B.R. 575(2) C

AUDIO FREQUENCY EQUIPMENT

A.F.100 SERIES

BROADCAST SYSTEMS

THE ALARM PANEL

A.P.12651

Director of Electrical Engineering
ADMIRALTY, S.W.1

AMENDMENTS

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B.R. 575(2)C, *Audio Frequency Equipment—A.F.* 100 *series, Broadcast Systems, The Alarm Panel,* A.P. 12651, 1953, having been approved by My Lords Commissioners of the Admiralty, is hereby promulgated for information and guidance.

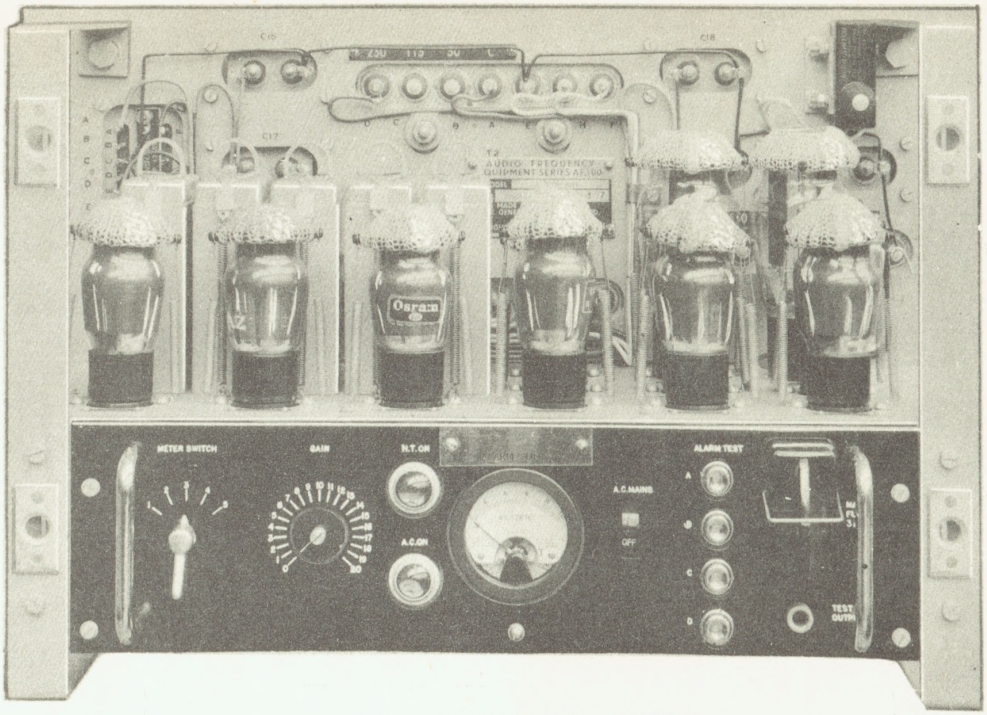
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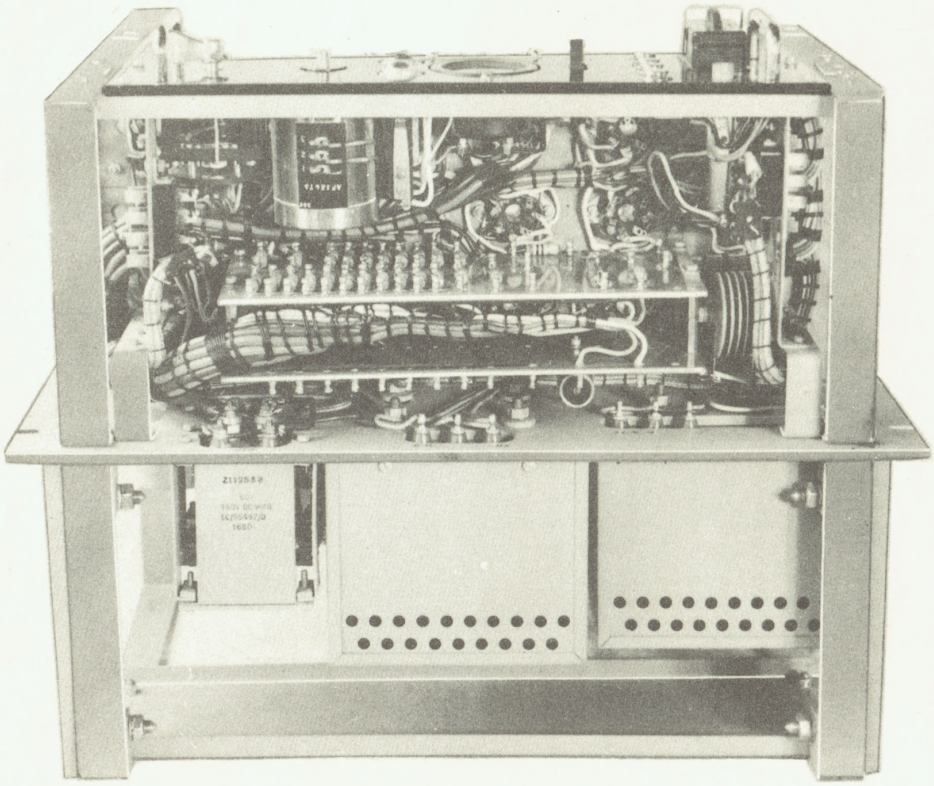
D. E. Lang

To Flag Officers and Commanding Officers of H.M. Ships and Vessels concerned,

Suggestions for improvement of the text or illustrations which can be incorporated by way of amendment or in any future revision of this book, will be welcomed and will receive careful consideration; they should be forwarded to the Secretary of the Admiralty through the usual channels.



(a) ALARM PANEL. A.P.12651
GENERAL VIEW. COVER REMOVED



(b) ALARM PANEL. A.P.12651.
UNDER DECK VIEW

PLATE 1.

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Plate 1 (a) The Alarm Panel. General view (cover removed) } *frontispiece*
(b) The Alarm Panel. Under deck view }

At end of Text

Figure 1. Alarm Panel, A.P. 12651. Circuit Diagram

Figure 2. Alarm Panel, A.P. 12651. Arrangement Drawing (Structural details)

Figure 3. Alarm Panel, A.P. 12651. Pictorial Wiring Diagram

SAFETY WARNING

1. The voltages employed in the alarm panel are sufficiently high to endanger human life. Every reasonable precaution has been taken in the design to safeguard the operating personnel. All the bare terminations of the panel are protected by the main cover, the removal of which opens a safety switch in the A.C. power supply, thereby cutting off power from all the exposed parts except those on the control plug and socket. Power should be completely cut off before changing valves or making any internal adjustments.

2. Certain tests which at times need to be made in connection with maintenance work require that the panel shall be energised when the protective cover is removed, and the safety switch therefore open. This necessitates the temporary closing of the safety switch by other means. Work under these conditions is to be undertaken only by persons who are fully aware of the dangerous conditions, and who have taken adequate steps to avoid direct contact with high voltages.

INTRODUCTION

3. The Alarm Panel A.P. 12651 (*see Plate* 1) is an electronic device in the nature of a signal generator which produces a voltage oscillating at audio frequencies suitable for amplification and reproduction as alarm or warning notes over the loudspeakers of a broadcast system.

4. Two warning notes, " high " and " low ", and two systems of spacing each can be produced by the standard arrangement of the valves and other components of the panel, thus making four warning or alarm signals available. These are identified as " A ", " B ", " C " and " D ", and the test push buttons on the panels are marked accordingly.

5. The warning and alarm notes generated by the panel, and the spacing of the notes to produce the required signal, are governed by switching over control of multivibrator valves from one set of capacitors and resistors to others. The switching is effected by the operation of relays.

6. The characteristics of the four signals are:—

LETTER	TONE	NATURE OF SIGNAL	TIME PERIOD FOR ONE CYCLE (APPROX.)	RATIO OF SOUND TO SILENCE
A	Low	on and off	2/3rds of a second	1 : 1
B	High	on and off	2/3rds of a second	1 : 1
C	Low	long on, short off	1½ seconds	3 : 1
D	High	long on, short off	1½ seconds	3 : 1

7. The usual allocation of these four signals is:—

LETTER	PURPOSE
A	General warning for all the ship.
B	Flight deck " alert " (A.F. 125 and A.F. 126).
C	General alarm for all the ship.
D	Flight deck and Hangar alarm (A.F. 125 and A.F. 126).

8. When the warning or alarm is sounded it takes precedence over all other broadcast messages. For this reason, where an alarm panel forms part of an A.F. system, all inputs to the amplifiers are taken through it in order that they may be switched as necessary with the minimum of wiring.

9. The alarm panel has no input in the ordinary sense. It is interposed in the circuit between the microphone and the 50 watt amplifier in the A.F. system in which it is employed. The microphone connections of the system enter the alarm panel at the PLI plug and, when the alarm panel is not in use, they pass straight through and out at the PLO plug to the 50 watt amplifier. When any one of the alarm pushes is pressed the microphone connections are opened by a relay and, by the same means the connections leading to the amplifier input are switched to the output of the alarm panel.

10. Alarm panels are fitted in the following A.F. systems:—

A.F. NO.	TYPE OF SHIP	PURPOSE
101, 101A	Carriers	General warning and general alarm.
102, 103	Destroyers, etc.	
104	Cruisers	
111	Destroyers	
112	Frigates	
125, 125A, 126	Carriers	Flight deck " alert " and flight deck and hangar " alarm ".

Mounting weight and dimensions

11. The panel is rack mounted. Its weight is 70 lb.

Dimensions:—

Height	12¼ in. (7 E).
Depth (back to front)	17 in.
Width (overall)	19 in.

CIRCUIT DESCRIPTION

(*Figure* 1)

12. The panel employs a system of three multivibrators and a mixing valve output stage. Multivibrators numbers one and two each consist of one pair of valves, but in number three each side of the multivibrator consists of a parallel pair. The multivibrator valves, V1 to V8, and the output stage valves are C.V. 1067.

Power Supply

13. Power supply is from the C.W.S. or similar source, usually at 230 volts, 50 cycles, single phase. An alternative supply is provided. The H.T. and heater transformers have tapped primary windings which makes a supply at 115 volts or 50 volts also acceptable. The supply frequency is nominally 50 cycles but variation from this figure between the limits of 45 c.p.s. and 65 c.p.s. will have no appreciable adverse effect either on volume or the tones generated provided that the supply voltage is maintained.

14. One pole of the incoming A.C. supply is taken through a safety switch SW2 which opens the circuit by spring action when the panel front cover is removed, thus ensuring that H.T. and heater circuits are dead under these circumstances. Before closing this switch by extraneous means for any purpose the safety warning on page one should be read.

H.T. Supplies

15. H.T. supply for the panel is taken from the H.T. transformer TR1 and rectified by two C.V. 1071 valves, V11 and V12, in parallel bi-phase operation. The H.T. for the multivibrators is taken through the choke input filter circuit—L2, L1, C20, C19, C18, C17 and C16. The H.T. for the mixing valve output stage is unsmoothed. Transformer TR1 also provides a supply at 4·5 volts for the " H.T. on " pilot lamp LP1.

Heater and Relay Operation Supplies

16. Transformer TR2 provides power for:—

(*a*) Rectifier valve cathode heating at 2·5 + 2·5 volts (J–K–L).

(*b*) Heating for valves V1 to V10 at 6·3 volts (F–H).

(*c*) Rectified supply for relay operation at 50 (nom.) volts (P–M).

(*d*) " A.C. on " pilot lamp LP2 at 4·5 volts (P–N).

Cathode Bias

17. Automatic cathode bias is used in all multivibrator and output stage valves. The bias resistors are also used as meter shunts. The bias values are given in Appendix 2.

The Multivibrators

18. The action of a multivibrator is fairly well known, but a brief summary of the operation as applicable to the first multivibrator, V1 and V2, of the alarm panel is as follows:—

19. The action is rather like that of an amplifying stage in which the output of the second stage is coupled and applied to the grid of the valve in the first stage. Referring to Figure 1, assume that the cathodes are heated and the H.T. switched on; both valves will conduct. The anode potential of both valves will be equal to the applied H.T. minus the drop caused by the anode load resistors R3 and R4.

20. At the instant of the application of the H.T. the anode potentials will be across R2 and R5 causing a strong positive potential on the grids of both valves. As the capacitors C21 and C2 charge the P.D. across R2 and R5, and therefore the grid potential, will fall exponentially to zero. Because R5 is of a lower value than R2 (82 K ohms compared with 100 K ohms), let it be assumed that the potential of the grid of V2 falls more rapidly than that of V1. Under these conditions at a given instant V1 will be passing a larger current than V2. V1 anode voltage will be lower than that of V2.

21. C21 will discharge through V1 and R5 and the grid potential of V2 will be negative. The current through V2 will fall and its anode potential rise; C2 will charge and produce a positive potential on the grid of V1, causing an increase of current through that valve, with a further drop in anode potential. C21 will discharge further, producing a more negative potential on the grid of V2, still further reducing the current through that valve, and increasing the charge of C2.

22. The action is cumulative and in due course results in V2 being cut off while V1 passes the maximum current. When this stage is reached the discharge current from C21 through R5 falls, the grid potential of V2 rises, the charging current of C2 through R2 falls and the grid potential of V1 falls exponentially towards zero. When the rising grid potential of V2 passes cut off V2 will conduct, with a resulting drop in anode voltage. C2 will discharge through V2 and R2, producing a negative potential on the grid of V1, reducing the current through that valve and increasing the anode potential.

23. The action is again cumulative, resulting in this case in V1 being cut off, while V2 passes a maximum current. Thus there will be a constant switching action between the two valves, each passing the maximum and zero current alternately. Normally this switching effect is extremely rapid, but by careful selection of the values of the coupling capacitors and grid leak resistors the timing can be made suitable for most requirements.

24. The output of V2 in the first multivibrator is coupled by C3, R6, R23, R21, RV1 and C13 to the grids of the mixer valves V9 and V10. The second multivibrator, V3 and V4, acts in a manner similar to the first, and its output is coupled by C8, R12, R24, R21, RV1 and C13 also to the grids of the mixer valves. The tones from the first two multivibrators are mixed in V9 and V10 which operate in parallel. The H.T. of the mixing valves being unsmoothed, the H.T. ripple is imposed by these valves on the mixed tone and the resulting combination of frequencies is the tone heard in the output.

25. As already stated the tone produced by the panel when either button A or C is pressed is " low "; when either button B or D is pressed the resulting tone is " high ". Figure 1 shows the circuit as it is when the low tone is produced. In order to produce the high tone, capacitors of different values are switched in to

the coupling between the anode of V1 to the grid of V2, and from the anode of V3 to the grid of V4. It may be seen from the Figure that in each case the alternative capacitor is of a smaller value, which has the effect of speeding up the switching action of the multivibrator and therefore the frequency of the tone. The capacitor switching is done by relays as is explained later.

26. The spacing of the tones is achieved by means of the third multivibrator, V5, V6, V7 and V8, working in a parallel combination. The action is similar to that already described. Figure 1 shows the circuit as arranged for equal spacing of sound and silence.

27. The grid circuit of one parallel pair of valves of this multivibrator is coupled by R22 to the grids of the mixer valves. The effect of the switching action of this group of valves and the coupling to the mixer valves is to cause the latter to conduct and cut off for approximately equal periods. The length of the period is determined by the values of C11 and C12 which, it will be seen, are much higher than those of the corresponding capacitors in the multivibrators producing the tones.

28. For the unequal 3 to 1 spacing required for signals C and D, alternative grid lead resistors are switched in to the circuit of the third or timing multivibrator. For the equal spacing the resistors were as nearly as possible equal, having just sufficient difference to cause the switching action to start and continue. For the 3 to 1 spacing it will be seen that the values are approximately 3 to 1, which gives the " long on ", " short off " effect required for the alarm signals.

The Output

29. The tone, produced by the mixing of the output from the multivibrators numbers one and two, modulated in the mixer valves by the H.T. ripple frequency, and interrupted at regular intervals by the action of the third multivibrator, is cathode coupled to the output by transformer TR3.

30. A test output jack, TJO, is connected permanently across the primary of TR3, and on test a voltage of the order of 300 mV may be obtained. The transformer has a step down turns ratio of 40 : 1 in order to produce a line output voltage suitable for an input to the associated 50 watt amplifier. The transformer secondary is connected to the outgoing lines 7 and 8, and 9 and 10, of the plug PLO. Test figures for the output are given in Appendix 2.

Relays

31. The panel has five relays used for switching purposes. They are of the Post Office 3,000 type, all of 300 ohms resistance, and operated by the rectified 50 volt supply from transformer TR2. Two of the relays, namely, M/5 and H/2, must be closed for any operation of the panel. The other three, namely, AB/3, AC/3 and AD/2, are for the purpose of selecting the tone and its spacing.

32. The relays can be operated locally by push buttons A, B, C and D, or remotely from the broadcast control positions. For the latter purpose operating lines for each signal are taken from the plug PLC to the Bc. control boxes or other push positions.

Relay and Relay Contact Operation

33. *Button A pressed.* Low tone, even spacing. Contact SW4 closed. Relay M/5 and H/2 operated.

RELAY CONTACT	SWITCHING ACTION
M1 and M2 .	At PLO plug. Isolates the 25 ohm microphone input and connects the alarm panel output to lines 7 and 8 of PLO.
M3 and M4 .	At PLO plug. Isolates the 8 ohm microphone input and connects the alarm panel output to lines 9 and 10 of PLO.
M5 . .	Closes the circuit of the H.T. relays for associated rack units (only where no other arrangements are provided).
H1 and H2 .	Closes the supply to the primary of the H.T. transformer TR1.

34. *Button B pressed.* High tone, even spacing. Contact SW5 closed. Relay AB/3 operated.

RELAY CONTACT	SWITCHING ACTION
AB1 . .	Transfers control of the second multivibrator from C5 of 10,000 pF to C6 of 1,000 pF.
AB2 . .	Closes the circuit for the operation of relays M/5 and H/2.
AB3 . .	Transfers control of the first multivibrator from C21 of 4,700 pF to C1 of 390 pF.

35. *Button C pressed.* Low tone, uneven spacing. Contact SW6 closed. Relay AC/3 operated.

RELAY CONTACT	SWITCHING ACTION
AC1 and AC2 .	Alters the values of the grid leak resistors in the mixer valve circuit.
AC3 . .	Closes the circuit for the operation of relays M/5 and H/2.

36. *Button D pressed.* High tone, uneven spacing. Contact SW7 closed. Relay AD/2 operated.

RELAY CONTACT	SWITCHING ACTION
AD1 . .	Closes the circuit for the operation of relay AB/3.
AD2 . .	Closes the circuit for the operation of relay AC/3.

Gain Control

37. Output level is controlled by the potentiometer RV1 in the input to the mixer valves. The potentiometer is of the rotary, stud type. Adjustment is made by a screwdriver in a slot at the end of the stainless steel spindle

which projects through a hole in the panel escutcheon plate. The dial is graduated 0–20. The switch arm makes contact on studs disposed 13½ degrees apart over an arc of 270 degrees, the stud positions being located by detent action.

The Meter

38. The meter M1 is a milliammeter which, by means of the switch SW1, can be connected across shunts in the cathode circuits of the valves. The scale is graduated 0 to 10 in equal divisions, figure marking being by even numbered digits only. Each division is graduated in five equal subdivisions.

39. The resistance of the instrument is 100 ohms; the resistors in the cathode circuits of the valves which act as shunts are all of 10 ohms resistance. Thus the current passing through the meter is equal to one-tenth of that passing through the shunt to which it is connected. One milliampere through the meter gives full scale deflection, therefore a full scale deflection indicates 10 mA passing through the shunt, and the number marking on the scale reads direct in mA for current through the shunt.

40. The meter switch positions and the valve circuits to which they are connected are:—

SWITCH POSITION	VALVES
1	Not used.
2	V1 and V2.
3	V3 and V4.
4	V5, V6, V7 and V8.
5	V9 and V10.

41. The meter readings for current values through each pair or group of valves which should be considered as normal are given in Appendix 2.

42. Regular and frequent use of the meter as laid down in the maintenance routines may prevent the total failure of the alarm panel. The failure of a valve of either of the parallel pairs in multivibrator number 3, or of one of the mixer valves will be indicated on the meter, when switched to the defective circuit, by a reading lower than normal. Failure of any valve in either of the multivibrators numbers 1 and 2 will result in a changed output tone. The use of the meter will enable the defective multivibrator to be identified by its giving a reading lower in value than the normal.

43. A red line on the meter dial at 3·16 has no significance relating to the alarm panel.

44. When not otherwise in use the meter switch should be left at position 5.

Pilot Lamps

45. Two pilot lamps are fitted to the panel. The "A.C. on" pilot lamp has a green glass and glows at all times when the panel is ready for use. The "H.T. on" pilot lamp has a red glass and glows only when the panel is actually in use, *i.e.*, when one of the buttons is pressed and the relay H/2 consequently closed.

Cable Connections

46. Three multi-pin plugs and sockets PLI, PLO and PLC are employed for making all the connections to the panel. PLI carried the two pairs of incoming microphone leads for the 50 watt amplifier and two earth connections; the former, when no alarm tone is being sounded, pass direct to PLO. PLO carries the two pairs of outgoing leads for the 50 watt amplifier and one pair for the relay contact M5; the former carry either the microphone or the alarm tone currents as required. PLC carries the leads for the A.C. supply; five leads for external pushes for the four alert and alarm signals and a common return; an earth connection and leads for external pilot lamps.

47. Plug PLI is mounted on the side at the left of the chassis as viewed from the front, with PLO and PLC at the corresponding position on the right hand side. Details of the connections to all the plugs and sockets are shown in Figure 1.

H.T. and Heater switching

48. Switch SW3 marked "A.C. Mains" on the panel escutcheon plate, must be "on" at all times in order for the panel to be ready for use. When this switch is closed the "AC on" lamp glows, the valve cathodes are maintained at emission temperature and a rectified supply for relay operation is available. H.T. switching is entirely by relay as already explained.

Controls

49. The controls are mounted on the panel escutcheon plate. The statement below shows the order of their arrangement when viewed from the front, from left to right and from top to bottom. The conditions or position in which each control should be for normal working is shown against each.

CONTROL	NORMAL CONDITION OR POSITION
(*a*) Meter switch (SW1)	Position 5.
(*b*) Gain control (RV1)	As found by experience to be best.
(*c*) "H.T. on" pilot lamp (LP1)	Glowing when any alarm signal is being generated.
(*d*) "A.C. on" pilot lamp (LP2)	Glowing.
(*e*) Meter (M1)	When no alarm is being sounded — pointer on zero. When panel is in use— pointer registering.
(*f*) A.C. mains switch (SW3)	To "on".
(*g*) Alarm test push buttons "A", "B", "C" and "D".	Not in use.
(*h*) Fuses (FS1 and FS2)	In place.
(*j*) Output test jack (TJO)	Vacant.

Table 1. List of Components and their functions

Capacitors

C1	Tone capacitor. First M/V. (High.)
C2	Tone capacitor. First M/V.
C3	Coupling capacitor. First M/V to mixer valves.
C4	Filter by-pass capactor. First M/V.
C5	Tone capacitor. Second M/V. (Low.)
C6	Tone capacitor. Second M/V. (High.)
C7	Tone capacitor. Second M/V.
C8	Coupling capacitor. Second M/V to mixer valves.
C9	Filter by-pass capacitor. Second M/V.
C10	Cathode bias by-pass capacitor. Third M/V.
C11, C12	Coupling and tone spacing capacitors. Third M/V.
C13	Blocking capacitor.
C14	Coupling capacitor. TJO.
C15	H.T. de-coupling capacitor. V9 and V10.
C16, C17, C18, C19	Smoothing capacitors.
C20	Reservoir capacitor.
C21	Tone capacitor. First M/V. (Low.)

Resistors

R1	Cathode bias (and meter shunt). First M/V.
R2	Grid leak. V1.
R3	Anode load. V1.
R4	Anode load. V2.
R5	Grid leak. V2.
R6	Filter resistor. First M/V.
R7	Cathode bias (and meter shunt). Second M/V.
R8	Anode load. V3.
R9	Grid leak. V3.
R10	Grid leak. V4.
R11	Anode load. V4.
R12	Filter resistor. Second M/V.
R13	Cathode bias (and meter shunt). Valves V5 to V8.
R14	Anode load. V5 and V6.
R15	Grid leak. V5 and V6. Even spacing.
R16	Grid leak. V5 and V6. Uneven spacing.
R17	Grid leak. V7 and V8. Even spacing.
R18	Grid leak. V7 and V8. Uneven spacing.
R19	Anode load. V7 and V8.
R21	Coupling resistor. First and second M/Vs. to mixer valves.
R22	Filter resistor. Third M/V.
R23, R24	Filter resistors.
R25	Loading or damping resistor for primary of transformer T3.
R26	Cathode bias (and meter shunt). Valves V9 and V10.
R27	De-coupling resistor. Valves V9 and V10.
R28	Capacitor discharge resistor.
RV1	Gain control potentiometer.

Miscellaneous

LP1	" H.T. on " pilot lamp.
LP2	" A.C. on " pilot lamp.

Miscellaneous—continued

L1	Smoothing choke.
L2	Smoothing choke.
TR1	H.T. transformer.
TR2	Heater transformer.
TR3	Output transformer.
MR1	Relay current rectifier (half wave).
M1	Cathode current milliammeter.
PLC	Control plug. Ten way.
PLI	Input plug. Eight way.
PLO	Output plug. Six way.
SW1	Meter switch.
SW2	Safety switch.
SW3	" A.C. on " switch.
SW4	Local test push. Alarm " A ".
SW5	Local test push. Alarm " B ".
SW6	Local test push. Alarm " C ".
SW7	Local test push. Alarm " D ".
H/2	High tension relay.
M/5	Change-over relay. Speech to alarm.
AB/3	Alarm " B " relay.
AC/3	Alarm " C " relay.
AD/2	Alarm " D " relay.
FS1, FS2	Fuses. 3 ampere.
TJO	Output test jack.

MAINTENANCE

50. Attention is drawn to the safety warning given on page 1 of this book.

Ready use Maintenance Box A.P. 12685

51. The items of portable testing apparatus carried in this box which are needed for testing the alarm panel are:—

(*a*) The test load for the 50 watt amplifier.
(*b*) The headset.

General Maintenance

52. The maintenance of the panel in good working order is very largely dependent upon frequent inspections and a constant and alert watch for incipient defects. A series of maintenance routines given in paragraphs 72 to 74 will ensure as far as is possible that minor defects cannot develop into major breakdowns.

53. The inspections and maintenance routines cover the following points:—

(*a*) Those which may be attended to without interference with the normal working of the panel:—

(i) Meter the cathode currents of the multivibrators and the mixer valves.

(ii) Adjust the gain control as found necessary.

(iii) Listen carefully to the tones so as to detect any change which may be due to a defective valve or other cause.

(iv) See that the pilot lamps are working correctly.

(*b*) Those for which the panel and its associated 50 watt amplifier must temporarily be put out of use:—

(i) Periodical audio tests by dummy load and headset.

(ii) Exchange of valves.

(iii) Removal of dust from the terminals and surfaces in the valve compartment.

(*c*) Those for which the panel must be removed from its rack:—

(i) Inspect for visible signs of overheating of any component.

(ii) Cleaning and adjustment of switch contacts.

(iii) Renewal of components.

(iv) Removal of accumulated dust from the interior.

(v) Testing for and location of known defects.

54. Each alarm panel should be given a complete examination and test yearly.

55. Unless a regular system of periodical test soundings is adopted it is likely under peace conditions that the alarm signals will not be used for long periods. It is therefore of importance that a testing routine should be observed in order, not only to test and maintain the efficiency of the panel, but also to accustom the personnel to the tones and their uses and to provide an opportunity for gain control adjustment.

56. For audible testing when it is not required or convenient to use the loudspeaker system the test should be made in conjunction with the associated 50 watt amplifier as follows:—

(*a*) At the 50 watt amplifier:—

(i) Disconnect SKO and connect the test output load in its place.

(ii) Plug a headset or portable loudspeaker into TJO.

(iii) Close the H.T. test switch.

(*b*) At the alarm panel:—Press all the lettered test buttons in turn; the signals will be heard in the plugged in headset or loudspeaker.

The opportunity should be taken during the test to meter the valve currents; the readings will be of assistance in the event of the test not proving satisfactory.

57. Spare alarm panels are carried by large ships. Stowage is provided in the racks near the place of use. Where carried, spare panels should be given regular periods of use as a routine. The serial number on the panel identity plate enables a record of employment to be kept.

58. If the panel fails and no spare is carried emergency arrangements must be made for giving warning or alarm signals by broadcast speech, or bugle or other instrument.

59. If and when it becomes necessary to remove an alarm panel from its rack and no spare is available to replace it, arrangements must be made for the affected A.F. system to continue in use for speech Bc. purposes. This may be done by the connection of the alarm panel input leads to the input of the associated 50 watt amplifier, either by direct connection of socket to plug or by short connections between terminal blocks on the terminal panel.

Valves

60. Factors which contribute to the shortening of valve life are vibration, shock and the overrunning of the heaters. Vibration and shock should not be serious unless local conditions are abnormal or some mounting component is defective. Heater overrunning is unlikely if the supply voltage does not vary greatly from the specified value.

Metering of Valve Cathode Currents (*paragraph reference* 38–44)

61. This item of routine maintenance is of importance because it may afford a method of anticipating and therefore avoiding a breakdown due to valve failure. Metering can be done only when an actual warning or alarm note is being generated. The opportunity should be taken to meter the valve currents on every occasion of sounding a practice warning or alarm.

62. With most alarm panels only two tones will be used in practice, namely, tones " A " and " C " in the panel used for general Bc., and tones " B " and " D " in the flight deck system. Since all valves are in use for each tone, meter readings taken during the generation of any tone will hold good for the others.

63. If it is impracticable to take meter readings in all the switch positions during the routine practice sounding of the alarms it will be necessary either to repeat the sounding or to employ the method described in paragraph 56, but the latter method involves putting the associated A.F. system out of action while in progress.

64. When any valve has been exchanged, or removed and replaced, time should be allowed for it to reach emission temperature and the cathode current metered to ensure correct replacement and working.

Output Measurements (*paragraph references* 29 *and* 30)

65. The voltage which may be expected from the primary of the output transformer, and which may be measured at TJO is given in Appendix 2. The limitations of the Avometer when used on low A.C. voltages, especially those of non-sine wave form, makes the readings on this instrument under these conditions uncertain and not to be taken too literally.

Gain Control (*paragraph reference* 37)

66. Adjustment of the gain control should be made during the periodic routine sounding of the tones, and as found by experience to be best. The gain control of the associated 50 watt amplifier should not be altered if it is set correctly for speech broadcast.

Cleanliness. Dust

67. The accumulation of dust is bound to lead to unsatisfactory working and it must therefore be removed at frequent intervals. The areas most likely to be affected by dust are the transformer terminals and surfaces generally in the valve compartment. These should be dusted at least monthly and more often if found to be necessary. Dusting can be done without the removal of the panel from its rack. The most effective methods are by suction cleaner, blowing, and the use of a small fairly stiff bristle brush lightly applied.

68. Care must be taken to preserve the cleanliness and freedom from dust of components such as relays, by not removing the covers during, or for, general cleaning, but only when known to be necessary and during annual maintenance routines. The protecting covers or screens of individual components should be replaced immediately upon completion of the part of the work for which they were removed.

Ventilation

69. The design of the framework, racks, and covers of rack units has taken into account the need for a flow of air around the valves, resistors, chokes and transformers. Nothing should be allowed to impede the normal ventilation, either of the racks and their contents, or of the compartments in which they are situated.

Switch Contacts

70. Contacts of *switches* can be cleaned when necessary with " Solution, switch, cleaning and lubricating ", A.P. 55945. The solution should be applied sparingly by means of a " dropper ". A thin film of lubricant remains on the switch contacts after each application; any accumulation of dirty lubricant should be cleaned away during the annual examination and test of the amplifier.

Relay contacts

71. Relay contacts should be treated with the greatest discretion. On no account should they be touched so long as they are working correctly. Special tools are available for adjustments of relay contacts and springs. Relay contacts should always remain dry and never be lubricated. The most important item in the maintenance of relays is the complete exclusion of dust, oil and grease from all parts. Further information on relays can be obtained from book (2)G of this series.

Maintenance Routines

RECORDED ROUTINES

72. *Monthly*:—	PARAGRAPH REFERENCE
(*a*) The items (*a*) to (*d*) of the occasional routine	74
(*b*) Removal of accumulated dust from the valve compartment	67
(*c*) Examine and if necessary clean switch contacts	70

73. *Annual*:—	PARAGRAPH REFERENCE
(*a*) Carry out a complete examination and test of the panel in the workshop.	
(*b*) Obtain test figures for all lettered test points and compare with those given in Appendix 2.	

NON-RECORDED ROUTINES

74. *Occasional.* As frequently as convenient and as found necessary:—

		PARAGRAPH REFERENCE
(*a*) Meter the valve cathode currents	During the periodic sounding of the warning and alarm signals	61–64
(*b*) Adjust the gain control as found necessary		66
(*c*) Listen carefully to the output so as to detect any change of note in its early stages		
(*d*) See both pilot lamps are working correctly		
(*e*) See the ventilation is not obstructed		69
(*f*) Audio test by test load and headset or loudspeaker		56

FAULT LOCATION

75. See that the earthing connections are good, components to chassis, unit to rack, rack to framework and from framework to ship's structure. See that the " A.C. on " pilot lamp is alight. Examine all plug connections for cleanliness and good contact. See that the controls are set as shewn in paragraph 49.

76. Faults may become evident by one or more of three indications:—

(*a*) No warning or alarm tones.

(*b*) Wrong tone or frequency.

(*c*) Wrong spacing of the tone in the signal.

Absence of any tone is more likely to be caused by some external defect rather than by failure of the panel. If the " H.T. on " pilot lamp glows when the tone should be sounding it may be assumed that the external switching on the input side is correct. Wrong tone or frequency can be caused only by the failure of a valve or other component in the first two multivibrators or in the mixer stage. Wrong spacing of the tone indicates a similar defect in the third multivibrator.

Testing for faults with the Panel in place

77. One audio test only can be made without interference with the usual work of the A.F. system, and that involves the sounding of the test signal over the connected loudspeakers. A headset can be plugged into TJO of the alarm panel, 50 watt amplifier or, where fitted, the 300 watt amplifier. Any alarm signal sounded over the system may be heard in the headset. The operation of the signal may be from any control position or from the

push buttons on the relay panel. If the buttons on the alarm panel are used the signal may be heard only from the TJO of the alarm panel. For any further audio test permission must be obtained to put the system temporarily out of use and the method as described in paragraph 56 adopted.

78. No Warning or Alarm Tones. If the tests described above indicate that the defect lies in the panel, *i.e.*, the " H.T. on " pilot lamp glows and no signal is heard in the headset when any push is pressed, the fault is probably in the output or mixer stage. A change of valves in that stage should be made and the test repeated. If there is still no signal, and if the meter readings in switch position 5 are normal, the panel must be removed to the workshop for further examination.

79. Wrong Tone or Frequency. Both the first and the second multivibrators and the mixer stage are involved in the production of every warning or alarm tone, therefore any incorrect tone may be due to a defect in the circuit of any of the valves V1 to V4, V9 or V10. Metering of valve cathode currents for each pair of valves may indicate where the defect lies. A change of valves is all that can be tried without the removal of the panel to the workshop.

80. Wrong spacing of the tone or signal. The spacing of the signal being entirely dependent upon the action of the third multivibrator, it follows that any incorrect spacing must be due to some cause in that stage. If a complete change of valves fails to eliminate the defect, workshop treatment will be necessary.

Tests of the Panel in a Workshop

81. When preparing to carry out the tests bear in mind the safety warning given on page 1.

82. When using an Avometer for voltage readings other than those of the test points, select a range which will give the clearest indication without danger of overloading the instrument.

83. The internal wiring of the panel should never be altered in an attempt to locate a fault. The fact that the panel has worked satisfactorily is proof that the wiring scheme is correct. Broken or dry joints are the only defects likely to be found in the wiring.

Amplifier Test Data. (Appendix 2)

84. The data given in Appendix 2 comprises:—

Table 1. Test voltages at:—
- (*a*) Anodes of all valves.
- (*b*) Cathodes of valves V1 to V10.
- (*c*) Grids of valves V1 to V10.
- (*d*) Certain points in the H.T. supply.

Table 2. Output voltages.
Table 3. Transformer secondary A.C. voltages.
Table 4. Meter readings. Cathode currents of valves.
Table 5. Oscillator frequencies.
Current and power consumption.
Noise level.

85. The voltage values given in the Tables were measured with an Avometer A.P. 47A, and are the averages for a number of alarm panels tested; the readings from a single panel may therefore be expected to deviate by small amounts from the values shewn. The differences in the readings which may be expected as normal in the valve circuits are those due to the acceptable manufacturing tolerances allowed in the valves and the resistors or other components. Care must be taken to use the Avometer on the range shewn against each reading, this being the range used when the figures were obtained.

86. If a failure occurs in the panel the external symptoms will give some evidence as to the nature of the defect, as stated in paragraphs 78 to 80. The defect may be due to the mal-operation of a relay, though this is unlikely.

Checking Relay Operation

87. It cannot be over emphasised that relays and their contacts should not be touched, or their covers removed unless there is definite evidence of mal-operation. In almost all cases relay operation can be checked by external means without removal of the covers. If a fault is present, exhaust every other line of investigation before suspecting the relays.

88. Relay H/2. This relay must operate for all tones. Its operation is indicated by the glowing of the " H.T. on " pilot lamp. Failure of the lamp to glow when any test push is pressed should not be taken as conclusive evidence that the relay is inoperative. Check by Avometer at a H.T. test point or by the heat of the H.T. rectifier valves.

89. Relay M/5. Like relay H/2 this relay must operate for all tones. Four closed contacts on it are in use when the alarm panel is idle, being in the circuits of the 8 ohm and the 25 ohm microphone lines which pass through the panel to the 50 watt amplifier. The fact that an input from a microphone is reaching the amplifier through these lines is evidence that these contacts are making correctly. These four contacts open and five close when the relay operates. A headset plugged into the TJO of the panel, and into TJI of the 50 watt amplifier, or connected to lines 7 and 8 or 9 and 10 of PLO of the panel will enable confirmation of the working of four of these contacts to be obtained when any test push is closed. Evidence of operation of the fifth contact when in use for this purpose is provided by the glowing of the " H.T. on " lamp in the connected 50 watt amplifier when any test push is closed.

90. Relay AB/3. Two contacts on this relay are employed to produce the high tone by altering the values of control capacitors in multivibrators Nos. 1 and 2. The third operates relays H/2 and M/5. Evidence of the first two contacts working correctly is provided by the production of the high tone when test push " B " is pressed. Proof of the third contact working is the glowing of the " H.T. on " pilot lamp.

91. RELAY AC/3. The production of uneven spacing of the tone is proof that two contacts of this relay are working correctly. The converse is by no means true; failure to produce an uneven tone spacing may be due to failure of other components. Proof that contact No. 3 is correct is the same as that for relay AB/3.

92. RELAY AD/2. Proof that this relay is operating correctly can be obtained by checking the operation of relays AB/3 and AC/3 when test push " D " is closed.

ALARM PANEL TESTING

93. The tabulated series of tests which follow are suggested for testing the alarm panel. While the tests are being carried out the results may be checked by the use of a headset plugged into TJO.

94. Abbreviations used in the tests:—

OC = open circuited.
SC = short circuited.
D = otherwise defective.

(*a*) *No tone when any push is closed:—*

PROCEDURE	POSSIBLE DEFECT	ACTION
(i) See valves and pilot lamps are on.	(i) No supply	Provide.
	(ii) Not switched on	Switch on.
	(iii) Fuses OC	Renew
	(iv) Lamps or valves not firmly in sockets	Refit
	(v) TR1 or TR2 D	Renew
	(vi) Push D	Refit
(ii) Check H.T. voltage. *If zero:—*		
	(i) H/2 or S3 not closed	Close
	(ii) Rectifier valves D.	Renew
	(iii) MR1 D	Renew
	(iv) L1 or L2 OC	Renew
	(v) R28, C16 or C17 SC	Renew
	(vi) C18, C19 or C20 SC	Renew
	If low:—	
	(i) Rectifier valves D.	Renew
	(ii) R28 D.	Renew
(*b*) *Wrong Tone or Frequency* (low tone) (button "A"):—		
(i) Check anode voltage of V1 to V4 and V9 and V10.	Load resistors R3, R4, R8, R11 or R27 may be OC	Renew
(ii) Connect similar capacitors in turn across C21, C2, C5, C7 and C16.	May be OC.	Renew
*(iii) Check grid voltages of V1 to V4 and V9 and V10.	R2, R5, R9, R10, R28 may be OC.	Renew
(*c*) *Wrong Tone or Frequency* (high tone) (button " B "):—		
(i) As for (*b*) (i) above.		
(ii) Connect similar capacitors in turn across C1, C2, C6, C7 and C16.	May be OC.	Renew
*(iii) As for (*b*) (iii) above.		
(*d*) *Wrong Spacing of the Tone or Signal* (high and low) (tones "A" and " B "):—		
(i) Check anode voltages of valves V5, V6, V7 and V8.	R14 or R19 may be OC.	Renew
(ii) Connect similar capacitors in turn across C11 and C12.	May be OC.	Renew
*(iii) Check grid voltages of valves V5, V6, V7 and V8.	R15 or R17 may be OC or SC.	Renew
(*e*) *Wrong Spacing of the Tone or Signal* (high and low) (tones " C " and " D "):—		
(i) As for (*d*) (i).		
(ii) As for (*d*) (ii).		
*(iii) Check grid voltages of valves V5, V6, V7 and V8.	R16 or R18 may be OC or SC.	Renew

* Tests so marked can be made satisfactorily only by means of a valve voltmeter.

95. On completion a final test including a test of transformer TR3 should be made in connection with a 50 watt amplifier. If no amplifier can be made available the final test should be made with the headset connected in turn across lines 7 and 8, and 9 and 10, of PLO while all tones are tested.

APPENDIX 1

TRANSFORMER AND CHOKE WINDING DATA

Notes on re-winding Transformers and Chokes

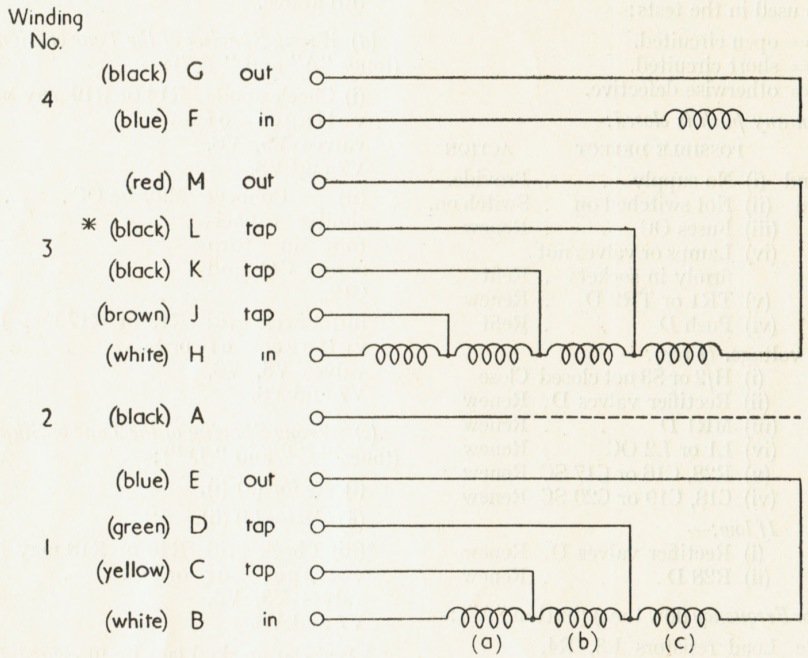
1. It is not intended that transformers or chokes should be re-wound in ships except in cases of necessity.

2. In connection with the winding data given in the following pages it is assumed that the defective article will be available for study as to the manner of leading the ends of the windings in and out, it being impracticable to give full winding directions in this book.

3. Particular care must be taken when re-winding transformers which have screens, to ensure that any overlap of the single turn is well insulated.

4. Chokes and certain transformers have a spacer of insulating material inserted in the iron circuit, usually in the centre leg. Its purpose is to prevent the D.C. flowing from causing saturation of the iron, and therefore to preserve the inductive properties of the choke or transformer under load. In re-winding care must be taken to ensure correct replacement. Details are given in the winding data sheet.

Transformer TR1 A.P. 12665



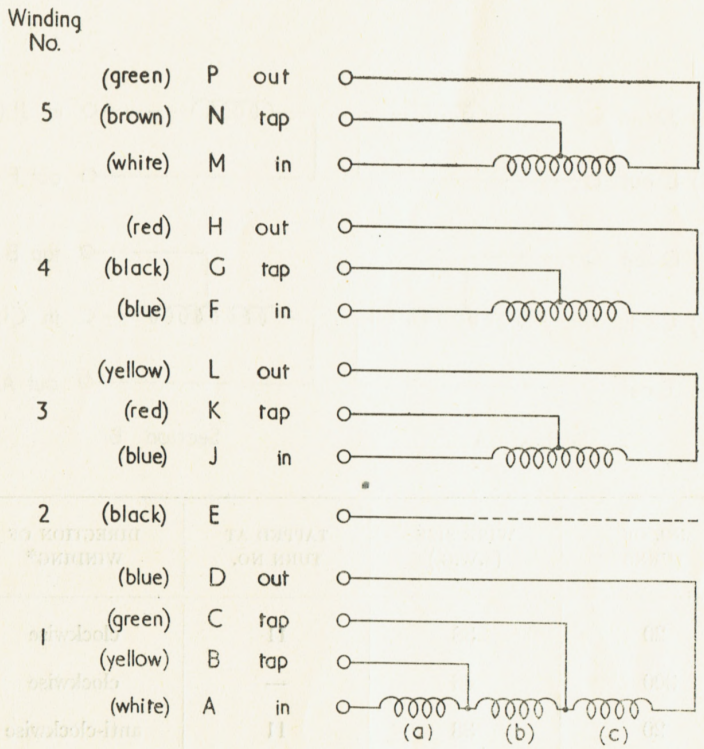
* In amplifiers of later serial numbers this tap lead is brown.

WINDING NO.	NO. OF TURNS	SIZE OF WIRE (S.W.G.)	TAPPED AT TURN NO.	D.C. RES. (OHMS)
1 (*a*)	95	16	—	0·27
(*b*)	123	18	—	0·57
(*c*)	219	22	—	4
2	1	(—	screen	—)
3	2060	26	560, 1030, 1501	70·7
4	8·5	24	—	0·4

Wire insulation.—Enamel covered.
All windings wound clockwise as viewed from the end of the former where the winding ends are brought out.
Insulation over windings—
Nos. 1 and 4—two turns of insulating cloth.
Nos. 2 and 3—three turns of insulating cloth.
Windings Nos. 1 and 3—All adjacent layers separated by one turn of manilla paper 3 mils. thick.
Wire material—Copper.
Screen material—Tinned copper foil, 2 to 3 mils. thick.

APPENDIX 1—*continued*

Transformer TR2 A.P. 12664

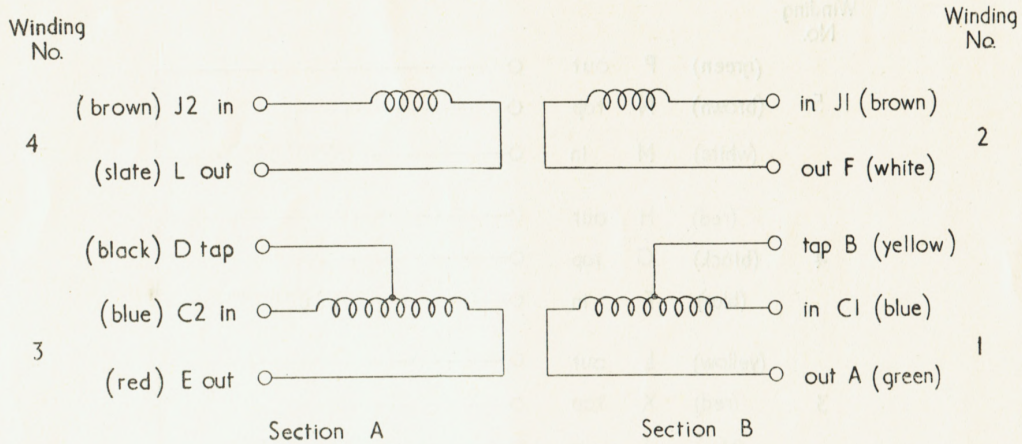


WINDING NO.	NO. OF TURNS	SIZE OF WIRE (S.W.G.)	TAPPED AT TURN NO.	D.C. RES. (OHMS)
1 (*a*)	203	18	—	0·49
(*b*)	234	22	—	2·14
(*c*)	413	24	—	7·3
2	1	(—	screen	—)
3	20	14	10	0·04
4	25	14	12·5	0·05
5	193	24	176	0·13

Wire insulation—Enamel covered.
Winding direction—All windings clockwise as viewed from the end of the former where the winding ends are brought out.
Winding No. 1 (*a*), (*b*) and (*c*), and winding No. 5—All adjacent layers separated by one turn of manilla paper 3 mils. thick.
Insulation over each winding and the screen—Two turns of insulating cloth.
Wire material—Copper.
Screen material—Tinned copper foil, 2 to 3 mils. thick.

APPENDIX 1—*continued*

Transformer TR3 A.P. 12659



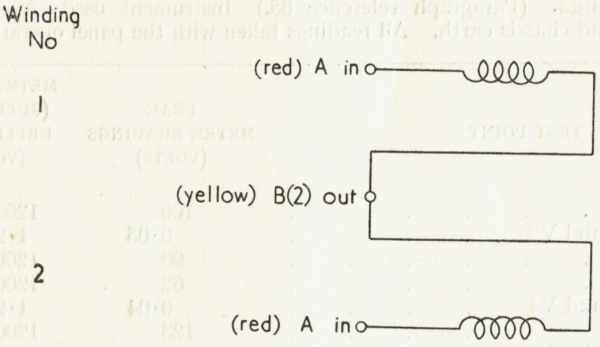
WINDING NO.	NO. OF TURNS	WIRE SIZE (S.W.G.)	TAPPED AT TURN NO.	DIRECTION OF WINDING*	D.C. RES. (OHMS)
1	20	38	11	clockwise	1·1
2	800	46	—	clockwise	308
3	20	38	11	anti-clockwise	1·1
4	800	46	—	anti-clockwise	308

* Direction of winding—As viewed from the end of the former where the ends of that particular winding are brought out.

Wire insulation—Enamel and single wound silk (natural or artificial) covered.
Insulation over each winding—Two turns of unimpregnated natural silk ribbon.
Wire material—Copper.
Inductance of secondary windings (Nos. 2 and 4 in series) 3·8H + 3·8H = 15H total.

APPENDIX 1—*continued*

Choke L1 and L2 A.P. 12671



WINDING NO.	NO. OF TURNS	SIZE OF WIRE (S.W.G.)	D.C. RES. (OHMS)
1	6500	37	660
2	6500	37	660

Wire insulation—Enamel covered.

This double choke consists of two identical coils on one mounting. The coils are connected in series with a common centre terminal.

Adjacent layers are separated by one turn of manilla paper 1 mil. thick.

Insulation over winding—Two turns of insulating cloth.

Wire material—Copper.

Iron circuit spacers—One in the centre of each coil—Bakelite sheet 10 mils. thick.

Inductance—40H at 50 mA. (20H each coil.)

APPENDIX 2

Test Data

Table 1. Voltage readings. (Paragraph reference 85.) Instrument used—Avometer A.P. 47A. Readings taken between test point and chassis earth. All readings taken with the panel operating on note " C ".

LETTER	TEST POINT	PEAK METER READINGS (VOLTS)	METER RANGE (FULL SCALE DEFLECTION) (VOLTS)	ACCEPTABLE TOLERANCE + OR − (PERCENTAGE)
A	Anode of V1	100	1200 D.C.	†
B	Cathodes of V1 and V2	0·05	1·2 D.C.	†
C	Anode of V2	90	1200 D.C.	†
D	Anode of V3	62	1200 D.C.	†
E	Cathodes of V3 and V4	0·04	1·2 D.C.	†
F	Anode of V4	123	1200 D.C.	†
G	Anodes of V5 and V6	220	1200 D.C.	†
G1	Grid of V1	40*	1200 D.C.	†
G2	Grid of V2	35*	1200 D.C.	†
G3	Grid of V3	25*	1200 D.C.	†
G4	Grid of V4	38*	1200 D.C.	†
G5	Grids of V5 and V6	85	1200 D.C.	†
G7	Grids of V7 and V8	122	1200 D.C.	†
G9	Grids of V9 and V10	20*	1200 D.C.	†
H	Cathodes of V5, V6, V7, V8	0·04	1·2 D.C.	†
J	Anodes of V7 and V8	240	1200 D.C.	†
K	Anodes of V9 and V10	320	1200 D.C.	10
L	Cathodes of V9 and V10	0·43	1·2 D.C.	†
M	Across C16 and C17	320	1200 D.C.	10
N & NN	Anodes of V11 and V12	240	1200 A.C.	10
O	Across C18 and C19	310	1200 D.C.	10
P	Across C20	320	1200 D.C.	10

† Tolerances undefinable due to valve and resistor wide limits.
* Readings taken with the ÷ 2 button pressed.

Table 2. Output Voltages

Instrument—Valve voltmeter

TONE OR BUTTON	VOLTAGE AT	
	25 OHM LINE	TJO
A	9 mV	300 mV
B	8 mV	280 mV
C	9 mV	300 mV
D	8 mV	280 mV

APPENDIX 2—*continued*

Table 3. Transformer secondary A.C. voltages. Instrument and conditions as for Table 1

TRANSFORMER			METER READINGS (VOLTS)	METER RANGE (FULL SCALE DEFLECTION) (VOLTS)
TR1.	(i) H.T.	J–K–L	240 + 240	1200 A.C.
	(ii) Pilot	G–F	4·3	12 A.C.
TR2.	(i) Rectifier	J–K–L	2·53 + 2·53	12 A.C.
	(ii) Valve heater	F–G–H	3·2 + 3·2	12 A.C.
	(iii) Pilot lamp	P–N	4·33	12 A.C.
	(iv) Rectifier (relay)	N–M	46	120 A.C.

Table 4. Meter Readings

Readings direct in milliamperes.

SWITCH POSITION	INDICATION	READING	TOLERANCE (PERCENTAGE)
1	—	—	—
2	Cathode currents of V1 and V2	4.3	10
3	Cathode currents of V3 and V4	4.4	10
4	Cathode currents of V5, V6, V7 and V8	3.4	10
5	Cathode currents of V9 and V10 ÷30	0.6	10

Table 5. Oscillator Frequencies (Fundamental)

TONE OR BUTTON	MULTIVIBRATOR NO. 1	MULTIVIBRATOR NO. 2	MULTIVIBRATOR NO. 3
A	480 c.p.s.	400 c.p.s.	88 c.p. *minute*
B	1150 c.p.s.	1100 c.p.s.	88 c.p. *minute*
C	480 c.p.s.	400 c.p.s.	44 c.p. *minute*
D	1150 c.p.s.	1100 c.p.s.	44 c.p. *minute*

Current and Power Consumption

Current H.T. total (dynamic) =307 mA

Power (dynamic) = 125 VA

Noise Level

Decibels below full output = 34

APPENDIX 3

Summary of Structural and Electrical Details

Structural

Dimensions:—	
Height	12¼ in. (7 E).
Width overall	19 in.
Depth front to back	17 in.
Projection, front, from mounting rack	9 in.
Withdrawal clearance	18 in.
Weight	70 lb.
Types of mounting	Rack and Bulkhead.
Fixing particulars	Slide rails and clips.
Cable entry	Multi-pin sockets. 6, 8 and 10 way. One of each. I.S. Cat. Nos. Z 560115, Z 560117 and Z 560119 respectively. With side entry covers.
Positions	At sides.

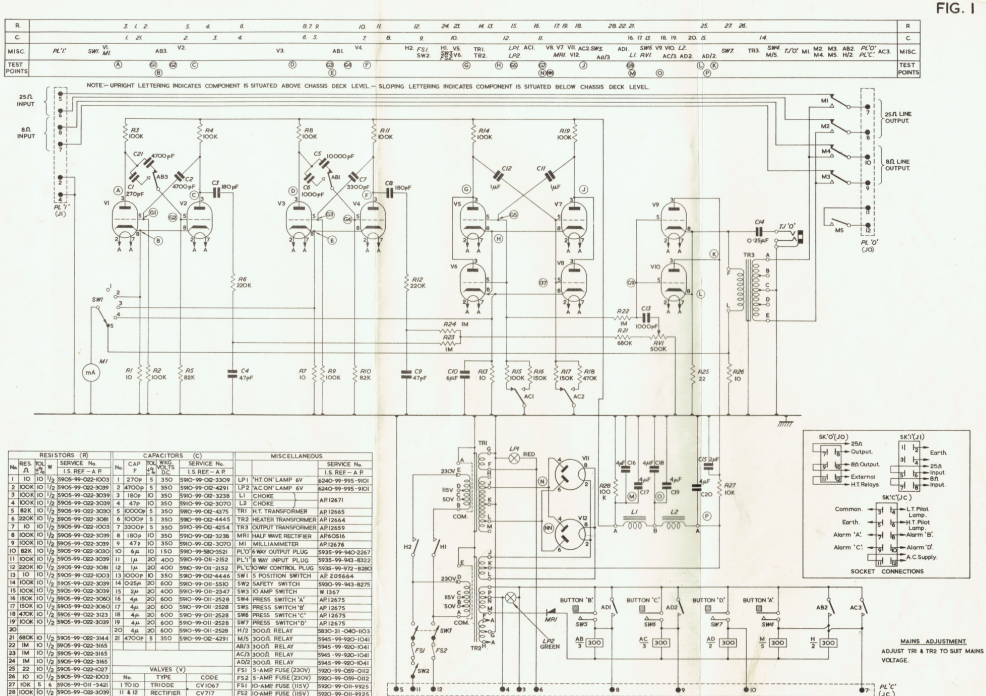
Structural—*continued*

Casing material	Mild steel sheet.
Type of enclosure	Protected. Ventilated.

Electrical

Supply	A.C.
Voltage	230, 115 or 50 volts.
Frequency	50 to 60 c.p.s.
Power consumption	125 VA.
Fuses:—	
No. and pattern	2—A.P. 19247.
Capacity	3 amperes.
Valves	10—C.V. 1067. 2—C.V. 1071.
Pilot lamps	2—X959101.
H.T. voltage, maximum	320 V.

FIG. 1



RESISTORS (R)

No.	Res. Ω.	Tol. %	W	SERVICE No. I.S. REF — A R
1	10	10	1/2	3905-99-022-8003
2	100K	10	1/2	3905-99-022-8039
3	100K	10	1/2	3905-99-022-8039
4	100K	10	1/2	3905-99-022-8039
5	82K	10	1/2	3905-99-022-8093
6	220K	10	1/2	3905-99-022-8081
7	10	10	1/2	3905-99-022-8003
8	100K	10	1/2	3905-99-022-8039
9	100K	10	1/2	3905-99-022-8039
10	82K	10	1/2	3905-99-022-8093
11	100K	10	1/2	3905-99-022-8039
12	220K	10	1/2	3905-99-022-8081
13	10	10	1/2	3905-99-022-8003
14	100K	10	1/2	3905-99-022-8039
15	100K	10	1/2	3905-99-022-8039
16	150K	10	1/2	3905-99-022-8060
17	150K	10	1/2	3905-99-022-8060
18	470K	10	1/2	3905-99-022-8123
19	100K	10	1/2	3905-99-022-8039
20				
21	680K	10	1/2	3905-99-022-8144
22	1M	10	1/2	3905-99-022-8165
23	1M	10	1/2	3905-99-022-8165
24	1M	10	1/2	3905-99-022-8165
25	22	10	1/2	3905-99-022-8027
26	10	10	1/2	3905-99-022-8003
27	10K	5	1/2	3905-99-011-3421
28	100K	10	1/2	3905-99-022-8039

CAPACITORS (C)

No.	CAP F	Tol. %	Volts D.C.	SERVICE No. I.S. REF — A R
1	270p	5	350	5910-99-012-3309
2	4700p	5	350	5910-99-012-4291
3	180p	20	350	5910-99-012-3238
4	47p	10	350	5910-99-012-3070
5	10000p	5	350	5910-99-012-4375
6	1000p	5	350	5910-99-012-4445
7	3300p	5	350	5910-99-012-4254
8	180p	10	350	5910-99-012-3238
9	47p	10	350	5910-99-012-3070
10	4μ	10	150	5905-99-940-9301
11	1μ	20	400	5910-99-011-2152
12	1μ	20	400	5910-99-011-2152
13	10000p	10	350	5910-99-012-4445
14	0.25μ	20	600	5910-99-011-5530
15	2μ	20	600	5910-99-011-2347
16	4μ	20	600	5910-99-011-2528
17	4μ	20	600	5910-99-011-2528
18	4μ	20	600	5910-99-011-2528
19	4μ	20	600	5910-99-011-2528
20	4μ	20	600	5910-99-011-2528
21	4700p	5	350	5910-99-012-4291

VALVES (V)

No.	TYPE	CODE
1 TO 10	TRIODE	CV 1067
11 & 12	RECTIFIER	CV7117

MISCELLANEOUS

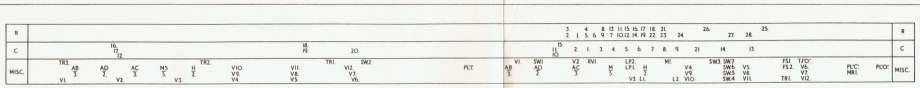
		SERVICE No. I.S. REF — A P
LP1	'HT ON' LAMP 6V	6240-99-995-9101
LP2	'AC ON' LAMP 6V	6240-99-995-9101
L1	CHOKE	AP12671
L2	CHOKE	
TR1	H.T. TRANSFORMER	AP 12665
TR2	HEATER TRANSFORMER	AP12664
TR3	OUTPUT TRANSFORMER	AP12659
MR1	HALF WAVE RECTIFIER	AP16516
MI	MILLIAMMETER	AP12676
SW1	5 WAY OUTPUT PLUG	5935-99-940-2267
PL'T'	5 WAY INPUT PLUG	5935-99-943-8322
PL'C'	SWC CONTROL PLUG	5935-99-972-6280
SW1	5 POSITION SWITCH	AP 20564
SW2	SAFETY SWITCH	5930-99-943-8275
SW3	10 AMP SWITCH	M 1367
SW4	PRESS SWITCH 'A'	AP12675
SW5	PRESS SWITCH 'B'	AP 12675
SW6	PRESS SWITCH 'C'	AP12675
SW7	PRESS SWITCH 'D'	AP12675
H/3	300Ω RELAY	5830-21-040-1103
M/5	300Ω RELAY	5945-99-920-1041
AB/3	300Ω RELAY	5945-99-920-1041
AC/3	300Ω RELAY	5945-99-920-1041
A300	300Ω RELAY	5945-99-920-1041
FS1	5-AMP FUSE (230V)	5920-99-089-0112
FS2	5-AMP FUSE (230V)	5920-99-089-0112
FS1	10-AMP FUSE (115V)	5920-99-011-9925
FS2	10-AMP FUSE (115V)	5920-99-011-9925
T/O	OUTPUT TEST JACK	AP 64686
RV1	POTENTIOMETER	5905-99-972-2923

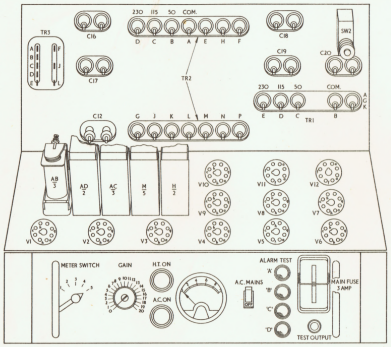
ALARM PANEL PATT. 0558/12651. CIRCUIT DIAGRAM

Red alarm goes wing

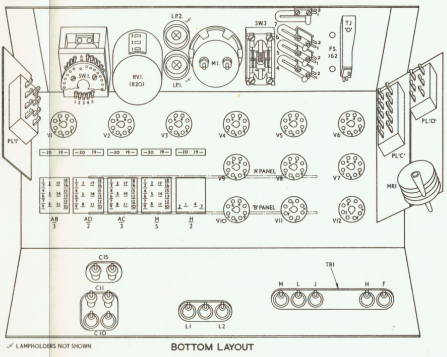
88 575 (2) C
Change No. 1 10-67

FIG. 2



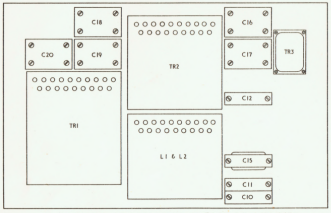


TOP LAYOUT SHOWING FRONT PANEL

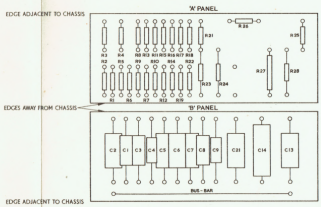


* LAMPHOLDERS NOT SHOWN

BOTTOM LAYOUT



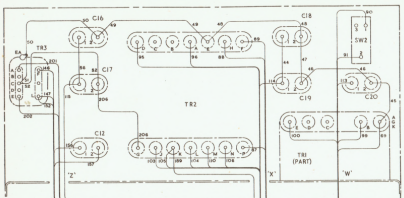
DISPOSITION OF APPARATUS AT BACK OF AMPLIFIER

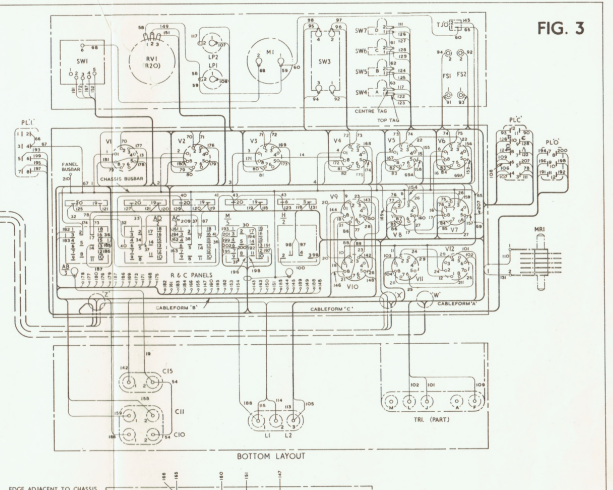


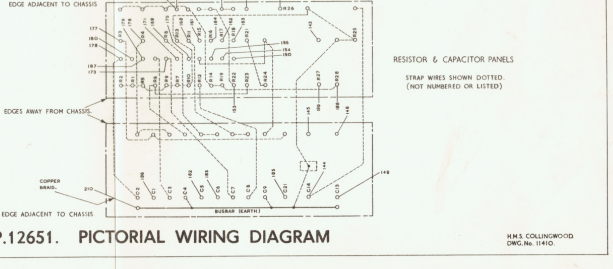
H.M.S.COLLINGWOOD.
DWG No. 11404/6.

ALARM PANEL A.P.12651. ARRANGEMENT DRAWING. (STRUCTURAL DETAILS)

FIG. 3







STRAPPING WIRES				STRAPPING WIRES				CABLEFORM 'A'				CABLEFORM 'B'			
LINE	FROM	TO	COLOUR	LINE	FROM	TO	COLOUR	LINE	FROM	TO	COLOUR	LINE	FROM	TO	COLOUR
1	V1-1	BUSBAR	BLACK	54	C5-2	C12-2	BLACK	103	V1-2	TR2-J	RED	163	R18	AC-5	WHITE
2	V2-1	"	"	55	C16-1	C17-1	RED	104	V11-8	TR2-L	BROWN	165	V8-8	R13	BROWN
3	V3-1	"	"	58	RV1-1	LP1-2	BLACK	105	TR2-K	L2-3	SLATE	166	R13	C10-1	SLATE
4	V4-1	"	"	59	LP1-3	M1-1	"	106	TR2-N	PL10-4	WHITE	167	V5-8	SW1-1	BLACK
5	V5-1	"	"	60	M1-1	TJ0-1	"	107	PL7-4	LP1-1	YELLOW	168	R12	C9-1	SLATE *
6	V6-1	"	"	61	SW7-2	SW8-2	"	108	LP1-1	PL12-4	YELLOW	169	V7-3	R8	RED *
7	V7-1	"	"	62	SW8-2	SW5-2	"	109	SW5-2	SW6-2	YELLOW	171	V3-8	R7	BROWN
8	V8-1	"	"	65	SW5-3	"	"	110	PL2-14	M0-1	WHITE	172	V4-8	SW-3	BROWN
9	V9-1	"	"	66	PL0-1	BUSBAR	"	111	PC0-3	SW7-2	BLACK	173	V5-5	R5	GREEN *
10	V10-1	"	"	68	PL0-2	PC0-4	"	112	L2-3	C10-1	SLATE	174	V6-5	AB-12	GREEN *
11	V11-1	"	"	69	PL0-4	BUSBAR	BLACK	114	C19-1	L1-2	SLATE	175	V6-5	R10	GREEN *
12	V12-1	BUSBAR	BLACK	69	SW1-3	M1-2	RED	115	C17-1	L1-1	RED	176	V2-5	R4	SLATE *
13	V1-8	V2-8	BROWN	69	TR1-A0	BUSBAR	BLACK	117	LP2-2	SW7-2	BLACK	177	V1-3	R3	SLATE *
14	V3-8	V4-8	"	69A	V5-1	J5-5	BLACK	118	M-8	M-19	YELLOW	178	V1-5	R2	BROWN
15	V5-8	V6-8	"	CABLEFORM 'A'				119	M-19	AC-19	"	179	V2-5	R5	YELLOW
16	V6-8	V7-8	"					120	AC-19	AB-19	"	180	V2-8	R1	GREEN
17	V7-8	V8-8	"	70	V1-2	V2-2	WHITE	121	AB-19	AB-19	YELLOW	181	V1-8	SW1-2	GREEN
18	V9-8	V10-8	BROWN	71	V2-2	V9-2	"	122	PL2-10	SW4-1	RED	182	C2	AB-1	BROWN *
19	C15-2	BUSBAR	BLACK	72	V3-2	V8-2	"	123	SW4-1	M-8	RED	183	C6	AB-3	GREEN *
20	V9-2	V10-2	WHITE	73	V4-2	V5-2	"	124	PL0-14	SW7-1	SLATE	184	R10	AB-10	RED
21	V9-7	V10-7	YELLOW	74	V5-2	V6-2	"	125	SW5-1	AB-20	SLATE	185	AB-15	C21	BLUE *
22	V5-3	V6-13	"	75	V9-3	V7-2	"	126	PL0-10	SW7-1	BLUE	186	AB-10	R5	RED
23	V9-3	V10-3	"	76	V7-2	V8-2	"	127	SW7-1	AB-20	BLUE	187	AB-14	R5	RED *
24	V11-2	V12-3	"	77	V8-2	V9-2	WHITE	128	PL0-12	SW5-1	GREEN	188	L1-1	R20	RED
25	V11-5	V12-5	RED	78	PL0-3	AB-17	BLACK	129	SW8-1	AC-20	GREEN	189	TR2-K	R27	SLATE
26	V7-3	V8-13	SLATE	79	M-17	V2-7	YELLOW	131	M9-2	M-5	YELLOW	CABLEFORM 'C'			
27	V7-5	V8-5	GREEN	80	V3-7	V3-7	"	CABLEFORM 'B'				191	PL0-11	M-13	WHITE
28	V9-5	V10-5	GREEN	81	V5-7	V4-7	"					192	M-14	PL0-12	YELLOW
29	V11-4	V12-4	BROWN	82	V4-7	V5-7	"	142	C15-1	V10-3	RED	193	M-15	M-1	GREEN
30	M-2	M-3	GREEN	83	V6-7	V6-7	"	143	C7-1	R17	RED	194	M-2	PL0-17	RED
31	M-3	M-6	BROWN	84	V8-7	V7-7	"	144	V9-8	C14	BROWN	195	M-3	M-1	BLACK
32	AB-20	AD-3	SLATE	85	V7-7	V8-7	"	148	C13	TJ0-2	WHITE	196	M-16	M-1	GREEN
33	AB-17	AD-2	BLACK	86	V8-7	V9-7	YELLOW	149	V10-8	TR2-P	BLUE	196	M-16	PL0-13	RED
34	AD-2	AD-5	BLACK	87	AC-17	TR2-P	BLACK	148	C13	TR2-P	BLACK	197	M-17	PL0-14	YELLOW
35	AC-12	AB-15	RED	88	V10-2	TR2-N	WHITE	149	V10-5	C13	RED	198	M-11	PL0-15	BLUE
36	AC-5	AB-5	RED	89	V10-7	TR2-N	YELLOW	149	C13	RV1-2	BLUE	199	PL7-6	M-4	WHITE
37	AC-4	AC-10	BLACK	91	V12-2	PL0-1	WHITE	150	V9-5	R22	WHITE	200	M-5	PL0-18	GREEN
38	AC-8	AC-20	RED	91	SW2-2	PL0-1	YELLOW	151	RV1-3	R21	GREEN	201	M-3	TR3-A	GREEN
39	AC-18	M-20	"	92	TS2-2	SW5-1	WHITE	152	TR3-L	SW1-5	BLACK	202	M-6	TR3-E	BROWN
40	M-20	M-5	RED	93	PL0-12	PL0-1	GREEN	153	V6-5	R22	BROWN	STRAPPING WIRES			
41	C15-1	C18-1	BROWN	94	PL0-2	SW3-3	YELLOW	154	V8-3	R19	SLATE				
42	TR1-N0	C20-3	BLACK	95	SW3-4	TR2-D	GREEN	155	V5-3	R14	RED	204	C17-2	TR2-G	BLACK
43	C20-2	C18-2	"	96	SW3-2	TS2-A	RED	156	V8-3	C8-1	RED	205	BUSBAR	"	"
44	C19-2	C18-3	"	97	SW3-3	M-4	RED	157	C12-2	V7-5	GREEN	209	BUSBAR	AC-2	"
45	C18-2	TR2-E	"	98	SW7-4	R11	GREEN	158	V7-5	C12-2	GREEN	210	BUSBAR	BUSBAR	BLACK
49	TR2-E	C18-3	"	99	M-3	TR-B	WHITE	159	V7-3	C11-1	SLATE		PANEL	CHASSIS	
50	C16-2	TR3-K6	"	100	M-2	TR-E	BLUE	160	V8-5	BTR-EB	SLATE	211	V12-8	V12-6	BROWN
51	TR2-C	TR3-K4	"	101	V12-4	TR1-J	BROWN	161	R15	AC-1	YELLOW				
52	TR1-C	C17-2	BLACK	102	V12-6	TR1-L	RED	162	R17	AC-4	BROWN				

* DENOTES SCREENED LEAD.

ALARM PANEL A.P.12651. PICTORIAL WIRING DIAGRAM

H.M.S. COLLINGWOOD
DWG.No. 11410.

C.B.H. 22641 - Wt. 32591 - Dd. D.B179 - 1700 - 6/53