Form 619

"GEN"

ROYAL AIR FORCE.

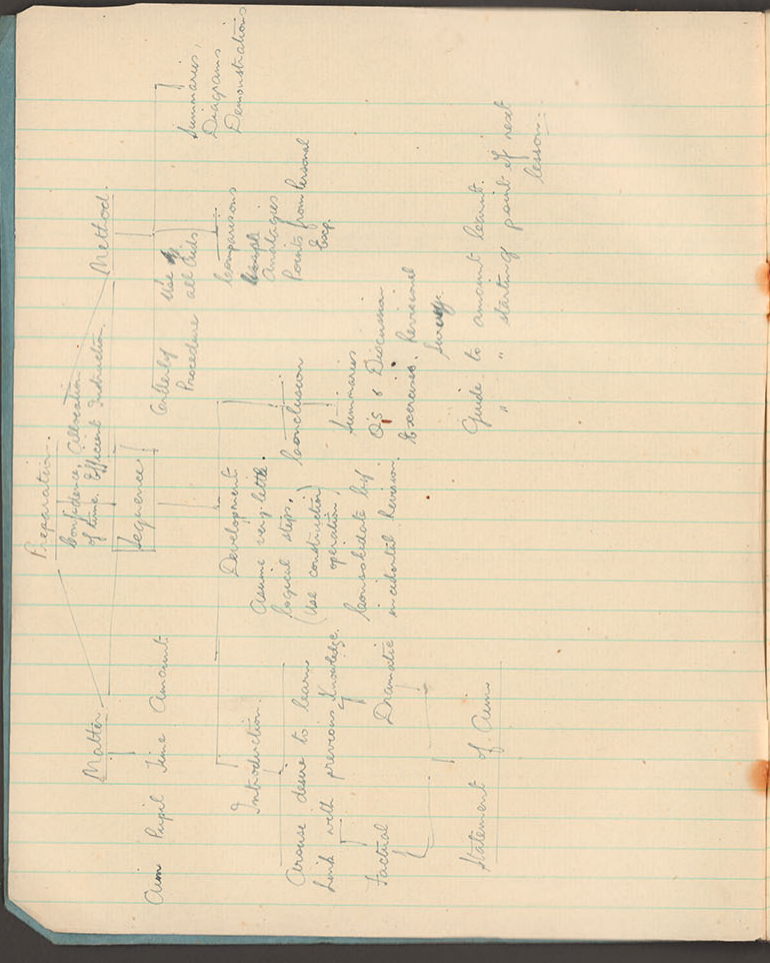
Notebook for use in Schools.

91/5769. Wt. 6631. 500M Bks. 11/43. C.W.S. Ltd.

Lecture Technique.

Instruction.

- **Presentation**
  - Introduction
    - Links with previous knowledge
    - Aim
  - Development
    - Logical Steps
  - Conclusion.
    - Revision
    - Survey.
- **Ensuring of comprehension.**
  - Interest
    - Attitude
    - Manner.
    - Voice.
  - Class co-op.
    - Q & Discussion
  - Consolidation
    - BB. Summary
    - Diagrams etc
    - Notes.



Construction & Action of a Mechanism

Introduction
Purpose and Use. (How it has developed)

Development
General Survey of whole apparatus
Main Parts
Details
Discussion of advantages & disadvantages. limitations
ranges etc. Uses.

Conclusion
Run through construction & action (by a student)
Deal with Q's from class
Discuss practical uses.

Theory Lesson.

Introduction. State the problem. Say what the purpose & value of the solution is.

Development. Examine the main factors involved.
Reason each step separately, using as far as possible previous knowledge possessed by class
Illustrate with examples.

Conclusion. Practical exercises.

Presentation

Personality

Attitude — Manner / Bearing of — Voice

Be
Confident
Vital. Patient
Interesting.

Class Management
Self discipline. Tact.
Punctuality Equal Temper.

Classroom conditions

Lighting — Heating — Ventilation

Instructional Speech

Clear Speaking of

Voice & Choice of words

Good Articulation — Simplicity
Correct Speeds — Precision
Pauses
Emphasis

Class Co-operation

Practical

Use of Apparatus
Equipments. Examples

Oral Work

Written

Pupils own notes inadvisable.
BLB. Summary to be amplified
Duplicated Notes

Q's & Answers.

USE.
Revision
Exploratory
General: to test application of knowledge.

FORM.
Clear. Simple
No catches
No YES-NO types
Limit the Scope

CHARACTERISTICS.
Clarity: Simplicity
Exhaustive
Admitting of one answer
To sustain interest & provoke thought.

ANSWERS.
Sympathy
Patience & Tact. Use names last.
Allow time
No { Repetitions / Interruptions / Sarcasm

Q's from Class
Invite them
at proper stage
Deal with them
Honestly.
Always provide an answer.

Black Board Work.
Visual Aid

Clarity | Unity | Emphasis | Simplicity

Position
Writing - Drawing - Printing

Choice of words
Layout

Summaries

Types	Use
Headings	Recap
Tree	Progressive
Tabulated	Revision

General Points

Clean at Start
Short Intervals
Avoid Restlessness
Look at Class
Illustrate
No mistakes.
Preparation & Practice

Diagrams

Types	Constr.	Use
Temporary	Visualise	Build Up
Annotated	complete	with talk
Graphs.	Main compnt. first	on finished ready for use.

Other Teaching Aids (cont)

2. Episdiascope

3. Demonstration Model

4. Actual Apparatus

5. General
   (a) Be sure when to use it
   (b) Show appreciation of the size.

6. LIBRARIES (d). Periodic Checks.
   (a) Good cataloguing & clear references. (d) Good facilities for occasional references
   (b) For a period of loan.

The Revision Lesson

Mainly through Q's & examples
Stick to main points
Q's & Examples will follow the same general order as in the original lesson.

Teaching of a Skill

Introduction:
Arouse interest & demonstrate completely

Development
1. Demonstrate carefully with full explanations
2. Take first section: demonstrate. Individual practice: errors corrected. further practice.
3. Proceed similarly with each section of the operation
4. Combine stages together until whole operation is learned.

Conclusion
Illustrate practical use & give opportunity for use.

Other Teaching Aids.

1. Mechanical
   a. Gramophone: Has definite revision use
   b. Films.
      I Preview - make notes
      II Normal run with class.
      III. Discussion.
      IV. Final Run.

Learning & Memory

Rapid Learning — Permanent Retention — Ready Accessibility.

Psychological Factors	INTEREST — AIDS	Kinds of Learning
Attitude Confident · enthusiastic Problem · saving · Attract Attention – Retain with Interest Sustain interest with Varied activity Motives Excellence of progress Self-competition Praise.	Learn by wholes Examine by results Association Recapitulate, Rest, Revise No fatigue Imagery – (Vis and Mus). No distractions Goal to be seen & be attainable	Imitative Attitudes picked up in this way Cite skills of first Rote Mechanical skills Learning by heart Dispense with rote by written records of facts. Rational Most important Meaning. Associations Psych factors –

CONCENTRATION

Instructional Organisation

1. Planning a course
   Bear in mind: (Intro:
   Revt: Consolidation)
2. Time Tables
   (a) Least elastic factor
   (b) Distribute subjects.
   (c) Bear in mind learning value of periods.
   (d) Allow for breaks.
3. Instructor's Records
   (a). Lecture Notes.
   (b). Record of Work Done.
   (c). Record of Tests.
   (d). Charts of Progress Etc.
4. Tests
   (a) Aim is to test - sample.
5. Setting of Tests
   (a). Clarity of Q.
   (b). Main points. Whole of section to be covered.
   (c) Sufficient easy Q's to enable the average pupil to pass. A few harder ones to bring out the better pupils.
   (d). Instructions must be clear.
6. Types
   (a), Set Q's which involve factual answers.
   (b). " " " require a diagram.

Instructional Organisation (cont).

7. Questions
   (a) Arrange that the answers demand effort proportional to marks allotted.
   (b) State which diagram is required.
   (c) " what kind of definition.

8. Assessment & Use of Results
   (a) Explain the System.
   (b) Severity represses. Leniency tends to forfeit respect.
   (c) Watch grading (Distribution Curve)

9. Orals
   (a) Intending Instructors.
   (b) Borderline cases.
   (c) Practical Subjects.
   (d) Use cards with Q's taken from the whole syllabus.

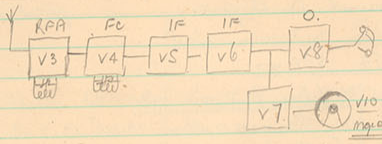
10. Recording.

Question	Points expected	Max marks obtainable	Marks Obtained.

Marconi Fault Finding.

AMP 180 Good Gen Book.

R1155. Valves



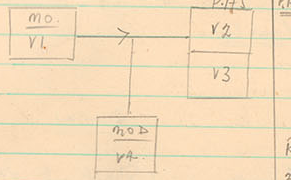
BFO 280.5 K/cs.

Valves U/S.	SYMPTON	REMEDY
V3. RFA VMB. TET	No (weak possibly) Signals Local 280.5 K/c note — Magic Eye Deflects to this signal only.	1 Short out V3 — Remove grid to V4 for Sensitivity. (Emphasis) 2 Replace V3 by V5 & short V5's cap on to V6. for Selectivity.
V4. F.C. TRI/HEX	No Signals No 280 K/cs note. Magic Eye will not Deflect.	Replace by V1 or V2.
OR. V5 1st IF. VMB. TET / V6 2nd IF. VMB TET	Weak Signals Weak 280.5 K/cs note No Magic Eye Deflection.	Detect U/S valve (5 or 6) Put Serviceable valve in V6's position & short out V5 stage.
V8 DYO. DDT.	No Signals. Magic Eye Deflects normally. No 280 K/cs note	Replace with V7 and Remove Screening cans from V5 & V6. Replace V8 with V10 (ME) short

Emergency Tuning (without M.O.). Middle Jones Plug in Rx [ ] Phones to 2nd pin on left (going up). Tune for "Dead Space".

Valves U/S	Symptom	Remedy
V7 DDT BFO	No Magic Eye Deflection Only MCW x R/T Signals received. No 280 K/cs Note.	Change V8 with V10 & place V8 in V7's position.

T 1154 Valves



P.A.'s

P.A. Valve Emission Test

1. Remove either V2 or V3.
2. Select Yellow Range, Taps selected 17 x 18, Fine Tuning control fully anti-clockwise. M.O. set at 500 K/cs. Remove M/F Aerial (side of Tx).
3. Press key on Tune

Valves U/S	Symptom	Remedy
V1.	Mag Feed above normal No dips on any range.	Replace with V4.
V2 and V3 (together)	No Mag Feed reading.	NIL.
V2 or V3	Low Mag Feed.	Check valves by "Emission Test" and remove U/S valve.
V4	No Side-Tone	NIL.

4. Observe Mag Feed reading - Should be 190 A/cm or above. Will be 120 or below for U/S valve. Soft P.A. valve reads 300 ma or over (blue lights).

Power Supply Shorts to Earth

6.3v -	Already Earthed at LTPV - No change
6.3v +	Dead short across 6.3v brushes of LTPV - Input fuse blows.
220v -	On ⊙ and ∞ full gain on Rx. No volume control - bias network is shorted out. AVC Balance Pot. Almost normal, but no 36v negative safety bias.
220v +	Full H.T. across Biasing network R1 R2 and R4 burns out.
1200v -	to earth. - Permanent input on the Mag feed meter. Key up or key down. (No paralysing Bias).
1200v +	to earth; - Key up - nothing happens. Key down. - 750 ma fuse blows.

VHF - So 43. T.R.

Advantages

1. Above frequency of Natural Static.
2. Short Ground wave ∴ Security.
3. Unaffected by the Heaviside Layer.
4. Accurate D/F up to maximum Range by Day & Night.
5. Large Frequency Coverage allows good station separation.
6. ¼ wave aerial quite short and easily fitted.

Disadvantages

Frequency Coverage 100 to 156 M/cs.

Range Varies with Height – 30 mls at 1000 ft.
– 180 mls at 20000 ft
(approx max.)

Txmitter Output 8 to 9 Watts.

4 Preset Frequencies

TR. 1196 ((VHF in Bomber C))

Intro. Took the place of the TRG 6 was designed for the F.A.A. as an R/T & MCW. Tx Rx. Later it was adapted for use in multi-seater A/C in conjunction with the A1134A. Advantages over TRG. — Superhet. Better Ranges. 1000 4 Freq Ranges 4 channels

DEV

Self contained unit Tx & Rx

Freq coverage. 4·3 to 6·7 M/cs.

Ranges. Air to Air 30 mls } Alt 2000 ft
Air to Ground 50 mls } (("C" "D" 8 to 10 mls))

Power Supplies

LT 6·3v 1·3amp HT 250 v 65ma From Motor Generator which is driven from the A/C Electric (Input 24v 2·6amp) System

General 4 Xstal controlled frequencies — selected one at a time by Push Buttons on Controller Electric. Marked A.B.C.D.

Tx BLOCK DIAGRAM (A.B. - 1·8 watts C.D. - ·8 watts)

MO. Stage. VR 91 PENTODE.

Circuit is a Pearce Oxe Cct and is Quartz Xstal Controlled. One of 4 Xstals is selected by the Step by step motor in the chassis assembly ((Grid leak & condenser Bias))

((Advantages)) a Freq Stability of 1 part in million can be maintained over long periods in good conditions with temperature control. (In T1154 freq could drift owing to "mechanical vibration.

MO. coupled to PA. via a condenser (as in T1154).

PA. Stage VT 501 TETRODE

Amplifies oscillations produced in M.O. Consists of tuned cct & valve. 4 Tuned ccts each a "Continuously Variable Inductance" with "Aerial & Earth" as "capacity". One of these ccts is selected at each position of the step by step motor.
((High Power Output is obtained by operating the valve as a Class "C" amplifier))

Resonance while tuning the PA stage is indicated by a low power lamp in the Aerial circuit, which is normally shorted out by a spring plunger.

"C" Range "D" The power of the Tx is reduced on these ranges, to give the necessary Darkly range of 10 mls. Done by inserting an 1800 ohms resistor in the AE cct of this range.

MODULATOR STAGE VT 52 PENTODE

Acts as an A/F amplifier whose A/F output is passed on to the R.A. valve. ((Anode choke Modulation explained later))

COMMON AE CCTS

Before going any further we have to feed the signals from our RA. on to an aerial, and in this case we use a "Common Aerial Coupling Unit" for Tx & Rx.

The PA tuned cct forms the Grid cct of the R.F. Amplifier in the Rx ∴ it is necessary to tune the Tx before tuning the Rx.

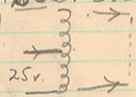
So much for Tx values. But in "96 we use A.F. stages of our Rx as a Sub-modulator for Tx. They are V5. & TRIODE Portion of V6. Put in ON BB.

ANODE-CHOKE MOD.

Audio Freq input from mikes after amplification in the AF Stages of the Rx is applied, to the control grid of the Modulator V. The Anode load of our Modulator valve is in this case a TAPPED CHOKE.

VOLTAGE VARIATIONS FED ACCROSS ~~A.C.~~ B.C. ARE AMPLIFIED ACCROSS A.C. DUE TO AUTO-TRANS ACTION IN THE CHOKE

((REVISE))



THE AUDIO SIGNAL WHICH IS THEN PASSED INTO OUR RA. ANODE CCT. IS AN ALTERNATING VOLTAGE WHICH PERIODICALLY ADDS OR SUBTRACTS FROM THE FIXED H.T. VOLTAGE. THE VARIATIONS IN ANODE POTENTIAL THUS RESULTS IN THE PRODUCTION OF A MODULATED AE CURRENT.

((VARY THE ANODE & SCREEN VOLTAGES OF OUR R.A. VALVE AT MODULATION FREQ))

IF TIME RUN OVER N/E SWITCH

Conclusion

Q'S ON ALL LESSON. & FILL IN SPACES ON BOARD.

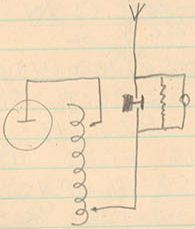
ON NORMAL (For Reception.)

A 1134A amplifies the output from the Detector of V6 to the Phones. Amp. portions of V5 & V6 not used.

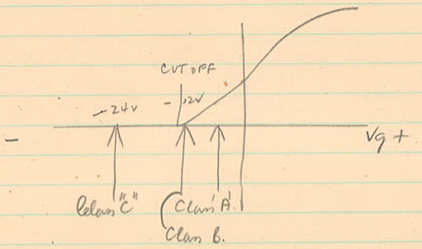
On Emergency

When A1134A fails. Output of V6 TRIODE is connected to PHONES & with mike input fed to Transformer makes V5 & V6 act as i/comp.

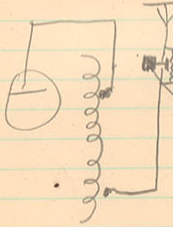
NB THE A1134A DOES NOT AMPLIFY THE MIC INPUT TO TR1196



Class "C" Amplification



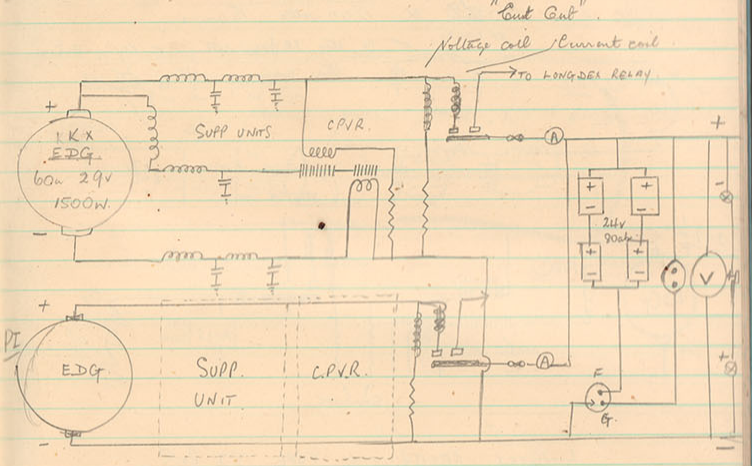
TUNING



On C & D ranges for tuning Short out 1800 Ω resistor on use Ameter

Lancaster Electrical Layout

2 Generators - SI & PI.



SCR 578 "GIBSON GIRL"

General Details.

Automatic Code Tx (500 K/cs)
Signal lamp incorporated.

Power Supplies

300 v HT. 28 v LT. Hand driven Generator.

Valves

Audio Oscillator & Amp. 12 SC
RF Amplifier 12 A6.

Controls

Tuning Control (PA).
Radio/Light Switch.
Key.

Aerial 300 ft long
Range 250 to 500 miles
Dessicant Silica Gel (Dampness)

"Walter" Tx 3180.

Freq: 176 Megs
Mast Aerial 7ft 6 ins. (Current consumption 120 ma.)
Power Supplies 90 v HT. 1.5 v LT. (2 1.5 v in Parallel) (3 30 v in Series)
Weight 2 lbs 10 ozs.
Ranges:

4 mls	A/c flying at	50 ft
10 mls	" "	250 ft
14 mls	" "	500 ft
18 mls	" "	1000 ft
20 mls	" "	1500 ft
25 mls	" "	5000 ft

Operation

1 Fix Weather Apron 2 Tear off wrapper.
3 Pull out guy lines & fix to dinghy rings
4 Erect PE mast ensuring that each section clicks home.
5 Tighten guy lines. 6 Switch On.
Life of battery 20 hrs. (Normal conditions) In Tropical & Arctic conditions 8 hrs

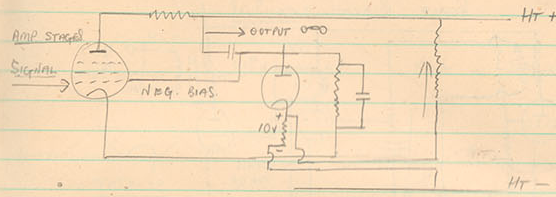
Valve used is a TRIODE CV 91

SQUEG FREQ
35 & 60 K/cs

M.O.

To generate signal into 1st
Variable condenser
3 tuned circuits for 3 diff ranges
Hartley Oscillator

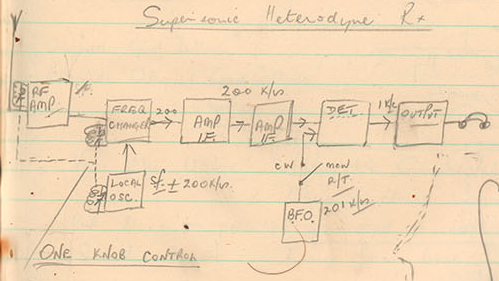
DELAYED AVC.



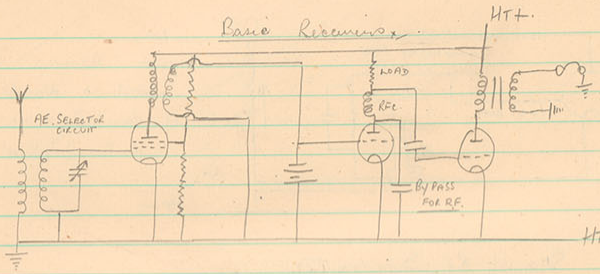
Straight Rx Disadvantages.

1. Poor Sensitivity.
2. Poor Selectivity
3. Poor Stability. (Liable to go off into Self-oscillation).
4. Complex Tuning (More tuned circuits).

Supersonic Heterodyne Rx



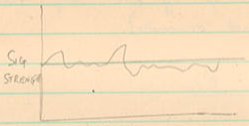
Basic Receiver

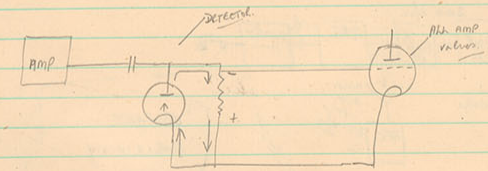


Rx for c/t, MCW

AVC.

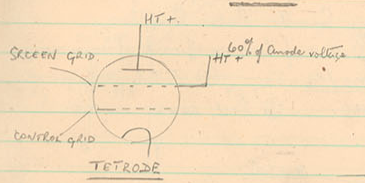
Simple



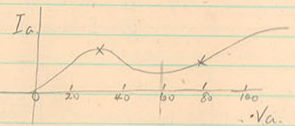


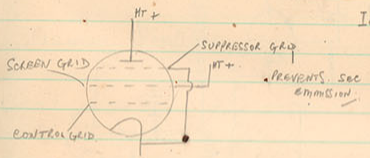
Delayed AVC. (see over)

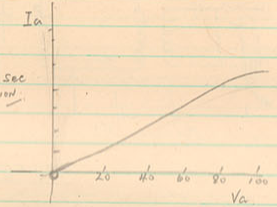
Valves



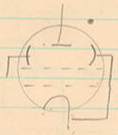
Kinks in Tetrode characteristic







"Aligned Grid Tetrode."
"Beamed Aligned Grid Tetrode."

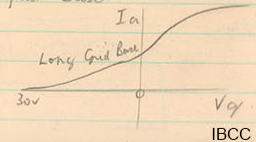


Vari-Mu Valve (Variable Amplification).

1 Open & closed wound control grid

(Put large − potential on grid to stop valve working)

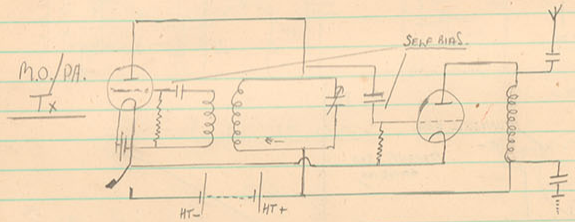
(Smooth volume). Long Grid Base



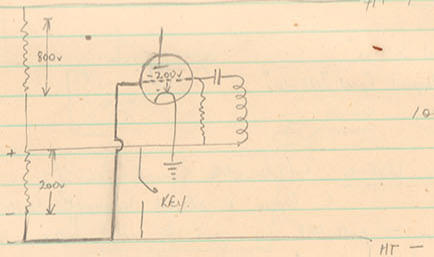
Simple Tx Disadvantages.

Frequency Drift ⑥ Smooth Power Supplies.
⑤ Parts of low co-efficient of expansion.

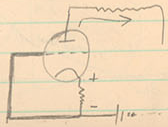
Overcome by ① Use of MO/PA Tx. ④ IDH. MO. Valve.
② Screening MO. ③ Low power on MO.



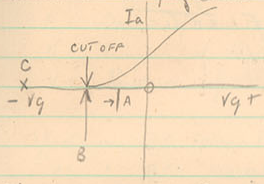
KEYING BIAS.



Cathode Bias.

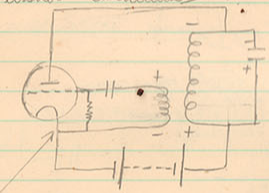


Below "C" Amplification twice the voltage from cut off point.



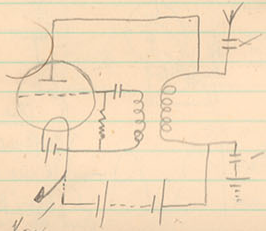
Triode as an Oscillator

Meissner Oscillator



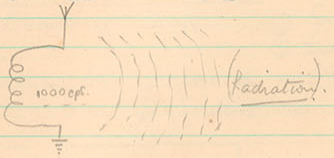
Automatic Bias. - Grid leak & condenser.

Simple Tx.



Open Oscillatory Circuit.

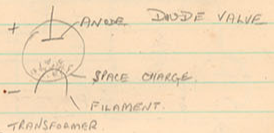
$$f = \frac{1}{2\pi\sqrt{LC}}$$



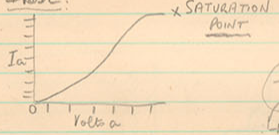
Increase Inductance or Capacity. Frequency Decrease.
Decrease " " " " Increase.

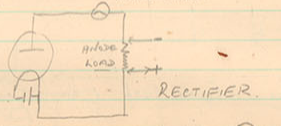
Valves.

Thermionic Valve.

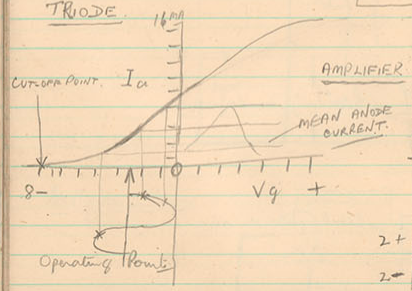


DIODE.

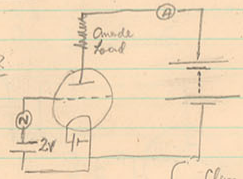


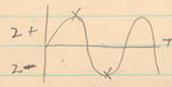


TRIODE.



AMPLIFIER.





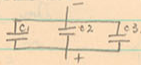
Class A. Amp.
Half wave between O volts & cut off point.
Class "B" around cut off point.

Formula.

K = Dielectric. (ie. Air = 1). (Mica = 6). (Sulpher = 4).
A = Area of overlap of the plates in □ cms.
N = Number of Dielectrics.
d = Thickness of Dielectric. (cms).

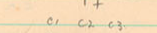
Affect in D.C. current = Blocking condenser. (Blocks DC).
" " A.C. current = Appears to pass AC.

Condensers in Parallel.

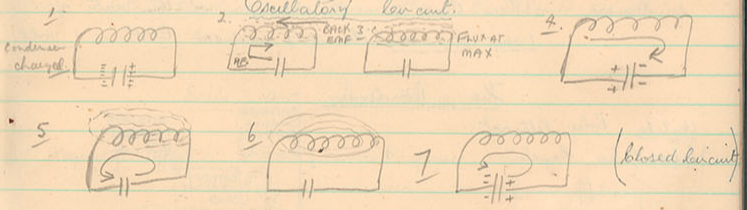


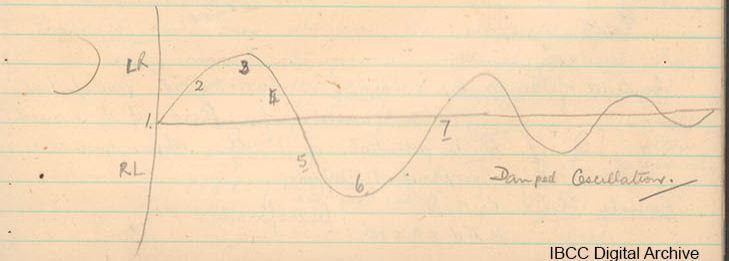
$C = C_1 + C_2 + C_3$.

Condensers in Series

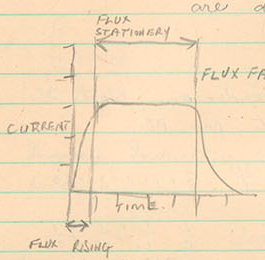


$\frac{1}{C} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3}$





Lenz's Law = Induced EMF.s act in such a direction as to oppose the direction to which they are due.



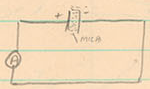
An Inductance opposes a change in direction of current flow.

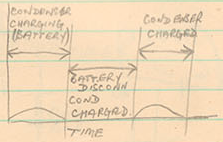
Unit of Inductance is HENRY.

1 Henry = When the current changes at the rate of 1 amp per sec its self induced EMF. is 1 volt.

The Condenser.

Unlike Poles Attract.
Like Poles Repel.



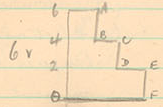


Capacity of Condenser. - FARADS. - A charged body has a capacity of 1 farad if it raised to a potential of 1 volt, when given a charge of 1 Ampere.

Formula. $C = \frac{K A N}{4 \pi d \times 9 \times 10^5}$ Microfarads.

Resistors - Series

$R = r1 + r2 + r3$



Voltage Drop 6v.

Parallel.

$R = \frac{1}{\frac{1}{r1} + \frac{1}{r2} + \frac{1}{r3}}$ OHMS.

$\frac{1}{R} = \frac{1}{r1} + \frac{1}{r2} + \frac{1}{r3}$.

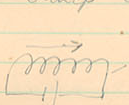
$\therefore \frac{1}{R} = \frac{1}{2} + \frac{1}{4} + \frac{1}{6} = \frac{11}{12}$

Total Resistance is lower than the least resistance in parallel.

Coils and Inductances.

1. Magnetic Effect. When current passes through a piece of wire

Faradays Law. says. whenever the magnetic flux in a circuit changes an EMF is produced. This EMF. directly proportional to the rate of change of the flux.



Simple Electrical Units.

Water	Types	Electrical
Gallons.	Quantity.	Coulombs. (10^{18} Electrons)
Gallons per minute.	Current.	Amperes. (1 coulomb past a point in 1 sec).
Lbs.	Resistance	Ohm. (the resistance offered to an electrical current by a standard column of mercury).
Lbs per square inch.	Pressure.	Volts. (Amount of potential pressure needed to maintain 1 amp through 1 Ohm.

Sub-Multiples.

	MICRO	1/1,000,000
	MILLI	1/1,000
Multiples.	KILO	1,000
	MEG	1,000,000

OHMS LAW. Pressure Increase will equal proportionate current increase.

Resistance Increase will equal proportionate current Decrease.

$V = IR$ Voltage is directly proportional to I & R.

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

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

Basic Electricity.

Matter - Anything that has weight. (ie. Liquids Solids or Gases.)

Molecule - smallest particle of a compound that can exist, and still retain the properties of that compound.

Atoms - sub-division of a molecule.

92 atoms known to be in existance. - Element.

ATOM.

NUCLEUS — PROTONS (+) (ELECTRONS)

ORBITTING ELECTRONS.

Atom with no electrons is pos. ionised

Atom with 2 electrons is neg ionised

Free Electrons - Electrons which are free to move from one atom to the other.

Conductor - A substance with a large number of free electrons.

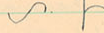
Insulator - Opposite of a conductor.

Conduction Current - takes place inside a conductor.

Insulator - Displacement current when potential is applied.

Basic Theory.

Waves

Kinds 1. Transverse Waves.  (i.e. Water, Radio).

2. Longitudinal Wave. (i.e. sideways). 

1. Length. 

2. Amplitude.

3. Speed. 186,000 miles per sec. (Radio).

4. Frequency. Greater wave length = Smaller freq.
Smaller " = Higher freq.

$f = \frac{300000}{w/l}$ = K/cs.

$w/l = \frac{300000}{f}$ = Metres

Damped Oscillations. (i.e. piano string).
Un-damped " (i.e. organ note).

Electrical & Radio Pubs.

AP 1970 - Standard Note for Wops.
AP 1186. - All Marconi Gen. (Pt 4). & Everything.
AP 2548A. * Gen on T1154 & R1155. complete.
AP. 1186A. VHF Equipment.
1186B. Radio Aids & Navigation.
1186D. Airborne Electrical Equipment.
1186E. Ground. " "
AP 2528. TR 1143. VHF.
AP 2535C * TR1196 complete.
CD 0769A Radar principles.
AP2554A Tx "Walter." design & effort "3180"

* Ratcliffe - The Adult Class.
Woodworth - Psychology.
Hughes & Hughes - Learning & Teaching.

Publications.

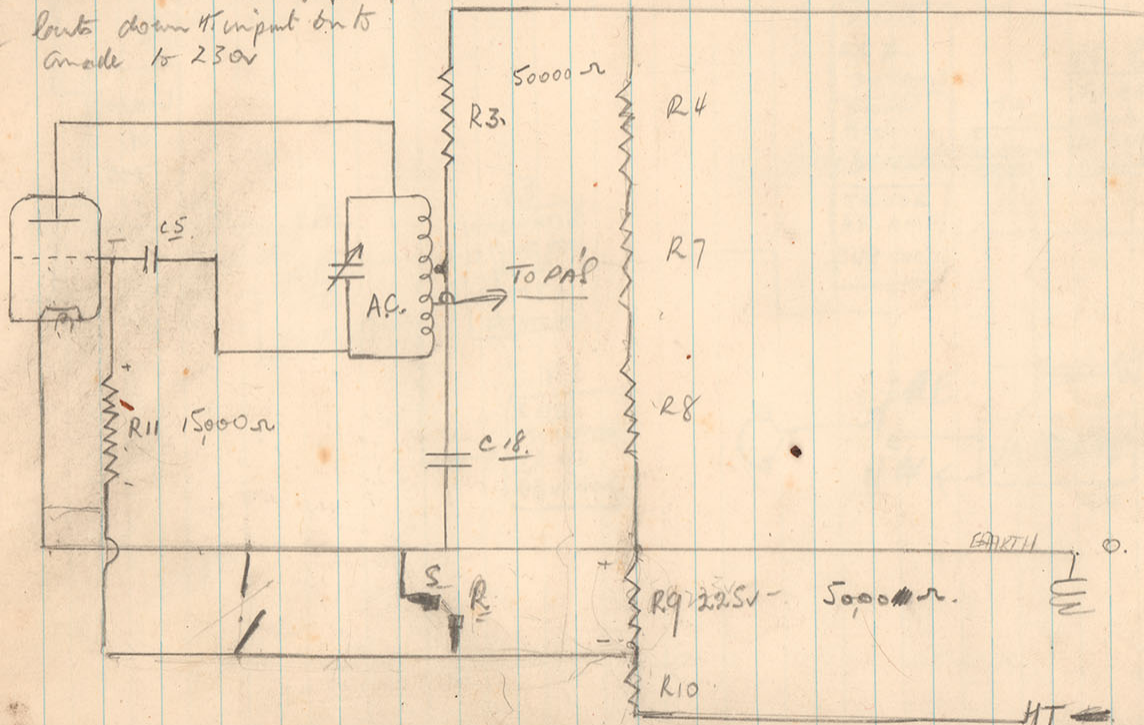
S.D. Secret Docs C.D. Confidential Docs. AP. - Air Pubs.
A.M.P. Air Ministry Publications Pamphlets.

AP. 113 - List of all AP. Air diagrams. forms etc.
SD. 0500A. - Index to signals & radar publications.
C.D. 0500 C. Index to American radio & radar publications.
AMR 1083. RAF sigs manual Pt. I.
Outlines the RAF. signal organisation & method.
organisation of signalling.
AP 3032. * RAF sigs manual Pt III. signalling procedure.
(W/T R/T visual).
BC.SSI. 1. General 2. Operations 3. Aircraft. 4. Ground station
5. Tele-communications 6. SD's & CD's. 7. Radar.
CCBP. 1-5. Combined Communications Board Procedure.
Pts. 1. W/T procedure
2. Operating Signals Pt 2.
3. R/T procedure.
4. Visual procedure.
5. Teleprinter "
CCBP. 0127. Air & Ground Authentication Sigs.
AP3026. - "Q" Code.
3 Gp SSI's - Group Standing Signal Instructions.
AMO's feet A. Standing Orders.
N Temporary Orders.
AP. 1762. - Electrical & Radio Notes for W/Ops.
AP 3023. Theory Notes for Radio Mechs.
AP 1093. RAF Sigs Manual Pt. 2. (Highly Technical Theory).

TR11Gb Tx PORTION

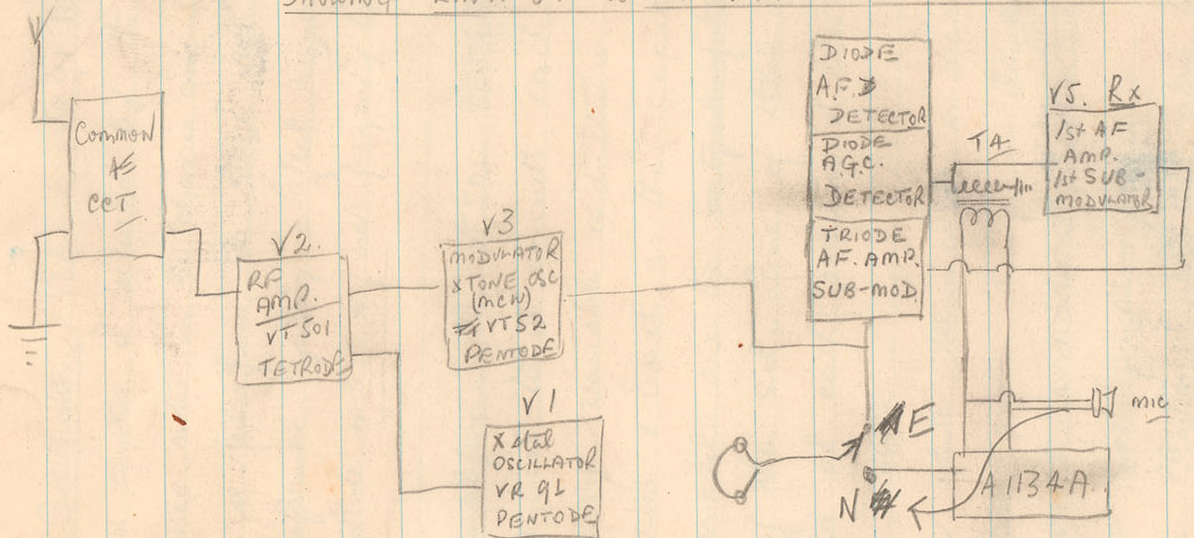
T1154 MO.

C5 Gives grid bias to grid.
R11 Electrons lead away from grid
R3 Lowers down H.T. input bias to anode to 230v



TR1196 Tx PORTION

SHOWING LINK UP WITH VALVES 5 & 6 in THE Rx



1. Crystal Oscillator. Valve 1. VR 91 PENTODE

One of 4 crystals is selected by the step by step motor in the chassis assembly. The P.A. is fed from this stage via an RF transformer giving a flat response to the whole 3 to 6·7 mc/s frequency band.

2 Power Amplifier V2. VT 501 TETRODE

Four identical tuned circuits, each a continuously variable inductance, with Aerial & Earth as the capacity of the circuit, are the ~~output of the~~ output of the set. One of these ccts is selected at each position of the step by step motor.

Resonance while tuning is indicated by a low power lamp in the aerial circuit, which is normally shorted out by a spring plunger.

Since the P.A. tuned circuit also forms the grid circuit of the R× RF. Amplifier

it is necessary to tune the Tx before tuning the Rx.

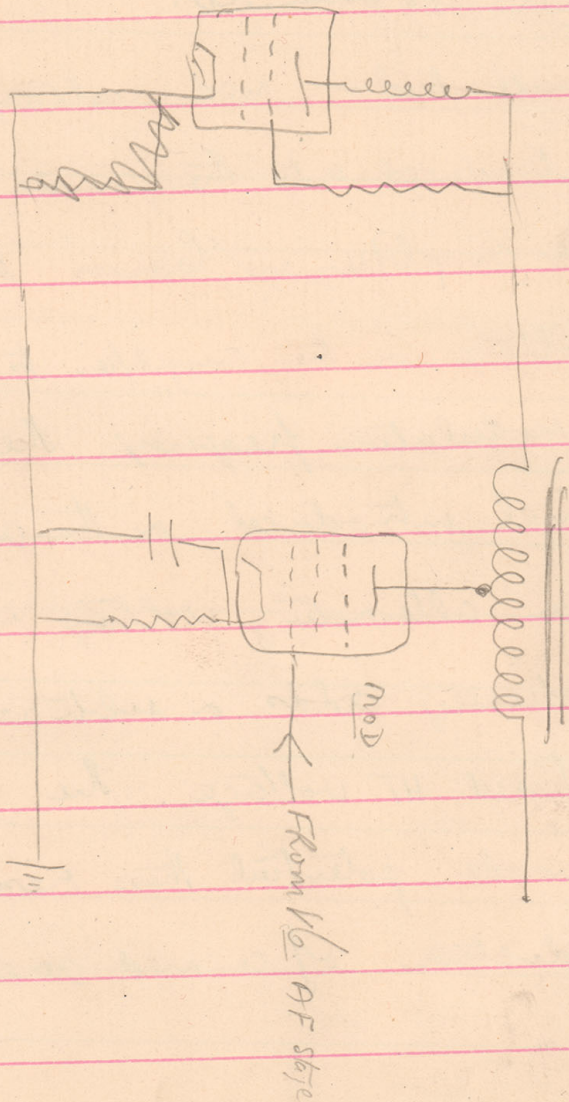
Range 'D'

The power of the Tx is reduced on this range, to give the neccessary Darby range of 10 mls. This is done by inserting an 1800 ohms resistor in the HE circuit of this range.

3. MODULATOR V3. VT 52. PENTODE

The Rx output stages V5 & V6 act as Sub-Modulator, and feed modulation frequencies to V3. whose anode load is a tapped choke. Voltage variations accross a part of this choke (a.b) are amplified accross a.c. due to Auto Transformer action in the choke, and vary the anode & screen voltages of the P.A. Valve at modulation frequency.

Modulation is the impression of audio freq waves on to radiation waves of radio frequency.



The Tx output cets are used as input to tuned A cets. In the RX

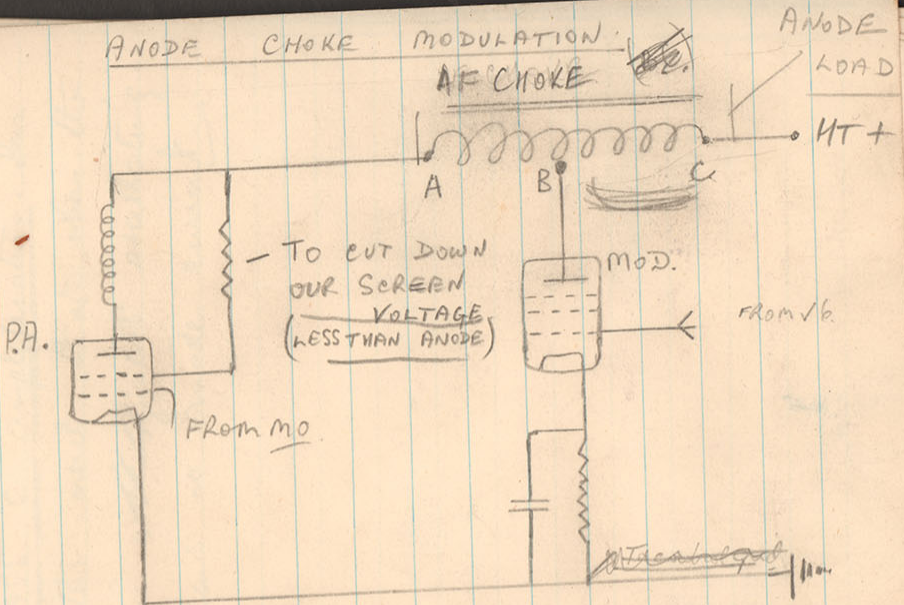
Power unit. ~~input~~ is A/C geared electrical system.

~~"D" 18 ohm cet~~

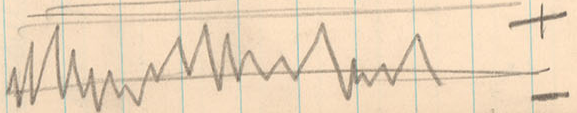
Anode Mod — mod voltages are introduced into the anode cct of the amplifier. / Causes the anode voltage on the amplifier to fluctuate at modulation frequency. The audio signal introduced in the anode cct is an alternating voltage which periodically adds or subtracts from the fixed HT voltage. The variation in anode potential thus result in the production of a mod aerial current.

A given RF output power is obtainable for less DC. input if the PA values are biased beyond cut off, so that the drive is in the form of sharp "flicks" at positive peaks of the oscillator output CLASS "C" amplification. This also has the merit that when the oscillator is ~~working~~ not oscillating the PA draws no anode current.

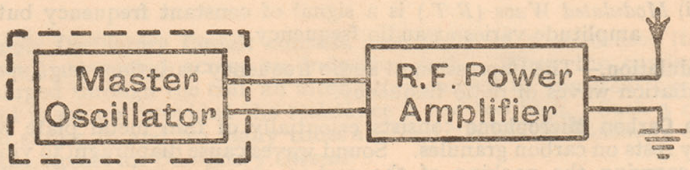
ANODE CHOKE MODULATION.



Auto-Transformer Action.



minimised by the use of the *Master Oscillator*. This M.O. is a low power screened oscillator working into a Power Amplifier, which is the real transmitter.



Crystal Control.—Frequency control may also be obtained by using a quartz crystal. The crystal controlled oscillator has a very stable frequency.

Bearings.—*Circular Measure* :—

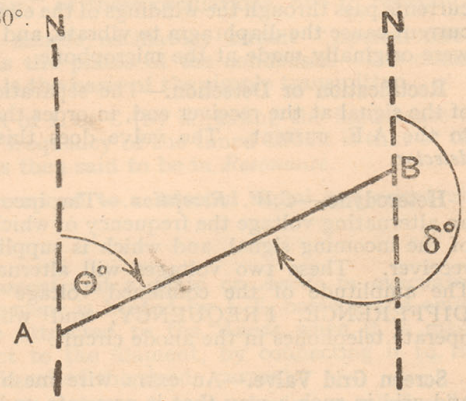
One revolution is equal to 360°.

North is regarded as 000°.

East = 090°, South = 180°.

West = 270°, N.E. = 045°.

N.W. = 315° and so on.



A *bearing* is the direction of one place from another measured in degrees (clockwise) from 000° at N.

(i) *Forward Bearing* is the angle which the direction A to B makes with the *N at A*. (Angle Θ° in Fig.)

(ii) *Back or Reverse Bearing* is the angle which the direction B to A makes with the *N at B*. (Angle δ° in Fig.)

To convert from forward bearing to back bearing, and vice versa, if the bearing is less than 180° ADD 180°. If the bearing is *greater* than 180° SUBTRACT 180°.

Note.—The direction finding bearing obtained *by* an aircraft will be a *forward bearing*.

The Loop Aerial used for direction finding on account of its directional properties. It receives or transmits maximum signal in the direction in which the loop is pointing, and zero signal at right angles to the loop. For aircraft fitted with rotatable loop, tune in and identify a ground station transmitter of good signal strength. Rotate loop until signal is at minimum strength. Read off from the 360° scale attached to loop, the bearing of transmitter relative to the direction of the aircraft. The "sense" of the station can be found by taking a second bearing of the transmitter after a short interval.

(65435) Wt. 41718/T.2871 6,000 12/43 Hw. G.371

M6 Stores.

FOR OFFICE USE ONLY. **A.M. Pamphlet 115.**

ELECTRICAL AND WIRELESS NOTES

Electron is the smallest amount of negative electricity which exists.

Electrical Current is the flow of free electrons in one direction. The symbol for electric current is I. Must have (i) a continuous path, i.e., a complete circuit; (ii) an electric pressure difference (POTENTIAL DIFFERENCE) to force the electrons in one direction.

Conductor.—A substance through which a current can be passed.

Insulator.—A substance which does not conduct a current of electricity.

Quantity of Electricity.—The practical unit is the *Coulomb*. It is a very large number of electrons.

Unit of Current.—The *Ampere* which is one Coulomb of electricity passing a given point in one second.

Voltage.—The electric pressure necessary for a current. Is usually called Electromotive Force, or P.D.

Unit of E.M.F. or P.D. is the *Volt*: Symbol V.

Production of E.M.F.—

(i) Electro-magnetic, e.g., dynamo or generator.
(ii) Chemical, e.g., cell or batteries.
(iii) Thermal—heating a thermo junction.

Resistance is the opposition to the flow of electricity: Symbol R.

Unit of Resistance is the *Ohm*. Symbol Ω.

Ohm's Law.—This law means that if the voltage is changed then the current changes in a like manner, i.e., double the P.D.—double the current; and if the resistance is altered then the current alters inversely; i.e., if resistance is doubled, current is halved.

Shorthand method of writing Ohm's Law:—

$$\frac{V}{I} = R \text{ or } I = \frac{V}{R} \text{ or } V = I \times R.$$

Resistances.—(i) *In Series.*—Combined resistance (R) is sum of separate resistances.

$$R = r + r_1 + r_2 + r_3$$

(ii) *In Parallel.*—Combined resistance (R) is less than the least resistance of the group.

$$\frac{1}{R} = \frac{1}{r_1} + \frac{1}{r_2} + \frac{1}{r_3}$$

Multiple and Sub Multiple Unit.—

MEG — M = 1,000,000 times the standard unit: e.g.,
1 MΩ = 1,000,000 Ω.

KILO — K = 1,000 times the standard unit, e.g.,
1 Kv = 1,000 volts.

MILLI — $m = \frac{1}{1,000}$ part of the standard unit: e.g.,

$$1\ m\text{A} = \frac{1}{1,000}\ \text{A}$$

MICRO — $\mu = \frac{1}{1,000,000}$ part of the standard unit: e.g.,

$$1\ \mu\text{F} = \frac{1}{1,000,000}\ \text{F}.$$

Instruments.—

(i) *Ammeter*—

(*a*) measures size of current.
(*b*) connected in *series* in circuit.
(*c*) has low resistance.

(ii) *Voltmeter*—

(*a*) measures size of voltage.
(*b*) connected in *parallel* across circuit.
(*c*) has high resistance.

Uses of Current.—

(1) *Heating effect*—fuses, electron emission in valves, etc.
(2) *Chemical effect*—accumulator charging, electro plating, etc.
(3) *Magnetic effect*—electro magnets, electro magnetic induction, etc.

Cells.—

(1) *Primary*—

(*a*) Wet Type—Leclanche cell—liquid electrolyte.
(*b*) Dry Type—electrolyte—moist paste.
(*c*) Inert type—electrolyte in form of crystals—needs activating before use.

(2) *Secondary or Accumulator*—

(*a*) *Lead acid type.*—Can be recharged by sending a current through it. Chemical effect of current restores original components and *energy* is thus stored in accumulator.

Charged State—

Voltage about 2·2 volts in open circuit.
S.G. of electrolyte (sulphuric acid) 1·270.
+ ve plate—brown lead peroxide.
— ve plate—grey spongy lead.

Discharged State—

Voltage falls to 1·8 volts on load.
S.G. of electrolyte falls to 1·15.
Both plates change colour due to formation of lead sulphate.

Capacity of Accumulator—described as *Ampere Hours* usually based on 10 hr. rate; e.g., 90 A.H. at 10 hr. rate means cell ought to give 9 amps. for 10 hrs.

(3) *Alkaline Cell*—Electrolyte alkaline. Voltage about 1·4 volts when charged, and about 1·1 volts when discharged. S.G. of electrolyte does not vary.

Milne H.T. unit consists of 96 of these cells and can be used to give 120 volts for H.T. purposes.

Magnetic Fields.—The region around a magnet in which magnetic forces act or can be detected is called the *Magnetic Field*. Conductors in which currents are maintained behave like magnets, and possess a magnetic field. The magnetic field due to a coil or *Solenoid* carrying a current is similar to that of a bar magnet. *Lines of Force* indicate the directions in which these magnetic forces act. An iron core inserted in a solenoid causes the magnetic forces to become much stronger: e.g., an electro magnet.

D.C. Motor.—Changes electrical energy into mechanical energy. A coil of wire, mounted on a shaft, and carrying a current of electricity, is placed in a magnetic field. The result of superimposing these two magnetic fields (i.e. a magnetic field of coil and the one supplied) is the development of a force which tends to rotate the coil. In an electric motor a number of coils are used. As these rotate the current is sent through each coil by means of a *commutator*, which is connected to the external supply by means of *brushes*.

Induced E.M.F.—Whenever the *Magnetic Flux* threading a circuit changes an E.M.F. is induced in the circuit. The size of this induced E.M.F. depends upon the speed at which the flux changes, i.e., the greater the speed of changing flux, the greater is the induced E.M.F. (Faraday's Law).

D.C. Generator.—Changes mechanical energy into electrical energy. A continual change of flux is produced by rotating a coil of wire in a magnetic field, so inducing and maintaining an induced E.M.F. in the coil. An alteration in the speed of rotation or the flux, or both, produces an alteration in the maximum value of the E.M.F. induced. This E.M.F. so produced is an *alternating E.M.F.*, and to obtain a *direct E.M.F.* a commutator must be used.

Back E.M.F.—The E.M.F. induced in the coils as they rotate in the magnetic field. It acts in opposition to the applied voltage in the case of the electric motor.

The Motor Generator (M.G.).—This is an electrical motor driving a generator. The armature windings for each machine are wound on the same armature, but are insulated from each other. Type E Motor Generator is employed in aircraft for the H.T. supply to the radio transmitter. Each armature winding has its own commutator and brush gear.

Type 49 Switch.—Tumbler switch and resistance for starting the M.G.—Has three positions OFF—START—RUN.

Type "A" Starter.—For remote control in starting the M.G. and automatically cuts out starting resistance when motor has gained speed.

Radio Communication.—*Requirements—Transmitter* to transmit a signal; a *Medium* to convey the signal; a *Receiver* to receive the transmitted signal.

Alternating Voltage or Current, is one which continually varies in size and direction.

Cycle is one complete sequence of variations.

Amplitude is the maximum value of the alternating quantity in a cycle.

Frequency is the number of cycles per second. Symbol (f).

Frequency Ranges.—

(i) *Audio Frequencies* (a.f.) between 50 cycles per second and 10,000 c/s.
(ii) *Radio Frequencies* (r.f.) between 10,000 c/s and 50,000,000 c/s.

Wavelength is the distance traversed by 1 cycle. Symbol λ.

Inductance.—The property of a coil of wire to oppose current changes. Symbol L. *Unit of Inductance* is the *Henry*. Smaller unit is the micro henry (μH). A larger number of turns of wire and a soft iron core increases the inductance.

Condenser.—Consists of two conductors, very often metal plates, separated by an insulating medium such as air, mica, waxed paper, oil, etc.

Capacity.—The ability of a condenser to acquire a charge of electricity. *Symbol C. Unit of Capacity* is the Farad. Smaller unit is the microfarad (μF).

Simple Oscillatory Circuit consists essentially of a condenser (to give capacity) connected across an inductive coil. When the condenser is discharged through the coil, an alternating current of numerous cycles per second is set up, provided the resistance is not too high. Such a current which surges to and fro many times a second is called an *Oscillatory Current* and the circuit an *Oscillatory Circuit.*

Frequency of Oscillations is given by $f = \frac{1}{2\pi\sqrt{LC}}$

Note that if L or C is increased f is decreased, and vice versa.

Damping is the "dying away" of these oscillations, due to resistance.

Open Oscillatory Circuit is simple oscillatory circuit "opened out" i.e., aerial and earth acting as the plates of the condenser. The circuit then emits wireless waves and is the basis of the simple transmitter.

Tuning means the alteration of L or C (by adjusting the inductance or condenser) so that the natural frequency of the tuned circuit is that of the incoming signal. The circuit is then said to be in *Resonance.*

Selectivity.—The ability to respond to a selected signal and reject unwanted signals.

The Thermionic Valve.—

(i) *Diode* consists of *Filament* and a plate or *Anode* in evacuated glass bulb. The filament is heated by L.T. battery and emits electrons which are attracted to the *Anode* when it is made positive with respect to the filament, by connecting it to the H.T. supply. This is called the anode current.

(ii) *Triode.*—Similar to Diode but has a mesh of wire or spiral called the *Grid* between the filament and anode. By varying the grid potential with respect to the filament, the anode current can be controlled and varied.

Uses of Valve.—

(1) *As a Sustainer of Oscillations.*—By means of "feeding back" energy from the output of the anode circuit to the grid circuit, the oscillations will be maintained at a steady amplitude and will not be damped. The valve is then acting as an oscillator.

(2) *As a Detector or Rectifier.*—When an alternating voltage is applied, the valve allows impulses to flow in one direction. This means of obtaining a direct current from an alternating current is called *Rectification.*

(3) *As an Amplifier.*—Enables a magnified alternating voltage to be passed on to the next stage. This is done by passing the fluctuating anode current through a load (a resistance, choke, etc.) which sets up an amplified voltage across it. ($V = I \times R$).

Types of R.F. Signals.

(i) *Continuous Wave* (*C.W.*).—Continuous train of waves of constant frequency and amplitude, used for Morse signals, and received by use of heterodyne method.

(ii) *Interrupted Continuous Wave* (*I.C.W.*).—Interrupted train of waves of constant frequency, by means of "tone" wheel, used for Morse signals and can be received by ordinary receiver.

(iii) *Modulated Wave* (*R.T.*) is a signal of constant frequency but the amplitude varies at audio frequency.

Modulation.—The impression of audio frequency variations (e.g., speech) on radiation waves of radio frequency.

The Carbon Microphone consists essentially of thin metal plate which lightly rests on carbon granules. Sound waves cause diaphragm to vibrate, thus carrying the packing of the carbon granules and so altering the resistance of the circuit. The current in the circuit will fluctuate at A.F.

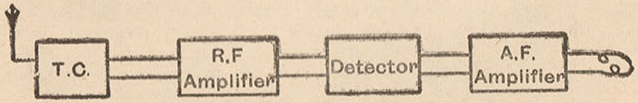
The Telephone Receiver.—This is really an electromagnet together with a thin iron diaphragm, which can only respond to A.F. When A.F. currents pass through the windings of the electromagnets, the fluctuations in current cause the diaphragm to vibrate, and so reproduce the sounds which were originally made at the microphone.

Rectification or Detection.—The separation of the A.F. from the R.F. of the signal at the receiver end, in order that the telephone may respond to the A.F. current. The valve does this unravelling when used as a *detector.*

Heterodyne.—*C.W. Reception.*—The incoming signal is combined with an alternating voltage the frequency of which is slightly different from that of the incoming signal, and which is supplied by a local oscillator in the receiver. These two voltages will alternately get in and out of step. The amplitude of the combined voltage will thus vary at BEAT, or DIFFERENCE, FREQUENCY, and when detected the pulses will operate telephones in the anode circuit.

Screen Grid Valve.—An extra wire mesh is placed between the anode and grid in such a way that it prevents undesirable oscillations due to the internal anode-grid capacity of the valve.

Block Schematic Diagram of Straight Receiver.



T.C.—Tuned circuit used to "tune to" or "select" the required signal.

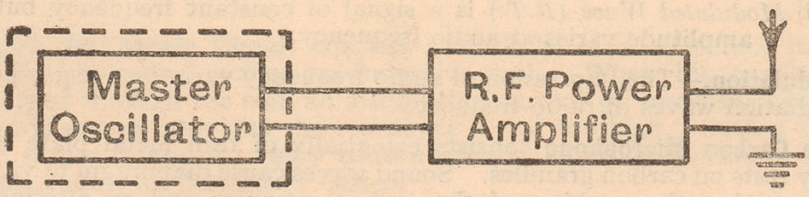
R.F. Amplifier Stage is valve circuit to magnify the incoming signal voltage.

Detector Stage is valve circuit to obtain the a.f. voltage from the R.F. signal.

A.F. Amplifier Stage is valve circuit to increase the A.F. voltage from detector circuit in order to operate telephone.

The Master Oscillator (M.O.).—Swaying aerials, mechanical vibration, temperature changes, etc., may cause variations in the frequency of a signal radiated from a simple transmitter. These frequency variations are

minimised by the use of the *Master Oscillator*. This M.O. is a low power screened oscillator working into a Power Amplifier, which is the real transmitter.



Crystal Control.—Frequency control may also be obtained by using a quartz crystal. The crystal controlled oscillator has a very stable frequency.

Bearings.—*Circular Measure* :—

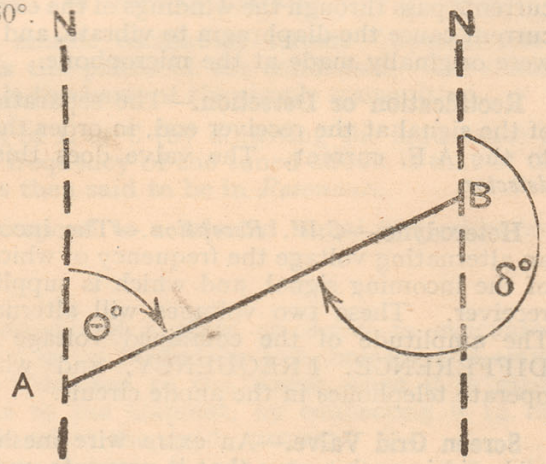
One revolution is equal to 360°.

North is regarded as 000°.

East = 090°, South = 180°.

West = 270°, N.E. = 045°.

N.W. = 315° and so on.



A *bearing* is the direction of one place from another measured in degrees (clockwise) from 000° at N.

(i) *Forward Bearing* is the angle which the direction A to B makes with the *N at A*. (Angle Θ° in Fig.)

(ii) *Back or Reverse Bearing* is the angle which the direction B to A makes with the *N at B*. (Angle δ° in Fig.)

To convert from forward bearing to back bearing, and vice versa, if the bearing is less than 180° ADD 180°. If the bearing is *greater* than 180° SUBTRACT 180°.

Note.—The direction finding bearing obtained *by* an aircraft will be a *forward bearing*.

The Loop Aerial used for direction finding on account of its directional properties. It receives or transmits maximum signal in the direction in which the loop is pointing, and zero signal at right angles to the loop. For aircraft fitted with rotatable loop, tune in and identify a ground station transmitter of good signal strength. Rotate loop until signal is at minimum strength. Read off from the 360° scale attached to loop, the bearing of transmitter relative to the direction of the aircraft. The "sense" of the station can be found by taking a second bearing of the transmitter after a short interval.

(65435) Wt. 41718/T.2871 6,000 12/43 Hw. G.371

2 ~~How~~ How used A1134/1.

USES as HS i/c Amplifier.

1. Krems mikes are always connected to INPUT & phones to OUTPUT

2 W/Ops. phones & mike connected to to i/c system on B & C pos only.

AS OUTPUT AMPLIFIER

1 Amplifies TR1196 RX output in all pos of ABC switch

2 Amplifies R1155 output for whole crew on "C" pos. of ABC switch

NB ~~A~~ NO amplification of R1155 for Wop in A & B pos.

AS SUB-MODULATOR

Works ONLY on "C" position & all ~~[redacted]~~ mikes can modulate T1154.

4

Conclusion

Questions. Etc.

R.A.F.

(Input circuits designed to give low magnification at freq below 500 cps. cut down engine noise (Sub-Mod.) due to much smaller output obtained from E.M. mikes than from C. Output of A1134A is fed to Mod valve of T1154.

1

A 1134A.

INTRODUCTION. A most important piece of Equipment in an A/c. (provides i/c in A/C.) (conversant) (over the ~~Overall~~ Details, its Uses and the i/c Faults. A detailed description of the circuit will be given you in a later lecture.

A battery operated 2 Stage AF Amplifier is used with Electro-Magnetic mikes. There are 2 Valves in the set - 1 is (Q to class). VR 21 TRIODE (voltage amp) and the other (Q to class). VR 35 DOUBLE PENTODE Q.P.P. which gives High Power Amplification. (no HT current with speech reg are done economy to HT)

POWER SUPPLIES: - 2v ACC. 120v HT BATT

6v GRID BIAS {6v to 35. 3v to 21}

Weight 4½ lbs. without Batteries.

FUNCTIONS: 1. "Q" i/c AMPLIFIER

2 "Q" OUTPUT AMPLIFIER FOR THE 1196 Rx & R1155 ON "C" position of ABC switch

3 "Q" SUB-MODULATOR FOR T1154 on "C" pos of ABC switch.

3

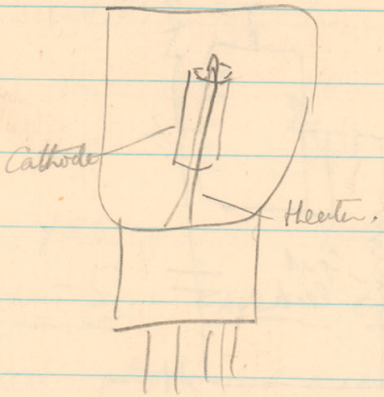
A.B.C. SWITCH.

	W/OP			CREW.		
	I/C	TR1196	T1154/55	I/C	TR1196	T1154/55
A.	—	—	YES	YES	YES	—
B.	YES	YES	YES	YES	YES	—
C.	YES	YES	YES	YES	YES	YES

FAULTS.

Q's	FAULT.	CAUSE	REMEDY.
	(Feedback between phones & mike circuits)		
LOW H. 1.	Dampness in I/C sockets or in headset.		
LOW H. 2.	Defective screening & bonding in Leadset or A/C wiring. (ie broken mike lead)		
LOW H. 3.	Run down Power Supplies.		
H.	A. Defective valves.	(High Phonl).	
	5. Intermittent I/C — Loose plugs, (1355 - slip rings on M/U turret.)		
	No Joy.	Clean A/cc spade leads.	
	IF U/S.	N/E switch on 192 panel. Switch off A1134A. Using the AF stages of the 1196 Rx as I/C amplifier. (3 to 5 pair of phones.)	

IDN valve can have a fluctuating supply to the heater but it will not affect the cathode.



Keying.

Key up. large neg V to grids of MO. PAs

Value of RG. 5000 Ω.

45 m/a. passing through RG.

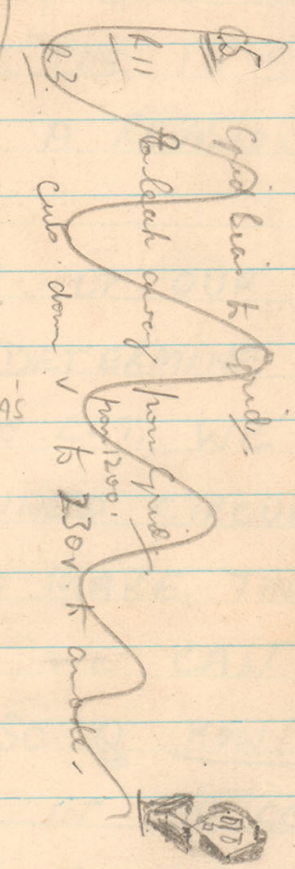
225 V. dropped across RG.

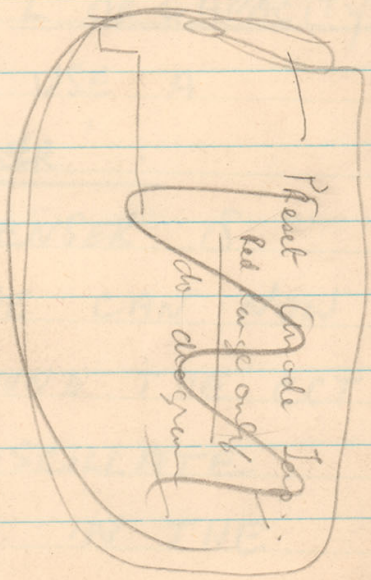
~~Supp. Grids control output power of Tx~~

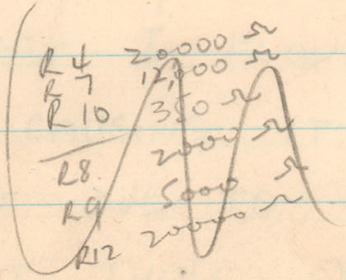
~~vary output power | vary I through PAs~~

(40 V – ~~on Supp Grids when key is pressed on Tune~~)

CW. ~~SGrids 30 V + from RG~~





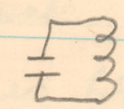


1

T 1154 MO.

INTROD. WE HAVE ALREADY GONE THROUGH THE VARIOUS STAGES OF THE Tx SO NO I INTEND TO HAVE A REVISION OF THE MO STAGE.

IN THE BUILDING UP OF OUR Tx WE FOUND THAT TO DETERMINE THE FREQ OF OUR MO CCT. WE MUST HAVE A Q TUNED CIRCUIT



WE WANT TO MAKE THIS CCT SO THAT WE CAN TxMIT ON ANY FREQ SO Q HOW CAN WE VARY THE FREQ IN THIS CCT.'

ANS BY VARYING THE L OR CAPACITY. IN THIS CASE WE USE A 'VARIABLE CONDENSER'.

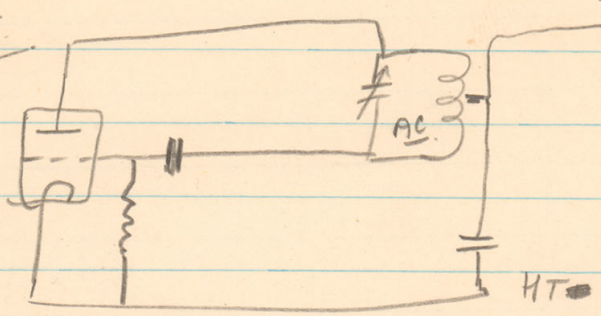
SUPPOSING THE CONDENSER IS ALREADY CHARGED WE CAN NOW GET I FLOWING ROUND THE CCT & CAUSING IT TO OSCILLATE. BUT DUE TO RES ETC. IN THE CCT THESE OSC DIE AWAY AND

The MO valve has its tuned cct connected between grid & anode & the HT supply is fed through a tapping point on the coil. ~~Blocking~~ Connection to Earth via condenser. "Series fed H. osc cct."

When the Tx is osc. the MO valve receives automatic bias from the grid leak & condenser combination CS R11 the res R9 being short cctd & the grid leak keyed to earth via the keying relay contacts

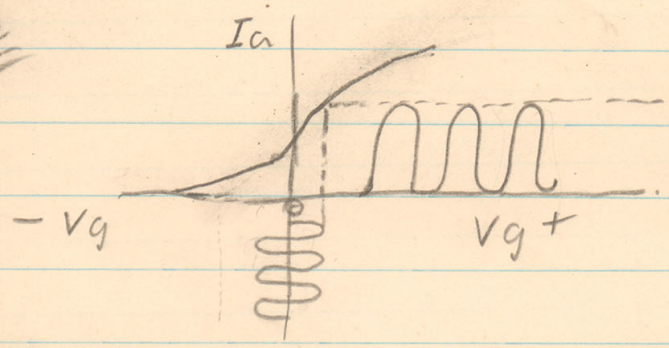
2. When the Tx master switch is on Tune & Key Up. the keying contacts are open. & the flow of HT current through R9. renders the control grids of the MO-PA. valves negative with respect to their cathodes & no osc takes place. When the key is down the relay contacts close short cctg R9. so that bias is removed from the control grids & the cct oscillates.

3/ Grid leak & Condenser put into ccct.



Disadvantage of other gives a large anode current & ∴ we want to cut it down.

ie



Q How do we cut Anode current down?
A By using grid Bias. & the means we use is by putting a condenser and a grid leak between the grid & filament.
We employ a — bias on the grid so that the grid just