

**MAINTENANCE OF
STONE'S L. B. B.
TURBO-GENERATOR
TYPE T.G.I.**

INCLUDING

RECHARGING AND OVERHAUL



FLATON GEBRÜDER
Handels- & Ingenieurwerk
RAABHUSPLAUSSEN 4, BUNDESR. N. N. DE. P. A. L. E. 8190

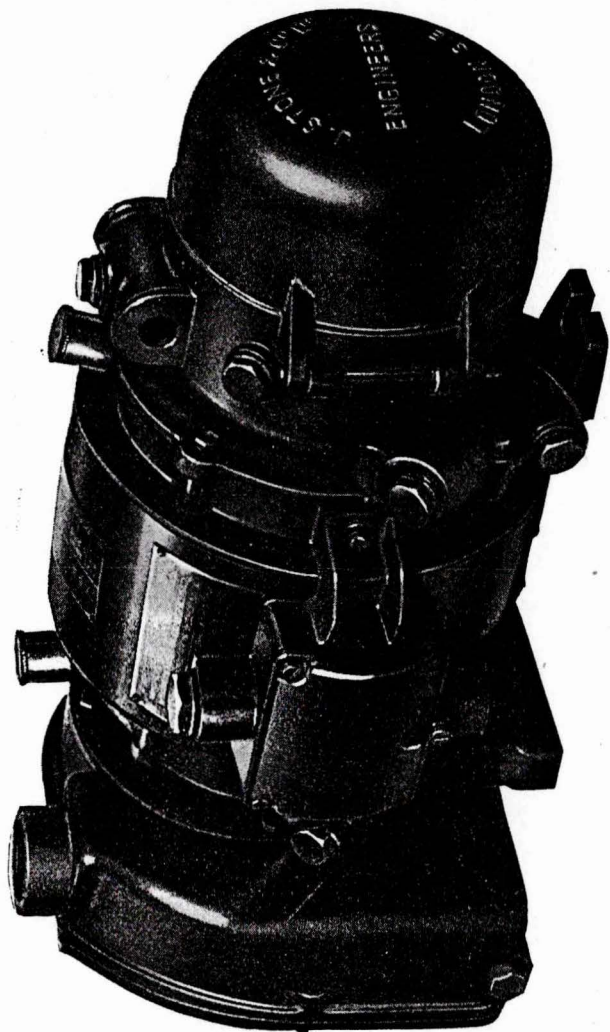
**J. STONE
& COMPANY LIMITED**

ENGINEERS AND FOUNDERS

OCEANIC HOUSE, 1A COCKSPUR STREET, LONDON, S.W.1
Telephone : Whitehall 9683 (5 Lines). Telegrams: "Oceanilla, Lesquare, London"

WORKS ADDRESS **DEPTFORD, LONDON, S.E.14**
Telephone : Tideway 1202 (16 Lines). Telegrams: "Tostones, Nucros, London"

BRANCH WORKS **CHARLTON, LONDON, S.E.7**



STONE'S L.B.B. TURBO-GENERATOR TYPE T.G.I.

STONE'S L.B.B. TURBO-GENERATOR T.G.I.

General Information. These Turbo-Generators are designed to provide a supply of Electric Current for lighting purposes on Railway Locomotives, Fishing Vessels, Break-down equipment, stationary plant, and they may be used in any circumstances where steam is available as the primary source of power.

No storage batteries are required and power for electric lighting is obtained solely from an impulse steam turbine, direct coupled to a single phase alternating current generator of the Inductor type.

The Turbo-Generator forms a compact and self-contained unit designed with feet for conventional mounting on any flat surface, which may be readily applied to a saddle mounting on curved surfaces, such as locomotive boilers, tanks, etc.

The Turbine incorporates a "bucket" wheel of special design to which rotary movement is imparted by a jet of steam passing through a nozzle appropriate to the conditions of steam pressure and electrical output.

The A.C. Generator has stationary armature windings, and the only rotating part is a laminated nine tooth rotor. Field excitation being provided by permanent magnets arranged round the periphery. The principle of generation is based on the diversion of magnetic flux by the rotor

teeth passing across the face of stationary poles, in which the coils are embedded, so that the flux passes alternatively through the centre and to either side of the two armature coils.

The electrical frequency of current is naturally high, as it is governed by the nine tooth rotor construction, and speed of rotation. **Standard commercial instruments may not be suitable for current and voltage measurement, unless they are of the type designed to give accurate reading up to 1,000 Cycles per second.**

Notes on Erection. To facilitate dismantling, the steam and exhaust pipes should be provided with unions adjacent to the machine. Similarly, the conduit outlet of the terminal box should be provided with a nipple, running socket, and backnut.

The steam pipe entries are drilled and tapped to take $\frac{1}{2}$ " British Standard Pipe threads, and the feed can be taken to either the Right or Left hand side, but not vertically, although for manufacturing convenience a tapped hole and plug is provided in this position.

The exhaust outlet is positioned at the top of the turbine casing, and is drilled and tapped to take $\frac{1}{2}$ " British Standard Pipe Thread, in this case, the pipe line may be diverted from the vertical by easy bends but no elbows.

The water drain hole in the turbine casing is screwed $\frac{3}{8}$ " British Standard Pipe thread and the machine is supplied with a plug fitted in this position, this must be removed and replaced by a suitable length of pipe to carry away the condensate, with no stop cock so that wheel casing is always open to atmospheric pressure.

The Cable Conduit outlet on Terminal Box is screwed to $\frac{3}{4}$ " British Standard Pipe thread and arrangements are

provided for entry at either top or bottom, and running sockets with backnuts should be provided to facilitate removal of the machine.

Instructions to be observed at the time of installation.

Before the turbo-generator is started up, the following points should be given careful attention :—

1. See that both oil wells are filled with the correct grade of oil.
2. Two "breather" cups, filled with copper wool, on tubular extensions from the oil well casings, will be observed prominently on both sides of rotor, at the top of the machine ; these are for vacuum relief and should on no account be used for filling the oil wells.
3. Before coupling Turbine to a new steam pipe, blow through piping with live steam to clear out dirt and scale.
4. Examine strainer in steam inlet union, and see that same is clean.
5. When starting, turn steam on gradually, but finally, the steam feed pipe cock should be fully open, and not partially closed.
6. When the speed has settled down, observation should be made to see that the correct voltage in relation to the load that may be switched on is obtained, otherwise a re-adjustment of the governor must be made. See Instructions on pages 9 and 10 relating to speed adjustment.

Valve. The valve is located within the cover at the governor end of the machine.

STONE'S L.B.B. TURBO-GENERATOR

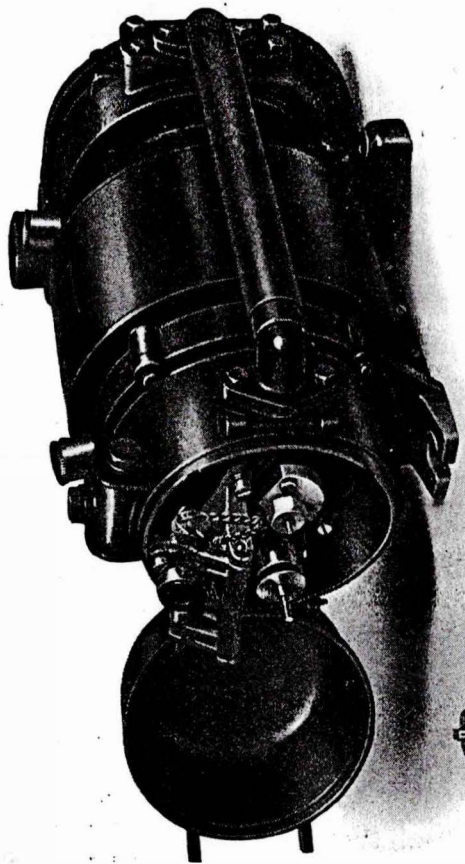


FIG. 1.
Rocker swung back giving access to valve and governor.

SERVICE MAINTENANCE

Lubrication. The two ball bearings (2368E) and (2368J) are ring lubricated and they require clean, fresh oil of the correct grade for prolonged and satisfactory service.

“DO NOT USE CYLINDER OIL.”

WAKEFIELD'S “PERFECTO” or equivalent oil is recommended.

Two oil cups for filling are provided on the terminal box side of the machine, and it is strongly recommended that the oil wells are drained off and refilled at fairly frequent intervals (depending on the conditions of service) to dispose of any condensate or impurities that may accumulate.

Valve. Remember that the satisfactory running of the turbine depends almost entirely on the free working of the valve. Should the running be irregular, or starting difficult, the valve should be tested for freedom of movement. Proceed as follows:—

Remove spring pin and withdraw quadrant adjusting pin (2374J) releasing valve stem. Remove split pins and lock-nuts (2375N) and outer thrust plate (2375M) on governor stem (2375G) and swing back the rocker (2374A.) The valve stem which is now accessible should be free to slide in and out without appreciable friction. (See Fig. 1.)

To remove the valve, first remove the three screws holding the securing plate; then unscrew the circular nut at the end of the valve body. Then screw on to the end of the valve body the special spanner provided, until the valve body comes away.

When a valve body is replaced, there is no necessity to use a spanner. Place the valve in the governor end casting and by means of the securing plate which is

secured in position by three screws, the valve is then firmly held in position.

NOTE—Be careful not to bend the valve stem when removing or replacing. If bent, do not attempt to rectify but replace by a new valve and stem.

Use petrol for cleaning—DO NOT use an abrasive.

When reassembling, do not omit to replace stop-ring in the end of the valve sleeve and finally the spring pin in the quadrant.

NOTE—When refitting the stop-ring see that it is flat and the ends are not bent inwards—otherwise the limit of travel of the valve will be extended past the full-open position and the quadrant setting will not be correct.

Before reconnecting the quadrant to the valve stem, push the stem in (without forcing it) until it meets the stop-ring. This represents the **full-open** position of the valve. Hold the rocker so that the thrust-blocks bear against the outer thrust-plate. Swing the quadrant until one of its holes registers with the hole in the valve stem. Insert the adjusting pin and the spring pin which secures it.

If the turbo-generator has been out of use for a considerable time, it is advisable to test the valve for freedom of action before re-starting. Also remove and clean the steam strainer.

A falling-off in speed, indicated by the lights becoming dim, is due, usually, either to the valve not being free or to dirt in the strainer. (See also "Speed Adjustment" page 9.)

Thrust Blocks. The thrust blocks (2374G), which transmit the action of the governor to the rocker, are made of a self-lubricating material and require no attention until it becomes necessary to replace them on account of wear. One or both should be renewed when the total "play" between the thrust-plates (2375M) and (2375L) exceeds $\frac{1}{16}$ ".

When fitting new thrust blocks, the clearance between the blocks should be .004" measured with feelers; too little clearance will cause excessive wear and an extreme case may result in the turbine failing to start. To obtain the required clearance, the thrust block should be reduced by rubbing on a fine emery cloth strip on a true, flat, metal surface.

Governor. The governor normally requires no attention and should not be tampered with, but should it be necessary to remove it, the locking screws (2375B) in the body must be slackened. Access to these is gained through the plug-hole on the terminal box side of governor end casing (I.2371A) through which a long thin screwdriver may be inserted.

The governor can then be removed with the special box-spanner provided. A **sharp** blow, given with a mallet on the end of the "Tommy" bar, is sufficient to loosen it, the inertia of the rotor and magnetic pull of the generator field offering sufficient resistance against the blow.

When replacing the governor, be careful to screw it up tightly on the shaft and secure the locking screws.

To dismantle the governor itself, unscrew the adjusting nut (2375C).

Starting. Before starting, open the throttle valve slightly for a few moments to warm the turbine and clear out water. The turbine should start easily either with or without load provided that steam pressure is sufficient.

SPEED ADJUSTMENT. Correct setting of the governor is most easily arrived at by measuring the full-load voltage. For this purpose a voltmeter specially calibrated for the high frequency of the alternating current generated, is absolutely necessary—a volt-

meter calibrated for usual power frequencies is quite useless.

Some slight adjustment in the setting of the governor to increase the speed, may be necessary after a considerable time in service owing to a slight weakening of the spring or wear of other moving parts.

To alter the speed, insert the small "Tommy" bar (a piece of steel $\frac{1}{2}$ " diameter) into one of the holes in the governor adjusting nut (2375c).

When facing the governor end of the machine, turn the nut **clockwise**. This compresses the spring, and **raises the speed**; turning the nut **counter-clockwise** **lowers the speed**.

The governor adjusting nut (2375c) is self-locking, but when completing the adjustment, the nut-lock (2375d) must be allowed to fall into a slot (indicated by a "click").

After adjustment, see that the full load voltage corresponds to the rated voltage of the lamps.

SHOP MAINTENANCE

Tools, Accessories and Instruments. The maintenance shop should be equipped with the following special tools, accessories and instruments which may be obtained from J. Stone & Co., Ltd. :—

1. **Tool kit** containing special tools for L.B.B. Turbo-generator. Namely :—
(a) Box Spanner for governor body ; (b) Extractor for ball bearings ; (c) Extractor for Bucket Wheel ; (d) Ring Spanner for Bucket Wheel Nut ; (e) Box Spanner for ball bearing ; (f) "Tommy" Bar for (a) and (e) ; (g) Locking strap for Bucket Wheel ; (h) (j) Tubular drifts for ball bearings, Ring Spanner for valve body and strainer cap (See Fig. 7) and valve extractor.

2. **Keeper** (See Fig 7).

3. **Charger** suitable for 24 to 32 volt circuit (Note—this voltage is recommended, as the inductive discharge when breaking a current on high voltage may be dangerous). (See Fig. 7).

4. **Ammeter**—D.C. complete with shunt, to read 5-0-150 amperes (if for 24-32 volt circuit).

5. **Voltmeter**—A.C., calibrated for high frequency current, to read 0-40 volts, or 0-200 volts.

6. **Ammeter**—A.C., calibrated for high frequency current to read 0-25 amperes, complete with shunt.

If current for remagnetising is to be taken from a battery or any other constant voltage supply, the following will be required :—

7. **Variable Resistance** for charger, with multiple contacts, complete with quick-break switch.

Charging. The process of remagnetising, or "charging" as it is termed, is extremely simple, but, as it involves the use of special electrical apparatus it should only be entrusted to experienced electrical staff. After remagnetising and re-assembling, the turbo-generator should be tested for output and voltage, and the speed adjusted as found necessary.

NOTE—Use only the special instrument referred to under "Speed Adjustment." (See Page 9.)

As a precaution, it is recommended that opportunity should be taken to remagnetise the generator, whenever it has been dismantled for any reason, before it goes back into service.

Dismantling for Charging. It is not necessary to dismantle the turbine end of the machine for charging.

Commence at the governor end and proceed as follows :—

1. Withdraw hinge pin and swing back governor end cover (2373A).
2. Unscrew lock-nuts on governor stem and remove outer thrust-plate (2375M).
3. Remove spring pin and withdraw adjusting pin (2374J) in quadrant then swing rocker (2374A) with thrust-block carrier (2374F) clear of governor stem (2375G) and remove inner thrust-plate (2375L).
4. Unbolt and remove steam-pipe but do not remove the nozzle at the turbine end.
5. Remove screws inside governor end casing (I.2371A), and after loosening the case with a copper or lead mallet, remove it complete with valve and valve rocker.
6. Slacken locking-screws (2375B) in governor body which lock it on the shaft.
7. Apply the special box spanner and unscrew governor by a blow on the "Tommy" bar with a mallet. The residual magnetism offers sufficient resistance against a sharp light blow to effect this. **Note** : The Governor body has a right-handed thread.
8. Remove the bolts in the governor end housing cap (2377G) and apply the extractor, screwing the two long bolts provided, into the two threaded holes in the housing. By tightening the "Tommy" screw against the shaft end, the housing will be drawn off. (See Fig 2.)
9. Slacken back the lock screw in the bearing nut (2368D) and apply the box spanner to the nut which may then be loosened by a sharp blow on

STONE'S L.B.B. TURBO-GENERATOR

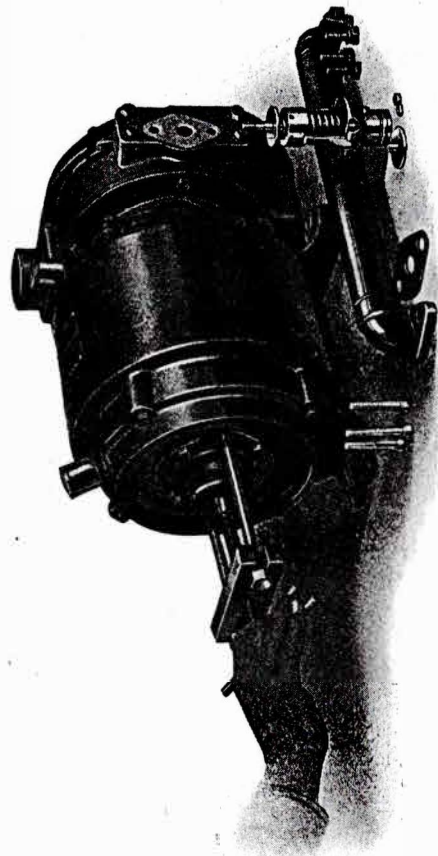


FIG. 2.
Using extractor to pull off bearing housing cap.

the "Tommy" bar. Remove the oil ring (2368c).

10. Using the "claws" instead of the bolts, apply the extractor to the ball-bearing and draw it off the shaft. Remove the oil sleeve and deflector (2368B). (See Fig. 3.) If tight, remove with housing (I.2377A).
11. Unscrew bolts holding the governor-end housing (I.2377A), loosen by light blow with mallet applied through a screwdriver at the joint and remove housing. The rotor (2387A) is then exposed.
12. Now turn to the turbine end of machine and unscrew the bolts securing the turbine-end housing and loosen the housing by a light blow with a copper mallet on the turbine case. The rotor is then ready for removal.

CAUTION, DO NOT withdraw the rotor before reading the following :—

NOTE—Removing the Rotor. The field of the generator is excited by powerful permanent magnets of high retentivity. The rotor while in position acts as a keeper and maintains the magnetic circuit through it. Should this circuit be broken, even momentarily, the magnets will be weakened and require recharging. **If it is not intended to recharge the machine, a keeper must be inserted simultaneously as the rotor is withdrawn from the generator.** In the absence of a keeper, a charger may be used as a substitute.

If the machine is to be recharged subsequently, no such special precautions are necessary.

STONE'S L.B.B. TURBO-GENERATOR

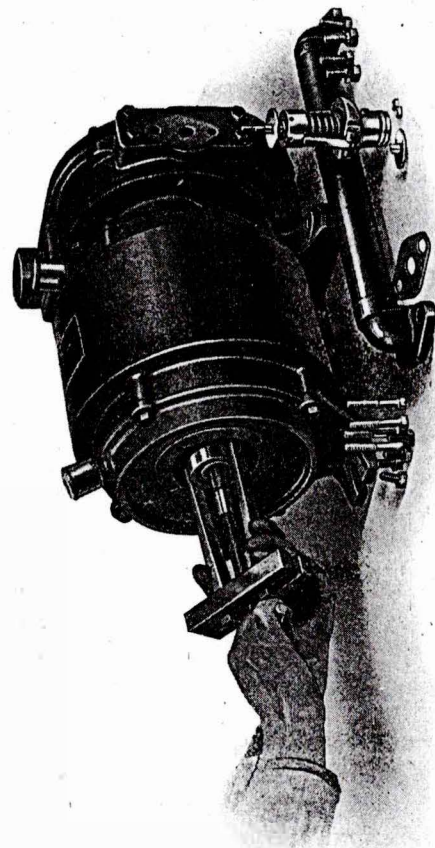


FIG. 3.
Using extractor to pull off ball-bearing.

13. To introduce the keeper (or charger used as such), let an assistant support the turbine casing while the keeper is pushed in from the governor end, thus displacing the rotor without breaking the magnetic circuit.

Charger. The charger is a powerful electro-magnet with poles designed to fit closely between the pole-pieces of the generator.

It requires from 100 to 120 amperes, direct current, at 24-32 volts (say 3 k.w.) to charge the magnets. A train-lighting dynamo will provide this current for the short time required. If a dynamo of this size is not available, a battery of train-lighting cells may be employed. If only small cells are available, two batteries of an equal number of cells should be used in parallel. Alternatively a charger wound for high voltage can be supplied, i.e. 110 or 220 volts, D.C.

One pole of the charger is chamfered off at its extremity, and when inserting it between the pole pieces, this pole should be placed on the terminal box side of the generator. The positive is marked with a (+) and should be connected to the current supply accordingly.

Recharging with a Train-Lighting Dynamo. The dynamo is slung on the test arm, connected up direct to the charger with a D.C. ammeter, reading 5-0-150 amperes in circuit but no switch or cut-out.

After checking the polarity it is run up in speed so as to give a current of 100-120 amperes, which need only be maintained for a few seconds. The speed is then cut down gradually until it stops. Do not break any connection until the dynamo has stopped.

Recharging with a Train-Lighting Battery. When a battery is employed, the following equipment will be required (See Fig. 6) :—

- (a) Quick-break knife switch, with a long break, for the inductive field of the charger.
- (b) Variable resistance and multiple switch with about 10 "live" steps. On the last step, with all resistance in circuit, the current flowing should not exceed 5 amperes. The circuit should be broken by the knife switch and not on the last step of the multiple switch.
- (c) Direct current ammeter reading 5-0-150 amperes.

Insert the charger between the poles and make connections with knife switch "open" and the multiple contact switch on the last step **with all resistance in circuit.**

After checking the connections and polarity of the charger, switch on by closing the knife switch and increase current by moving the multiple switch arm, gradually cutting-out resistance until the ammeter reads 100 to 120 amperes. After maintaining full current for a few seconds move back the handle slowly, to cut-in full resistance, and open the knife switch when the current has dropped to 5 amperes. Do not remove the charger.

Should, in error, the current be applied in the wrong direction, this may be rectified by reversing the connections of the charger and again applying the current as directed. In this case it is advisable to repeat the process a second time.

The machine will generate equally well even if magnetised with the wrong polarity, but it is advisable to retain uniformity.

Replacing the Rotor.

14. **After recharging the MAGNETIC CIRCUIT MUST NOT BE BROKEN.**

To replace the rotor in the stator, insert at the turbine end while an assistant supports the charger as it leaves the stator. (See Fig. 4.)

STONE'S L.B.B. TURBO-GENERATOR

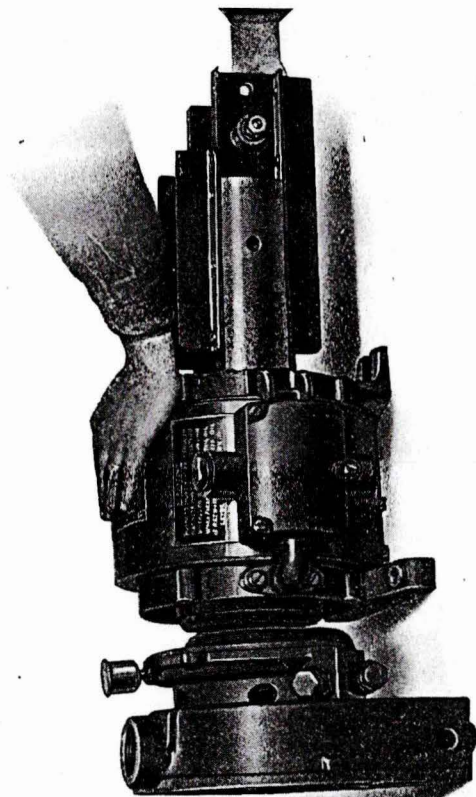


FIG. 4.
Entering rotor pushing out charger.

The rotor must not be removed after recharging unless substituted by a keeper.

(See para. 12, page 14.)

Reassembly.

15. Replace turbine-end housing (I.2378A), inserting bolts with spring washers and tighten up evenly.
16. Replace the governor-end housing (I.2377A), insert bolts with spring washers and tighten up evenly.
17. Replace the oil sleeve and deflector (2368B) and then fit the ball-bearing on shaft, using the special tools provided in the kit to engage the inner ring of the ball race. Do not force the bearing and be careful not to damage the screw thread on the shaft.

Pass the oil ring (2368c) over the bearing so that it rests on the sleeve (2368B).

18. Replace the bearing nut (2368D), tightening it well with the box spanner by means of a sharp blow. **Tighten up the lock screw** on the bearing nut securely.
19. Replace housing cap (2376A), noting that the two projecting pins go at the top above the oil ring.

NOTE—The pins are to prevent the accidental displacement of the oil ring from its position on the shaft.

20. Screw on the governor body, tightening it with the box spanner by a sharp clockwise blow on the "Tommy" bar. **Tighten up locking screws (2375B)** in governor body securely.
21. Replace governor casing (I.2371A), insert bolts with spring washers and tighten up evenly.
22. Before re-assembling the steam pipe, thoroughly clean the flange faces of old jointing and fit new

STONE'S L.B.B. TURBO-GENERATOR

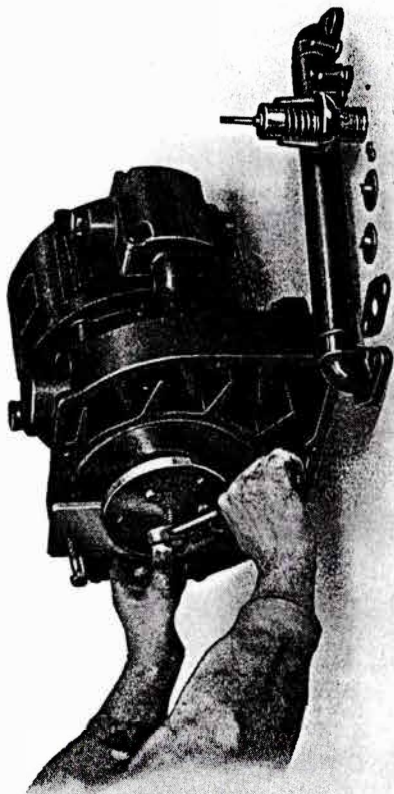


FIG. 5.
Removing bucket wheel from shaft—note use of locking strap.

joints; we recommend the use of a special graphite jointing compound; apply this also to the bolts, it will ensure easy removal. This special compound will withstand a temperature of 600° F., and can be obtained from J. Stone & Co., Ltd.

23. Test the valve (2384c) to see that it works freely. (See "Valve," page 7.)
24. Replace inner thrust-plate (2375L), and ensure that the pin through the shaft engages with the slot. Swing the thrust block carrier (2374F) into position and replace outer thrust plate (2375M). Then replace and lock the governor stem lock nuts (2375N) and replace split-pin.
(See "Thrust-Blocks," page 8, for proper clearances.)

Testing. After re-assembly the turbo-generator should be tested for output and voltage, and the speed adjusted as found necessary (see pages 9 and 10).

NOTE—Use only the instrument referred to under "Speed Adjustment," page 9.

Dismantling of the Turbine End. Should it be necessary to dismantle the turbine, say to renew the ball bearing (2368J), proceed as follows:—

1. Remove steam pipe and exhaust-end cover (2525).
2. Remove split-pin (2368R) and bucket wheel nut (2368Q) and attach the wheel-locking strap, using two of the bolts from the exhaust end cover, to prevent the wheel from turning. Then apply the plate extractor by screwing the 3 bolts provided into the corresponding holes in the bucket wheel (2387B). Tighten the "Tommy"

screw against the shaft centre, and give the head a sharp blow with a copper hammer. The bucket wheel may then be removed. (See Fig. 5.) Remove the key (2368P) from the shaft.

NOTE: When reassembling, the old gland ring (2380B) should not be used again but replaced by a new and identical spare part.

3. Remove the turbine-end casing (2524A), noting that flanges must be cleaned and joint renewed when replacing.
4. Remove the water-deflector (2368M) and the soft-steel pin (2368MA) which locates it on the shaft.
5. Apply the extractor to the housing cap (2379A) and remove cap.
6. Slacken lock-screw and remove bearing-nut (2368K) with the box spanner.
7. Apply extractor to ball-bearing (2368J) and remove bearing, being careful not to damage oil ring.
8. When it is desired to remove the turbine-end housing (I.2378A) first remove the oil ring (2368H) then the oil sleeve (2368G) from shaft. If tight, it may be removed with the housing.

Reassembly of Turbine End.

1. Replace turbine-end housing (I.2378A) and bolts with spring-washers, tightening up evenly.
Replace oil sleeve (2368G) and oil ring (2368H) on the shaft, taking care that the ring rests on the sleeve.
2. Replace ball-bearing (2368J), using the special tool provided.
Replace bearing nut (2368K), and **tighten the lock-screw.**

3. Replace housing cap (2379A) and the bolts with spring washers, tightening up evenly.
4. Insert pin (2368MA) in shaft and replace the water deflector (2368M).
5. Smear flanges with special graphite jointing compound to ensure steam-tight joints and replace the turbine-end casing (2524A) and the bolts with spring washers, tightening up evenly.
6. Attach wheel-locking strap and replace key in shaft. Refit bucket-wheel (2387B). If a new key is fitted, see that all "burrs" are removed. Replace and tighten the bucket-wheel nut (2368Q) securely, using the special ring-spanner.

Insert a well-fitting split-pin through the bucket wheel nut, and splay out the ends.

NOTE—When a new bucket-wheel has been fitted, the shaft must be set on knife-edges and the unit accurately balanced.

7. If the steam nozzle has been removed, clean the joint faces and refit with new joint ($\frac{1}{8}$ " thick).

NOTE—The thickness is important as it regulates the clearance between bucket-wheel and nozzle. The nozzle is adjusted in position and then dowed before leaving the Works, there is therefore no difficulty in replacing it correctly. When fitting a new steam nozzle, it should be set so that the dimension from the extreme top edge to the periphery of the bucket-wheel is $\frac{1}{8}$ " and a new dowel pin fitted if necessary.

8. Refit steam pipe, with new joints smeared with special graphite jointing compound to ensure steam-tight joints,
9. Refit exhaust end cover, cleaning all traces of old jointing from flanges and fitting new joint (2525A) coated with special graphite jointing compound. Replace bolts with spring washers.

Packing Rings.—As a precaution against oil creeping along the shaft, felt packing rings (2377F) and (2378B) are

fitted in grooves in the housings adjacent to and on either side of the rotor. Additional grooves will also be observed at the other end of the bearing housing, and although these were in early models fitted with felt washers, this is no longer necessary as the shaft has been grooved and the bearing drilled to allow a natural egress of any steam or condensation that may penetrate along the shaft.

When overhauling the generator, it is advisable to renew the felt rings, but they should require no attention in service.

Spares for Turbo-Generators Type T.G.1.

A fully illustrated catalogue of spare parts, tools and accessories will be furnished on request.

When ordering any part, quote the type from the nameplate, and give the name and part, quote the type from the nameplate, and give the name and part numbers from the spare parts catalogue. Do **not** use the index numbers from this text. These are only for reference to the sectional drawings at the end of book.

In the case of Nozzle replacement, the maximum working steam pressure should be quoted, as this sometimes affects the dimensions of the tapered bore.

The complete range of turbo-generators is classified in four groups, as follows :—

- (1) 24 volts up to 500 watts.
- (2) 32 volts up to 500 watts.
- (3) 32 volts up to 500/750 watts.
- (4) 100/110 volts up to 1000 watts.

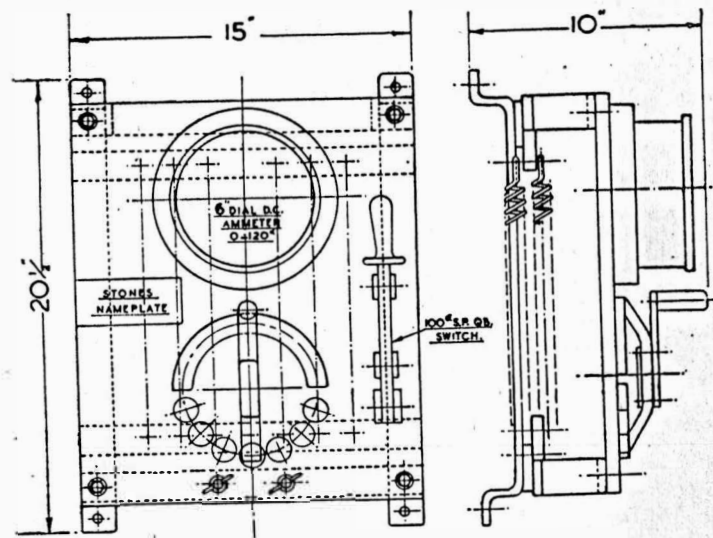


Fig. 6. STONE'S L.B.B. TURBO-GENERATOR

Typical Control board for charging magnet.

With regard to the coils, the voltage and output of the turbo should be quoted as per the nameplate, or any other aid to identification which may appear on the original order.

The standard range of windings being as follows:—

- (a) 24 volts up to 500 watts
- 32 " " " "
- (c) 32 volts up to 500/750 watts
- (d) 100/110 volts up to 1000 watts

Tools and Accessories.

It is our recommendation that the following tools and accessories should be available at each Maintenance Depot:—

At least one each of the following:—

1. **Tool kit** containing special tools for L.B.B. Turbo-Generator.
2. **Keeper.** (*Not included in Tool Kit.*)
3. **Charger** for 24 to 32 volt circuit. (*Not included in Tool Kit.*)
4. **Ammeter**—D.C., complete with shunt, to read 5-0-150 amperes.
5. **Voltmeter**—A.C., calibrated for high-frequency current, to read 0-40 volts or 0-200 volts.
6. **Ammeter**—A.C., calibrated for high-frequency current, to read 0-25 amperes, complete with shunt.

If current for re-charging the stator is to be taken from a constant voltage supply, the following will be required:

7. **Variable Resistance**, with multiple contacts, and a quick-break switch.

All these tools and accessories may be obtained from J. Stone & Co., Ltd.

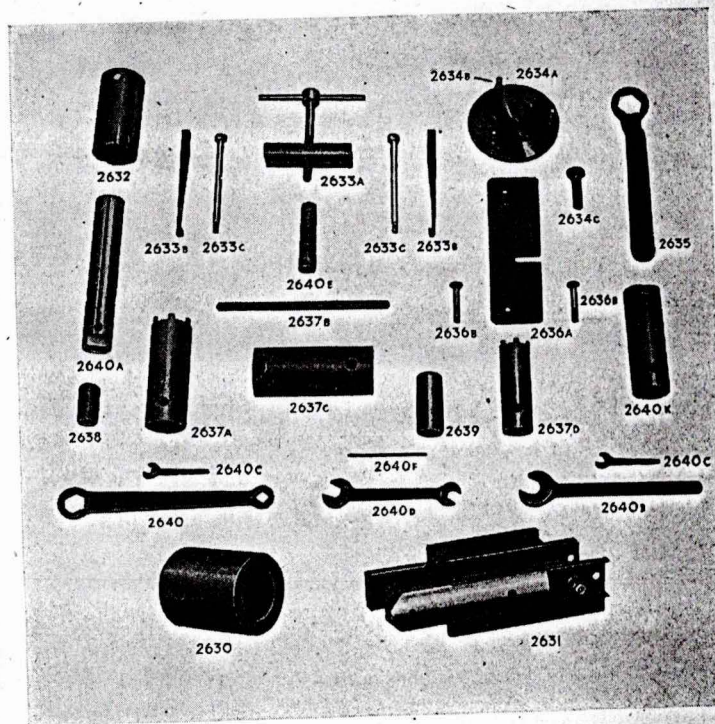


FIG. 7.

Stone's L.B.B. Turbo-Generator.—Special Tools and Appliances, viz

Ref. No.	Component Parts.
2630	Keeper.
2631	Charger, 24 to 32 volts, Complete.
2629	Tool Kit Complete in Box.
2632	Box Spanner for Governor Body.

- 2633 Extractor for Ball Bearings and Housing Caps, Complete, including :—
- 2633A Tommy screw and plate.
- 2633B Claw legs, 1 pair.
- 2633C Bolts, 1 pair.
- 2634 Extractor for Bucket Wheel, Complete, including :—
- 2634A Extractor plate.
- 2634B Fixing screw with retaining ring.
- 2634C Tommy screw.
- 2635 Ring Spanner for Bucket Wheel Nut.
- 2636 Bucket Wheel Locking Strap, Complete, including :—
- 2636A Locking strap.
- 2636B Fixing screw.
- 2640H Box Spanner for Ball Bearings Locking Nuts, Complete, including :—
- 2640K Box Spanner, Governor End (T.G.I. only.)
- 2637B Tommy bar (also for 2632).
- 2637C Box Spanner, Turbine End (T.G.I. only.)
- 2638 Tubular Drift for Ball Bearings, Governor End.
- 2639 Tubular Drift for Ball Bearings, Turbine End.
- 2640A Valve Extractor. (T.G.I. only.)
- 2640B $\frac{1}{2}$ " Whitworth Spanner for Oil Plugs. (T.G.I. only.)
- 2637A Peg Spanner for Ball Bearings Locknuts, (T.G.H. and before.) (Turbine End.)

- 2637D Peg Spanner for Ball Bearings Locknuts. (T.G.H. and before.) (Governor End.)
- 2640 Ring Spanner for Valve Body and Strainer Plug. (T.G.H. and before.)
- 2640c O.B.A. Flat Spanner.
- 2640D $\frac{1}{8}$ "— $\frac{3}{8}$ " Flat Spanner.
- 2640E $\frac{1}{8}$ "— $\frac{3}{8}$ " Box Spanner.
- 2640F Governor Gear Adjusting Rod.

STONE'S L.B.B. TURBO-GENERATOR

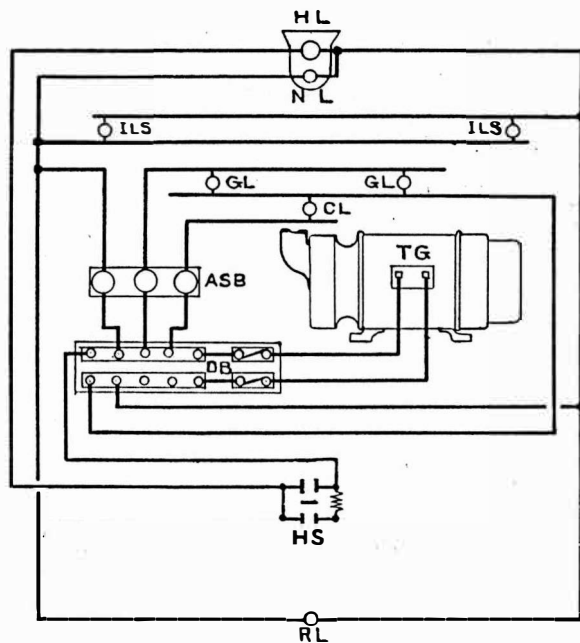


DIAGRAM A.

FIG. 8—DIAGRAM OF CONNECTIONS FOR L.B.B. TURBO HEADLIGHT EQUIPMENT WITH SINGLE HEADLIGHT.

- TG L.B.B. Turbo-Generator.
- HS 3-way Headlight Switch with dimming resistance, for "full," "dim" or "off."
- ASB Auxiliary Switch Box for controlling other lamp circuits.
- DB Distribution Box with main fuses.
- HL Headlamp with (NL) pilot or numeral light.
- CL Cab light.
- GL Gauge lights.
- ILS Portable inspection lamp sockets.
- RL Tail light.

STONE'S L.B.B. TURBO-GENERATOR

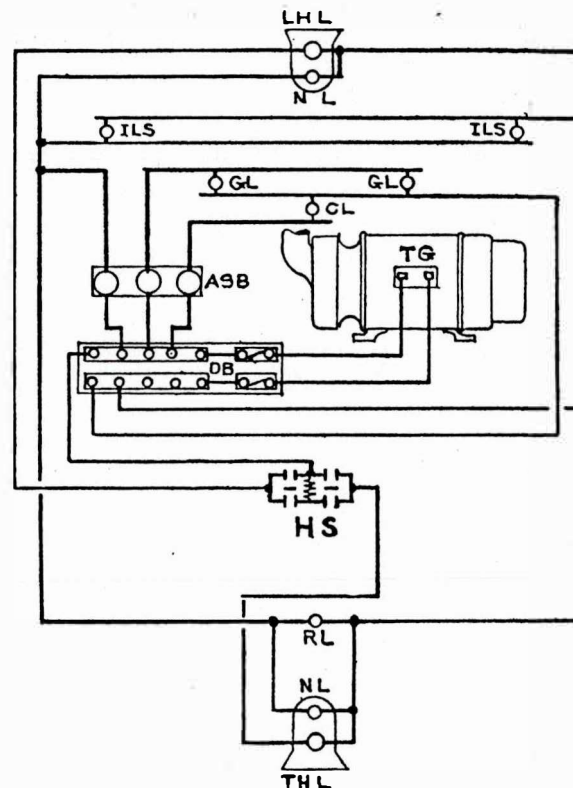


DIAGRAM B.

Fig. 9.—DIAGRAM of CONNECTIONS for L.B.B. TURBO HEADLIGHT EQUIPMENT with HEADLIGHT at EACH END of LOCOMOTIVE

- TG L.B.B. Turbo-Generator.
- HS 5-way Headlight Switch with dimming resistance to provide "full," "dim" or "off" to either front or rear headlight.
- ASB Auxiliary Switch Box for controlling other lamp circuits.
- DB Distribution Box with main fuses.
- LHL Front Headlight with (NL) pilot or numeral light.
- RHL Rear Headlight with (NL) pilot or numeral light.
- CL Cab light.
- ILS Portable inspection lamp sockets.
- GL Gauge lights.
- RL Tail light.

STONE'S LOCOMOTIVE LIGHTING EQUIPMENT TURBO GENERATOR

MAINTENANCE INSTRUCTIONS AND TESTING EQUIPMENT

The following notes are intended to convey some idea of the requirements and equipment for a test rig for the testing of not more than two Turbo-Generators simultaneously.

Reference to the accompanying drawing will show the general arrangements of steam facilities that must be provided, together with an instrument board upon which is mounted all the necessary electric meters and a steam gauge.

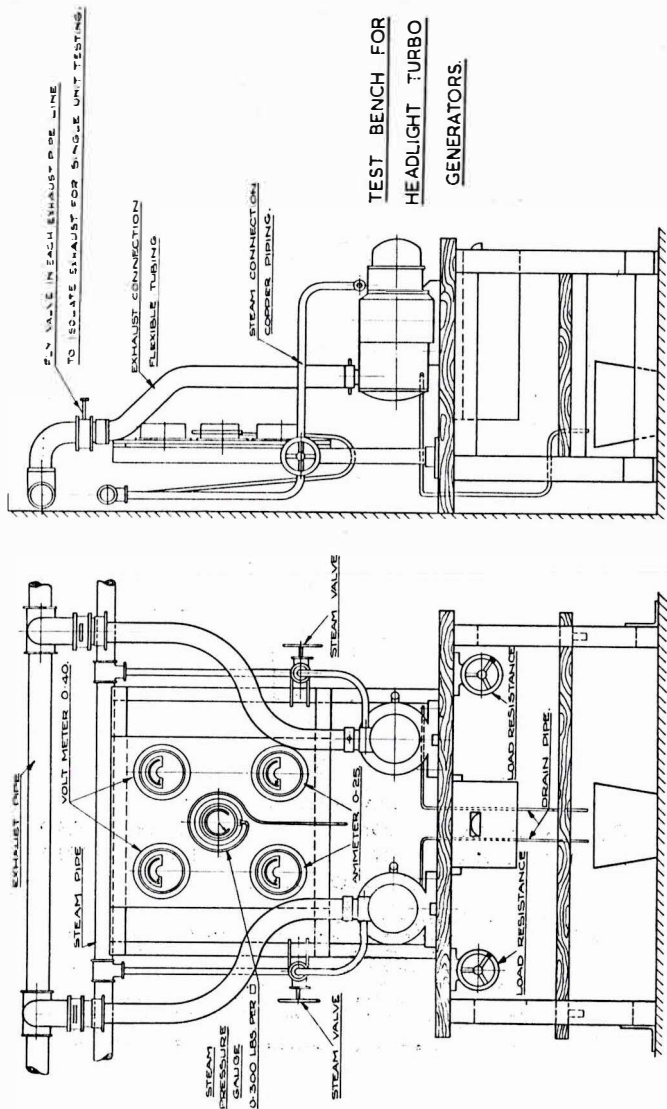
It is important that an adequate supply of steam is available at the pressures normally encountered on the locomotives to which the turbines are fitted, and it should be possible to control the steam pressure by adjustment of the steam valves. The design of these valves is important and they should be fitted with large hand wheels capable of adjusting the steam over the entire range between the minimum pressure of 100lbs., say, for normal starting conditions, to the maximum pressure likely to be encountered on the locomotives.

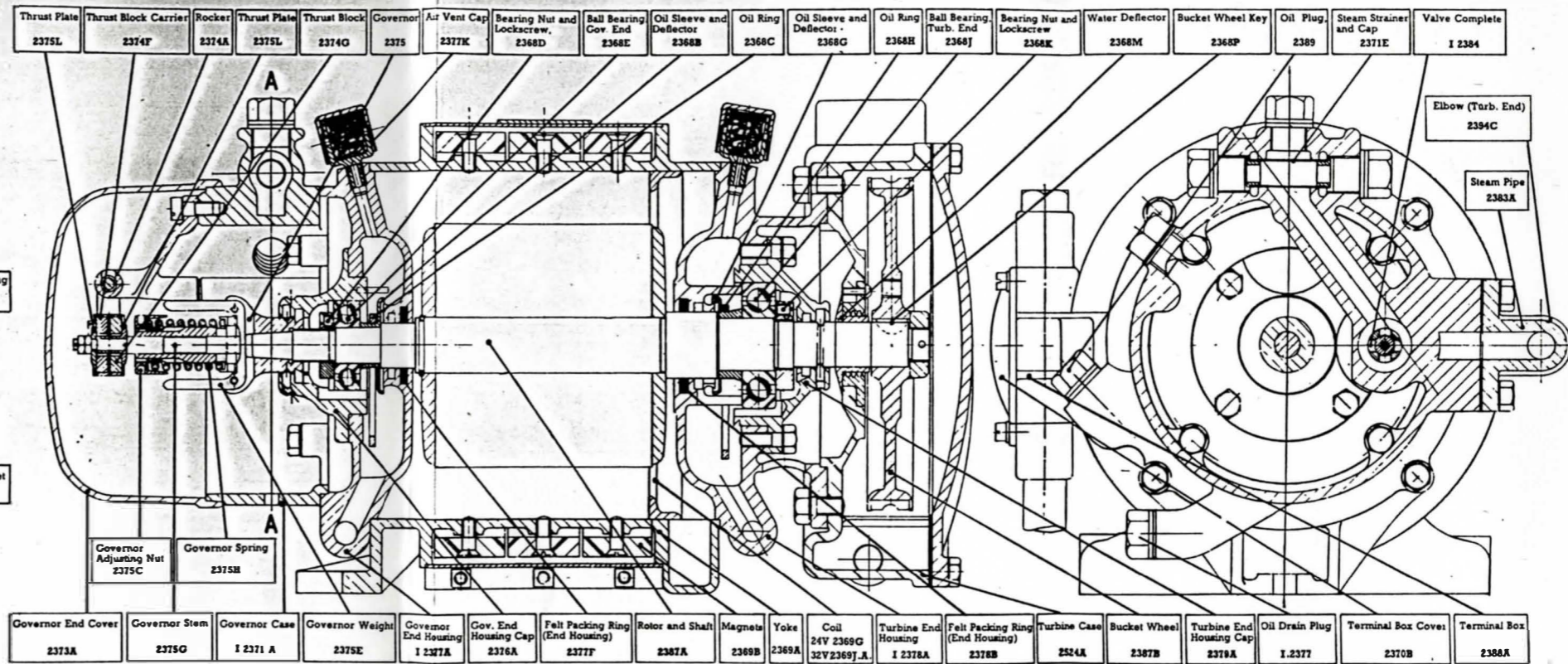
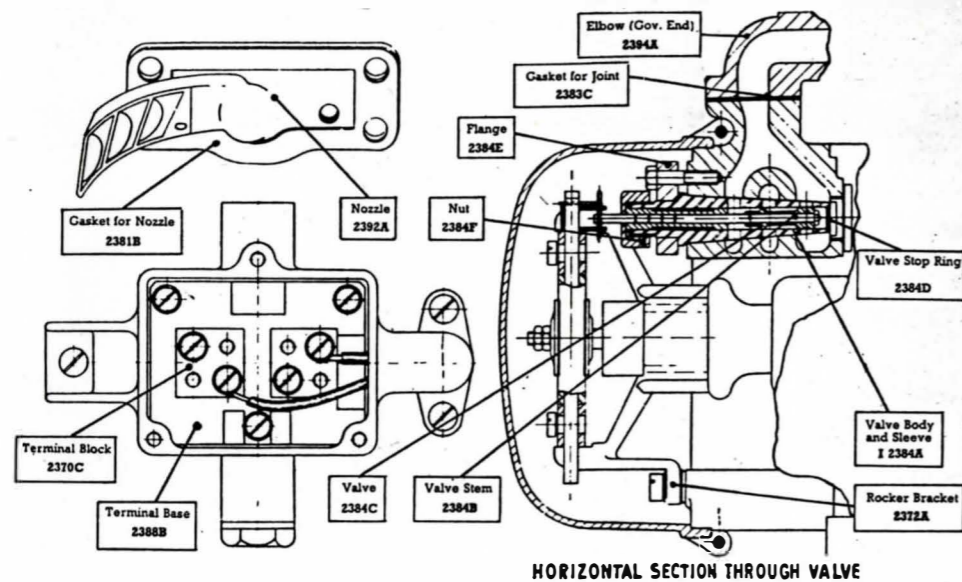
In the event of only one turbo-generator being run it will be necessary to provide fly valves in the exhaust to prevent the exhaust steam feeding back to the second rig. These valves need only be of the fly valve or damper type.

The drain pipes are illustrated with a common outlet but these should also have provision made for individual isolation to avoid any risk of scalding.

The electric equipment should comprise the following items:—

- (a) A voltmeter for each set reading 0-40 volts and calibrated to give accurate indication up to and including 1,000 cycles per second. Preferably they should be of the hot wire type, in which case the question of frequency range does not arise.





TURBO-GENERATOR Type T.G.I.