

The Brown
STEERING
GYRO COMPASS



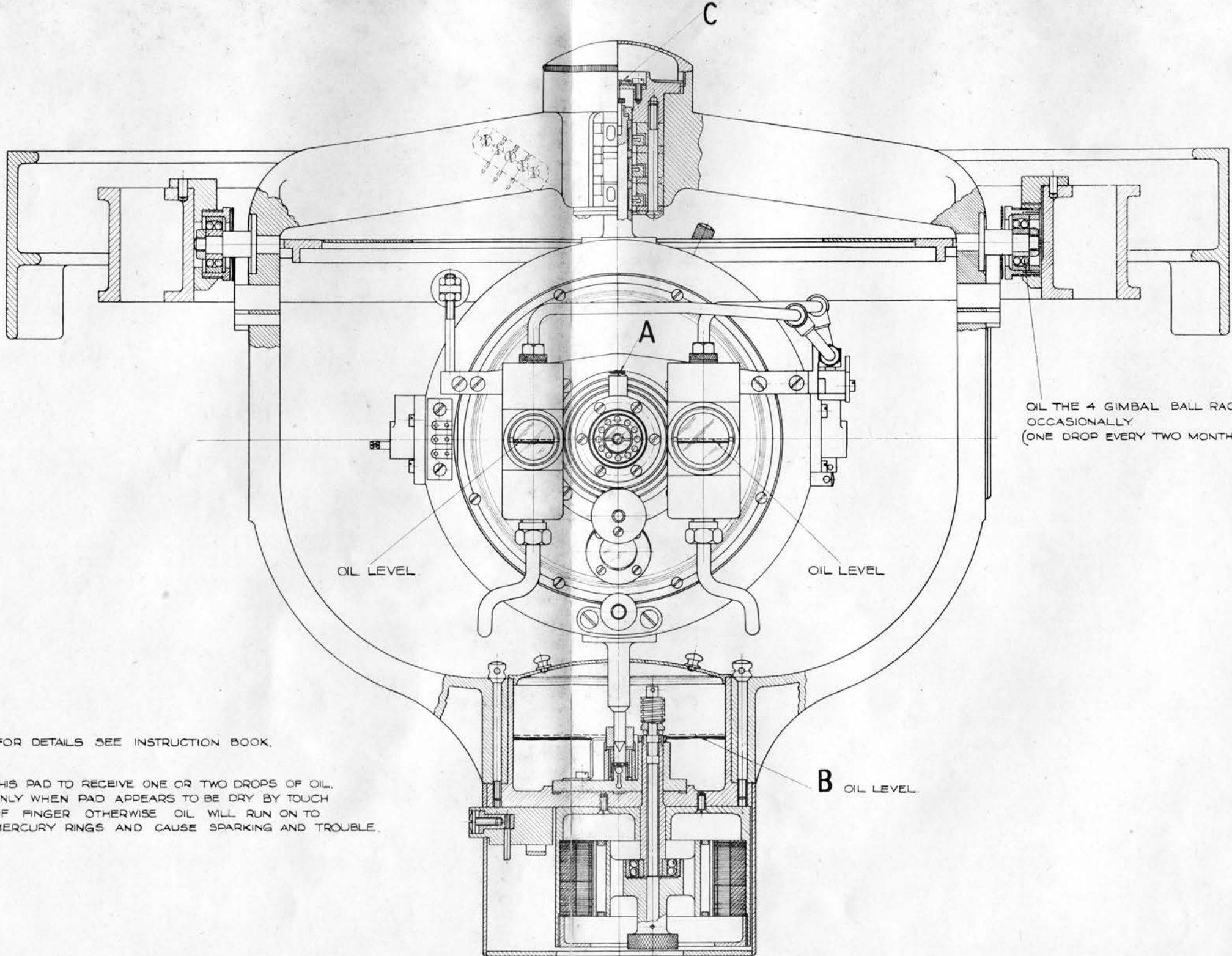
OILING CHART

FOR

Brown

STEERING

GYRO COMPASS



"A" FOR DETAILS SEE INSTRUCTION BOOK.

"C" THIS PAD TO RECEIVE ONE OR TWO DROPS OF OIL, ONLY WHEN PAD APPEARS TO BE DRY BY TOUCH OF FINGER OTHERWISE OIL WILL RUN ON TO MERCURY RINGS AND CAUSE SPARKING AND TROUBLE.

The Brown

STEERING GYRO COMPASS

" . . . My confidence in Brown's gyro compass was further strengthened when I piloted the ' . . . ' out of London during the week-end fog.

It was a fine test of reliability to steer the many courses with wonderful accuracy in a 20,000 ton ship from Gravesend to Dover under the worst conditions—and to pass that port ahead of even some vessels which left London a tide previous.

From my experience, it is the only compass, gyro or magnetic, which is not liable to 'unemployment error,' i.e. it is always correct on being restarted after a spell in port" *

HANDBOOK

TYPE 'B' EQUIPMENT

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LIVERPOOL

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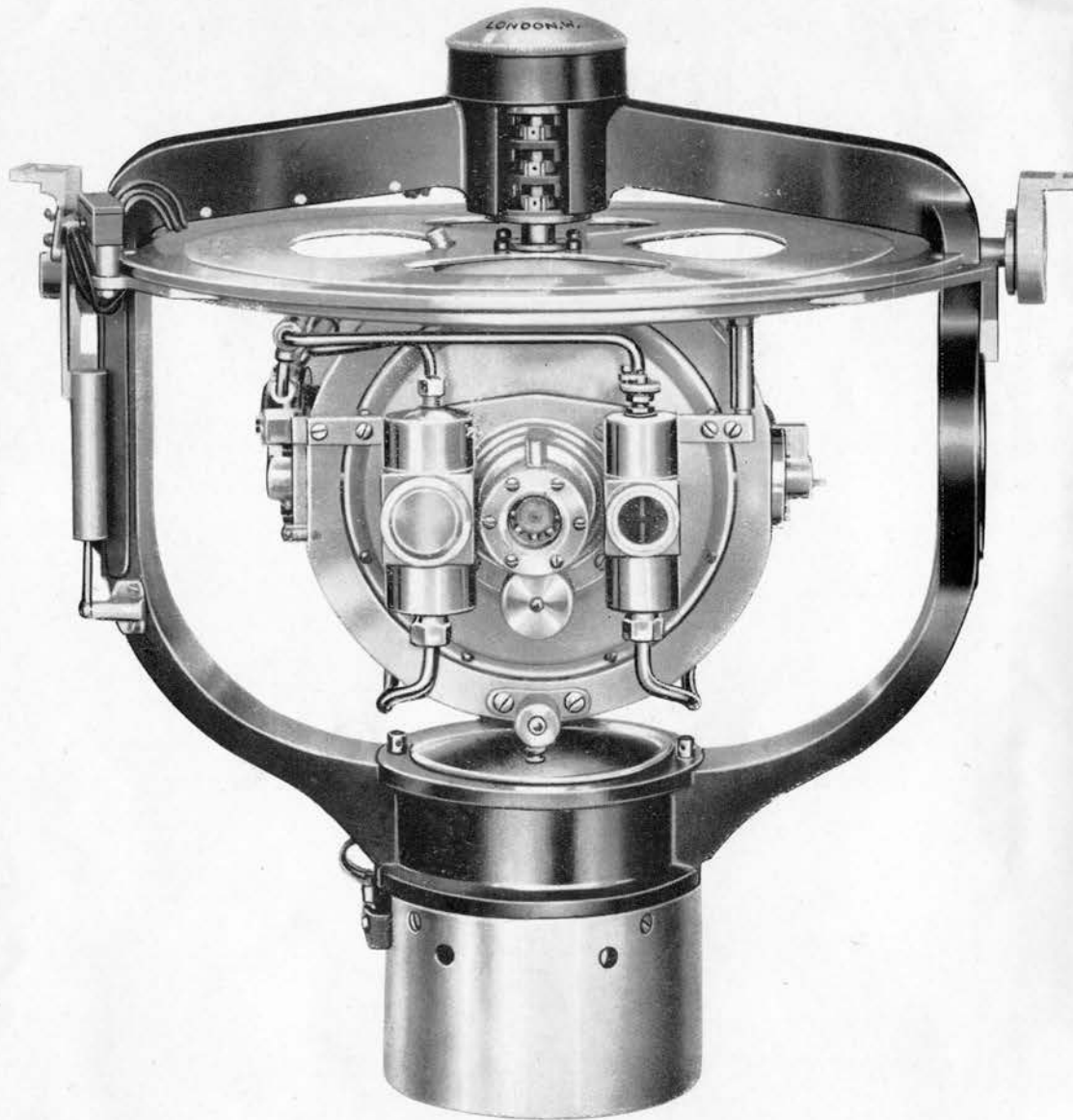
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The Gyro Compass

(Type B)

The Brown

STEERING

GYRO COMPASS

The equipment consists of the following six units :—

- UNIT No. 1 (a) Master Compass and gimbal rings.
(b) Binnacle.
(c) Illuminated projector.
- UNIT No. 2 Motor Generator.
- UNIT No. 3 Switchboard.
- UNIT No. 4 Mains Resistance.
- UNIT No. 5 Emergency Battery.
- UNIT No. 6 Tools and Spare Parts Cabinet.

Description of Units

UNIT No. 1.

(a) **The Master Compass** is identical in principle and construction to the standard Brown compass, except that those parts associated with the repeater system are eliminated. The compass consists of :

The wheel in its case, on which are mounted the control and damping bottles and connecting pipes.

The vertical ring which carries the perforated compass card.

The main frame, which carries at its base the motor-driven pump, and at the top the mercury rings through which the current is conveyed to drive the wheel.

The gimbal rings, which carry the compass in the binnacle.

(b) **The Binnacle** is made of non-magnetic and non-corrodible aluminium. On the forward side is the lamp box containing the lamp which projects a beam

upwards through the perforated compass card to the projector. On the after side is the dimmer switch. The cover is made of copper and its top plate is of brass. A padlock is provided. The binnacle and cover combine to make a splash-proof unit.

(c) **The Illuminated Projector** is made of bronze and is fitted with the necessary optical arrangement for projecting the compass reading on to the ground glass screen, which is adjustable to suit the convenience of each particular helmsman.

UNIT No. 2.

The Motor Generator is designed on simple lines, is compact and silent in operation. The input side consists of a 50 volt D.C. motor, while the output side is a generator of the permanent inductor type, and produces 70 volts A.C. for driving the gyro wheel and pump motor.

UNIT No. 3.

(a) **The Switchboard**, which is entirely splash-proof, is made of non-magnetic and non-corrodible metal. The door is provided with a window through which the meters can be viewed; a lock is fitted for security from interference. The voltmeter on the left indicates the ship's supply (110 or 220 volts) when the external supply switch is "On." In the centre is the ammeter, which shows the rate of the "charge" or "discharge" of the battery and to the right is the voltmeter which indicates the voltage of the battery (53-55 volts).

The upper switch is the main switch, and when it is "On" the battery is connected to the reduced voltage from the ship's supply, the ammeter and right-hand voltmeter are in operation. The left-hand voltmeter will indicate the battery voltage when the external switch is "Off." The lower switch is the starting switch and when "On" starts the motor generator and at the same time starts the gyro wheel and pump motor. The centre handle operates the resistance for adjusting the charging rate of the battery.



Binnacle, Cover and Projector
(Type B)

UNIT No. 4.

The Main Resistance (for 110 or 220 volts mains, according to the ship's supply) reduces the ship's supply to the required 53-55 volts D.C. for driving the motor generator.

UNIT No. 5.

The Emergency Battery is contained in a hard-wood ventilated box. The cells are of the heavy glass type, which permit easy inspection of the level of the acid. It forms a 53-55 volt unit, and it is arranged to float on the ship's supply, so that in the event of a failure of that supply the compass and lamp will continue to function. It serves also to smooth out any fluctuations in the ship's supply voltage.

UNIT No. 6.

The Tools and Spare Parts Cabinet is of hard wood and provides all that is required for the maintenance of the equipment. It is fitted with a lock.

Inspection

before starting the compass

To the uninitiated the following suggestions may appear numerous, but on becoming familiar with the compass the simplicity of the equipment will become apparent and the time required for inspection but a few minutes.

Unit No. 1 (a) Master Compass.

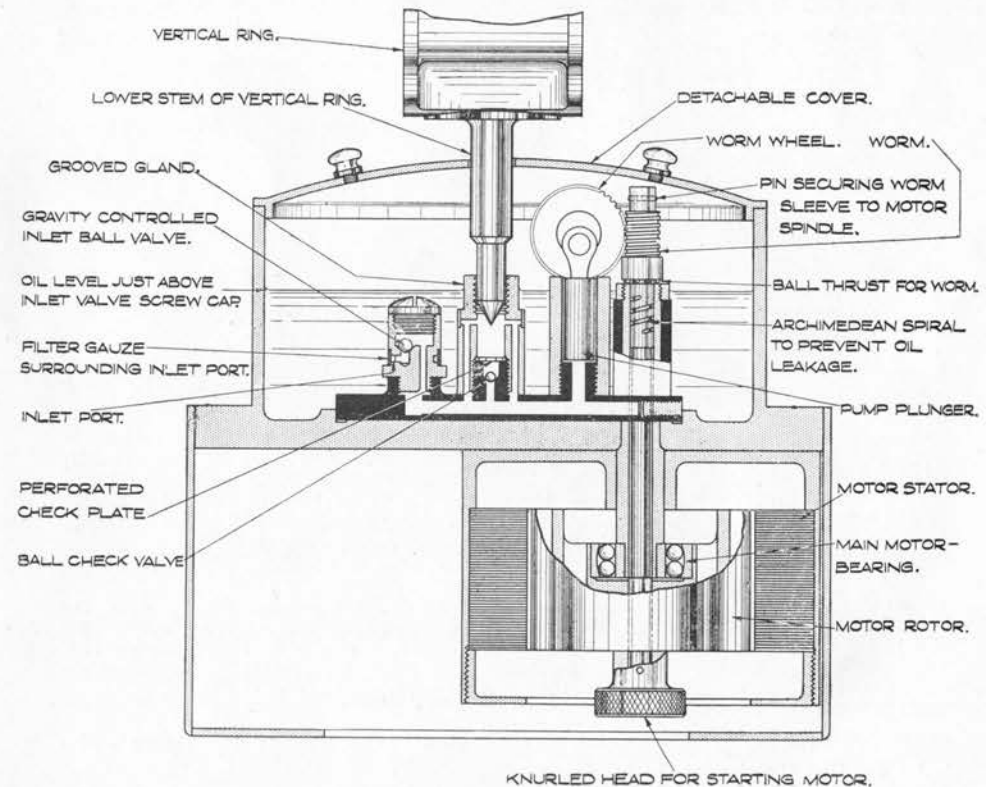
1. See that the mercury rings on the top vertical axis contain sufficient mercury. The mercury should be half-way up the inspection window on each ring. Should replenishment be required, use only the special mercury and mercury filler supplied in the spare parts cabinet.

2. See that there are no surplus beads of mercury clinging to the outside of the rings or vertical axis. A rubber bulb syringe, provided in the spare parts cabinet, may be used to blow away this surplus.

3. See also that there are no beads of mercury clinging to the wheel case, oil bottles or pipes (for fuller information on care of mercury rings see page 16).

4. Inspect the level of oil in the pump chamber by removing one half of the cover with a pair of tweezers. The oil should just cover the inlet valve cover screw (see Fig. 1). Any deficiency should be made good with special pump oil found in the spare parts cabinet.

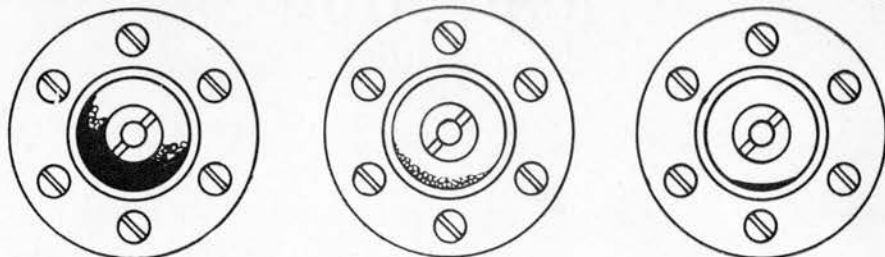
5. Inspect the level of oil in the damping and working bottles, which should be half-way up the inspection windows on each side. (See Fig. 7, page 15). Any deficiency to be made good with special D and W oil injected with the glass syringe supplied for the purposes (Note: This oil is carefully filtered before leaving our works and care should be taken to exclude dirt and dust



Sectional Diagram of Pump
(Fig. 1)

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(Fig. 2) Too much oil

Correct

Too little oil

Oiling the gyro wheel bearings need only be done about once in every two or three weeks. Open the lid of the binnacle and put six drops of oil in each of the oil holes at the ends of the gyro casing marked N and S. When the wheel is spinning a thin film of oil should be just visible at the bottom edges of the glass windows at the ends of the bearings.

from the bottle containing the spare supply. The syringe should be quite clean before being put into the bottle to withdraw the oil, after which the bottle should be immediately recorked).

6. Examine the nuts on oil and air pipes to see that they are tight; loose nuts result in a leakage which should not exist. See that there are leather washers under the filling screws.

7. Unscrew the top bearing cap and see that the fabric lubricating pad is just damp. Lubricating oil should be used for damping this pad, but oil should be applied very sparingly. An excess will result in oil creeping down the vertical spindle and interference with the mercury rings.

8. The gyro wheel bearings should be examined to see that the correct amount of oil is contained in each (See Fig. 2). An excess of oil in these bearings will result in oil being drawn into the wheel case and blown out of the air nozzle. If necessary, a few drops from the oil can provided should be applied to lubricator caps.

9. See that the flexible wires on gyro case, gimbals rings and mercury rings are properly spaced and perfectly free.

(b) Binnacle.

1. See that the lamp is burning. This should light when the main and starting switches are "On" and the dimmer switch is "On."

2. See that the lens over the lamp is clean and the binnacle free from dust.

3. When a new lamp is fitted care should be taken to ensure correct alignment with the optical system. Two adjustment screws are provided at the lamp base for this purpose.

(c) Illuminated Projector.

1. See that the glass at the lower end of the vertical tube is clean. (Note: Do not remove the projector from the binnacle cover or take to pieces the projector, which is filled with dry air and sealed).

Unit No. 2. Motor Generator.

1. See that the commutator is clean. If necessary, clean with a small piece of soft rag damped with petrol. This can be done when the generator is running, but use petrol very sparingly.

2. See that the carbon brushes are free in the holders and not chipped.

3. The bearings are packed with grease and should run for six months without attention. When necessary, remove bearing end caps and charge with grease provided.

Do not alter brush position. This has been set at our Works.

Unit No. 3. Switchboard.

See that all terminal nuts are tight.

Unit No. 4. Mains Resistance.

No inspection required.

Unit No. 5. Emergency Battery.

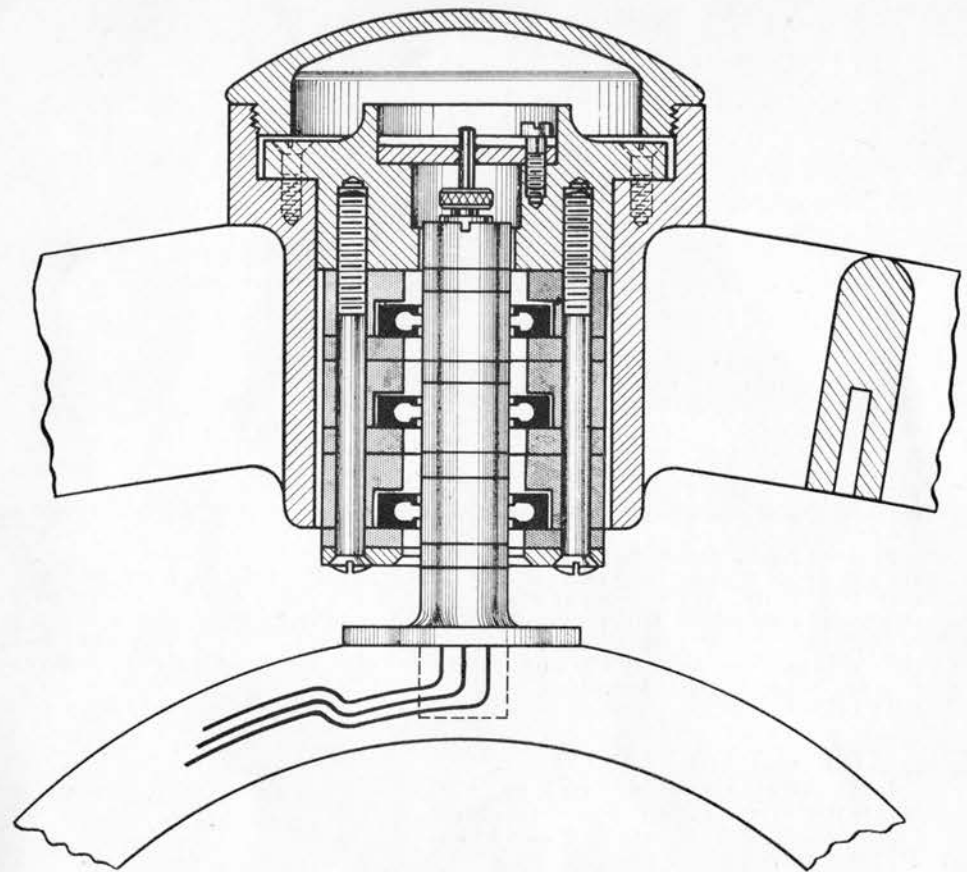
1. See that the liquid in each cell is sufficient to cover the plates. If necessary add distilled water to bring liquid up to proper level and wipe off any moisture around the terminals. The material used for wiping must not be used for any other purpose, as the acid will cause deterioration of any metal parts.

2. See that terminals are clean. Smear with vaseline occasionally.

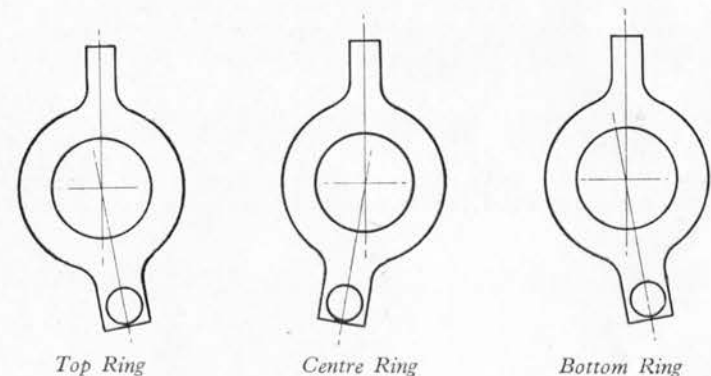
3. Take the specific gravity of the liquid in each cell with the hydrometer supplied. It should read between 1125 and 1260. (For further particulars see page 13).

Unit No. 6. Tools and Spare Parts Cabinet.

A list of tools and spares is provided. An inventory should be taken occasionally and replenishment ordered as required. (See Spare Part List, page 19).



Section through
Top Housing of Vertical Axis
(showing top of Vertical Axis
and arrangement plan of Mercury Rings)
(Fig. 3)



Operating Instructions

Preliminary Note.

A gyro compass differs from a magnetic compass in almost every particular. The magnetic compass oscillates with irregular and short periods, whereas the gyro compass oscillates into the meridian with a regular and long period of approximately 100 minutes.

From the point of view of the navigator, the long period is particularly advantageous, inasmuch as no movement of the ship can possibly coincide with the period of the compass. But it necessitates starting the compass three to four hours prior to going to sea, so as to enable it to settle in the meridian.

TO START THE COMPASS.

1. So that the compass may settle as soon as possible, set the North point of the card somewhere near the meridian (within 10° will suffice).

2. Switch on the external supply switch. (The voltmeter on the left will show the ship's supply voltage).

3. Switch on the main switch. (The voltmeter on the right will show the voltage of the battery and the ammeter the charging rate of the battery).

4. Switch on the starting switch by turning slowly to the right, allowing the motor generator to gather speed easily. The gyro wheel will now start rotating and the pump motor start working. Note: If the wheel does not start, which can be seen through the inspection window in the wheel case, swing the compass in the plane of the wheel (see notes on alternating current). If the pump motor does not start, turn the pump by hand by means of the knurled knob at the very bottom of the pump chamber. It should be turned in a clockwise direction when looking down on the compass card. (See Fig. 1, page 5).

5. Return to the switchboard and turn the centre handle until the ammeter shows $\frac{1}{2}$ ampere on the charge side.

6. About five minutes later return to the compass and release the "red stop," which has locked the gyro case to the vertical ring (complete freedom is now given to the gyro and it will commence to oscillate slowly into the meridian).

7. Put the binnacle cover on and lock it.

8. Observe the switchboard occasionally, and adjust the battery charging rate so that the ammeter shows $\frac{1}{2}$ ampere on the charge side, or a maximum of 53 to 55 volts, as indicated by the voltmeter on the right-hand side.

AT SEA.

1. Inspect the switchboard every watch, and see that the ammeter shows $\frac{1}{2}$ ampere on the charge side. If it should show a heavy discharge, look at the ship's supply meter on the left, and should that show only 53-55 volts, then a fuse has blown either on the switchboard or between the switchboard and the ship's dynamo. On the other hand, the ship's supply may have been interrupted by switching off the mains.

2. Inspect the motor generator daily to see that the commutator is clean.

TO STOP THE COMPASS

1. Turn the starting switch to the "Off" position.

2. Turn the main switch to the "Off" position.

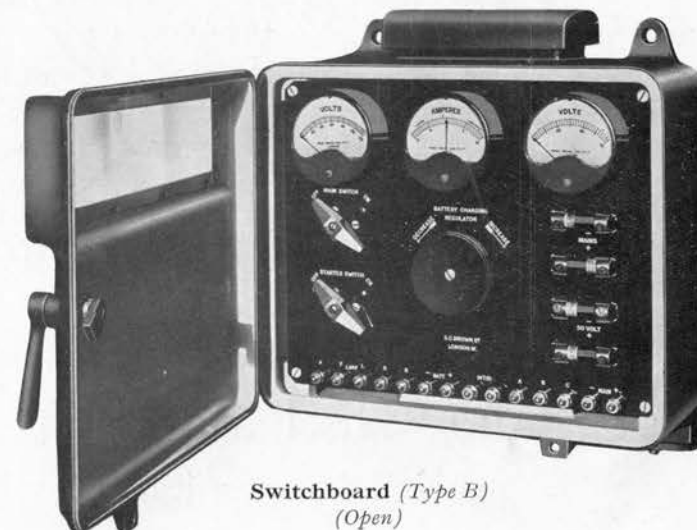
3. Turn the external supply switch to the "Off" position.

4. Remove binnacle cover and insert "red stop" so that the gyro wheel will not topple over when it ceases to rotate.

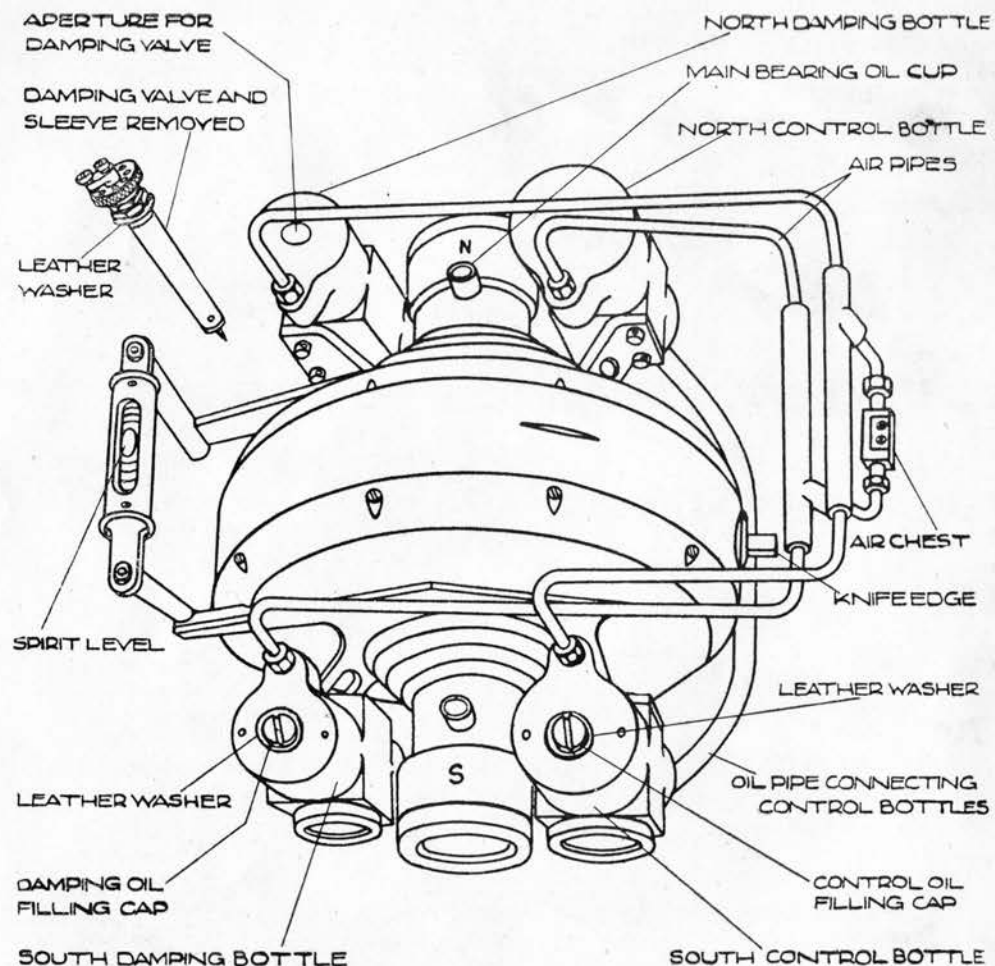
5. Replace binnacle cover and lock it.



Switchboard (Type B)
(Closed)

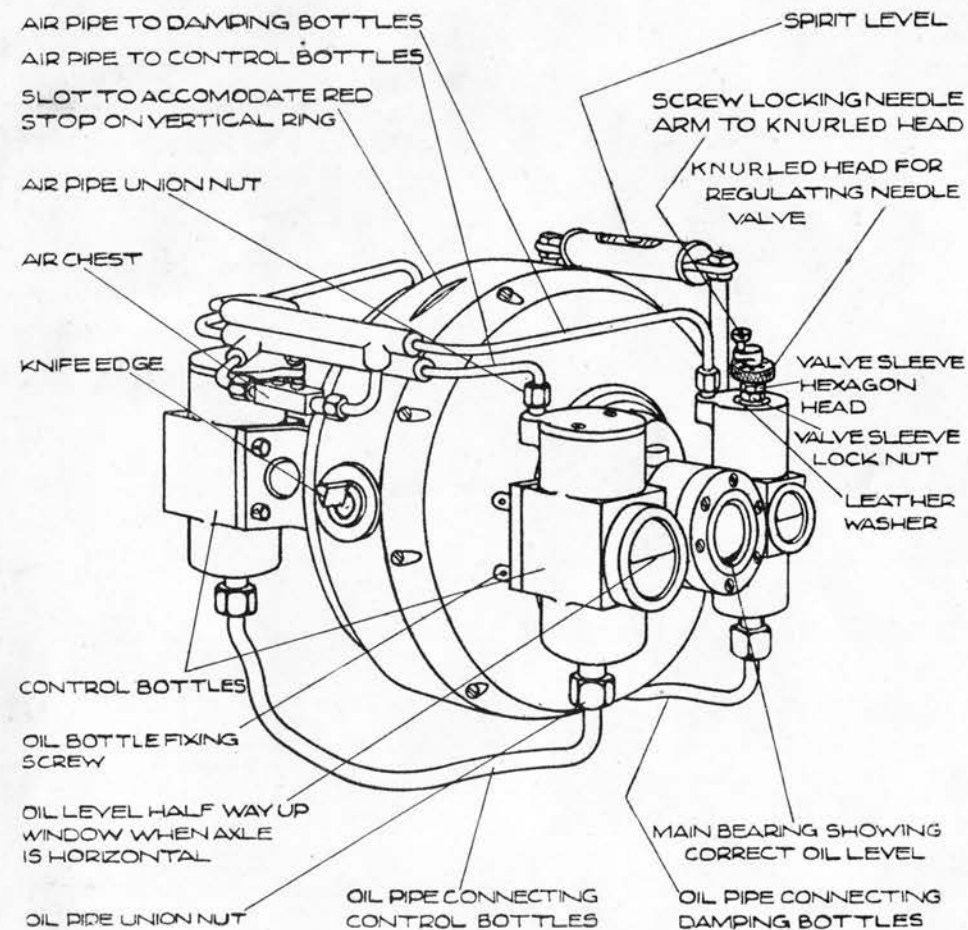


Switchboard (Type B)
(Open)



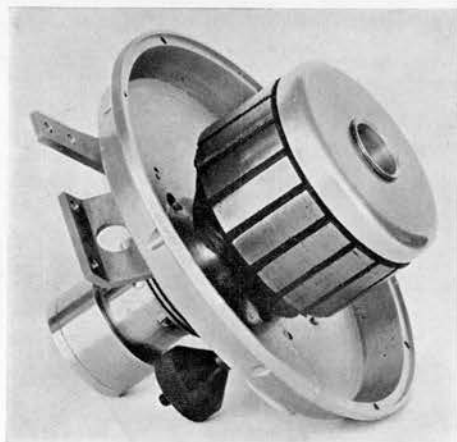
Plan view of
Gyro Wheel and Casing
removed from vertical ring

(Fig. 4)

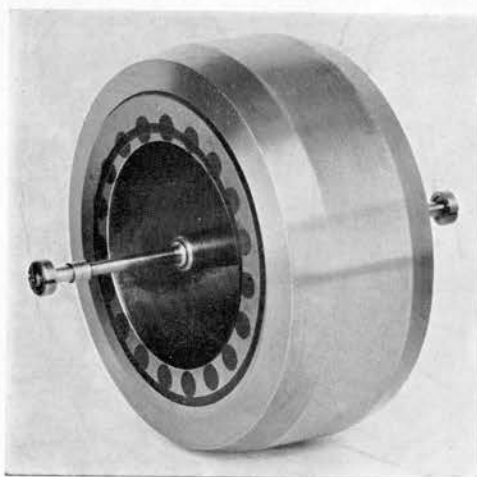


North-east view of
Gyro Wheel and Casing
removed from vertical ring

(Fig. 5)



On left:
South end of Gyro
wheel case, showing
stator and case
balance weight



On left:
Gyro wheel and
flexible shaft showing
copper bars and
spiral for ascertain-
ing speed of wheel



On right:
Centre ring and
north end of Gyro
wheel case showing
air scoop, knife edge,
and case balance
weight

Fig. 6

Possible electrical defects

Direct Current.

When starting the equipment you should switch on the external supply switch. If the supply voltmeter (on the left) does not show a reading, either the main fuses are faulty or the ship's dynamo is not working.

Secondly you switch on the main switch. The battery voltmeter and ammeter should now read. If not, examine the contacts of the main switch.

Thirdly, move the starting switch from left to right. Should the generator fail to rotate and the binnacle lamp not light, the battery fuses are at fault. Ammeter needle wavering indicates that the generator brushes are sparking. Clean the commutator and see that the brushes are bearing on the commutator firmly and evenly, and also that they are free in the holders.

Alternating Current.

When the generator is running the gyro wheel and pump motor should rotate. In case of neither the pump nor the gyro wheel starting up, a break or bad connection is indicated between the generator and the compass. Examine the red flexible wires on the gimbal rings. If broken, fit new ones. Ensure that all terminal screws are tight.

In case of the pump operating but the gyro wheel remaining stationary, investigation will show that the gyro case flexible wires are broken, or the red flexible wires on the mercury rings are damaged. When renewing either sets of flexibles, care must be taken that a cross-over is not effected, as this will reverse the direction of rotation of the gyro wheel. The gyro wheel rotates clockwise as viewed from the South side.

Battery maintenance

Storage Battery, 21 amp. hr. capacity.

Comprises four units each of six glass cells, contained in hardwood crates. The whole battery is fitted on the Bridge in a hardwood, ventilated box, designed for the purpose.

The following instructions have been compiled by the makers with the idea of providing the necessary hints for the most efficient working of the battery.

Fully charged, 2.55 volts per cell.

S.G. 1260.

Fully discharged, 1.86 volts per cell,

S.G. 1160.

Maximum Charging Rate, 3 amps.

Minimum Charging Rate, 1½ amps.

(See Note 8, instructions for operating the compass).

Maximum Discharge Rate, 9 amps. for 1 hour.

Acid Level.

During the first three discharges, the porosity of the plates increases, causing the level to fall. The acid must then be raised where necessary to $\frac{3}{8}$ " above the top edges of the plates, by adding distilled water or rain water collected from clean roofs. Town supply water frequently contains lime, iron and other impurities that reduce the capacity and life of the battery. Use a clean, earthenware vessel for adding the water. The additions of water must be made before commencing a charge. Maintain the acid level at about $\frac{3}{8}$ " above the plates. Do not add acid. A full charge will always raise the specific gravity to normal.

Replace the vent plugs after adding water; these arrest the acid spray and reduce the necessity for adding water to a minimum.

WORKING INSTRUCTIONS.

Discharging.

Do not discharge lower than 1.8 volts per cell or 43.2 volts over the whole battery when discharging at any rate not exceeding 2 amps., and not lower than 1.65 volts per cell or 39.6 volts over the whole battery at any higher rate up to 9 amps. In the event of the battery having been discharged to these voltages, it must be recharged as soon as possible. If this is neglected, the plates will harden and require a very long charge to raise their condition to normal. To ensure economical charging in a reasonable time, the battery should not be discharged beyond 1.9 volts per cell when discharging at 2 amps. or less.

Charging.

Do not exceed the maximum charging rate. When the battery is charged the positive plates are a clear chocolate colour and the negative plates are a clear slate grey. Positive and negative plates gassing freely. Specific gravity, 1.250 to 1.260.

Conditioning Charge.

Once every three months, after the voltage has risen to 2.4 volts per cell, when charging at the normal rate reduce to 1½ amps., and continue charging for two to three hours. This assists in maintaining the maximum porosity of the plates.

Idle Battery.

In the event of the battery not being required for several months, charge it fully by the conditioning charge method, and every third month thereafter.

Compass refuses to settle

IF, after three or four hours the compass should fail to settle, the cause can invariably be attributed to a fault in the damping system. This may be due to (a) a choked damping valve, (b) an air lock in the damping valve.

NOTE: The damping valve is to be found in the smaller of the two bottles on the north side of the gyro (see Fig. 4).

Proceed as follows:—

1. With the spanner supplied for the purpose, slack back the lower of the two hexagonal nuts. (This is a lock-nut and tightens down to the leather washer). (See Fig. 7).

2. Unscrew the damping valve as a whole by applying the spanner to the top hexagonal nut. (This is integral with the valve sleeve).

3. Lift the damping valve out of the bottle, and in order to do this it will be found necessary to slightly tilt the gyro.

4. Remove the needle by turning the knurled head. (Do not remove the little screw which locks the arm—pinned to the needle—to the knurled head. This is set to give the correct damping and must not be touched).

5. Clean the needle carefully with clean rag.

6. Flush out the valve sleeve by squirting petrol in at the top, so that it passes out of the small hole at the bottom. Treat the side holes in a similar manner.

7. Dry the sleeve. Replace it in the bottle and screw tightly by hand into the thread at the bottom of the bottle.

8. Apply the spanner and tighten carefully.

9. Tighten the lock-nut down to the washer.

10. Tilt the gyro from one side to the other to ensure that oil passes from one bottle through the valve to the other bottle.

11. Tilt the gyro so that the bottle containing the valve sleeve approaches the compass card. In that position enter the needle just sufficiently to enable it to

clear the card when the gyro axle is returned to the horizontal.

12. With the needle in that position tilt the gyro the other way so that the bottle containing the valve sleeve and needle is as low as possible and thus allow oil to accumulate in that bottle.

13. With the gyro in that position, move the needle gently up and down the bottle and finally push it right home and screw it in tightly by turning the knurled head. Note: Nos. 11, 12, 13 should be followed closely so as to avoid an air-lock. An air-lock can arise when the needle is carelessly replaced.

If, after cleaning the valve, the compass still refuses to settle, it is a sure indication that the oil in the damping bottles and pipe contains a foreign matter. Proceed as follows:—

14. Disconnect air pipes from the tops of the damping bottles.

15. Remove with the tommy provided the four screws holding the bottles to the brackets on the gyro case. The bottles and "U" connecting pipe can now be removed.

16. Take out complete damping valve from the one bottle and unscrew the filling cap from the other.

17. Empty out the oil and flush bottles and pipe with petrol.

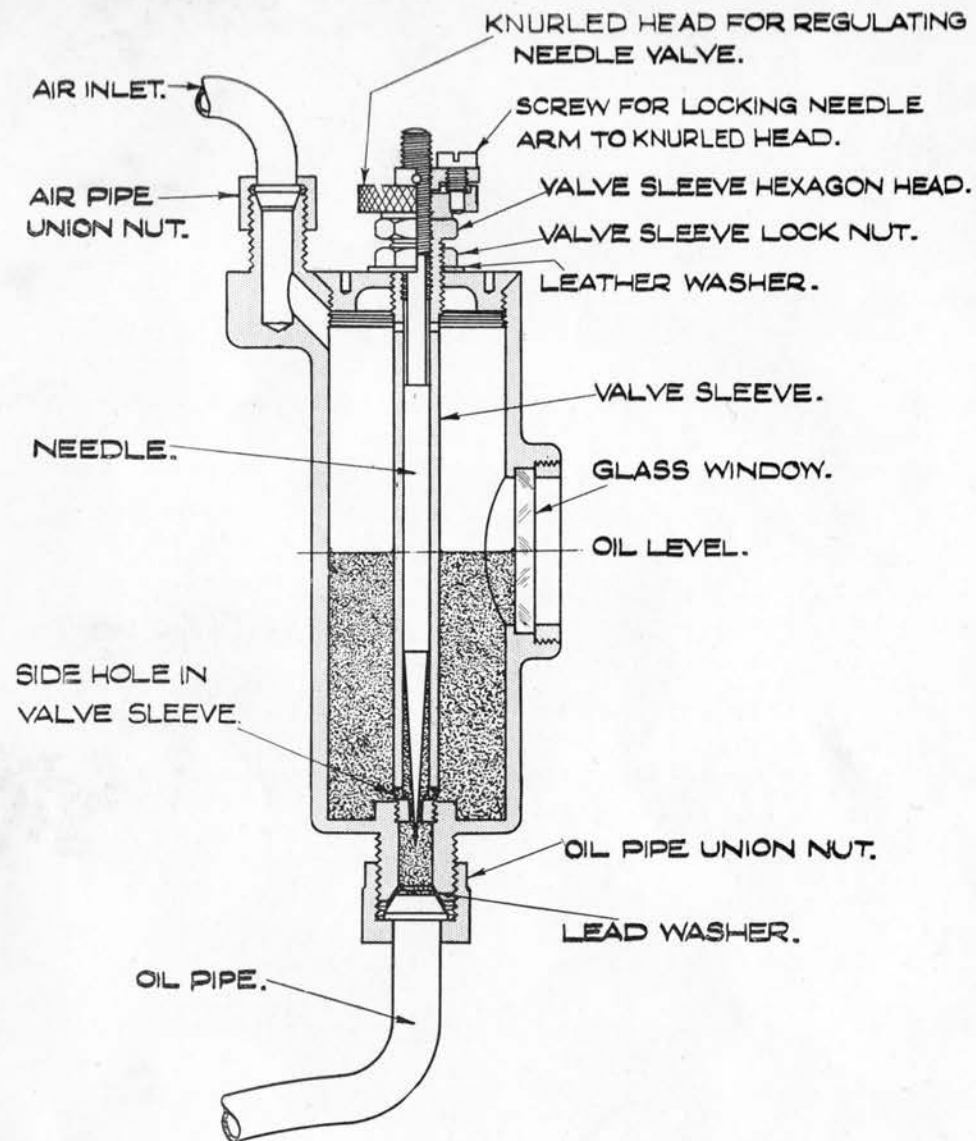
18. Refit bottles to the gyro case, reconnect air pipe; refill with fresh D and W oil to height half-way up each window.

19. Replace filler cap, taking care that leather washer is in position.

20. Clean again and refit damping valve as previously described.

Do not use a dirty syringe when filling bottles with oil.

A choked damping valve or the need of taking the bottles off may never occur, but instructions are given in detail so that should the occasion arise, no difficulty will be found in carrying out a simple operation which takes but a few minutes.



Section through
North Damping Bottle
(showing Valve)

(Fig. 7)

Cleaning and oiling

The most important part of the compass to keep clean is the top spindle, contact rings and mercury rings. This should be done after each passage. Proceed as follows :—

1. Unscrew the top bearing cover cap (on which is engraved "S. G. Brown," etc.).

2. Remove the four counter-sunk screws which hold the housing in position.

3. Disconnect the three flexible wires from the mercury rings.

4. Carefully withdraw the housing and mercury rings, taking care that the rings do not drop out from the housing. To prevent any mercury dropping over the compass gear, a paper disc, 8" diameter with a central hole $\frac{1}{4}$ " diameter, should be passed over the card and immediately below the mercury rings.

5. Take the three rings out of the housing and place them on one side. Care should be taken when removing to prevent any side strain to the vertical spindle. (Note carefully the arrangement of rings before removing).

6. Turn the housing upside down and replace in the frame in such a manner that it supports the vertical spindle.

7. Clean the contact rings with a piece of dry cotton tape, $\frac{1}{4}$ " wide. Pure petrol may be used when it is found impossible to

clean satisfactorily with the tape. Dry thoroughly.

8. Clean the mercury rings with a brush dipped in petrol and thoroughly dry before assembling.

9. Remove the housing and turn it up the proper way; insert the three rings in the original arrangement, and gently slide the unit back into its position and replace the four holding down screws.

10. Refill the rings with clean mercury until a level is reached half-way up the little windows. In case the mercury does not flow readily into the rings a slight tap will be required.

11. Connect the three flexible wires to the mercury rings.

12. Brush away from the compass, with the camel-hair brush, all beads of mercury.

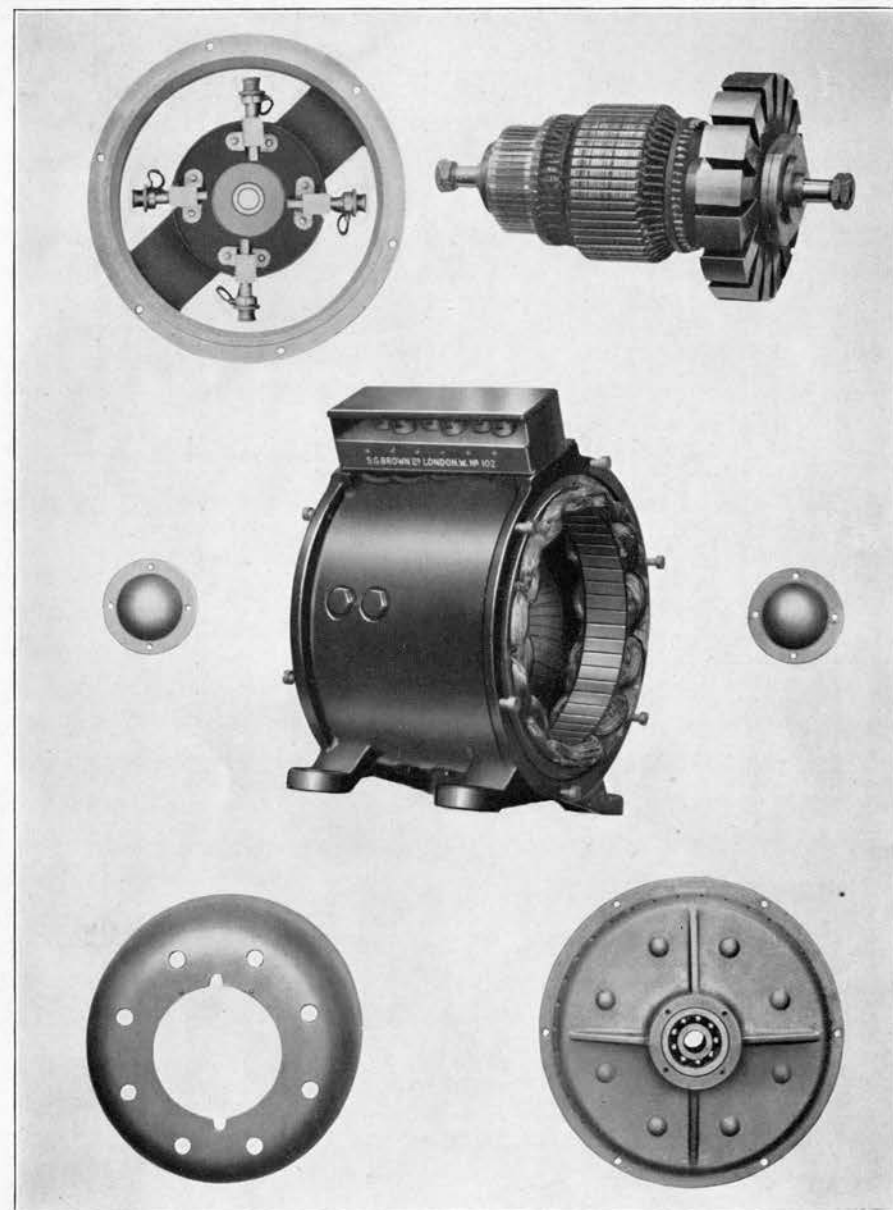
13. Give a general clean up of the compass card, lubber ring, bottles, pipes, etc., taking care not to damage the three fine wires leading from the vertical ring to the gyro case. (Before restarting, carry out routine previously described).

Examine oiling diagram carefully, and oil as required with special lubricating oil supplied.

Use pure petrol (Aviation) for cleaning.

Cleanliness is next to Godliness—

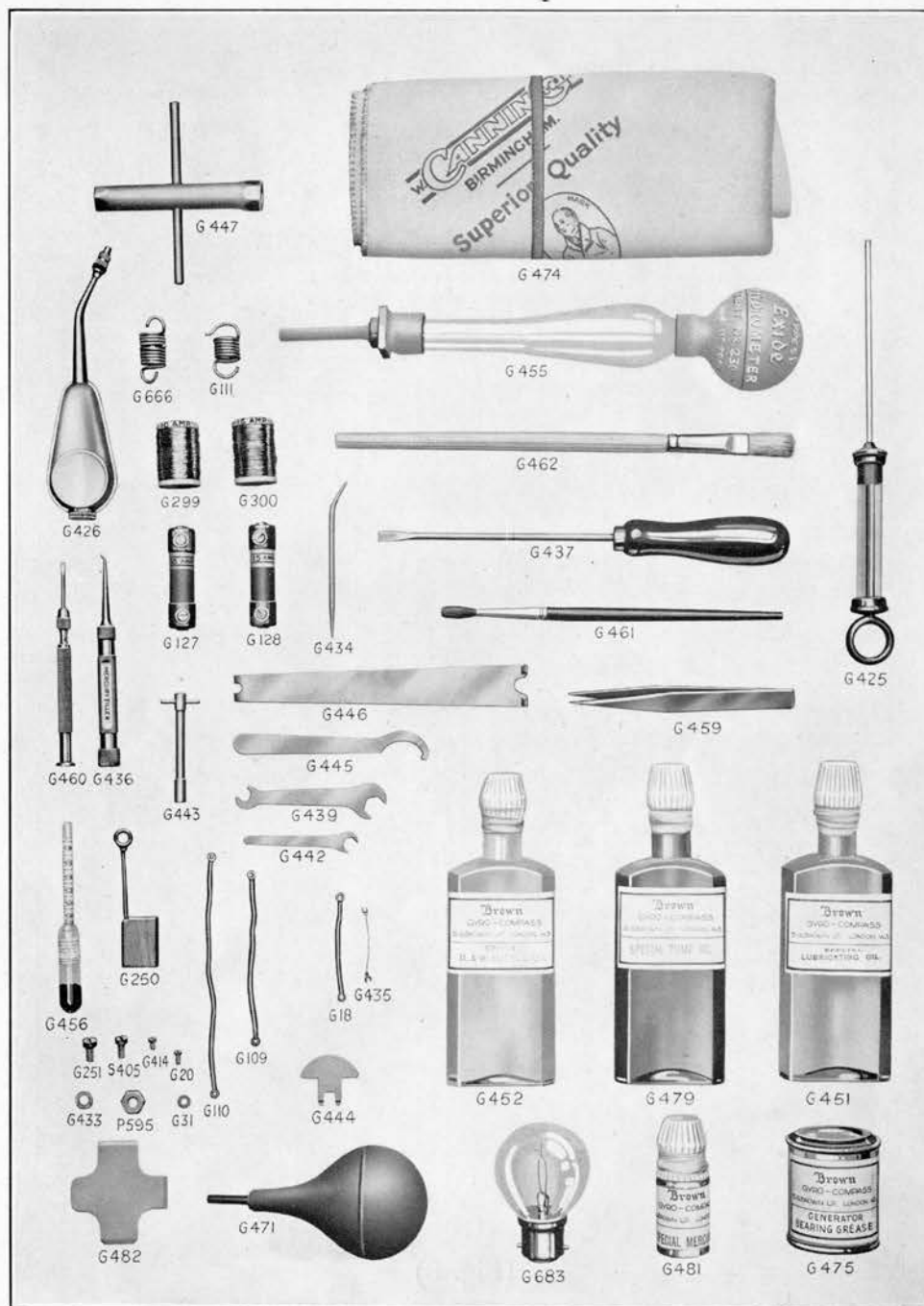
So never let the binnacle cover be open longer than is necessary.



Generator Details

(Fig. 8)

Top Left:—End plate with Brush Gear (D.C. end).
 Top Right:—Armature with permanent Magnet Rotor.
 Centre, Left and Right:—Bearing end caps.
 Centre:—Body showing A.C. windings.
 Bottom Left:—Brush Gear Cover.
 Bottom Right:—End plate (A.C. end).



Spare Parts and Tools

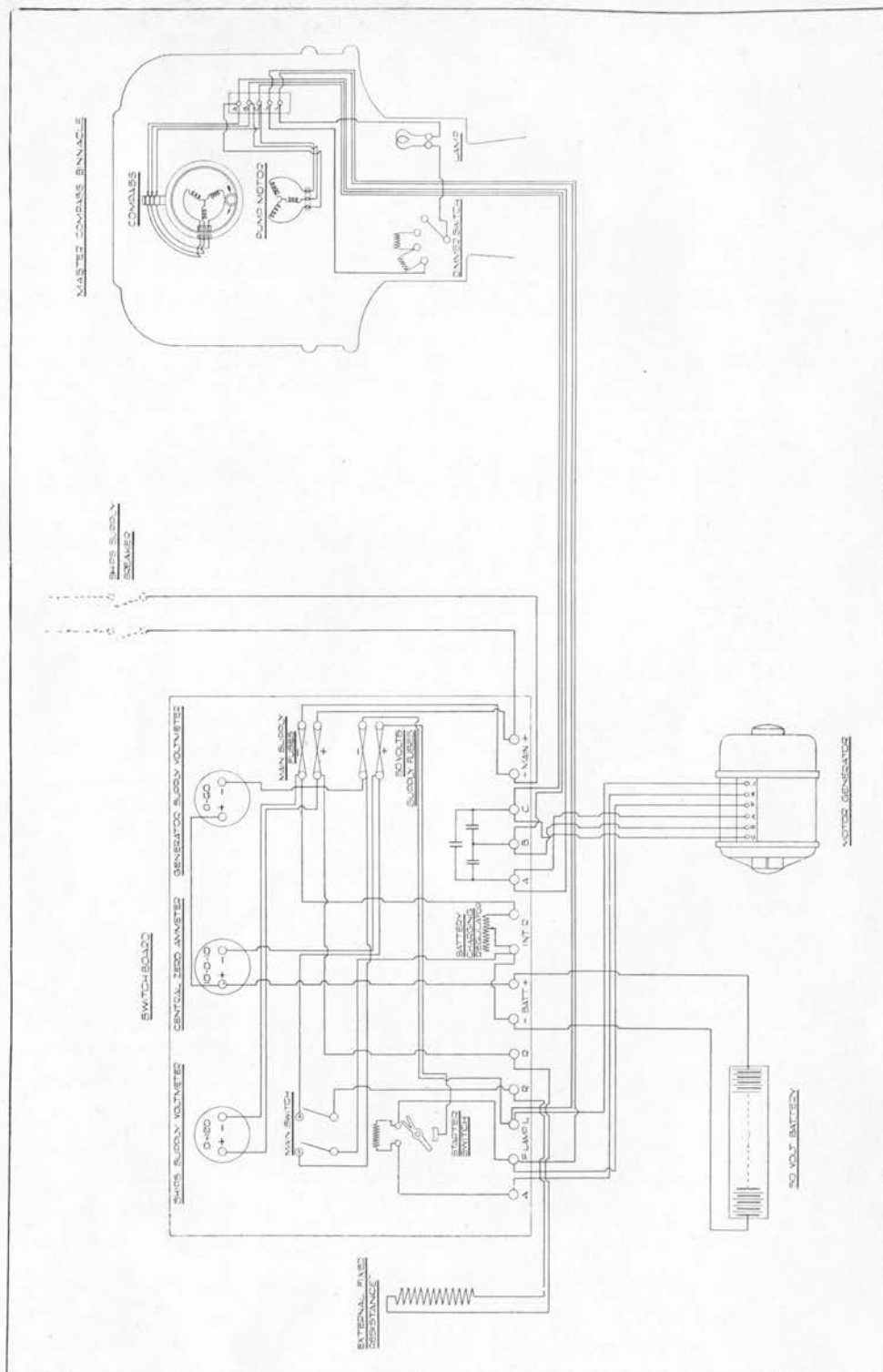
(For details see opposite page)



Contents of Tools and Spares Cabinet

Code No.	Item.	Code No.	Item.
G 452.	1 Bottle of specially prepared D and W oil.	S 405.	4 Generator brush gear terminal screws (4 B.A.).
G 479.	1 bottle of specially prepared pump oil (6 oz. size).	G 414.	6 Gimbal ring red flex terminal screws.
G 451.	1 Bottle of specially prepared lubricating oil.	G 442.	1 Damping Valve spanner.
G 481.	1 Bottle of treble distilled mercury.	G 443.	1 Gyro wheel and case balance box spanner.
G 475.	1 Pot of H.M.P. grease for generator end bearings.	G 444.	1 Quadrantal weights key.
G 127.	2 Renewable type cartridge fuses (10 amp.).	G 434.	1 Tommy.
G 128.	2 Renewable type cartridge fuses (15 amp.).	G 445.	1 Gimbal ring balance spanner.
G 299.	1 Reel of 10 amp. fuse wire.	G 446.	1 Gimbal ring bearing locking key, double ended.
G 300.	1 Reel of 15 amp. fuse wire.	G 436.	1 Mercury filler.
G 433.	3 Damping Valve leather washers.	G 447.	1 Switchboard terminal box spanner.
G 31.	8 Oil pipe lead washers.	G 437.	1 Screwdriver (6 B.A.).
G 250.	4 P/M Generator carbon brushes.	G 439.	1 Oil and air pipe union nut spanner.
G 435.	3 Gyro case flexible leads.	G 425.	1 Oil syringe for filling D and W bottles.
G 109.	3 Gimbal ring red flexes (short).	G 461.	1 Camel-hair brush.
G 110.	3 Gimbal ring red flexes (long).	G 462.	1 Fitch Brush.
G 18.	3 Mercury ring red flex (2½ in. long).	G 471.	1 Rubber blower.
G 111.	6 Gimbal ring springs (6½ turns undamped).	G 482.	1 Key for compass windows.
G 666.	3 Gimbal ring springs (9½ turns damped).	G 454.	1 Hydrometer (syringe G 455; Float G 456).
G 683.	6 Lamps for projector illumination system.	G 459.	1 Pair of tweezers.
P 595.	4 Switchboard Terminal nuts (O.B.A.).	G 460.	1 Watchmaker's screwdriver.
G 20.	3 Mercury ring steel screws.	G 426.	1 Small oil can.
G 251.	2 Generator terminal screws (special 3 B.A.).	G 474.	1 Rex cloth duster.
			1 Card table of Course and Speed Error.

REMARKS.—To facilitate quick service when re-ordering, please quote Code No.



Complete Wiring Diagram of Steering Gyro Compass Equipment
(Type B)

The Brown GYRO COMPASS

Speed Correction Tables

The tables have been prepared to permit
of the corrections being easily
applied at various
latitudes

To find Course to Steer by Gyro add or subtract correction,
according as directed below, to the True Course to be made.

EXAMPLE 1.

True course to be made ... = 210°
Latitude = 50°N.
Speed = 12 Knots
From Tables, Correction = 1°—Subtract
Therefore Steer by Gyro 209°

EXAMPLE 2.

True course to be made ... = 354°
Latitude = 40°S.
Speed = 8 Knots
From Tables, Correction = 0·7—Add
Therefore Steer by Gyro 354·7° or 355°

CORRECTIONS IN DEGREES AND DECIMALS

LATITUDE 0° NORTH OR SOUTH

[illegible]

LATITUDE 10° NORTH OR SOUTH

[illegible]

LATITUDE 20° NORTH OR SOUTH

[illegible]

LATITUDE 30° NORTH OR SOUTH

[illegible]

CORRECTIONS IN DEGREES AND DECIMALS

LATITUDE 40° NORTH OR SOUTH

[illegible]

LATITUDE 50° NORTH OR SOUTH

[illegible]

LATITUDE 60° NORTH OR SOUTH

[illegible]

LATITUDE 70° NORTH OR SOUTH

[illegible]