse Elec. Sup. Co.  
 COLUMBUS, O., The Hughes-Peters Elec. Corp.  
 COLUMBUS, O., Pixley Elec. Supply Co.  
 DALLAS, TEX., Westinghouse Elec. Sup. Co.  
 DENVER, COLO., The Mine & Smelter Sup. Co.  
 DES MOINES, IA., Westinghouse Elec. Sup. Co., Inc.  
 DETROIT, MICH., Westinghouse Elec. Sup. Co.  
 DULUTH, MINN., Westinghouse Electric Supply Co., Inc.  
 EL PASO, TEX., The Mine & Smelter Sup. Co.  
 EL PASO, TEX., Zork Hardware Co.  
 ERIE, PA., Srac Electrical Co.

EVANSVILLE, IND., Westinghouse Elec. Sup. Co.  
 FLINT, MICH., Westinghouse Elec. Sup. Co.  
 FORT WORTH, TEX., Westinghouse Elec. Sup. Co.  
 GRAND RAPIDS, MICH., Westinghouse Electric Supply Co.  
 GREENVILLE, S. C., Westinghouse Elec. Sup. Co.  
 HOUSTON, TEX., Westinghouse Elec. Sup. Co.  
 HUNTINGTON, W. VA., Banks-Miller Sup. Co.  
 INDIANAPOLIS, IND., Westinghouse Elec. Sup. Co.  
 JACKSONVILLE, FLA., Westinghouse Elec. Sup. Co.  
 KANSAS CITY, MO., Columbian Electrical Co.  
 LOS ANGELES, CALIF., Westinghouse Electric Supply Co.  
 LOUISVILLE, KY., Tafel Electric Co.  
 MADISON, WIS., Westinghouse Elec. Sup. Co., Inc.  
 MEMPHIS, TENN., Westinghouse Elec. Sup. Co.  
 MILWAUKEE, WIS., Westinghouse Electric Supply Co., Inc.  
 MINNEAPOLIS, MINN., Westinghouse Electric Supply Co., Inc.  
 MONROE, LA., Monroe Hardware Co.  
 NASHVILLE, TENN., Tafel Electric Co.  
 NEWARK, N. J., Westinghouse Elec. Sup. Co., Inc.  
 NEW HAVEN, CONN., Westinghouse Elec. Sup. Co.  
 NEW ORLEANS, LA., Electrical Supply Co.  
 NEW YORK, N. Y., Times Appliance Co., Inc.  
 NEW YORK, N. Y., Westinghouse Elec. Sup. Co., Inc.  
 OAKLAND, CALIF., Westinghouse Electric Supply Co.  
 OKLAHOMA CITY, OKLA., Westinghouse Electric Supply Co.  
 OMAHA, NEB., Westinghouse Elec. Sup. Co., Inc.  
 PEORIA, ILL., Westinghouse Elec. Sup. Co., Inc.  
 PHILADELPHIA, PA., Westinghouse Electric Supply Co.  
 PHOENIX, ARIZ., Westinghouse Electric Supply Co.

PITTSBURGH, PA., Iron City Electric Co.  
 PORTLAND, ORE., Westinghouse Elec. Supply Co.  
 PROVIDENCE, R. I., Westmore-Savage Elec. Sup. Co.  
 RALEIGH, N. C., Westinghouse Electric Supply Co.  
 READING, PA., Westinghouse Elec. Sup. Co.  
 RICHMOND, VA., Westinghouse Elec. Sup. Co.  
 ROCHESTER, N. Y., Westinghouse Elec. Sup. Co., Inc.  
 SALT LAKE CITY, UTAH, Westinghouse Electric Supply Co.  
 SAN ANTONIO, TEX., Westinghouse Elec. Sup. Co.  
 SAN FRANCISCO, CALIF., Westinghouse Electric Supply Co.  
 SCRANTON, PA., Penn. Elec'l. Engineering Co.  
 SEATTLE, WASH., Westinghouse Elec. Supply Co.  
 SIOUX CITY, IA., Westinghouse Elec. Sup. Co., Inc.  
 SPOKANE, WASH., Westinghouse Elec. Sup. Co.  
 SPRINGFIELD, MASS., Westinghouse Elec. Supply Co.  
 ST. LOUIS, MO., Westinghouse Elec. Sup. Co.  
 ST. PAUL, MINN., Westinghouse Electric Supply Co., Inc.  
 SYRACUSE, N. Y., Westinghouse Elec. Sup. Co., Inc.  
 TAMPA, FLA., Westinghouse Electric Supply Co.  
 TOLEDO, OHIO, Westinghouse Elec. Sup. Co.  
 TRENTON, N. J., Westinghouse Elec. Sup. Co., Inc.  
 TULSA, OKLA., Westinghouse Elec. Sup. Co.  
 UTICA, N. Y., Westinghouse Elec. Sup. Co., Inc.  
 WASHINGTON, D. C., Westinghouse Electric Supply Co.  
 WATERLOO, IA., Westinghouse Elec. Sup. Co., Inc.  
 WICHITA, KAN., Westinghouse Electric Supply Co.  
 WILMINGTON, DEL., Westinghouse Elec. Sup. Co.  
 WORCESTER, MASS., Westmore-Savage Elec. Sup. Co.  
 YORK, PA., Westinghouse Elec. Sup. Co.  
 YOUNGSTOWN, OHIO, Mook Elec. Supply Co.

## WESTINGHOUSE SERVICE SHOPS

APPLETON, WIS., 1020 S. Outagamie St.  
 ATLANTA, GA., 426 Marietta St., N. W.  
 BALTIMORE, MD., 501 East Preston St.  
 BOSTON, MASS., 12 Farnsworth St.  
 BRIDGEPORT, CONN., Bruce Ave. and Seymour St.  
 BUFFALO, N. Y., 1132 Seneca St.  
 CHARLOTTE, N. C., 210 E. Sixth St.  
 CHICAGO, ILL., 2211 W. Pershing Road  
 CINCINNATI, OHIO, 207 W. Third St.  
 CLEVELAND, OHIO, 1216 W. 58th St.  
 DENVER, COLO., 2644 Walnut St.  
 DETROIT, MICH., 5757 Trumbull Ave.

FAIRMONT, W. VA., 602 Cleveland Ave.  
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 JOHNSTOWN, PA., 47 Messenger St.  
 KANSAS CITY, MO., 2124 Wyandotte St.  
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 MINNEAPOLIS, MINN., 2303 Kennedy Sr., N. E.  
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