Teleprinter No. 7E. This machine is similar to the Teleprinter No. 7D but an overlap-cam receiving mechanism is used to improve the receive margin and allow the last character received to be printed without delay (follow-on printing).

Teleprinters No. 7D/RP and 7E/RP. These machines are similar to the equivalent Teleprinter No. 7D or 7E but include a perforating unit controlled from the combination-head for producing fully perforated 5-unit tape. The machine may be used as a reperforator or as a keyboard perforator, and the perforator facility may be suppressed by operating a mechanical throw-out lever. The WRU, BELL and Answer-back codes are not perforated.

Printing Reperforator No. 1A. This instrument may be used in place of the teleprinter when a subscriber wishes to feed traffic received over the telex system into a tape-relay network. The facilities provided are similar to those offered by the Teleprinter No. 7D but the page-printing attachment is replaced by a perforating unit that produces printing and "chadless" perforations on a single paper tape. End-of-line and tape-exhaustion contacts are provided, together with a mechanism for preventing the perforation of the WRU signal.

Printing Reperforator No. 1B. This is similar to the Printing Reperforator No. 1A but, like the Teleprinter No. 7E, has an overlap-cam unit to improve receive margin and provide follow-on printing.

Automatic Transmitter No. 2F. This machine has a striker type transmitter and incorporates a motor on-speed relay, electromagnetic clutch mechanism, and auxiliary contacts to indicate tight-tape and tape-exhaustion conditions.

Teleprinter-only Station

The face of the signalling unit for subscribers' stations requiring teleprinter-only facilities (Fig. 5.3) accommodates four press-keys, two supervisory lamps, and a dial. The unit offers the following facilities—

(*a*) Initiating an outgoing call by operating the non-locking DIAL press-key.
(*b*) Starting the teleprinter motor and lighting the green CALL lamp to indicate that dialling may begin. The CALL lamp remains lit for the duration of the call.
(*c*) Setting up the required connexion by dialling.
(*d*) Disconnecting the dial and connecting the teleprinter to line when a connexion has been established; this condition is indicated by the automatic return of the called subscriber's answer-back code.
(*e*) Permitting the calling and called subscribers to exchange messages in either direction, the local record facility at each end giving a complete record of the transaction.
(*f*) Starting the teleprinter motor, lighting the CALL lamp and sounding a buzzer when an incoming call is received. The buzzer is silenced by depressing the RESET key, or may be prevented from sounding by operating an audible-alarm cut-off switch at the rear of the unit.

(*g*) Delaying the return of the call-connect signal until the teleprinter has reached governed speed.

(*h*) Returning the answer-back code automatically in response to the WRU signal transmitted by the exchange equipment.

(*i*) Lighting the red ALARM lamp and sounding the buzzer (under this condition not preventable) when either calling or called subscriber transmits the "Figs" and "J" combinations in sequence, to attract the attention of the distant subscriber.

(*j*) Releasing a connexion by operating the CLEAR press-key until the teleprinter motor stops and the CALL lamp is extinguished. Either calling or called subscriber can clear a connexion.

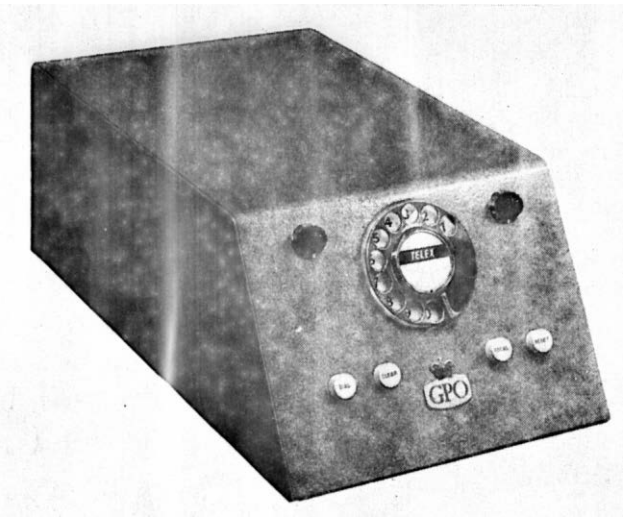

Fig. 5.3. Teleprinter-only Signalling Unit: Face Equipment
(*By courtesy of the Engineer-in-Chief, General Post Office*)

(*k*) Local copying by operating a locking LOCAL press-key which starts the teleprinter motor and lights the CALL lamp—maintaining a disengaged condition towards the exchange.

(*l*) Cancelling the local copying condition by operating the RESET key to release the mechanically locked LOCAL key.

(*m*) Lighting the ALARM lamp, sounding the buzzer and disconnecting the local record, if an incoming call is received whilst the LOCAL key is operated.

(*n*) Cancelling this alarm condition and allowing the incoming call to be completed normally if the RESET key is operated without delay.

(*o*) If the LOCAL key is not restored within 24–48 sec, allowing the incoming call to be completed under the control of the exchange equipment, the alarm condition is maintained until the RESET key is operated.

(*p*) Preventing the teleprinter motor from stopping with the answer-back drum off-normal.

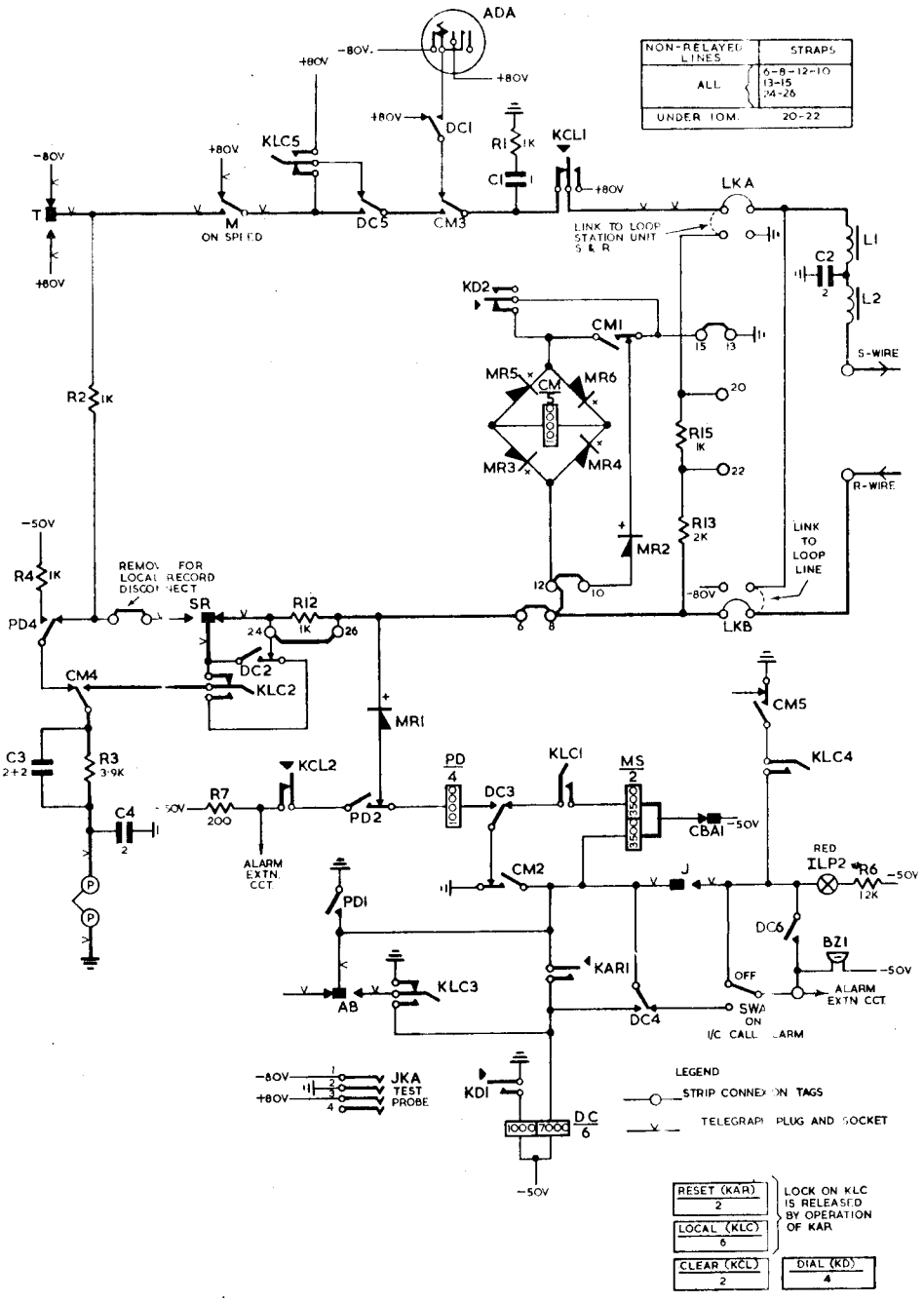

Fig. 5.4. Teleprinter-only Signalling Unit: Circuit Arrangements for Non-relayed Lines

(*q*) Permitting relayed line working by plugging-in a polarized relay of the appropriate type.
(*r*) Giving a "station closed" indication to the exchange when power is removed from the signalling unit.

Circuit Operation. Reference to the station line signalling conditions, set out in Table 4.2, will be helpful in considering the operation of the circuit shown in Fig. 5.4. In addition to the four press-keys, dial, two lamps and other components already mentioned, the signalling unit contains four 3,000-type relays together with auxiliary components, and a jack to accommodate a polarized relay for relayed line working. The functions of the four relays are as follows—

RELAY DC. Relay DC has two main functions; firstly, on outgoing calls, it is operated by contact **KD1*** of the DIAL key to extend the call (stop polarity) signal to the exchange and to connect the dial to line; secondly, if an incoming call is received whilst the LOCAL key is operated for local working and the key is not restored quickly, relay DC operates when the WRU signal trips the answer-back unit and closes the answer-back off-normal contacts to connect the transmitter to line at contact **DC5** and provide an alternative local record circuit via contact **DC2**. This ensures that the transmission of the called subscriber's answer-back code will "clear out" the WRU combination set up in the receiving teleprinter and so prevent the repetition of the answer-back code to the caller even if restoration of the LOCAL key is delayed. The WRU signal from the exchange equipment is not followed by any other character so that, in the absence of the local record of the answer-back code, the WRU combination would remain set up in the receiving teleprinter, causing the answer-back drum to rotate continuously until either the LOCAL key was restored, or another character received. On incoming calls, relay DC is used to reset the audible alarm; earth at contact **CM2** operates relay DC when the RESET key (KAR) is operated.

RELAY CM. Relay CM with its associated rectifier bridge MR3-MR6 is a line supervisory element designed to

(i) operate when stop polarity is received over the backward transmission path (R-wire),
(ii) remain operated whilst teleprinter signals are received over the R-wire,
(iii) release when the R-wire is either disconnected or connected to earth (no-volt condition),
(iv) offer a high impedance so that its connexion to the R-wire does not adversely affect received teleprinter signals.

Contact CM1 with rectifier MR2 provides the R-wire terminating condition when the station is in service and disengaged. Start polarity connected to the

* **KD1** indicates that contacts KD1 are operated. This method of indicating operated key and relay contacts is used throughout this volume.

forward transmission path (S-wire) via contacts DC1, CM3 and KCL1 operates relay LS in the exchange station line circuit via the R-wire rectifier MR2 and contact CM1 to earth—relay CM does not operate. When relay CM operates to stop polarity on the R-wire, contact **CM1** makes relay CM independent of earth at contact KD2, and relay CM can therefore be released only by a no-current (clear) condition on the R-wire once it has operated on either an incoming or outgoing call. On an incoming call, relay CM operates to the stop polarity call signal. Contact **CM2** operates relay MS to start the teleprinter motor. When the motor has reached governed speed and the governor contacts open, relay M, mounted on the machine, operates and its contact changes the polarity of the S-wire from start to stop to indicate the call-connect condition. The CM relay remains operated to the received teleprinter signals. Under local copying conditions, relay CM operates to the calling stop polarity if an incoming call is received.

RELAY PD. Relay PD is used on outgoing calls to detect the 50–100 msec proceed-to-select pulse of stop polarity returned by the time-zone metering equipment to indicate that dialling may begin.

RELAY MS. Relay MS is a sealed plug-in motor-start relay that connects power to the teleprinter motor. On outgoing calls it is operated by contact **PD1**, on incoming calls by contact **CM2** and for local copying by contact **KCL1**.

Clearing Arrangements. Calls can be cleared down either by the calling or called subscriber. The calling subscriber clears by depressing the CLEAR key until the CALL lamp is extinguished. Contact **KCL1** connects start polarity to the S-wire. When this polarity has persisted sufficiently long to be recognized by the exchange equipment as a clear signal, the no-current condition is returned over the station R-wire to release relay CM, which in turn releases relays DC and MS, to restore the station equipment to normal.

If the CLEAR key at the called station is operated, the sequence of release at the calling station is the same.

If for any reason the teleprinter answer-back drum is moved off-normal whilst the station is disengaged and not working in-local (resulting in the closure of the answer-back off-normal contacts AB) a circuit for relay MS is completed via contacts KLC3 and **AB**. Power is connected to the teleprinter motor until the AB contacts open.

Relayed Physical Station Lines. When the signalling unit is used with a station line which must be relayed, a polarized relay (RA) of the appropriate type is plugged into the jack provided; the necessary circuit rearrangement is made by strapping changes on the strip connexion (Fig. 5.5). The circuit arrangement is shown in Fig. 5.6.

Relay RA responds to incoming signals on the R-wire and contact RA1 repeats these signals to the teleprinter electromagnet with minimum added distortion: the other relays function normally to the repeated line signals.

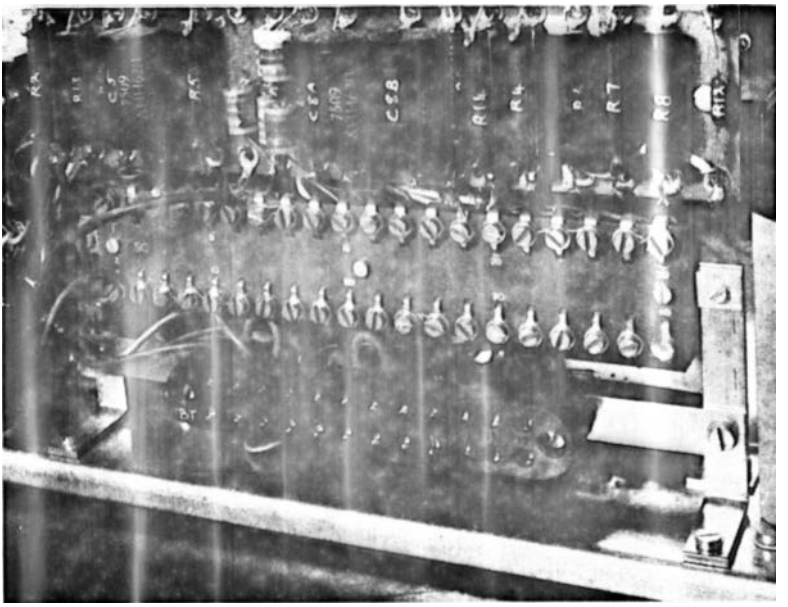

Fig. 5.5. Signalling Unit: Strapping Arrangements
(By courtesy of the Engineer-in-Chief, General Post Office)

Relay CM is now connected to line in series with RA but still functions as a no-volt supervisory relay to recognize the no-current clearing condition.

Station with Automatic Transmission Facilities

In addition to the face equipment provided in the teleprinter-only case, two additional press keys are used to start and stop the automatic transmitter (Fig. 5.7). The following facilities are provided in addition to those listed for the teleprinter-only station—

(*a*) Connecting the automatic transmitter to line by operating the non-locking AUTO. START press key when a call has been established.
(*b*) Delaying the commencement of automatic transmission until the automatic transmitter motor has reached governed speed, thus preventing the sending of incorrect characters.
(*c*) Stopping the automatic transmitter motor, restoring the teleprinter to line and operating an alarm should the tape break or fail to feed correctly during automatic transmission.
(*d*) Permitting the red ALARM lamp to be lit and the buzzer to be sounded at the station using the automatic transmitter if the teleprinter keyboard is operated at the receiving station.
(*e*) Restoring the teleprinter to line if the automatic transmitter motor stops.
(*f*) Stopping the automatic transmitter and restoring the teleprinter to line by operating the non-locking AUTO. STOP press key.
(*g*) Releasing the connexion from either end during automatic transmission by operating the CLEAR key as in the case of teleprinter transmission.

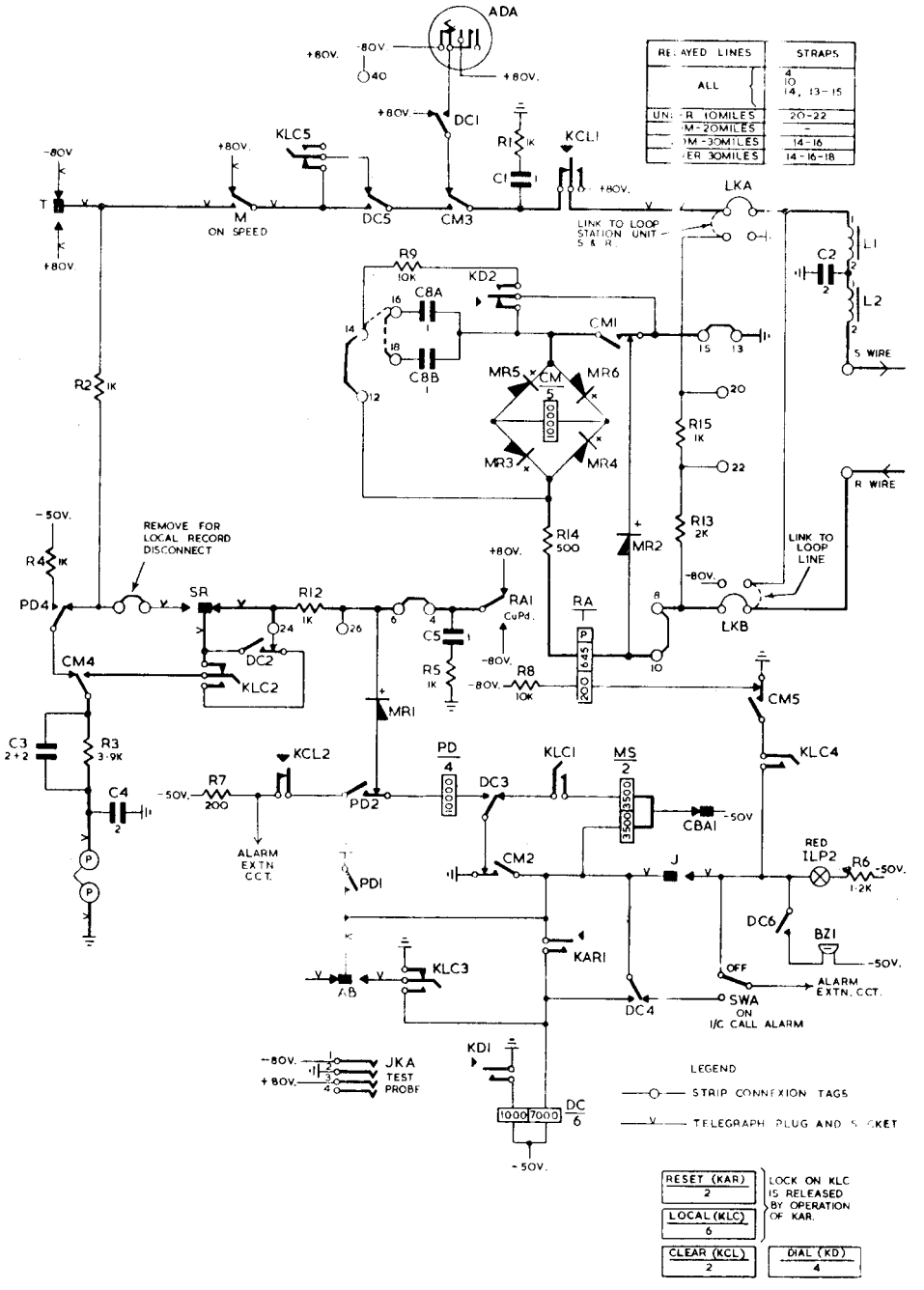

Fig. 5.6 Teleprinter-only Unit: Circuit Arrangements for Relayed Lines

(*h*) Lighting the red ALARM lamp and sounding the buzzer at the transmitting station when a connexion is released by the receiving station during automatic transmission.

(*i*) Local copying of an automatic transmission tape by operating the AUTO. START press key with the LOCAL key operated; a disengaged condition is maintained towards the exchange. The automatic transmitter is stopped by pressing the AUTO. STOP key.

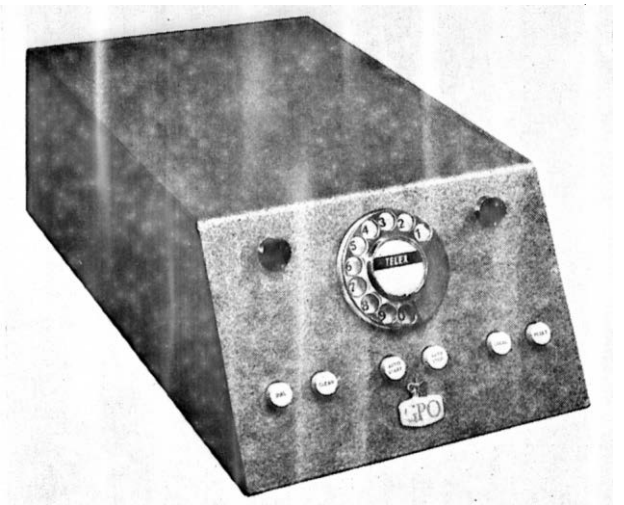

Fig. 5.7. Automatic Transmission Signalling Unit: Face Equipment
(By courtesy of the Engineer-in-Chief, General Post Office)

(*j*) Lighting the red ALARM lamp, sounding the buzzer, disconnecting (and stopping) the automatic transmitter and restoring the teleprinter to line when an incoming call is received with the AUTO. START and LOCAL keys operated.

(*k*) Disconnecting the local record circuit by operating a switch at the rear of the signalling unit. The provision of this switch is optional.

Circuit Operation. For teleprinter working the circuit operation is essentially the same as for the teleprinter-only station; identical component nomenclature has been followed wherever possible. From Fig. 5.8 which shows the circuit arrangements for the teleprinter and automatic transmitter stations, it will be seen that three additional 3000-type relays are used to control the automatic transmitter. The function of each of these relays is as follows.

RELAY AS. After a call has been set up by dialling the appropriate digits and connexion established with the required subscriber, the automatic transmitter is switched on, after inserting a tape, by operating the TAPE OUT (TO) contacts on the automatic transmitter and the AUTO. START key. Relay AS operates via contacts **CM5**, KLC4, **KAS1** and the TIGHT-TAPE (TT) and TAPE OUT (TO) contacts on the automatic transmitter. Contacts **AS1** and **AS2** connect power

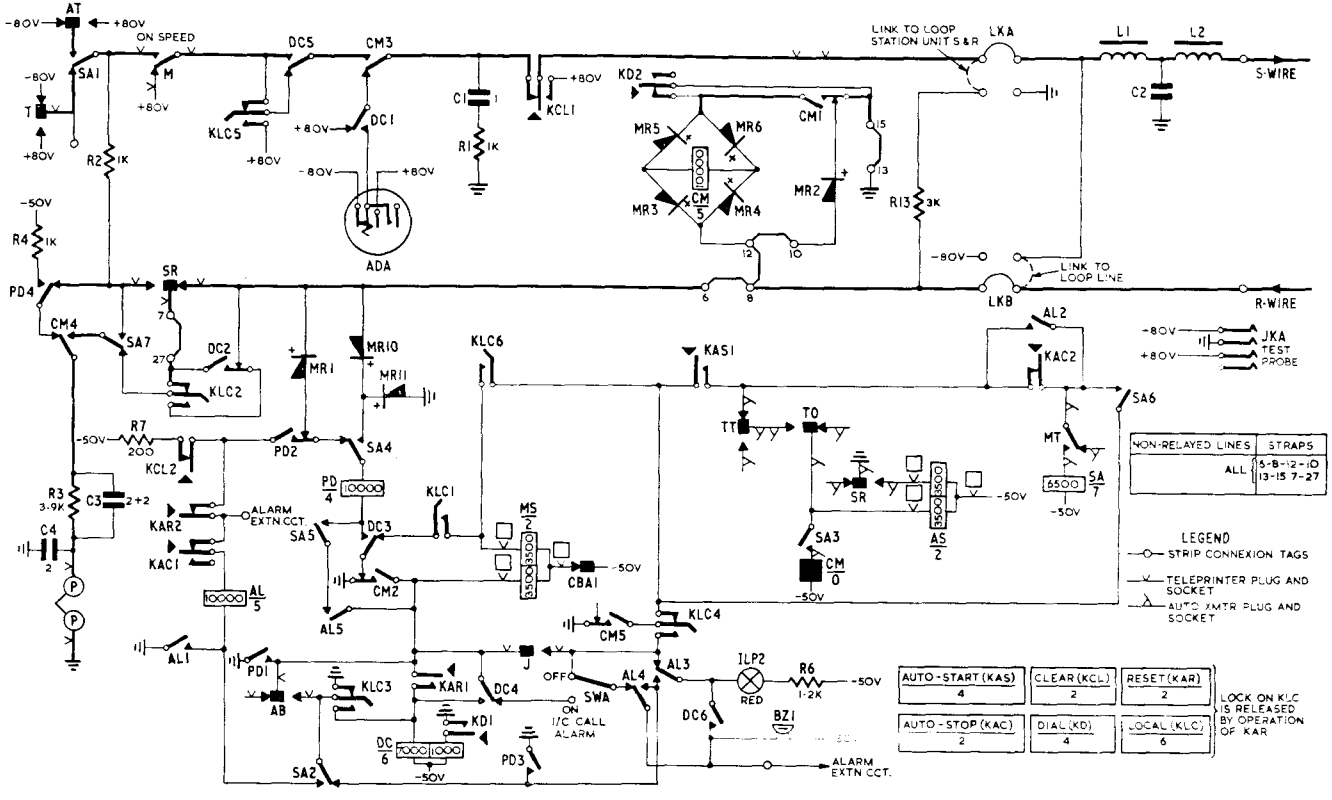

Fig. 5.8. Station with Automatic Transmission Facilities: Circuit Arrangements

to the automatic transmitter motor. The AS relay has the same function when the automatic transmitter is used in local but the operate path is: contacts CM2, DC3, **KLC1**, **KLC6**, **KAS1** and the TT and TO contacts.

RELAY SA. This has two major functions—

(i) When using the automatic transmitter on a switched connexion, the SA relay is operated by the contact of the automatic transmitter on-speed relay which operates when the automatic transmitter motor reaches governed speed. The operate path for relay SA is: contacts **MT**, KAC2, **KAS1**, KLC4 and **CM5**. The SA relay switches the automatic transmitter to line in place of the teleprinter transmitter, completes a local record circuit for the automatic transmitter, operates the automatic transmitter clutch magnet and converts the PD relay into a start polarity pulse detector to light the ALARM lamp and sound the buzzer if the called subscriber interrupts the automatic transmission by tapping the teleprinter keyboard.

(ii) When using the automatic transmitter in local, the SA relay operates over the path: contacts MT, KAC2, **KAS1**, **KLC6**, **KLC1**, DC3 and CM2. The SA relay connects the automatic transmitter to the teleprinter electromagnet and operates the transmitter clutch magnet. Since both the AS and SA relays remain dependent upon contact CM2, the arrival of an incoming call during local copying which, as described for the teleprinter-only station, operates relay CM, causes the teleprinter to be restored to line and the automatic transmitter to be stopped; the incoming call is completed as for the teleprinter-only station.

RELAY AL. This provides the alarm facilities required when the automatic transmitter is connected to line and is operated by the SA relay as follows: contacts KLC3, **SA2**, KAC1, KAR2 and KCL2. Under local copying conditions this circuit is broken at contact KLC3. When operated, relay AL provides its own hold circuit: contacts **AL1**, KAC1, KAR2 and KCL2, and can, therefore, be released by operating the AUTO. STOP, the RESET, or the CLEAR key.

If the tape breaks or runs out, the TAPE OUT contacts open (or if the tape becomes tight, the TIGHT TAPE contacts open) and release relay AS which disconnects power from the automatic transmitter motor. When the motor governor-contacts close, the on-speed relay MT releases and, in turn, releases relay SA. In addition to restoring the teleprinter to line, contact SA2 completes a circuit for the ALARM lamp and buzzer from contact KLC3 via contacts **AL3** and **AL4**. The alarm is reset by operating the RESET key to release relay AL. A similar alarm occurs if a clear signal is received from line whilst automatic transmission is in progress.

If the automatic transmitter is disconnected from line by operating the AUTO. STOP key whilst tape is running through the transmitter head, the AS and SA relays are held independently of contact **KAC2** by contact **AL2**, pending the release of relay AL at contact **KAC1**. The alarm circuit is disconnected at contacts AL3 and AL4 during the release sequence of relays AS, MT and SA.

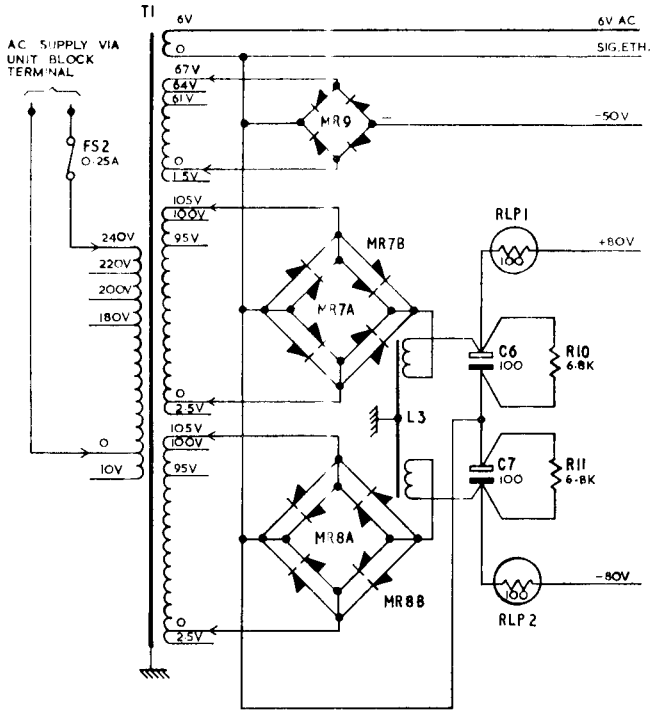

Fig. 5.9. Signalling Unit: Power Circuit

Power Supply Arrangements

Both teleprinter-only and teleprinter/automatic transmitter stations are designed to operate direct from a.c. mains. The machines are fitted with mains-voltage a.c. motors and the d.c. supplies required for relay operation and signalling are obtained from a small metal-rectifier power pack incorporated in the signalling unit. The power circuit illustrated in Fig. 5.9 produces a −50 V supply for relay operation and ±80 V supplies for line signalling. The power circuit has been designed to provide signalling potentials sufficiently stable within the accepted limits of mains voltage fluctuation, namely +6 per cent to −10 per cent of the declared voltage, to permit the transmission and signalling limits to be met. The required regulation has been obtained with a transformer and choke of moderate size. RLP1 and RLP2 are ballast lamps to limit the signalling current to a safe level under fault conditions.

In addition to the more usual 230 or 240 V a.c. power supplies, the following are encountered and have been catered for—

(*a*) a.c. supplies at 200, 220 or 250 V,
(*b*) d.c. supplies at 200 to 250 V.

Power Supply Connexions for 230 to 240 V a.c. Mains. Fig. 5.10 shows the supply connexions for the signalling unit. Contacts MS1 and MS2 are the

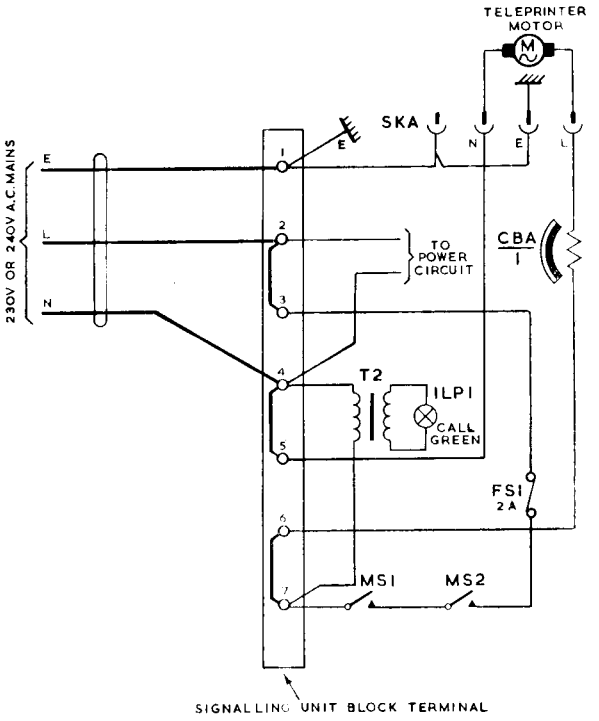

Fig. 5.10. Supply Connexions: 230/240 V a.c.

contacts of the plug-in motor-start relay included in Figs. 5.4 and 5.6. Transformer T2 supplies 6 V a.c. to the CALL lamp whilst the motor is energized. CBA is a miniature circuit breaker which, together with the 2 A fuse, FS1, protects the motor. Under stalled motor conditions, the motor current is probably insufficient to blow FS1 but operates the circuit breaker whose contact releases the motor-start relay MS (*see* Figs. 5.4 and 5.6) to disconnect power from the motor.

Power Supply Connexions for 200–220 and 250 V a.c. Mains. The power pack transformer is tapped to accommodate mains supplies within the range 200 to 250 V but the teleprinter motor is designed only for 230–240 V. To avoid the necessity for stocking motors suitable for other a.c. voltages, an auto-transformer is used. The supply connexions are shown in Fig. 5.11.

Power Supply Connexions for 200–250 V d.c. Mains. The teleprinter is fitted with a d.c. motor which is energized directly from the d.c. mains. Since the contacts of the motor-start relay (MS) in the signalling unit are unsuitable for switching direct current, they are used to operate an auxiliary relay carrying suitable contacts. This relay and a small vibrator mains-convertor unit designed to generate 230 V a.c. for the signalling unit power pack are contained in a small box mounted adjacent to the signalling unit. The supply connexions are shown in Fig. 5.12.