

RECEIVER B29

C 69

Date of Design:- 1941.

Frequency Range:- 15 - 550 kc/s.

Power Supply:- 100/110 or 200 - 250 volt 50 cycle A.C. Mains.
or 200 volt and 6 volt batteries.

1. Receiver B29 is a L/F receiver designed for the reception of C.W., I.C.W. or R/T signals. It may be found in all classes of vessels and can be operated from A.C. Mains or batteries.

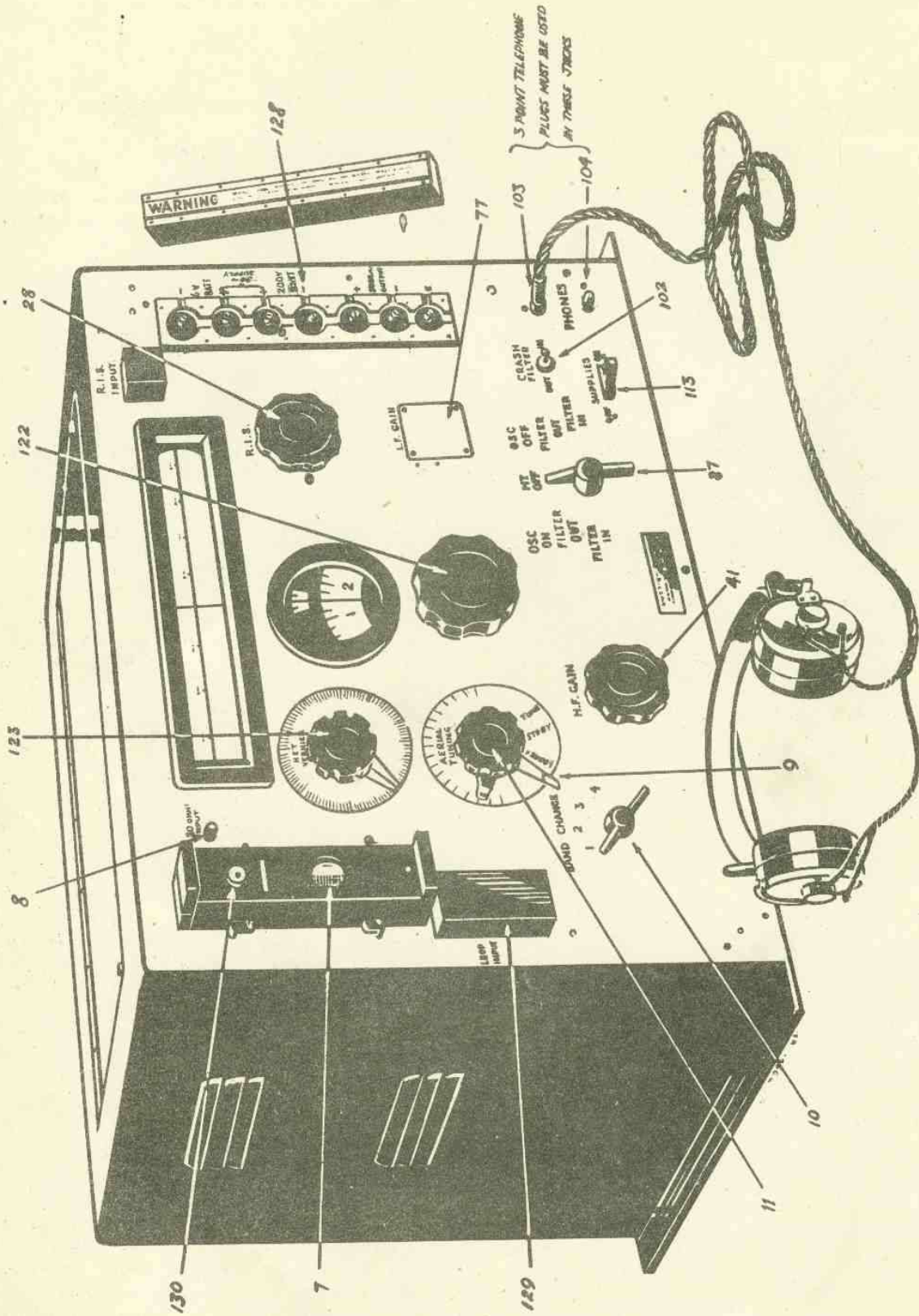
2. A line drawing of the receiver is given in Fig. A and a description of the controls and fittings, operating instructions and brief technical details are given below. The item numbers used in these notes are the same as those used in SS104 "Book of Instructions for Receiver B29".

3. Controls.

The controls described here are found on the panel of the receiver. The item numbers should be identified in Fig. A.

<u>NAME AND ITEM NO.</u>	<u>DESCRIPTION AND USE.</u>																				
Supplies ON/OFF Switch (113).	A double pole ON/OFF switch. In the "OFF" position it breaks the power supplies to the receiver.																				
Input Switch (9)	A four position switch which selects "Stand-by" or "Tune" positions for reception in surface vessels and "Loop" positions for submerged reception in submarines. The "Stand-by" position is used when searching for a station and the "Tune" position is used to give greater selectivity when interference makes this desirable. The "Loop" positions can only be used on Bands 1 and 2 (15-90 kc/s): "Loop 1" is for the ordinary low impedance single turn loop aerial and "Loop 2" is provided for use with a frame aerial. The position in use is the one immediately to the right of the switch arm and towards which the arrow on the arm points. (See para.9).																				
Operating Switch (87).	This switch brings in the Oscillator for C.W. Reception and also brings in the A/F filter to give additional selectivity when required. With the switch in its central position the H.T. supplies to the valves are disconnected, leaving only the heaters on. In this "stand-by" state the receiver is warmed up ready for instant use as soon as the switch is put to one of the other positions. The switch positions are as follows:-																				
	<table border="0"> <tr> <td>Oscillator</td> <td>ON</td> <td>Filter</td> <td>IN</td> </tr> <tr> <td>Oscillator</td> <td>ON</td> <td>Filter</td> <td>OUT</td> </tr> <tr> <td>H.T.</td> <td>OFF</td> <td></td> <td></td> </tr> <tr> <td>Oscillator</td> <td>OFF</td> <td>Filter</td> <td>OUT</td> </tr> <tr> <td>Oscillator</td> <td>OFF</td> <td>Filter</td> <td>IN</td> </tr> </table>	Oscillator	ON	Filter	IN	Oscillator	ON	Filter	OUT	H.T.	OFF			Oscillator	OFF	Filter	OUT	Oscillator	OFF	Filter	IN
Oscillator	ON	Filter	IN																		
Oscillator	ON	Filter	OUT																		
H.T.	OFF																				
Oscillator	OFF	Filter	OUT																		
Oscillator	OFF	Filter	IN																		
Crash Filter Switch (102).	A single pole tumbler switch which in the "ON" position, connects an output limiting device consisting of a pair of metal rectifiers across the telephone output. It is used to reduce strong interference such as might be experienced from local transmissions or heavy atmospherics. When tuning in a signal this limiter must always be out, otherwise the tuning will be flat and the receiver will appear to be unselective. After the signal has been correctly tuned the limiter may be switched in to reduce interference, but the H/F Gain Control (41) must then be turned down until the wanted signal is just beginning to weaken. If this is not done the effect of the limiter may be to cut down the output from the wanted signal until it is hardly greater than that of relatively much weaker interfering signals.																				

RECEIVER B29



<u>NAME AND ITEM NO.</u>	<u>DESCRIPTION AND USE.</u>								
Band Change Switch (10)	A four position switch which selects the frequency band required. It also rotates a drum which carries the frequency calibration scales of the various ranges, so as to present the appropriate calibration scale behind the window in the panel. The ranges are as follows:- <table border="0" style="margin-left: 40px;"> <tr> <td>Band 1</td> <td>15 - 38 kc/s.</td> </tr> <tr> <td>Band 2</td> <td>38 - 90 kc/s.</td> </tr> <tr> <td>Band 3</td> <td>90 - 240 kc/s.</td> </tr> <tr> <td>Band 4</td> <td>240 - 550 kc/s.</td> </tr> </table> <p>Suitable overlaps between the bands are provided.</p>	Band 1	15 - 38 kc/s.	Band 2	38 - 90 kc/s.	Band 3	90 - 240 kc/s.	Band 4	240 - 550 kc/s.
Band 1	15 - 38 kc/s.								
Band 2	38 - 90 kc/s.								
Band 3	90 - 240 kc/s.								
Band 4	240 - 550 kc/s.								
H/F Gain Control (41)	Controls the gain or amplification of the two R/F valves by altering the bias on their cathodes. It is used as a volume control.								
L/F Gain Control (77)	A plate on the front of the panel covers this Control. Adjustment is preset and should be altered only if, after considerable experience with the receiver, it appears that a permanent increase or decrease in A/F Output is desirable, as for example, when the receiver is employed for Auto H/S reception.								
Tuning Control (122)	Controls a four-gang condenser which tunes the various circuits. A cursor which moves over the range calibration scale at the top of the panel and a graduated scale visible through a window immediately above the Main Tuning Control are coupled to the condenser drive.								
Aerial Tuning Condenser (11)	This condenser is used to tune the input circuit to which the aerial is coupled when the Input Switch (9) is in the "Tune" or "Loop" positions. A pointer attached to the condenser drive moves over a scale calibrated in divisions from 0 = 25.								
Heterodyne Vernier Control (123)	This control enables the frequency of the local oscillator to be varied from the normal 1 kc above the frequency of the signal being received to approximately 1 kc below, and is used when interference is being experienced from a station operating approximately 2 kc/s above that of the wanted station. See para. 6 for detailed explanation. <p style="text-align: center;">Clockwise rotation of the control lowers the frequency of the local oscillator. THE HETERODYNE VERNIER CONTROL MUST ALWAYS BE RETURNED TO THE FULLY ANTI-CLOCKWISE POSITION WHEN SEARCHING FOR A STATION.</p>								
R.I.S. Control	The control knob is coloured Red and when R.I.S. equipment is fitted this control is used to reduce interference from own R.D.F. transmitters. When R.I.S. is not fitted or is not in use, it is essential that the knob should be turned to the "OFF" position, otherwise the receiver will suffer from some reduction in efficiency.								

Apart from the controls described above the only other items on the panel are as follows:-

- (i) Two telephone jacks (103) and (104).
- (ii) Terminal strip for supplies and L.S. output (128).
- (iii) Input Jack (8) for 80 ohm feeder line which may be connected to
 - (a) A dipole aerial.
 - or
 - (b) A remote unipole aerial.
- (iv) A plug in position (130) with gas gap arrester for the normal unipole aerial and
- (v) An input position (129) for loop aerials.

NOTE:- 3-point telephone plugs, such as Patt. 7151, must invariably be used. If a 2-point plug is used, half the secondary winding of the output transformer will be short-circuited with consequent great loss in signal strength.

RECEIVER B29

4. OPERATION.

- (i) Make the Supplies switch (113) to "ON". The lamps for illuminating the scales should light up if power is on the set.
- (ii) Set the Input Switch (9) to "Stand-by".
- (iii) Set the Operating Switch (87) to "Osc. ON - Filter OUT".
- (iv) Set the Crash Filter Switch (102) to the "OUT" position.
- (v) Set the Band Change Switch (10) to the band containing the desired frequency as shown below:-
- | | | |
|-----------|------|---------|
| 15 - 38 | kc/s | Band 1 |
| 38 - 90 | kc/s | Band 2 |
| 90 - 240 | kc/s | Band 3 |
| 240 - 560 | kc/s | Band 4. |
- (vi) Set the H/F Gain Control (41) to three-quarters of its travel in a clockwise direction.
- (vii) Set the tuning control (122) to the desired frequency as indicated on the tuning scale and search either side of this position until the wanted station is heard. The beat frequency obtained, i.e. the note heard in the telephones will change as the tuning control is moved and can be made to fall from a high audio frequency down to a "zero beat" or "dead space" and then to rise again on the other side of the "dead space". It is very important that the main tuning control should always be adjusted on that side of the zero beat position which gives an increasing beat frequency for a clockwise rotation of the main tuning control. If this is not done the R/F circuits will not be brought accurately into tune.
- (viii) If additional selectivity is required in order to avoid interference the input switch (9) is now set to "Tune" and the aerial tuning control (11) adjusted for maximum signal strength.
- (ix) If the signal being received is I.C.W. or R/T the Operating Switch (87) should now be set to "Ocs. - OFF Filter OUT".
- (x) Re-adjust the H/F Gain Control (41) as necessary. Too high a gain on strong signals will overload the receiver.
- (xi) When a C.W. signal is being received the A/F filter may be brought into circuit to increase the selectivity of the receiver. This is done by setting the Operating Switch (87) to the "Oscillator ON - Filter IN" position and carefully adjusting the beat note to the A/F Filter Frequency by tuning on the Main Tuning Control (122), until the beat note is at the frequency of the filter. The correct setting will be indicated by a sharp increase in output.

5. TUNING LOOP AERIALS (SUBMARINES ONLY).

The procedure for Operating the set when receiving on a loop aerial is similar to that described above with the following exceptions:-

For operation (ii) substitute

"Set the input switch (9) to "Loop 1" or "Loop 2", according to whether the loop aerial fitted is a low-impedance (single turn) or high-impedance (multi-turn) loop".

For operation (viii) substitute:-

Adjust the aerial tuning control (11) until the desired signal is at maximum strength, readjusting the main tuning control (122) as necessary.

6. HETERODYNE VERNIER CONTROL (123) - REASON FOR FITTING.

When the receiver has been tuned to a wanted frequency, as described in paragraphs 4 and 5, it sometimes happens that an unwanted station operating on a frequency of 2 kc/s above that of the wanted station can be received. A simple numerical example will explain why this happens.

If the required signal has a frequency of 300 kc/s and the main tuning control is adjusted to this frequency, the local oscillator will be oscillating at a frequency of 301 kc/s; the difference in frequency of the signal and the local oscillator giving a beat or heterodyne note of 1000 c/s, which is the optimum frequency of the A/F Filter.

If there is an unwanted station operating on a frequency of 302 kc/s the difference between the local oscillator and this station will also give a beat note of 1000 c/s, although the signal will be somewhat attenuated by the R/F tuned circuits which are tuned to 300 kc/s.

To overcome the difficulty of this type of interference the local oscillator frequency must be altered so as to give a 1000 c/s beat with the wanted station only. It is for this reason that the Heterodyne vernier Control (123) is fitted. This control adjusts the variable inductances (62) and (63) one of which is connected in the grid circuit of the local oscillator on each frequency range, and so varies the frequency of the oscillations generated by the local oscillator. Clockwise rotation of the control lowers the frequency of the oscillator.

In the example given above the Heterodyne Vernier Control would be rotated clockwise until the wanted signal reappeared. The local oscillator frequency would then have been lowered to 299 kc/s., so that the wanted signal would again give a beat frequency of 1000 c/s with the local oscillations. The unwanted signal, however, would give a beat frequency of 3 kc/s which would be eliminated by the A/F filter. The Vernier control must always be returned to the fully anti-clockwise position when searching for a station.

BRIEF TECHNICAL DESCRIPTION OF RECEIVER.7. GENERAL DESCRIPTION.

Receiver B29 consists of a two stage tuner and two R/F stages employing variable-mu screened pentodes with tuned grid circuits, followed by a tuned-grid detector stage with electronically coupled local oscillator using a triode hexode mixer valve for both functions, and two stages of A/F amplification. The first A/F stage is transformer-fed from the detector stage (via an R/F filter circuit) and is itself resistance capacity coupled to the second A/F (output) stage.

The grid circuits of the two R/F stages, the detector stage and the local oscillator are tuned simultaneously by a four-gang condenser, the coils and trimming condensers (and padding condensers in the case of the local oscillator) being brought into circuit by means of the band-change switch (10). All the tuning inductances have iron dust cores which are adjustable for trimming purposes.

Gain control is effected primarily by altering the standing positive bias on the cathodes of the R/F valves (1) and (2), this being equivalent to altering the negative grid bias. A secondary means of gain control is provided by the A/F gain control potentiometer (77) which is a preset control and is not used in normal operation of the receiver.

A vernier tuning inductance (62) and (63) is included in the grid circuit of the local oscillator by means of which the frequency of the oscillator may be lowered when it is desired to avoid interference from a station operating on the image frequency of the wanted station.

An A/F filter circuit tuned to 1,000 c.p.s. may be connected between the first and second A/F valves when receiving C.W. in order to provide additional selectivity (See Admiralty Handbook of W/T 1938 Vol. II, Para. F37).

Provision is made for feeding the set from either a normal vertical aerial or from a dipole aerial or remote vertical aerial through an 80-ohm feeder. On ranges 1 and 2 (15 to 90 kc/s) a high or low-impedance loop aerial may also be used.

An input from an Outfit R.I.S. (1) can be applied to the suppressor grids of the two R/F valves, the amplitude of this input being adjusted as necessary by a potentiometer (28) control.

RECEIVER B29

INPUT CIRCUITS, SIMPLIFIED DIAGRAMS

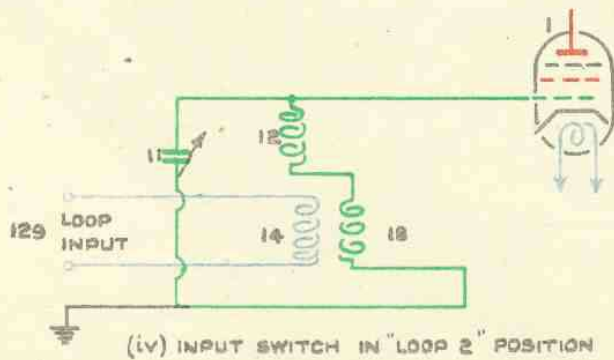
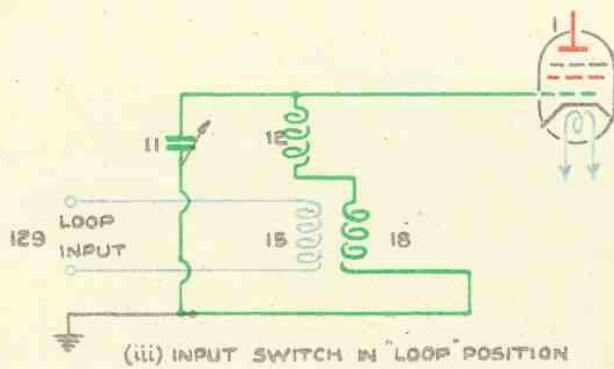
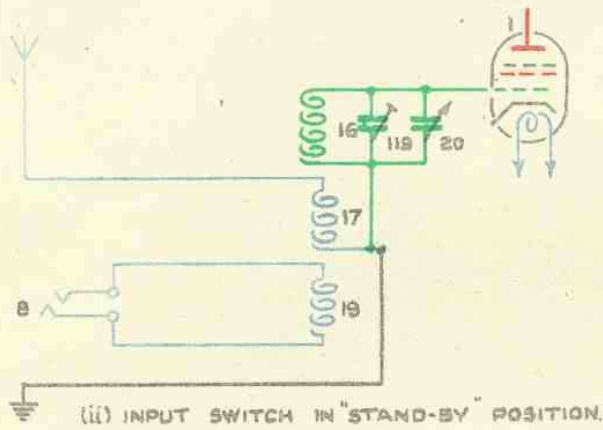
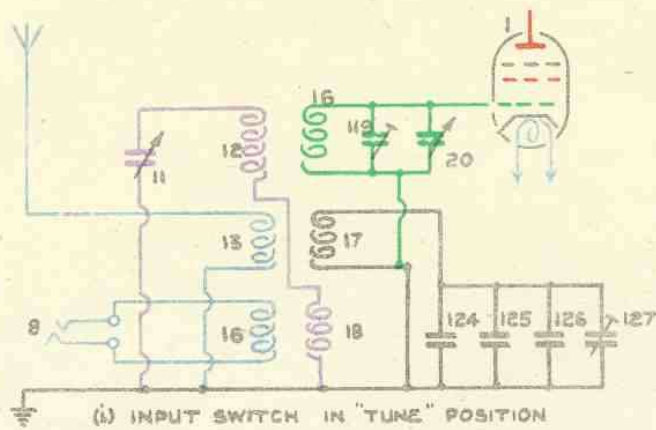


Fig. 6.

8. VALVES USED AND METHOD OF COUPLING.

1st R/F Amplifier	VR100	(Variable-mu Screened Pentode)	Transformer - Tuned Secondary
2nd R/F Amplifier	VR100	" " " "	" " " "
Detector/Oscillator	VR 99	(Triode Hexode Mixer)	Transformer
1st A/F Amplifier	NR 68	(Indirectly Heated Triode)	Resistance Capacity
2nd A/F Amplifier	6J5G	(" " ")	Transformer to Output
Rectifier.	VU71A	Full Wave Rectifier	

9. AERIAL CIRCUITS.

The aerial circuits of the receiver may be connected in one of four conditions, according to the position of the input switch (9). The four conditions are shown in Fig. B and are as follows:-

- "Tune" Aerial terminal connected to aerial coupling coil (13), which is coupled to aerial tuned circuit (11), (12), (18). 80-ohm input jack connected to coupling coil (15) which is coupled to aerial tuned circuit. Aerial circuit coupled by coil (18) to tuned grid circuit (16) (119) (20) of first R/F valve. Coil (17), which is connected to the aerial in the "Stand-By" position is shunted by condensers (124) (125) (126) and preset condenser (127). The addition of these condensers compensates for the removal of the aerial from this coil and prevents the ganging of the grid circuit tuning of the first valve from being upset.
- "Stand-by" Aerial terminal connected to coupling coil (17), which is coupled to first R/F tuned grid circuit (16) (119) (20). 80-ohm input jack (8) connected to coupling coil (19) which is coupled to first R/F tuned circuit.
- "Loop 1" Loop input terminals connected to low-impedance coupling coil (15), which is coupled to aerial tuned circuit (11) (12) (18). Aerial circuit connected direct to grid of first R/F valve.
- "Loop 2" Loop input terminals connected to high-impedance coupling coil (14), which is coupled to aerial tuned circuit (11) (12) (18). Aerial circuit connected direct to grid of first R/F valve.

The two "Loop" positions of the switch are only intended for use in submarines where a single-turn loop or frame aerial is fitted for submerged reception, on Bands 1 and 2 (i.e. on frequencies between 15 and 90 kc/s).

A gas gap arrester (7) is connected between the vertical aerial input terminal and earth.

10. FIRST R/F AMPLIFIER. ADMIRALTY HANDBOOK OF W/T (1938) Vol. II, Para. N33.

The grid circuit of the first R/F amplifier depends upon the position of the input switch (9). When this switch is in either the "Tune" or "Stand-by" position the grid circuit consists of one of the coils (16), tuned by its individual trimming condenser (119) and the main tuning condenser (20). When the input switch (9) is in either of the "Loop" positions, the grid circuit consists of the coils (12) (18) for the range in use and the aerial tuning condenser (11). The tuning condenser (20) is one section of the four-gang condenser operated by the main tuning control (122) which tunes the R/F, detector and oscillator stages. When Band 2, 3, or 4 is in use the coils of the lower-frequency ranges are short-circuited by the range switch (10).

The valve used is an VR100 variable-mu screened pentode (1) the anode of which is coupled to the tuned grid circuit of the second R/F stage by means of the coupling coil (31) the coil for the range in use being selected by means of the band change switch (10).

RECEIVER B29

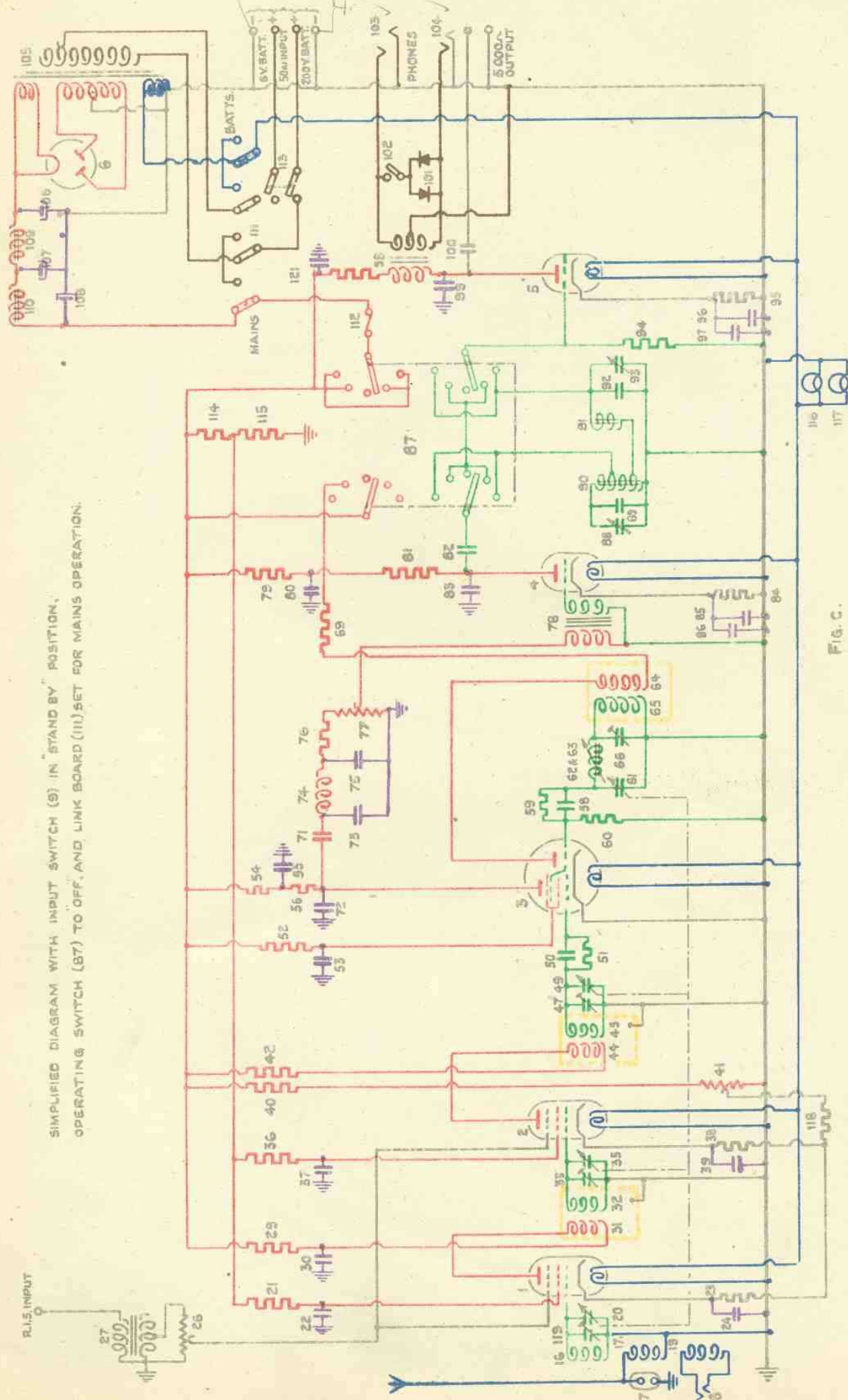


FIG. C.

SIMPLIFIED DIAGRAM WITH INPUT SWITCH (9) IN "STANDBY" POSITION,
OPERATING SWITCH (87) TO "OFF," AND LINK BOARD (111) SET FOR MAINS OPERATION.

11. SECOND R/F AMPLIFIER.

The grid circuit of the second R/F amplifier consists of one of the coils (32) tuned by the main tuning condenser (35) and its individual trimming condenser (33). The coil for the range in use is selected by means of the band change switch (10) any lower-frequency coils being short-circuited. The coil for range 1 is shunted by a 2-megohm resistance to decrease the gain.

The valve used is a VR100 screened pentode (2), the anode of which is coupled to the tuned circuit of the detector valve (3) by means of a coupling coil (44), the appropriate coil for the range in use being selected by means of the band change switch (10).

12. DETECTOR.

The grid circuit of the detector valve consists of one of the coils (45) tuned by the main tuning condenser (49), which is shunted by the range trimming condenser (47). The coil for the range in use is selected by the band change switch (10), which short-circuits any lower frequency coils. The coil for range 4 is shunted by a 250,000-ohm resistance to decrease the gain.

The valve is a VR99 triode-hexode mixer (See Admiralty Handbook of W/T 1938 Vol. 11, Para. F31) the hexode portion being used as the detector and the triode portion as the local oscillator. The signal grid of the hexode portion is connected to the tuned circuit through a 100-mfd. condenser (50) and 2-megohm resistance (51) in parallel.

The anode of the valve is connected to an R/F filter through a 0.01 mfd. condenser (71). The R/F filter consists of a choke (74), a 0.001 mfd. condenser (73) and a 0.0015 mfd condenser (75) followed by a 500,000-ohm resistance (76) and the 250,000-ohm pre-set A/F Volume Control (77). The slider of the Volume Control potentiometer is connected to the primary winding of the intervalve transformer (78).

13. LOCAL OSCILLATOR.

The tuned circuit of the local oscillator, which employs the triode section of the VR99 detector valve, consists of one of the coils (65) shunted by the range trimming condenser (66) in series with the appropriate vernier inductance (62) or (63) and is tuned by one section (61) of the main tuning condenser. On ranges 1 and 4 the inductance is shunted by resistances of 1-megohm, and 500,000-ohms respectively. On range 1 a padding condenser of 8,500-mfd. is connected in series with the tuned circuit.

The grid of the local oscillator valve is connected to the tuned circuit through a 100-mfd. condenser (58), which is shunted by a 2-megohm resistance (59). The vernier inductance and tuned circuit coil are selected by the range switch (10).

The anode of the local oscillator is connected via the range switch (10) to the appropriate coupling coil (65) by means of which the feedback necessary to make the system self-oscillatory is obtained. The other end of the coupling coil is connected to the H.T. line through a 30,000-ohm resistance (69) via the operating switch (87) when the switch is in either of the "Ret. ON" positions.

Coupling between the local oscillator and detector is electronic, the grid of the triode section of the VR99 valve being internally connected to a grid of the hexode detector portion.

14. FIRST A/F AMPLIFIER.

The grid of the first A/F amplifier valve (4), which is an NR68 indirectly heated triode, is fed from the secondary winding of the inter-valve transformer (78), the other end of which is connected to earth.

The output from the valve is taken from the anode via a 0.1-mfd. condenser (82) to the second A/F valve either via the A/F filter or direct, according to the position of the operating switch (87).

15. SECOND A/F AMPLIFIER (OUTPUT STAGE).

The grid of the second A/F amplifier valve (5), which is a 6J5G indirectly heated triode valve, is fed from the anode of the first A/F stage valve (4) either directly through the coupling condenser (82), when the operating switch (87) is in either of its "Filter Out" positions or via the A/F filter circuit when the operating switch is in either of its "Filter In" positions.

RECEIVER B29

The A/F filter consists of two iron cored inductances (90) (91) tuned by fixed condensers (89) (92) and preset condensers (88) (93) to the beat frequency of 1,000 c.p.s.

A high-impedance (5,000-ohm) output is taken from the anode of the valve through a 1-mfd. condenser (100), the anode of the valve being bypassed to earth for R/F by 0.01 mfd. condenser (99). The telephone output, which is matched to a pair of Pattern W621 head telephones, is taken from the secondary winding of the output transformer (98) to the telephone jacks (103) (104). When the "Crash Filter" Switch (102) is made, this output is shunted by a pair of metal rectifiers (101), which limit the amplitude of the voltage applied to the telephones. This prevents sharp peaks of audio frequency impulses from giving more than a limited A/F output. When "listening through" this limiter prevents excessive output in the telephones from the local transmitter. The 5,000-ohm output is intended to drive a D.C. Amplifier K31 for Auto-H/S reception.

16. POWER SUPPLIES.

Receiver B29 is designed to operate either directly from a 100/110 or 200 - 250, volt, 50 cycle A.C. supply or from 6-volt and 200-volt batteries.

If the model is to be operated from batteries the supply circuit must be changed over by means of the link board (111) situated on the top of the chassis. This board is accessible by opening the lid in the top of the cabinet. The four link screws may then be withdrawn from the "Mains" positions and inserted in the "Batteries" positions in the contact strips.

The power consumption of the receiver when supplied from A.C. mains or from batteries is given below:-

A.C.	100/110 or 200-250V. 33 watts.
Batteries	H.T. 19mA with oscillator OFF 22mA with oscillator ON
	L.T. 2.1 amps.

The H.T. supply may therefore be provided by four Pattern 3773 dry batteries, while the L.T. supply may be taken from three Pattern 5503 or 1551B cells connected in series.

The receiver is supplied with the supply change-over link board (111) set to "Mains" and the supply connected to the 230-volt tapping on the transformer. If the receiver is required to be operated from an A.C. supply of any other voltage than 230, the tapping lead must be unsoldered from the 230-V tag on the transformer and connected to the correct tag.

17. RECTIFIER.

The rectifier circuit is shown in Fig. C. The A.C. supply is connected to the terminals marked "50 cycle supply" in the terminal box at the right-hand side of the receiver panel and is fed from these terminals via the double-pole supplies ON/OFF switch (113) and the supply change over link board (111) to the primary winding of the mains transformer (105).

This transformer has three secondary windings, one of which supplies the rectifier valve filament at 5 volts, one the rectifier valve anodes at 215 - 0 - 215 volts, while the third supplies the heaters of the receiver valves at 6.3 volts.

The rectifier valve (6) is a VU71A directly heated full-wave rectifier. The H.T. supply is taken from the filament of the valve and supplies approximately 220 volts D.C. to the H.T. line through a smoothing filter consisting of 8-mfd. condensers (106) (107) (108) and 15-henry chokes (109) (110). A 60mA fuse (112) is included in the H.T. lead.

The screen grids of the two R/F amplifier valves (1) (2) are fed from the tapping of a potentiometer consisting of two 50,000-ohm resistance (114) (115) connected across the H.T. supply.

The cathodes of these valves are returned to the tapping of a variable potentiometer (41), which is connected in series with a resistance (40) across the H.T. supply. Adjustment of this potentiometer varies the positive bias on the cathodes of the valves, thus effectively changing the negative grid bias and hence the gain of the valves. This adjustment forms the normal gain control of the receiver.

When the receiver is operated from batteries, the 200-volt battery supply is fed via the ON/OFF switch (113), change-over link aboard (111) and fuse (112) to the H.T. line.

18. FILAMENT SUPPLY.

When the receiver is operated from an A.C. supply the valve heaters are fed from a secondary winding of the transformer (105) which supplies them at 6.3 volts via the change-over link board (111). When the receiver is battery fed the heaters are supplied from the 6-volt battery via the ON/OFF switch (113) and link board (111). In this case, care must be taken that the cables connecting the L.T. battery to the receiver are of adequate size to carry the current (2 amps), taken by the heaters without appreciable voltage drop.