

1444959 LA C. 3025 G

GROUP A

Form 714.

# ROYAL AIR FORCE.

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Rough Notebook for use in Laboratories and Workshops.

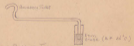
T. 3220 Wt. 2.97 412/399 346. R. 42 K.J.A. & S. Ltd.

Sketches in Pipe Instruments



Scale for  
 1000000  
 Feet  
 Scale for 1000  
 Feet

Radiation Thermometer



Vertical Balance Thermometer

Bulb Part at 1000 ft in 50° F  
 at 2000 ft in 46° F

## Basic Concepts - Introduction

### Atomic Course



### Magnetism



Magnetic Field



Magnetic Force



Magnetic Force



Lines of Force of Magnet



Magnetic Force



Lines of Force

## Electronics

Atoms is made up of one or more of the 92 elements in our earth. The smallest particle of any element is an atom. Every atom consists of nucleus around which revolve small units of negative electricity called electrons.

### Atom



### Atomic Model



A conductor is a substance in which there are a number of free electrons. A flow of electricity is said to flow when these free electrons are made to move along the conductor by the application of a force called Electromotive Force (E.M.F.).

E.M.F. is measured in Volt.

An accumulator contains very few free electrons and so a flow cannot be so easily set up.

Conditions for a electric current to flow are a complete circuit of conductor and E.M.F.

An E.M.F. causes a fall of potential along a conductor and between any two points in the circuit there will be a potential difference (P.D.) which is also measured in volt.



OHM'S LAW

This states that for a given conductor the current flowing is proportional to P.D. applied

| P.D. Applied (volts) | Current (amp) | $\frac{V}{I}$ |
|----------------------|---------------|---------------|
| 1                    | 1             | 1             |
| 2                    | 2             | 1             |
| 3                    | 3             | 1             |
| 4                    | 4             | 1             |
| 5                    | 5             | 1             |
| 10                   | 10            | 1             |
| 15                   | 15            | 1             |

Thus we also find it constant. If the above figures are for copper then for a similar gauge iron wire  $\frac{V}{I}$  is less & for iron is still less as great as for copper. These ratios express the resistance of the conductors in ohms.

Therefore Ohm's law can be written

$$\frac{V}{I} = R \quad I = \frac{V}{R} \quad V = I \cdot R$$

Watts:  $I \times V$

Costs of Work Done by Electricity

The rate at which work is done by electricity is measured in watts. The cost is measured in kilowatt-hours = 1000 watt hrs for 1 hr. A Board of Trade Unit = 1 B.O.T.U. = 1 UNIT

Find the cost of supplying a 500-watt fire 100-watt lamp 1000 B.O.T.U. for 5 hrs a day - 7 day week @ 1<sup>s</sup> per unit 2/- $\frac{1}{2}$ .

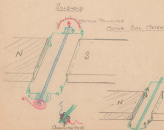
Thus many B.O.T.U. = 5 amp @ 240-volts

$$240 \times 5 = 1200$$

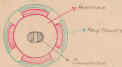
$$1200 \times 5 = 6000$$

2/-

MAGNETIC OF CURRENT



Current in the coil makes on face of the other south. coil moves to bring it north opposite North of permanent magnet and coil opposite North. It turns against the law, springs so that the pointer measures strength of current



ELECTRO-MAGNETIC INDUCTION



When a magnet is plunged into a coil current flows in one direction and if magnet is removed current is reversed. There is only an induced current when lines of force are being cut. The size of the E.M.F. is proportional to the rate at which lines of force are cut. The direction of an induced

E.M.F. is used as to oppose the motion producing it.

The Simple Dynamo



Rotating coil in a magnetic field in the correct way of continuously cutting lines of force and hence of producing a continuous induced E.M.F.

The size of the E.M.F. depends upon 1) Speed of rotation 2) Strength of the magnetic field 3) The number of turns on the coil.

2.6 Dynamos



A commutator is used to each end of the coil - note that the gap between the two brushes is opposite the brushes when the coil is vertical.

Thus the induced E.M.F. changes its direction the brushes make contact with the reverse ends of the coil. The current therefore always flows out at one brush and always flows in at the other, although it reverses its direction in the coil itself. Application to the Simple Dynamo.

1) A soft iron core is used to increase the effect of the magnetic field. The iron is laminated in order to reduce eddy.

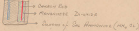
Practical Cells

1) Simple Cell



Bubbles will eventually form (oxygen) on copper plate and no steady current.

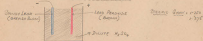
2) Leclanche Cell



3) Zinc Cell



Secondary Cells



Recharge - by passing an electric current through + plate at lower lead peroxide, - plate is reduced to spongy lead.

On Discharge - both plates tend to become lead sulphate (PbSO<sub>4</sub>).

①



②



③



③

Compass current passed by

- Two  $3\Omega$  in series
- Two  $3\Omega$  in parallel

at a potential of  $24V$

③



① 100,000

②

currents

- Many turns of wire on  $N$  shaped core
- Turns are distributed round the core



- Current Main Coil
- Current Sec Coil
- Current 1st Coil
- Current 2nd Coil

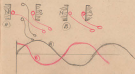
The core is made smooth by curved pole faces.

The core is made smooth by diagonal slotting.

Each magnet used instead of permanent magnet.

More than one pair of poles.

19 Phase A.C



Suppose two separate but similar A.C. supplies to be plotted on the same graph. It is unlikely to have the maxima of the two occur at the same time. The result shown in the graph could be obtained by having two coils mounted in the same axis at right angles to one another and rotated in the same field. The ends of these coils would be lead to separate slip rings. The result would be two phase A.C. Alternatively the coils could be stationary and the field magnet made to rotate (like motor). Advantages equals small currents for field excitation can be fed through brushes and slip rings while large currents and voltages for the armature are lead away through stationary leads.

### 3 Phase A.C.

See next page

### Case IV - Three Phase Induction

Consists of D.C. plane A.C. Generator  
D. Indicator (A.C. Induction Motor Type)

#### 3-Phase A.C. Generator

Consists of 2 pole permanent magnet which installs between 3 stator coils. 3 separate A.C.s will be produced with the coils differing in phase by a  $120^\circ$  here 3 phase A.C.

It can be seen by fig 2 that the total algebraic sum of the 3 E.M.F.s is zero

Also it is seen that since the 3 sets of the indicators have equal reactances (i.e. it is a balanced load) then no wires are necessary to take current back to generator.

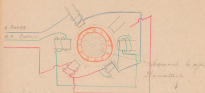


Fig. 1



Showing that the 3 E.M.F.s generated are out of phase

Indicator  
A.C. INDUCTION MOTOR



4 Pole permanent magnet surrounded by spiral steel - rotates against tension of spring carrying the A.C. supply

The Atmosphere

Composition - The mass of air round the earth. This is a mixture of 78% Nitrogen 20% Oxygen .02% Carbon dioxide water vapour and dust.

The pressure - At sea level 1 cu ft of air weighs .08 lb. This pressure is the total weight of a column of air to the top of the atmosphere. It can be measured by the mercury barometer (the best very accurate) or a aneroid barometer (without liquid barometer portable)

The Altimeter - the Altimeter is filled in all aircraft and it measures the height of the aircraft above sea level. It is an aneroid barometer with the scale calibrated in feet. This is possible because air pressure falls with height in a manner for 100 ft or 10 millibars approx. The air light case is connected with the static tube. Thus at mean sea level pressure is 14.7 lbs per sq in or 1013 millibars.

Correction - since the pressure at a height is affected by the temperature of the air, an altimeter has to be calibrated by assuming either standard atmospheric temperature etc.

A formula connecting height with



## Boat Gauge

$\frac{3}{8}$  OS  $\square$  + 1" O.D. (approx)

Hence 1" HO approx 30' diameter  $\frac{3}{8}$  OS  $\square$   
1" = approx 30' OS  $\frac{3}{8}$  OS  $\square$

## The Gyroscope



### Properties of Gyroscope

1. The rotor tends to maintain its plane of spin in space.
2. It tends to turn the outer ring (torque) shows position of the case very large or small position outer ring.

### Spring Scale of Precision

Rotate the torque by fast on rim of the rotor. It pulls 90° in short of spin with in direction of force which

### Each Ring

If the inner ring is perfectly unbalanced by a weight it can be made to push the outer ring round on rings with centre rotation. Gyroscope below type of 'Gyroscope' - Part of Gyroscope

The use of torque required:-  
Inclined with scale of precision.

③ Speed of Motor    ④ Weight of Motor.    ⑤  
Number of Motor

Large portion - but. Value - make to make  
Other part - on the water, with

Electricity - accumulators - dynamos. Electric  
Motor. A.C. D.C. Circuits. - Atmosphere  
Jan. 1903

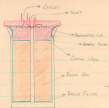
Installation of Yellow U.S. Cable (cont.)  
the loop in the end of the spring clip  
over the pin projecting from the mounting  
unit.

The accumulator portion must be  
placed in an extreme position so that  
the cable may be attached to the shaft  
end. Attach the cable to the pulley by  
a handle, the pin of which must be set  
in the slot of a beam plate secured  
to the accumulator. Pass the cable round  
the pulley where necessary and lead  
it to the rear of the motor and at  
Buck's starting cable to the pulley where  
it would enter it is fully wound, and  
where it is of a turn. Pass the cable then  
round the pulley and through the hole  
provided and mark where it penetrates  
the hole. (Draw in the pulley and cable  
and the cable the nipple on the end  
of the cable). Apply appropriate nuts  
holding it in on pulley, and pull slack  
cable through the pulley and be that  
it is unhooked. Then the cable is in

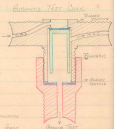




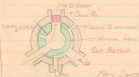
convenient, the chemical the tank from the lower part, oil is fed through a filter to the oil cooler which has a Y-shaped radiator. The oil then passes to the Automatic Valve which can be situated between the reservoir and the cooler, or between the cooler and compressor. If the reservoir is fitted lower than the compressor the valve ensures an oil supply to the compressor on starting. If the compressor is lower than the reservoir the valve prevents the former from being flooded with oil when it is not in use. It is fitted in the lower part of the oil system. Oil charged on each minor. Automatic Valve and Oil cooler flushed with 50-50 anti freeze and petrol and system re-filled. There are fibre washers on Oil Reservoir. Oil level maintained. Flow of Oil is in direction of Compressor.



Compressor Air Tank



Automatic Test Case



Cut Section



Stop Position



Run Position

Chemical Filter Drier (To prevent freezing up)

The chemical filter drier consists of an inner and outer container, the former being filled as follows: <sup>1</sup> gauge drier silica gel (1/2 inch approx 5' from the top) <sup>2</sup> gauge filter <sup>3</sup> Hoffmann cotton wool and then the porous material. Recharging must be done immediately prior to flight. A wash container with hot water and allowed to dry before using. <sup>4</sup> Silica gel must be returned to water in time powdered when app. silica gel is dry when colour changes from white to brown.

Test Cock

This is a three-way cock having two positions. In the Test position air is supplied to the units from an outside source via the flying position, air from the engine passes straight through the cock to the main control cock. <sup>2</sup> On a 1/2 inch or more dial cock is lock in flying position on 2 D and between flight inspection. <sup>3</sup> Stop check that locking tab is in position on

2 D and between flight inspection. If it is necessary to stop, the cock, ensure when replacing together that plug is put in the correct way - marked off end to the top of Test Cock.

Main Control Cock

This has three positions. <sup>1</sup> Cut - the jets and carburettor are covered to stop fuel supply. <sup>2</sup> Fly - air from back to regulated system through a check valve is fitted to maintain a pressure as set; <sup>3</sup> There is always an adequate supply of oil to the compressor. <sup>4</sup> No fuel flow inspection is ensured.

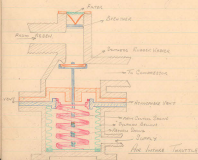
<sup>5</sup> Main air feeds to the jets, main valve, tongue valve and steering control. The centrifuge pipe line is well exhausted to atmosphere. <sup>6</sup> Free air is fed to the slow components and the centrifuge, to de-carburize the gumbal system and feed the main valve. <sup>7</sup> Dial action is checked on the

inner and outer bands are in them in the out position.

③ The bands can be fitted in any set positions.

④ A brass plate fitted into the "Out" in line with the handle when distances are coincident.

⑤ Some distance pieces fitted between brass plate and outer casing.



### The Inlet Throttle

Purpose - To maintain and regulate a pressure not exceeding 10 lb in the system, and to act as a non-return valve to prevent air from compressor (Oil Reservoir & S.D.) coming out along regenerative pipe lines.

### Construction

Has three connections to compressor, begins supply system, consists of a cylinder belled the outside of which is made of brass. Inside is a powerful spring which normally holds them open. A piston runs along the centre and when spring is not working, a small return spring forcing against a collar on the piston, holds the piston on its seat, and gives a non-return action. When spring is started the piston is down, after seating on the compressor, commences to draw air in.

The lower connection (supply) feeds the air round the bellows. The pressure increases in the system, the pressure will increase and the bellows

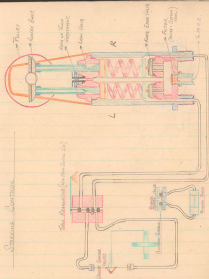
will be contracted against tension of springs the piston will then be forced up off its seat and air supply to compressor will be cut off.

An inlet or booster at top of A.P.V. allows an additional supply of air to be sucked in when starting - up, it also acts as a compensator for slight leaks. An arrow indicates direction of flow to compressor.

Is installed on tied pipe between A.P.V. back and Main Control back  
 Sliding Control

Is used by Bomb and a Petrol can do a sound stage. Little inlet (with connector) gauge and valve, through which air passes into the two compartments beneath the knife edge valves which are held in position by a spring. This leaves the compartment by the top outside union at base and in the course of a valve via steam regulator.

When starting control is operated, the pulley rotates the notes on wheel forms



Starting Control



Remo. Bolts

Follow the Bolt Guide



- 7 - A. 1 12 - A. 2
- 6 - A. 2 11 - A. 3
- 5 - A. 3 10 - A. 4
- 4 - A. 4 9 - A. 5
- 3 - A. 5 8 - A. 6
- 2 - A. 6 7 - A. 7

blotches

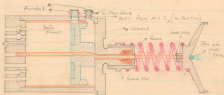
2 & 3 Take check bar out and take off controls by moving pulley in all all directions (broken or loose of controls are ok). Put check bar in next each of it central angle about head check slip in. Take off control with check bar. Remove check bar Use as an guide on the saw. Movement of soft controls with blotches is not so great as when blotches are out.

Stripping of Remo Bolt's blotches

3 Remove 200 nuts and lockers 104 from top of primary spindle

- 3) Remove white pins and take out clutch locking assembly from remove clutch disc arm
- 4) Remove spring return assembly with bar spanner
- 5) Remove clutch plate from splined shaft with removal tool (detrostar)
- 6) Remove rollers up pulley and dorsal plate by means of two spanners. Take care not to damage flange underneath.

7) Remove stop plate assembly

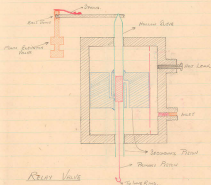
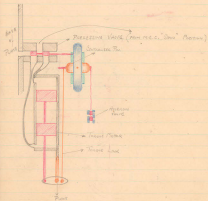


R. E. Cameron

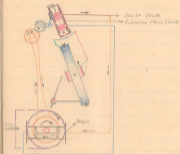




Pressure Valve and Turret Motor



Reverse Valve



Exhaust Process

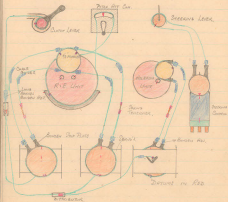
### Filter Plate

Frame of Granite Control Ducts & connects  
the frame in either direction of flow and  
aft of the s/p.

### Filters

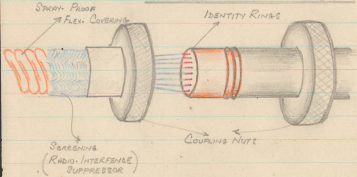
| <u>Anders and Edwards Plate</u> | <u>Quantity</u> | <u>Price</u> |
|---------------------------------|-----------------|--------------|
| Anders Main Valve               | 1               |              |
| Edwards Main Valve              | 1               |              |
| Relay Valve                     | 1               |              |
| Edwards Change Valve            | 2               |              |
| Edwards Jet                     | 1               |              |
| Edwards Jet                     | 1               |              |
| Edwards Motor Pipe              | 1               |              |
| <u>Filter Plate</u>             |                 |              |
| Filter Valve                    | 1               |              |
| Pressure Valve                  | 1               |              |
| Edwards                         | 1               |              |
| Supply Valve                    | 1               |              |
| Sparging Jet                    | 1               |              |
| Edwards Motor Pipe              | 2               |              |
| <u>Accessories</u>              |                 |              |
| Filter Intake Control           | 1               |              |
| Component (Filter Oil inlet)    | 2               |              |
| Oil Reservoir Outlet            | 1               |              |
| Chemical Filter Tray            | 1               |              |
| Steering Control                | 1               |              |

Cable Layout Mk IV



Q. Lead for cable joining at socket and test spring section of Spring  
Hensons

# BREEZE WIRING CONDUIT



## Fault Finding

| FAULT  | CAUSE   |
|--|---|
| 1) Indic. reads above zero when empty                                      | Bent plunger.   |
| 2) Pointers do not move off vertical when switched on or tank being filled | Broken supply lead.<br>Brush not contacting resistance<br>Bad contact at indicators |
| 3) Pointer comes 180° in advance when switched on and settles correctly    | Crossed supply leads  |
| 4) Pointer gives a fixed reading when tanks are known to be empty.         | Locating <sup>pin</sup> dislodged from brush.                                       |

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 1816 Dist  
 1817 Crpd  
 1818 R. for  
 1819

993  
 999  
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 18 12  
 36 6  
 3  
 39

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