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Colin Hinson

In the village of Blunham, Bedfordshire.

HADLEY TELETALK SYSTEM

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GENERAL INFORMATION

Introduction

1. The Hadley Teletalk Equipment is a loud-speaking telephone system providing intercommunication between a central point and up to 20 extensions which may be up to a mile away.

2. The equipment at the central point comprises a mains-operated two-stage amplifier. This is fitted with a moving-coil loud-speaker, which acts as a microphone and as a telephone receiver, and a three-position key-switch to select either a speak, listen or call function. This unit is mounted with the additional apparatus necessary for intercommunication with one, 10 or 20 extensions as necessary. The additional apparatus required at the central point for each extension consists of a lamp and key-switch, the former indicating that the associated extension is calling, and the latter for the central station to call the extension. The 20-line version is shown in fig. 1.

3. Each extension is connected to the central point by a two-wire line which is connected to the terminal board at the back of the amplifier unit, and is provided with an extension unit consisting

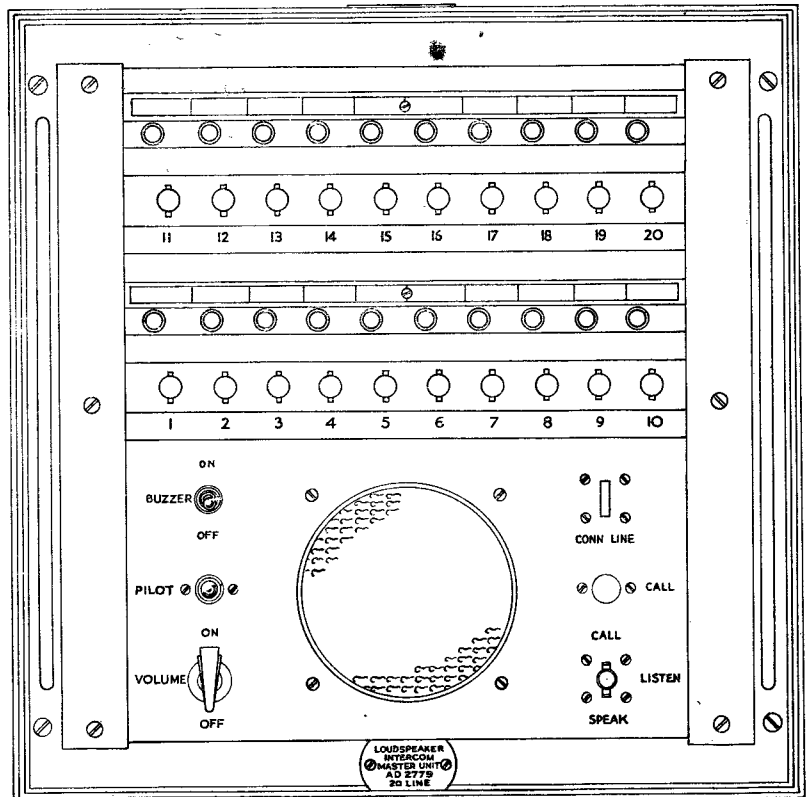


Fig. 1. 20-line unit, front

Note.—The 10-line unit has only one row of keys and lamps. The one-line unit has one key and one lamp—fitted in the CONN LINE and CALL positions in the top right of the amplifier unit.

of a moving-coil loud speaker (which also acts as microphone) and a key-switch for calling the central point. (Loud speaker extension unit, 10U/16863).

4. Communication can take place only in one direction at one time (i.e. it is a two-way simplex system), though the central point can talk to any number of extensions simultaneously. The direction of communication is determined by the setting of the three-position switch on the amplifier unit.

5. Extensions are called by a high-pitched note generated by the amplifier when the three-position switch is set in the CALL position. When this switch is in the LISTEN position, any extension throwing its key into the CALL position will cause the associated lamp at the central point to light up, and will also ring a buzzer mounted in the amplifier unless the buzzer is cut out by the operator at the central point.

Circuit description

6. Referring to the circuit diagram, fig. 2, the amplifying unit includes an input transformer L1 coupled through a tone control and attenuating network R1-C2-R2 (R11 being normally short-circuited, see para. 32) to the grid circuit of the pre-amplifier valve V1, a screened grid low-noise valve Type CV358.

7. V1 is resistance-capacitance coupled to the beam tetrode output valve etc., the value of the $0.002\mu\text{F}$ coupling capacitor C4 being such as to introduce a slight loss of bass. This capacitor, with the volume control R6 and R10 is effectively in parallel with R4 which is the anode load of V1.

8. The output valve V2 is transformer loaded, and a tapping on the primary of the output transformer L2, in antiphase with the anode of V2 provides feedback to the screening grid of V1 providing bass cut and so improving the overall HF response.

9. The voltage at the tapping point is in phase-opposition to the signal at the first grid of V1, and the effect of this voltage on the second grid of the valve is to oppose the effect of the signal on the first grid. The injected negative feedback voltage therefore opposes the input signal. The potential divider effect of R3 and C3 ensures that the negative feedback is far higher at low frequencies (when the reactance of C3 is high) than at high frequencies, and thus the overall gain of the amplifier is greatly reduced at the lower frequencies.

10. In the conditions as illustrated in the circuit diagram, fig. 2, the system is inoperative, assuming that the switches to all the extensions (only two are shown) are all in the normal position. If the mains switch SM is ON, the heaters of the three valves in the amplifier will be alight, so that the equipment is in the "stand-by" condition.

11. If now one of the extensions (say extn. 10) wishes to call the central point, the key switch KCB is thrown, thus completing a circuit from the 24-volt winding of the mains transformer L3 in the amplifier through the SIG terminal 3, the lamp LPC 10, springs 21 and 22 of the key KE 10, through the primary winding of the extension speaker transformer L5 and contacts 2, 3 and 22, 23 of the key KCB and similarly back to the mains transformer via terminal 4. Thus the lamp LPC 10 will light, and if the SBCO switch is open as shown, the buzzer at the central point will sound as well. A resistance is included in the extension line to limit the current to 7 mA. The operator will then answer the extension by changing over the appropriate switch, in this case KE 10, whereupon

- (1) springs 2 and 22 changeover the lines from the extension, break the circuit to the lamp LPC 10 and connect the extension lines instead to the primary of the line transformer L6.
- (2) springs 25, 26 complete the HT circuit to the amplifier valves.

12. To reply to the extension, the operator should then throw the key KLT into the SPEAK position, which:—

- (1) connects the loud speaker on the amplifier (L5) to the input transformer L1 of the valve V1, through springs 5, 6 of KLT.
- (2) connects the secondary winding of the line transformer L6 through the springs 25, 26 and 3, 2 to the output winding of the amplifier.

13. The operator can then speak to the extension, using his loud speaker as a microphone, whose output will be amplified by the valves V1 and V2 and delivered to the line.

14. Having replied, the operator will then throw the key KLT back into the central position to allow the extension to speak, the circuit being as follows:—

- (1) The changing-over of KLT spring 5 disconnects the operator's loud speaker from L1, and connects it instead through springs 4, 3 and 2 to the output of the amplifier (transformer L2).
- (2) Spring 25 of KLT similarly changes-over the line transformer L6 via spring 24 and the plug-and-jack IC to the input of the amplifier (L1).

Thus the incoming speech from the extension is amplified and delivered to the operator's loud speaker.

15. When the conversation, which continues by means of a sequence of changeovers as described, is completed, the key at the extension is restored to normal, the key KE 10 at the operator's position also, and the key KLT is left normally in its central (LISTEN) position also.

16. If the operator wishes to call an extension, he will throw the appropriate KE key, thus connecting the extension line to L6. Next, he will throw the key KLT to the lower, or CALL position, when

- (1) The secondary winding of L6 is connected by springs 1, 2 to the output transformer L2 of the amplifier.
- (2) The grid of the valve V2 is connected by springs 21, 22 to the junction of R7 and C6, causing the amplifier to start oscillating at a frequency of about 500 c/s.

This tone is radiated from the loudspeaker at the extension, and acts as a calling tone. Periodically the operator will let the key KLT revert to the LISTEN position until he hears a reply from the extension, when the conversation will proceed as described above.

17. The amplifier can also be arranged to act as a loud-speaker monitoring unit. For this purpose, the plug shown in the position IC in the circuit diagram is changed over into the jack MN, and at the same time the strap across terminals 7 and 8 is removed, so that the 0.17 megohm resistor R11 is introduced into the input line to the amplifier as an attenuating pad. The plug in the jack MN shunts the 0.5 mfd capacitor C12 across the secondary of the line transformer L6 when the key KLT is in the central (LISTEN) position, and in the same conditions the 1800-ohm resistor is introduced in series with the amplifier input transformer L1, through the removal of the plug from the jack IC. These circuit alterations produce the correct degree of gain correction for the purpose.

Operation

18. During working periods, the mains switch at the central point should always be left ON, and the pilot lamp on the amplifier unit will be alight. The key switches at the master unit and at all the extensions should be in their horizontal positions. The BUZZER switch on the master unit should be up (ON) unless the operator is continually watching for the signalling lamps to light up.

19. The operator calls an extension (or a number at a time) by setting the appropriate extension switches in their lower positions, and also setting his CALL/LISTEN/SPEAK key into the upper (CALL) position. After a few seconds, he should return this key to the LISTEN position and listen for the extension to answer, and continue alternately calling and listening until he gets a reply.

20. When the extension answers, the operator should set his key in the SPEAK position. When the message has been delivered, the extension should be instructed to reply if necessary, and the operator's key set to the LISTEN position for the purpose. On completion of the conversation, the operator should reset all the keys in their normal positions.

21. Speech should be conducted in normal tones at a distance of about 18 inches from the loud-

speaker, and the VOLUME control on the amplifier set to give a satisfactory level at the operator's end. Should the extension complain of inaudibility, the VOLUME control should be set further in a clockwise direction to correct this: the amplifier acts in both directions.

22. An extension can call the operator by depressing the key at his extension when the calling lamp corresponding to his extension will light up, and the calling buzzer will sound at the master unit (unless, of course, the buzzer switch at the master unit is OFF). The operator will then throw the key corresponding to the calling extension, thus extinguishing the calling lamp, and will also set his CALL/LISTEN/SPEAK key to SPEAK. The operator then answers, and sets the key to LISTEN so as to receive the communication from the extension, and so on. Again, when the conversation is over, the operator should reset all keys to their normal positions.

23. During conversations, it is as well for the operator to set the BUZZER switch OFF, particularly if there is usually a considerable amount of traffic on the system, so as to prevent the buzzer from interfering with a conversation in progress should another extension call during it.

Installation

24. The master unit should be set up where required, preferably at a desk or table where the operator will normally sit. If no sitting accommodation is provided for the operator, the master unit should be mounted at about five feet above the floor so as to be at head-level.

25. A 200-250 volt, 2-amp AC supply point should be wired adjacent to the master unit, and a switch provided. The most convenient connection will be provided by supplying a BSS 2-amp 3-way switched socket outlet, connected by a 3-pin plug and 3-core flex to the terminals on the mains transformer of the amplifier unit. The terminals used should be 0 for the neutral wire and 210, 230 or 250 for the live or line side, according to the rated supply voltage.

26. The extension units should then be set up in the required positions, again either at desk level or head level, and telephone pair wires run from them to the master unit. Extension numbers should be allocated to each of the extensions, and the wiring at the master unit end labelled accordingly.

27. The resistance of the wires running to each of the extensions should be measured, and the total resistance of each pair subtracted from 350. The difference is the resistance which has to be added to the line as a pad to avoid burning-out the signal lamps, and resistances of the required values should be obtained. The resistors should be of 2-watt rating, though 1-watt rating may be used for padding resistors of low values (below 220 ohms). The value of the resistor should be within plus or minus 10 per cent of the "preferred" value nearest the calculated figure.

28. The installation is completed by connecting-up the extension wiring at each extension point and at the master unit, in the latter case ensuring that the wires are connected to the appropriately-numbered EXTNS terminals, and the resistances inserted in series with the lines.

29. If a single-extension unit is provided, it will be necessary, before wiring-up the line at the master unit, to remove the two blanking dummies on the right-hand side of the front panel of the amplifier unit and fix, in the upper hole, a G.P.O. key No. 73 BLACK, and in the lower a lamp jack, G.P.O. No. 19A. After mounting, a lamp, G.P.O. No. 2, 6-volt is inserted in the lamp jack, and in front of it a lamp cap, G.P.O. No. 1-1A. The key and lamp jack should then be wired up in accordance with the circuit diagram, fig. 2. The wiring is provided in the amplifier cable-form, and only needs connecting-up

30. Finally, the installation should be checked to ensure that the mains transformer is connected to suit the mains voltage available, that all lamps and valves are in position, and that the plug is in the position marked IC.

31. The amplifier should then be switched-on and a functional test performed on the whole installation, to ensure that signalling and speech are satisfactory at all extension points, and work in both directions.

32. If the amplifier unit is to be used solely as a monitoring unit, the installation procedure is as follows:—

- (1) Supply and wire-up power point adjacent to telephone point to be monitored, and set up the amplifier where convenient.
- (2) Remove the plug from position IC to position MN.
- (3) Disconnect the strap across the terminals 7 and 8 of the amplifier.
- (4) Only if an existing telephone instrument is still to be used as stand-by, provide and fix a G.P.O. key No. 253 adjacent to the amplifier and wire-up in accordance with fig. 3 by disconnecting the existing telephone and reconnecting it and the telephone line as shown.
- (5) If no stand-by telephone is to be used, the telephone line is connected direct to terminals X5 and 6X on the amplifier unit, while terminals 1 and 2 on the amplifier are strapped together. No key is needed.

WARNING

Due care to avoid electric shock should be taken when carrying out tests on the chassis of the equipment whilst it is connected to the mains supply.

Mains supply

34. The amplifier operates from 200–250 volts 50 cycles supply. The mains transformer voltage selector should be adjusted according to the mains

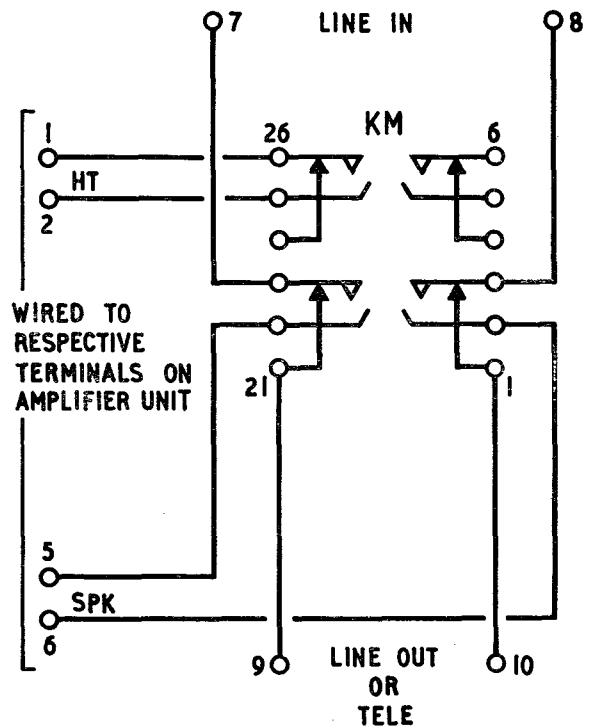


Fig. 3. Monitor wiring

- (6) Check over, switch on and test by calling over the line.

Construction

33. The master units are mounted in black-finished metal boxes arranged for use with the front panels vertical. The back is provided with a ventilation grille. The boxes are 14½ in. wide and 8½ in. deep, overall, including the projection of the fixing handles of the amplifying unit Type 8164 (Stores Ref. 10U/16968) mounted in them by four 3-B.A. screws. The heights of the units vary according to the number of extensions catered for, viz.—

Amplifier Type	Stores Ref.	Height	Remarks
A 1908 A 5173	10U/16862 16969	7¾ in.	One extension, less switch and lamp
A 8173 A 1496	10U/16860 16861	11¼ in.	Ten extensions
		14¼ in.	Twenty extensions

The extension units (loudspeaker extension units, Stores Ref. 10U/16863) each comprise a moving-coil loudspeaker and a key switch, mounted in a metal case.

SERVICING

voltage. The chassis must be earthed via the earth pin of the 3-pin plug.

Valves

35. The valves are as follows:—

CV358 (EF37A or 6J7GT)	First amplifier
CV509 (6V6G or 6V6GT)	Output stage
CV1863 (5Z4G)	Power rectifier

Indicator lamp

36. The indicator lamp is:—
P.O. Lamp No. 2, 6 volt ;

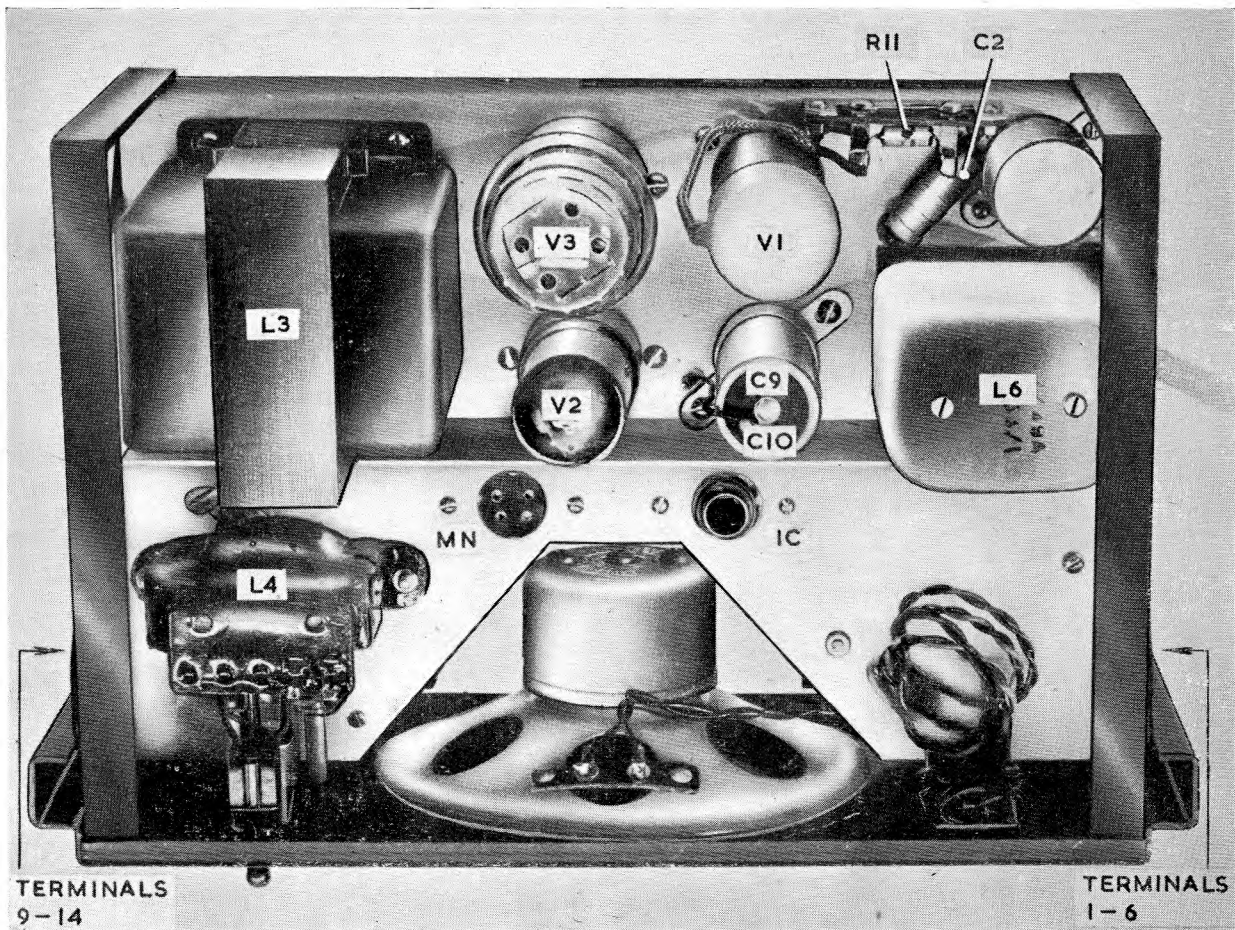


Fig. 4. Amplifying unit 8164, top of chassis

Test voltages

37. The following approximate voltages should be registered when measured on a 1,000 ohms per volt test-meter (no HT voltage will be present until terminals HT1 and 2 are strapped).

Chassis to either anode rectifier valve	(pins 4 and 6)		270V AC
Heater of rectifier valve	(pins 2 and 8)		5V AC
Heaters of 1st amplifier and output valves	(pins 2 and 7)		6.3V AC
Chassis to cathode of rectifier valve	(pin 8)		295V DC
HT line smoothed			275V DC
Anode of 1st amplifier and output valves	(pin 3)	respectively	50V and 260V DC
Screen " " " " "	(pin 4)	"	25V and 275V DC
Cathode " " " " "	(pin 8)	"	1.0V and 13.0V DC
Signal lamp supply terminals SIG 3 and 4			24V AC

DC resistance of components

38. Mains transformer	Primary	40 Ohms
" "	HT Secondary (Total)	700 "
" "	24V "	5 "
HT smoothing choke		400 "
Output transformer	Primary (Total)	600 "
" "	Primary anode section	400 "
" "	Secondary	4.5 "
Input transformer	Primary	2.75 "
" "	Secondary	2500 "
Loudspeaker	Speech coil	3 "
Speaker transformer	Primary	4.0 "
" "	Secondary	0.3 "

FAULTS LOCATION

39. Possible faults when used as a loudspeaker intercom master unit.

<i>Symptom</i>	<i>Possible Faults</i>
Equipment completely dead	No power supply to mains plug. Faulty fuse in mains plug. Broken mains lead. Faulty ON-OFF switch. Faulty mains transformer. Check circuit with testmeter to locate fault.
Equipment on but no reception or transmission from loudspeaker with:— (1) Call note to extensions O.K. (2) Call note faulty.	(1) Faulty loudspeaker or transformer L5. Bad contact on LISTEN/TALK key. (2) Faulty 5Z4 or 6V6 valve. Faulty HT smoothing choke or output transformer L2.
Equipment live but speech weak, distorted or absent.	Faulty input transformer L1, or contact in LISTEN/TALK key. Failing 5Z4, 6V6 or EF37A valve. Faulty output transformer. Faulty resistance or condenser in EF37A or 6V6 circuit. Check voltages and component values or substitute any suspected components.
No call note to extensions, otherwise O.K.	Faulty contact on CALL key. Faulty section on output transformer, or coupling condenser C6 or resistance R7 from output transformer to grid of 6V6 valve via CALL key.
Buzzer and all signal lamps not working.	Faulty buzzer or broken connection.
One call lamp not working.	Faulty lamp or extension circuit.
One extension out of action.	Faulty speaker unit or key in extension. Break in wiring. Check by substituting serviceable extension unit or short circuiting line at extension end. Call lamp will light if line is O.K.
Distorted speech from:— (1) All extensions (2) One extension	(1) Faulty speaker unit in Master. (2) Faulty speaker in extension unit.
Hum in loudspeaker.	Earth in extension line. Line too close to mains wiring. Faulty 5Z4 valve, HT smoothing choke or condensers C9, C10. Heater cathode leakage in EF37A or 6V6 valves.

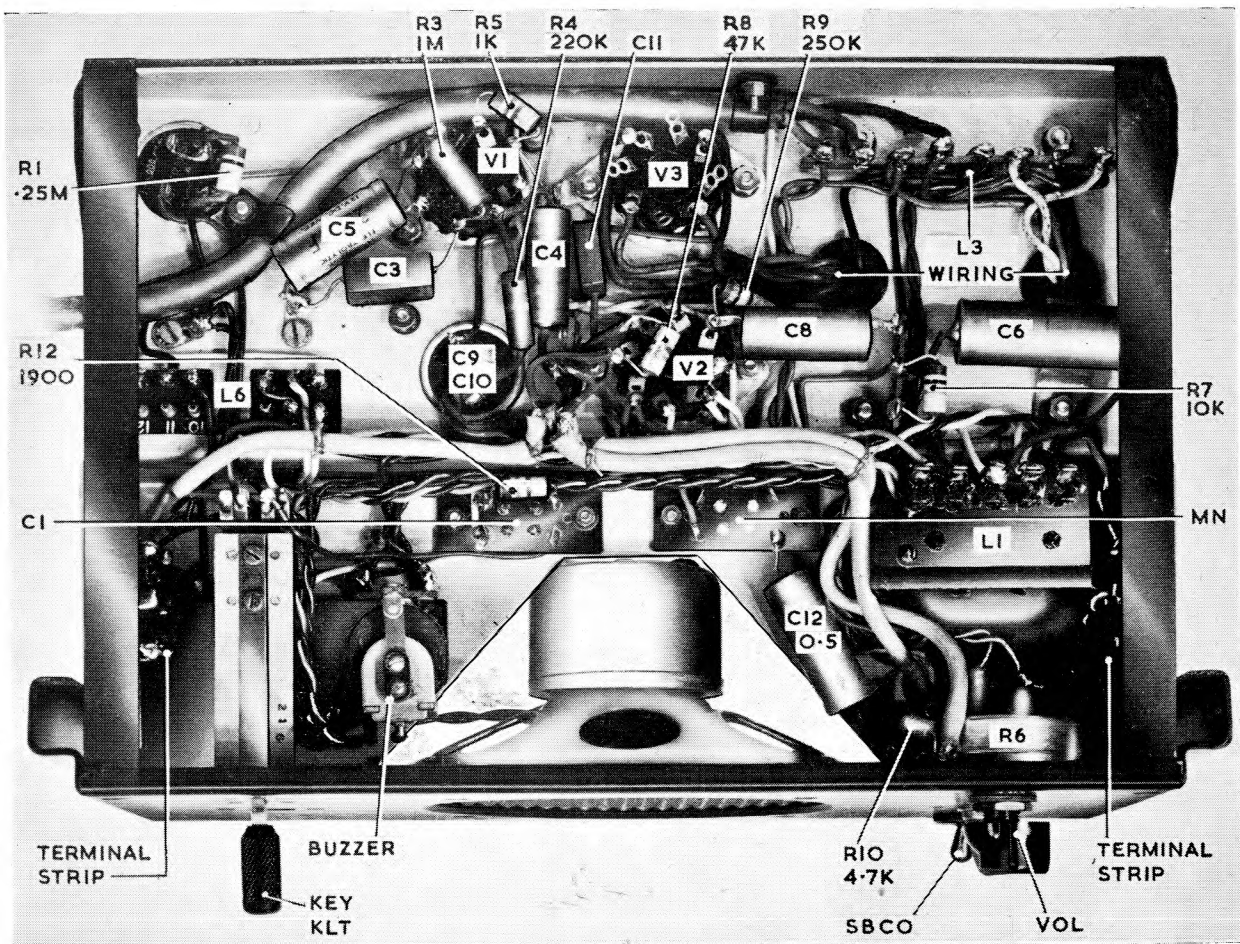
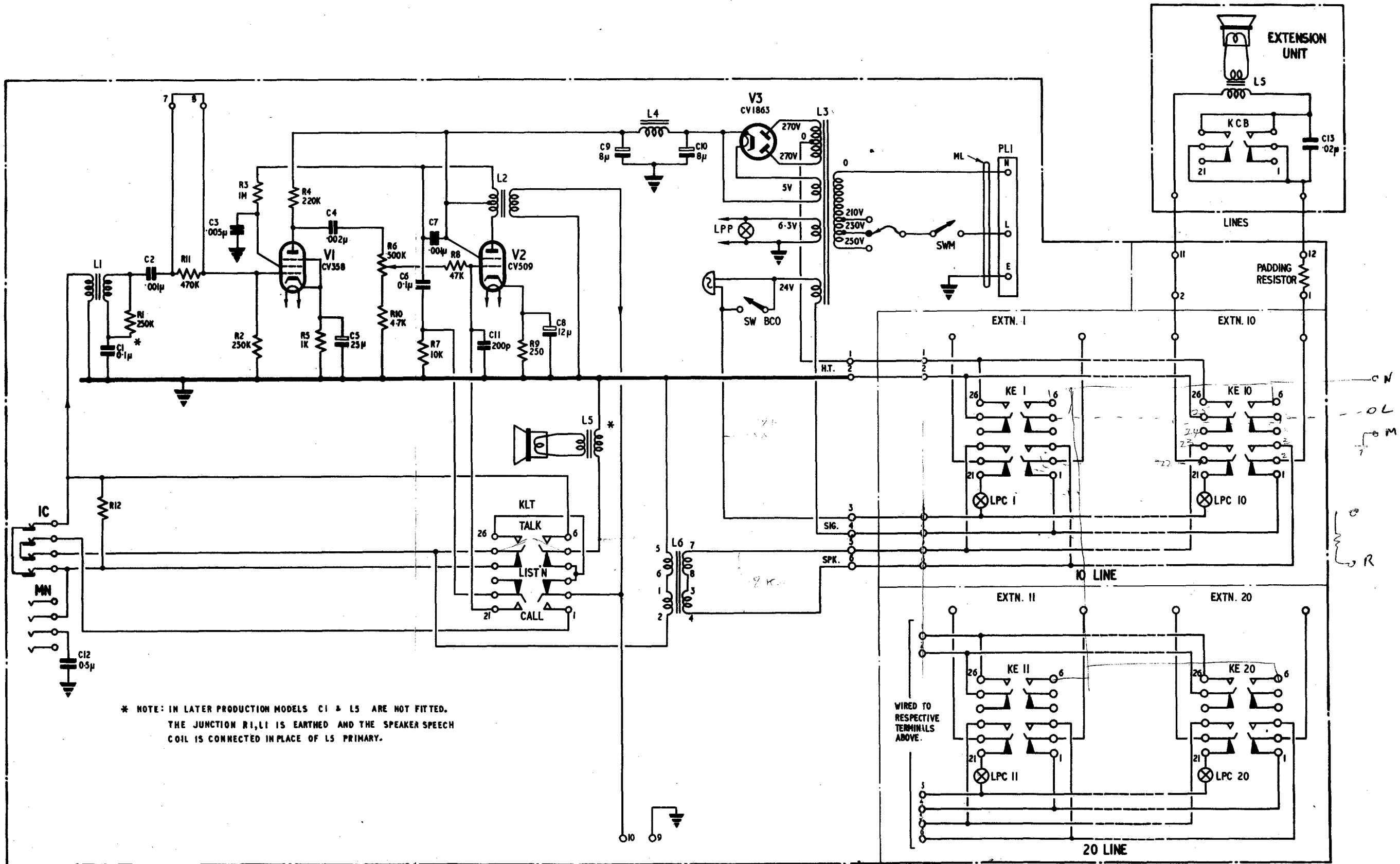


Fig. 5. Amplifying unit 8164, underside



* NOTE: IN LATER PRODUCTION MODELS C1 & L5 ARE NOT FITTED. THE JUNCTION R1, L1 IS EARTHED AND THE SPEAKER SPEECH COIL IS CONNECTED IN PLACE OF L5 PRIMARY.

AIR DIAGRAM
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Hadley teletalk : circuit

Fig. 2.