FERRANTI

HIGH SPEED TAPE READER
TYPE TR5b

Technical Manual

Ferranti

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TECHNICAL MANUAL

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The Ferranti High Speed Tape Reader
TR5b is protected under the
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British	711482
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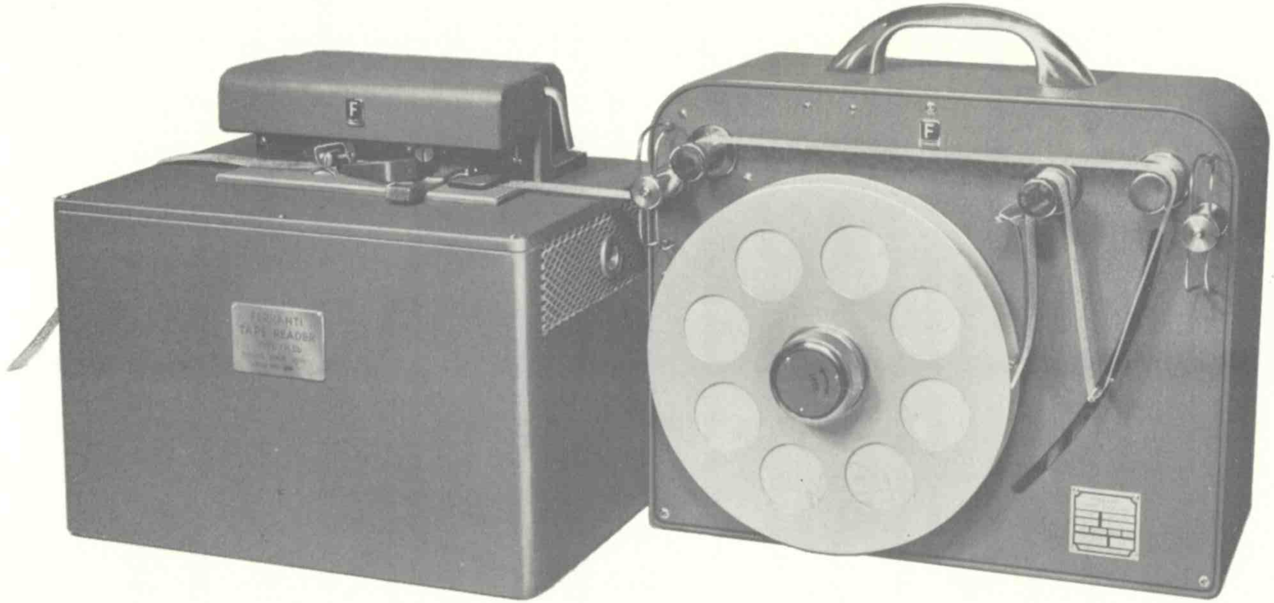
DIAGRAMS

Diagrams are grouped at end of book



General view of the TR5b Tape Reader used in conjunction with a type A11 Tape Spooler

CHAPTER 1

INTRODUCTION

The Ferranti TR5b tape reader is a high speed reader for punched paper tape, with a nominal maximum reading speed of 300 characters per second. Designed primarily for use with electronic digital computers, the reader is equally suitable for use in the field of communications.

The tape reader weighs 32 lbs and measures 9.25″ x 11.5″ x 10″ high. The container has a crackle finish with exposed parts of satin chrome and stainless steel. The reader comprises the tape feed drive, together with the brake and clutch mechanism, the optical projection system, and the read and location photocells; transistorised circuits for controlling the movement and reading of the tape; and power supplies.

In view of the high rate of tape feed, particular attention has been paid to minimising wear and deterioration of the tape. A friction drive is used for this purpose. It has the advantage over a sprocket drive in that if the tape is twisted or prevented from passing through the reader in the orthodox manner, it will slip in the drive mechanism without being torn. A correctly spliced tape will be taken without any difficulty. Tests have shown that a tape is unharmed by passing through the reader many thousands of time.

Considerable care has been taken to ensure not only rapid, but balanced acceleration and deceleration. A properly adjusted TR5 can be stopped from full speed in approximately 1.5ms; and when starting, the next character is in the reading position in less than 4.5ms.

The machine reads 5, 7 or 8 channel paper tape, the adjustment for tape width being by means of a simple slide mechanism, shown on Diagram 1.

A photoelectric system of reading is used, which assists in the preservation of the tape. A character is a row of holes across the width of the tape and represents a number, letter or symbol. The characters are spaced at 0.1″ intervals and up to 300 characters per second can be read. The tape can be stopped within 0.05″, thus enabling character by character reading.

When the reader is stationary, 9 characters are visible, making it easy to determine which one is being read and also to mark any character for subsequent inspection. The last character read does not have to be exactly over the mask holes as the information has been staticised on bistables within the reader and is available until the reader is restarted and the next character arrives at the reading position.

Tape readers are fitted with either a 50c/s or a 60c/s motor and a power supply of 115 volts 60c/s or 230 volts 50c/s is normally required. This is used to feed the capacitor-start motor and a transformer. The latter gives power to the low voltage d.c. supplies and the festoon lamp used to illuminate the photocells. Two 12-pin plugs carry the a.c. supply and the interconnections to the external equipment.

A tape spooler (type A11) has been produced for use with Ferranti tape readers. The spooler can be used for spooling or unspooling and is pictured in the frontispiece in use with the tape reader.

CHAPTER 2

MECHANICAL DESCRIPTION

2.1 Tape feed drive

The tape reader is driven by a capacitor-start, capacitor-run motor which continually rotates a differential gear on the stationary main shaft. As shown in Diagram 3, the main shaft carries two drums or output shafts, the clutch drum and the tape drive or brake drum, which are connected together by the differential gear. With an arrangement of this type, if either output shaft is held stationary, the other will rotate. The use of such a drive system allows the brake to be applied without causing the motor to stall.

2.2 Brake and clutch mechanism

There are two braking systems, one for the tape drive and brake drum and one for the clutch drum. The tape feed is controlled by electromagnetically-operated brake and clutch shoes engaging on the brake drum and clutch drum respectively. The action of the brake mechanism (shown on Diagram 2) is described below and the clutch works in the same manner.

Each armature is held in close proximity to the laminated core of the electromagnet, adjustment being made as described in Chapter 7. The brake shoe is held lightly in contact with the drum by means of a spring and since there is negligible movement of the armature the force produced by energising the electromagnet is utilised immediately, forcing the shoe against the drum. The air gap between the armature and the core is very small (0.006″ - 0.008″), resulting in a high gap flux. The negligible movement of the armature also ensures a quick transition between the driving and braking states.

In the control circuit of the reader, as described in sections 3.3 and 4.2, the two braking systems are connected to opposite phases of a trigger circuit (control bistable) which has two stable states. These latter determine whether the tape drive drum rotates or is held stationary.

2.3 Tape read

The tape release lever, shown on Diagram 1, raises the tape guide plate which carries a wire guide and spring loaded rollers, and permits the tape to be placed in the reading position. On clamping the guide plate, the spring loaded rollers hold the tape against the tape drive drum.

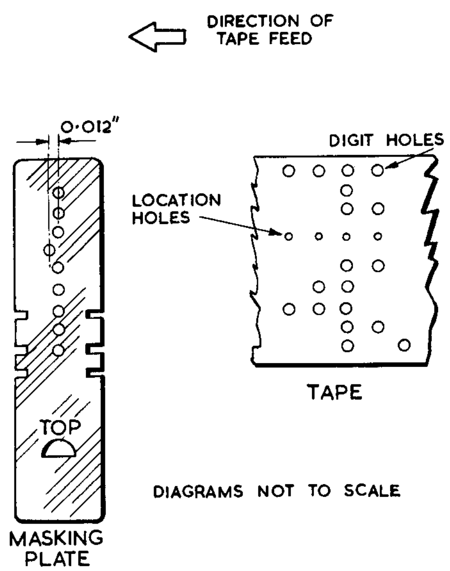


Fig. 1.

A masking plate, shown in Fig. 1, has a row of holes each filled with an epoxy resin in order to keep dust from the cells. These holes correspond with the holes in the tape. The location hole in the plate is set 0.012" beyond the line of digit holes, in the direction of movement of the tape, for the purpose described in section 3.3.

The optical system uses an under-run festoon lamp as a light source and the image of the filament is focused onto the holes in the masking plate by means of a cylindrical lens. Directly below the masking plate are the 9 photocells. When a hole in the tape passes over the masking plate, light is allowed to pass through the hole and strike the photocell, which gives an output. The diameter of the holes in the masking plate is chosen in order to ensure a large readable signal and a minimum overlap between holes of consecutive characters.

CHAPTER 3

LOGICAL OPERATION

3.1 Introduction

The logical operation of the tape reader is shown on Diagram 4, the logical circuits being carried on four plates or packages of electronics, i.e. one Plate A, one Plate B and two Plates C (C_1 and C_2). A START signal from the computer (for the purposes of this logical description it will be assumed that the reader is being used with a digital computer) initiates the reading cycle. When a character has been read, a BRAKE waveform is produced; this stops the reader unless it is immediately restarted. A READER READY signal is also produced: this indicates to the computer that a character has been read into the tape reader buffer (eight digit bistables) and that the cycle may now be repeated.

3.2 The reading cycle

A START waveform from the computer causes the clutch to become energised and the tape to move. A character on the tape arrives at the reading position and light passes through the holes in the tape on to the location hole photocell and the appropriate digit photocells. The outputs from these are strobed on the digit bistables by a RESET pulse derived from the location photocell output. The information is thus staticised, and may now be read into the computer.

Meanwhile a STOP pulse, also initiated by the location cell, has triggered the control bistable, causing it to be reset and the output causing brake coils to be energised. The tape then comes to a halt, unless restarted.

A READY signal is set up at the same time as the BRAKE waveform energises the brake coils. The computer will normally generate the next START waveform upon receipt of this READY signal, which indicates to the computer that the reader has staticised one character and is prepared to move to the next character on the tape.

By repeating this cycle all the information on the tape can be read into the computer at high speed.

3.3 START and CLUTCH signals

Diagram 4 shows the 8 digit bistables together with the control logic. Digit stats. P2, P3, P4 are located on Plate C_1, and P5, P6, P7 on Plate C_2, the remaining two, P0 and P1, being on Plate B. Immediately the START signal is received, the control bistable on Plate A is set and the CLUTCH waveform is produced. The latter is fed to a current switch (shown on Diagram 12) which allows the clutch electromagnet to be energised and hence engage the clutch. The tape then starts to move and the next character approaches the reading station.

From Fig. 1 it can be seen that the location hole has a further 0.012″ to travel, beyond the digit holes in the masking plate, in order to reach its reading position. Thus the inputs to the digit photocells will occur before the input to the location photocell and hence the digit waveforms will already be established when the location cell output is produced.

The location photocell waveform enters Plate B, is squared and the leading edge of the amplified output is differentiated and inverted to form the positive strobe or RESET pulse. This is applied to both sides of the digit bistables and triggers these according to the inputs from the digit photocells. These latter produce a negative-going waveform for a hole in the tape, as shown on Diagram 5, and will be giving their maximum output when the RESET pulse occurs. The character is therefore set on the digit bistables and will be retained until the next location hole is sensed, after the next START signal has been given. The information is available for transfer into the computer during this time.

3.4 INTERNAL STOP

An undifferentiated output is also taken from the location cell square wave generator on Plate B, to act as the INTERNAL STOP pulse. This is applied via a link to the input pin D of Plate A, where it is integrated and then differentiated and used to reset the control bistable after a delay of approximately 60μs (to allow the digit bistables to set). The BRAKE waveform and the READY signal are thus initiated simultaneously.

3.5 BRAKE signal

The BRAKE signal operates a current switch, shown on Diagram 12, which energises the brake coil and causes the brake shoe to press against the drum. The now positive CLUTCH waveform switches off the clutch transistor and disengages the clutch. The combination of these two effects brings the tape to rest (in the absence of another START pulse). As the CLUTCH and BRAKE waveforms are the outputs of opposite sides of the bistable, the energising of the clutch coil necessarily cuts off the brake, and vice versa.

The BRAKE waveform will only be reset by another START signal. With full speed operation however, a START signal is received before the inertia of the braking system can be overcome and the tape continues to pass through without perceptible pause. If the START signal occurs more than 200μs after the brake has been energised, the time lapse will allow the brake to operate.

3.6 READY signal

The READY signal appears at the same time as the BRAKE waveform, that is, when the bistable is reset by the delayed STOP signal. READY indicates that the present character is staticised and the information is available. The tape reader now awaits the next START signal, which will only be generated when the computer has received the READY signal. The latter is usually a negative-going waveform, but alternative links exist to provide an output of opposite polarity for the applications that require it.

3.7 EXTERNAL STOP

EXTERNAL STOP is a computer-produced waveform. When continuous information is entering the reader, for example when reading long tapes, circumstances may arise in which the brake is rapidly switched on and off with resultant wear. To eliminate this, the connector link between pin D of connector no. 1 and pin N of connector no. 2 can be removed and an EXTERNAL STOP signal applied to pin 9 of plug A (see Diagram 14). This withholds the INTERNAL STOP signal, originating from the location cell bistable, which normally energises the brake. The tape then runs through the reader unhindered and will stop only when a negative EXTERNAL STOP waveform appears.

CHAPTER 4

CIRCUIT DESCRIPTIONS

4.1 Introduction

The four plates, i.e. Plate A, Plate B, Plates C_1 and C_2, perform the logical operation of the tape reader. Control of the movement of the tape is provided by Plate A, whilst Plate B governs the operation of reading the tape. Plates C_1 and C_2 and part of Plate B hold the information read. Circuit descriptions follow. Idealised operating waveforms are shown in Diagram 5.

4.2 Plate A (Diagrams 6 and 7)

The A plate carries the control bistable (V2 and V4), a triggering transistor (V3), two inverting output amplifiers (V1, V5), a delay circuit (V6 and V7), and an emitter follower (V8).

The control bistable is set by START (at pin C) and reset via the delay circuit by either INTERNAL STOP or EXTERNAL STOP, applied to pin D. The negative CLUTCH waveform is the result of START, and the negative BRAKE and READY waveforms are produced when the bistable is reset.

The negative-going START waveform, normally of two volts amplitude (OV to -2V), is connected via link 8-9 to C3 and R23, where it is differentiated, making the base potential of V3 negative. V3 conducts and its collector potential moves towards OV, making the base potential of V4 positive; V4 is cut off. The base potential of V2 is then held negative, making V2 conduct and setting the bistable.

The START waveform may alternatively be of nine volts amplitude (OV to -9V). In this case the triggering transistor V3 is not required, and link 8-7 is set. The negative-going leading edge, differentiated by C2 and R19, makes D2 and V2 conduct, setting the bistable directly.

When the bistable is set, V2 is conducting and V4 is cut off. The output of approximately O volts at the collector of V2 holds the junction of R4/R6 at about the same potential (via D1). Potentiometer R4/R5 holds the base potential of V1 positive, cutting off V1. The negative potential on the collector of V1 (CLUTCH) then energises the clutch coils via switch transistor T1 (Diagram 12), and the tape starts to move.

Reset of the bistable is initiated by a negative input on pin D. This is integrated by R24 and C4, and after about 60μs the positive bias provided by R25 is overcome and V6 conducts. Its collector potential moves towards 0 volts and D5 conducts, making the junction of R27/R28 move in a positive direction, cutting off V7. A negative-going step is produced at the collector of V7, whose leading edge is differentiated by C8 and R22. The negative-going pulse thus produced makes D4 and V4 conduct, resetting the bistable. In this condition, V4 is conducting and V2 is not.

The collector potential of V4 is approximately 0 volts and D3 conducts. The base of V5 is thus held positive and V5 is cut off. The negative signal on the collector of V5 (BRAKE, pin E) energises the brake coils via switching transistor T2, shown on Diagram 12.

Emitter follower V8 is used to produce a READY waveform for the period when the bistable is reset. Links are used to determine the polarity of this waveform and to give a choice of output levels.

If link 3 - 1 is connected, the input to V8 is derived from the collector of V2 and is negative during the READY period, and 0V otherwise.

If link 3 - 2 is connected, the collector potential of transistor V4 provides the input to V8: this is 0V ('positive') during the READY period, and -9V otherwise.

The actual output levels depend on whether the input to V8 is connected to the base of the transistor directly or via a level changing potentiometer, R31 and R32.

If link 4 - 5 is connected, the output is taken via the potentiometer and the levels are changed to approximately +1.5 volts and -3.5 volts.

If link 4 - 6 is connected, the output levels are unchanged and are approximately 0 volts and -9 volts.

An input link must be connected according to the nature of the START waveform.

If link 8 - 9 is connected, the appropriate START waveform is negative-going, of amplitude 0 to -2V and having a rise time of approximately 5μs.

If link 8 - 7 is connected, the appropriate START waveform is negative-going, of amplitude 0 to -9V and an approximate voltage gradient of 4 volts/μs.

The A Plate is usually supplied with links 8 - 9, 4 - 5 and 3 - 1 connected: i.e. 0 to -2V input and negative-going READY signal of +1.5 volts to -3.5 volts levels.

4.3 Plate B (Diagrams 8 and 9)

The B Plate carries three circuits, a STOP and RESET generator (location cell bistable) V11 - V14, and two identical digit bistables (V1 - V5 and V6 - V10). The latter are emitter-followed and can supply up to 2mA.

The STOP and RESET generator or location cell bistable is a regenerative squaring circuit, whose input (pin M) is the negative waveform from the location photocell. A positive bias is applied to the base of the input transistors of the location and digit bistables, This eliminates misreading due to the imperfect opacity of the tape.

The negative waveform from the location photocell is applied to the base of V11. At a particular amplitude the waveform overcomes the bias voltage and V11 conducts, a positive-going output appearing on its collector. This reduces the current flowing in V12, and by regenerative action V11 is turned on and V12 is cut off. A negative pulse appears at the collector of V12, lasting until the positive-going edge of the location photocell output reverses the above process by starting to cut off V11. This square negative pulse is emitter-followed by V13.

The negative INTERNAL STOP waveform (levels 0 volts and -9 volts) is taken directly from the emitter of V13, at pin N. The negative output on the emitter is also differentiated and applied to the base of V14, which conducts on the leading edge. The positive RESET pulse is taken from the collector of V14 on pin J and used to strobe the inputs to the digit bistables.

The bistables (P0 and P1) on this plate are identical to those on the C Plate, described in the next section.

4.4 Plate C (Diagrams 10 and 11)

There are two C Plates in each tape reader, each carrying three identical bistable circuits. Plate C_1 carries the P2, P3 and P4 digit bistables, and P5, P6 and P7 are on Plate C_2. Each bistable is emitter-followed and can supply up to 2mA.

Precise discrimination is essential between 'light' when there is a hole and 'dark' when there is not. This is provided by a positive bias on the input to the bistables. As the bistables are identical, P2 alone will be considered here.

Between reset pulses, pin J is held at approximately 0 volts. If the input to pin F is 'no hole', the bias is not overcome and V3 base is held slightly positive by D1. Neither of gating transistors V3 and V4 conducts, and D2 and D3 are cut off. If the input to pin F is a 'hole', the bias is overcome and V3 conducts; but because of the large emitter resistor R5 (4.7kΩ) the current in R6 is very small and D2 remains cut off. V4 remains cut off.

During the positive reset pulse, which takes pin J to +9 volts, either V3 or V4 will conduct. If there is a 'hole', D2 is cut off and the base of V3 is negative with respect to the base of V4 (i.e. 0V). V3 conducts and 2mA collector current flows. The volt drop across R4 makes D1 conduct and irrespective of the previous state of the bistable formed by V1 and V2, the bistable is set to the condition where V1 conducts and V2 is cut off. This is the '1' state.

If there is 'no hole' during the reset pulse, the bias on V3 will not be overcome and D2 will hold V3 base positive with respect to V4 base. V4 and D3 therefore conduct and irrespective of the previous state of the bistable, it is set to the condition where V1 is cut off and V2 conducts. This is the '0' state.

Thus the condition of the bistable can only change at the time of the reset pulse, the input state ('hole' or 'no hole') at the time of one reset pulse being staticised until the next reset pulse occurs.

The bistable output is taken to pin C via emitter follower V5, links being set to determine the output levels and which output polarity corresponds to a '1'.

If link 3 - 1 is connected, the collector potential of V1 provides the input to V5: this is OV ('positive') for the '1' state, and -9V otherwise.

If link 3 - 2 is connected, the collector potential of V2 provides the input to V5: this is -9V for the '1' state and OV otherwise.

The actual output levels depend on whether the input to V5 is connected directly to the transistor or via a level changing potentiometer, R11 and R12.

If link 4 - 6 is connected, the output is taken via the potentiometer and the levels are changed to approximately +1.5 volts and -3.5 volts.

If link 4 - 5 is connected, the output levels are unchanged and are approximately 0 volts and -9 volts.

The B and C plates are normally supplied with links 3 - 2 and 4 - 6 connected. The output is negative (-3.5V) for a hole in the tape.

4.5 Current switches (Diagram 12)

The production of the CLUTCH and BRAKE waveforms by the control bistable has been described in sections 3.3, 3.4 and 4.2. These waveforms are used in the circuit shown in Diagram 12 to operate the current switches, so that either the clutch or the brake electromagnet is energised.

When the STOP signal resets the control bistable, the BRAKE waveform moves from OV to a negative level. Transistor T2 conducts and its collector potential becomes approximately -0.5 volts, allowing a current of about ½ amp to flow in each brake coil. The armature is therefore attracted and the brake shoes engage on the brake drum and the tape comes to rest.

Diode D10 prevents the potential of the collector of T2 from rising to above -25 volts at the time of switching off, when the back e.m.f. produced by the clutch coil would exceed this value.

The brake electromagnet has two identical coils connected in parallel and the two brake shoes are actuated simultaneously to stop the tape. The clutch system also uses two coils and works in the same manner as the brake. Plug B(11) and plug B(12) are points where the CLUTCH and BRAKE waveforms may be inspected.

CHAPTER 5

INSTALLATION

5.1 Power requirements

The tape reader may be set for mains voltages in 5 volt steps between 90-130 volts and 180-260 volts a.c., 50 or 60 cycles per second, with permitted fluctuations of ±7%. As supplied, it is connected for either 115 or 230 volts. The supply connections and the associated circuitry are shown on Diagram 12. It is important that the external terminals are connected correctly.

The power is used to drive a capacitor-start, capacitor-run motor and a transformer. The latter provides power to the festoon lamp and the -25 volts, -9 volts and +9 volts supplies.

5.2 Electrical insulation

Plug B, pin 5 is labelled EARTH and is connected to the metal case of the tape reader in the normal way as a safety precaution. It should be noted that none of the internal circuits are earthed. Thus 0 volts, +9 volts, -9 volts or -25 volts (pin 6, 7, 8 or 9 on plug B) may be connected to any external equipment when necessary. It is however strongly recommended that no part of the internal circuitry should be so connected that a potential difference of more than 50 volts exists between itself and the metal case which is mains earthed.

5.3 Heat insulation

A cooling system is provided to remove the heat dissipated by the transistor circuits. The air passing into the reader enters at the position shown in Fig. 2. Thus the dust from the bench on which the reader is standing, is not drawn into the air entry. The cool air drawn into the reader passes over the transistorised circuits and leaves through the fan compartment. Efficient cooling is thereby achieved. This cooling system ensures that the reader will work in ambient temperatures of up to 122°F(50°C).

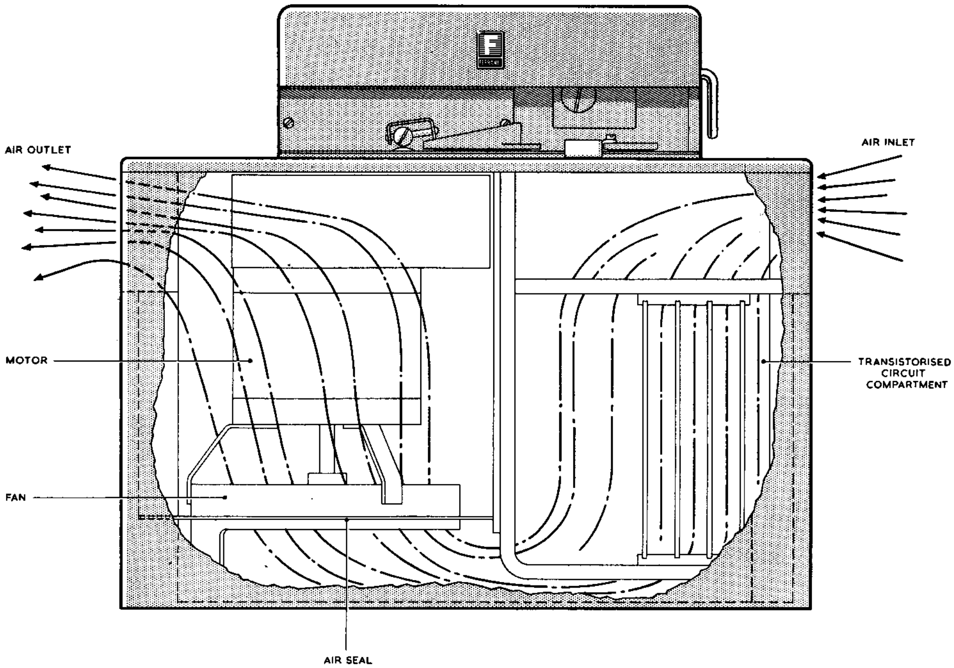

AIR OUTLET
AIR INLET
MOTOR
TRANSISTORISED
CIRCUIT
COMPARTMENT
FAN
AIR SEAL

Fig. 2.

CHAPTER 6

SETTING-UP PROCEDURE

6.1 Input and output plug connections

The printed board and input/output plug connections are listed on Diagram 14. With reference to plug B, the following should be noted:- For the mains input to the motor and transformer in the reader, terminals 1, 2, 3 and 4 (external connections) should be as shown on Diagram 16.

Pin 5 is connected to the metal case only and pins 6, 7, 8 and 9 are connected to the reader power rails.

CLUTCH monitor (pin 11) and BRAKE monitor (pin 12) are connected directly to the bases of the clutch and brake transistors.

6.2 Bias potentiometer

6.2.1 General adjustment

The bias potentiometer shown in Diagram 12 (RV1) sets the bias common to the digit bistables and the location cell circuit. The potentiometer is located in the air inlet (right hand) grille and is adjusted as follows:-

6.2.2 Method 1

Connect the oscilloscope to pin M of the printed circuit connector No.1 in order to display the READY waveform. Insert a test loop of the most translucent tape which will be used and operate the tape reader at full speed. Turn the bias potentiometer clockwise until the READY waveform fails and note the position of the screw adjuster. Repeat the test, turning the potentiometer anticlockwise and again note the position of the adjuster. Finally, set the bias to approximately the mid-point of the useable range.

6.2.3 Method 2

With the tape reader connected to a test set or computer and using the tape available, operate the reader at full speed and adjust the bias until the reader fails. Repeat the adjustment in the opposite direction. Finally, set the bias to the mid-point of its range.

6.2.4 Notes

(a) If the range of adjustment decreases, the most probable cause is the deterioration of the festoon lamp.

(b) With a good lamp and good photocells, the bias level for optimum operation is from 3.5-4.0 volts.

Note: Some TR5b Tape Readers are fitted with separate bias potentiometers for the location photocell and the digit photocells. These take the form of a twin pre-set co-axially mounted potentiometer with adjusting slots for large and small screwdrivers, the inner (or smaller) slot being the location photocell bias adjustment. The bias adjustments given in section 6.2 must therefore be carried out separately for each potentiometer.

6.3 Insertion of tape

A general view of the tape setting and release mechanism is given in Diagram 1. To insert a tape in the reader, the tape release lever should be turned in an anticlockwise direction so as to raise the guide plate. This enables the tape setting clip to be adjusted for 5, 7 or 8 unit tape as required. It is advisable to pull the tape to the next location hole after it has been inserted, after the machine is switched on. This ensures that the digit bistables are set to the character which is actually on the reading station.

CHAPTER 7

MAINTENANCE NOTES

7.1 Extender board

The extender board supplied with the tape reader simplifies the checking of the printed circuit plates A, B and C. The component layouts of these plates are shown on Diagrams 7, 9 and 11 respectively. The circuit plate under investigation should be removed from the tape reader, the extension plate plugged into its place and the printed circuit plate then plugged into the extender.

7.2 Wire guide

The wire guide may need to be replaced after long usage and three steps are required to execute the operation. The tape release lever should be turned clockwise to lower the guide plate and allow the old guide to be removed. The new wire guide is then fastened into place and should just rest on the detachable masking plate with no tape. The wire should then be paralleled with the masking holes and be as near to them as possible without reducing their illumination.

7.3 Optical projection system

The optical system will be correctly aligned when the tape reader is supplied. However, if it becomes necessary to change the festoon lamp, it is advisable to check the alignment.

To change the lamp, slacken the screw marked 1 on Diagram 1, and using screw 2 turn the complete lamp assembly through 90^0 in a clockwise direction. The lamp can now be easily removed from its contact clips. After inserting the new lamp, return the whole assembly to its original position.

The optical system is so designed that the cylindrical lens focuses the light from the festoon lamp into a beam with the same width as the holes in the masking plate.

To adjust the alignment of the lamp, screw 1 should be slackened and the whole assembly rotated until the beam of light shines directly into the holes in the masking plate. After tightening the appropriate screws, the system is in readiness for use.

7.4 Photocell outputs

These may be checked for ageing or damage as follows. The B, C_1 and C_2 plates are removed after ensuring there is no tape in the reader. The photocell output currents are then measured with a microammeter with a resistance of at least 1.8KΩ (e.g. a Model 8 Avometer switched to the 250μA scale). A minimum current of 160μA should be recorded. No cell current should differ by more than 10% from the mean current of the nine cells.

7.5 Care of the photocells

It is essential to keep the photocells free from dust and hence periodic cleaning is necessary. The tape setting clip and the masking plate, shown on Diagram 1, should therefore be removed in order to expose the photocells. A slightly moist cloth can then be used or the dust may be blown away. The masking plate should also be wiped fairly often with a damp cloth but great care must be taken to avoid scratching the resinated surface.

7.6 Tape feed mechanism

The chief requirement of the tape feed mechanism is that it should be possible to stop the tape within 0.05″ from the point at which braking commences. To achieve this it is necessary that the brake drum electromagnets are adjusted to have a small air gap between the armature and the electromagnet cores. A gap of 0.006″ to 0.008″ is considered to be ideal for the purpose.

To adjust the air gaps, the following procedure should be adopted. Remove the 6 screws marked Y in Diagram 1, thus allowing the complete tape reader assembly to be withdrawn from the casing. Remove the lamp housing by extracting the 4 screws indicated by X on Diagram 1. Disconnect the housing from the main assembly by removing the plug used for supplying power to the lamp filament. Take out the 4 printed circuit boards. Invert the whole tape reader as shown in Diagram 13, ensuring that the tape feed mechanism does not rest on the work bench.

Remove the 4 fan motor screws and extract the fan and motor from the assembly. The clutch and brake assemblies are now exposed and can be adjusted.

Slacken off the 3 pairs of screws, marked A, B and C on Diagram 2 allowing the retained parts to slide but without excessive play. Partly withdraw the armature stop screw D until it is well clear of the armature. Holding the armature firmly and squarely against the face of the electromagnet, carefully slide both the armature and the brake shoe until the latter is firmly in contact with the drum. Then still holding the assembly, tighten the screws marked A so as to clamp the armature pivot block. When adjusting the brake and clutch shoes, it is desirable to make the trailing edge of the shoes engage on the respective drums before the leading edge. To achieve this, insert a piece of paper approximately 0.003″ thick in the position shown in Fig. 3 and exert about 1 lb. pressure to the brake clamp screw B, nearest to the coil. A screwdriver or similar tool can be inserted in the slots provided in the platform. Meanwhile care should be taken that the armature does not interfere with the setting. The shoe should now be seated correctly and the two brake shoe clamp screws B tightened.

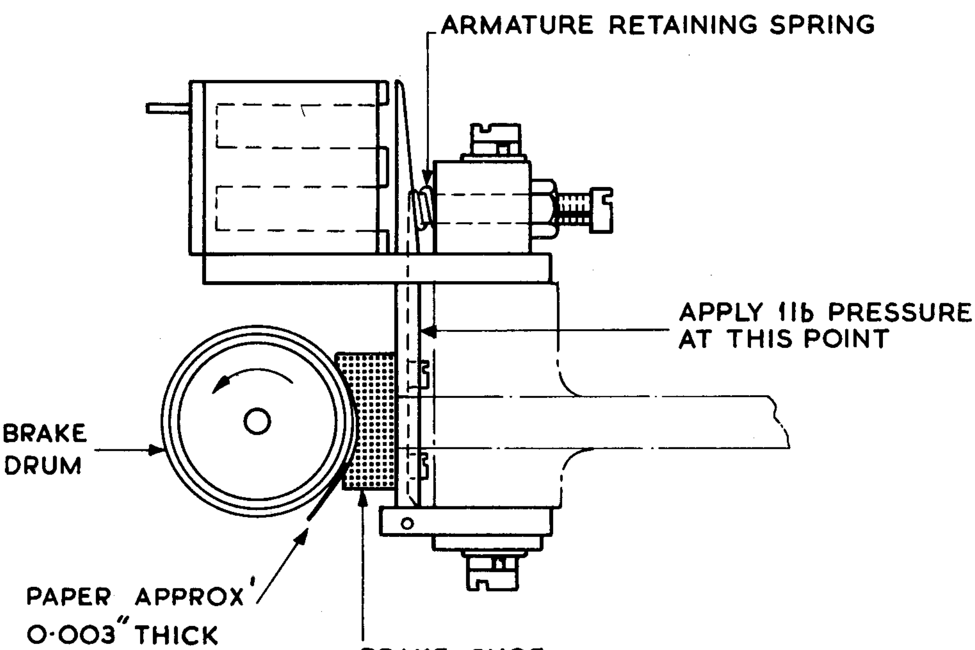


Fig. 3.

Still retaining the 1lb. pressure on screw B, slide the electromagnet assembly to produce the required air gap between the armature and the electromagnet. It is essential at this stage to check that the faces of the armature and the electromagnet are parallel in the horizontal and vertical planes; this will be the case if the previous adjustments have been carried out correctly. Clamp the electromagnet assembly by tightening the two screws C. If the shoes have been correctly seated, the air gap should still be in the region of 0.006″ to 0.008″. Finally adjust screw D until resistance to drum motion is felt, then screw until the drum is just free, and lock the screw.

7.7 Lubrication

After each 500 hours of running time a small amount of lubrication should be applied to the differential gear at the points shown in Diagram 3. The lamp housing cover must be removed to allow access to the gear. Only a very small amount of light grease or heavy oil (Rocol Molytone LM grease is recommended) should be used and on no account must the lubricant be allowed to spread to the surface of the brake or clutch drum. Excess lubricant must be carefully removed. A drop of light oil should be applied to the bearings of the tape pressure rollers, with any excess being removed.

7.8 Minor spares 65/47242

Part No.	Description	Quantity per Unit
65/11201	Armature spring	4
65/12109	Spring for tape guide plate	1
65/47258	Brake magnet complete	1
65/18057	Differential pinion	2
65/18059	Bearing plate for differential pinion	2
65/47018	Detachable masking strip	1
65/47086	Tape setting clip assembly	1
2836-267	Capacitor 1000μF 12v Plessey CE4058/9	1
2836-251	Capacitor 3000μF 25v Hunt KB62KZ	1
2851-791	Diode GJ3M A.E.I.	2
2881-115	Diode OA91	2
2741-014	Fuse 2A Bulgin F128	~~6~~
2522-281	Ball race Fischer FJP1	2
2881-355	Transistor OC42 Mullard	6
2881-604	Transistor OC35 Mullard	1
2881-454	Transistor GET. 103 G.E.C.	2
2764-359	Festoon lamp 12v 15w Phillips 12850	1
1765-202	Rocol Molytone LM grease	1

7.9 Major spares 65/47241

Part No.	Description	Quantity per unit
	Armature assembly - clutch	2
	Armature assembly - brake	2
65/12044	Spring roller assembly	1
65/12190	Brake magnet clamp block	1
65/12191	Armature stop screw	2
65/18005	Torsion spring	1
65/18253	Toggle bearing stud	1
65/18276	Rear tape guide	1
65/18277	Wire guide	1
65/47077	Transformer	1
2773-410	Motor	1
65/47225	Printed circuit assembly Plate 'A'	1
65/47229	Printed circuit assembly Plate 'B'	1
65/47233	Printed circuit assembly Plate 'C'	2
65/47107	Reading head	1
65/47029	Screw for reading head	2
2818-051	Coil resistor Erie style W 25w 50Ω centre tapped ± 10%	1
2828-122	Clip for coil resistor Welywn type 2H	2
2832-492	Motor capacitor 0.75μF	1

7.10 Screws, nuts, washers, etc. 65/47134

Description	Quantity per unit
Screw 8BA x 1/8" Lg. Ch. HD Brass Dull Chrome	4
Screw 8BA x 5/16" Lg. Ch. HD Brass Dull Chrome	2
Screw 8BA x 7/16" Lg. CSK HD M, Steel CAD. P.	2
Washer 8BA Std. Brass Dull Chrome	2
Hex. Nut 8BA Brass Dull Chrome	2
Screw 6BA x 1/4" Lg. Inst. HD Brass Dull Chrome	4
Screw 6BA x 5/16" Lg. CSK HD Phillips Brass Dull Chrome	2
Screw 6BA x 5/16" Lg. Inst. HD Phillips Brass Dull Chrome	2
Screw 6BA x 5/16" Lg. Ch. HD Brass Dull Chrome	4
Screw 6BA x 3/8" Lg. Ch. HD Brass Dull Chrome	2
Screw 6BA x 1 1/8" Lg. CSK. HD M. Steel CAD. P.	2
Screw 6BA x $1^{1}{}_{8}$" Lg. Ch. HD M. Steel CAD. P.	2
Washer 6BA STD. Brass Dull Chrome	4
Hex. Nut 6BA Brass Dull Chrome	4
Screw 4BA x 1/4" Lg. Ch. HD Mild Steel CAD. P.	2
Screw 4BA x 5/16" Lg. Ch. HD Mild Steel CAD. P.	4
Screw 4BA x 1/2" Lg. Inst. HD Phillips M. Steel Satin Chrome	4
Screw 4BA x 1/2" Lg. Ch. HD Brass Chrome	6
Screw 4BA x 3/4" Lg. Ch. HD Brass Dull Chrome	2
Washer 4BA STD. Brass Dull Chrome	6
Washer 4BA Single Coil Spring M. Steel CAD. P.	2
Hex. Nut 4BA brass Dull Chrome	6
Hex. Nut 2BA M. Steel CAD. P.	2
Washer 2BA Std. M. Steel CAD. P	2
Locknut 6BA Aero Thin	1
Allen Grub Screw 4BA x 3/16" Lg.	4
Allen Key 4BA 1/16" Across Flats.	2
Flat Spanner 8BA & 6BA	1
Flat Spanner 6BA & 4BA	1
Screw Driver Phillips No. 1	1
Screw Driver Phillips No. 2	1

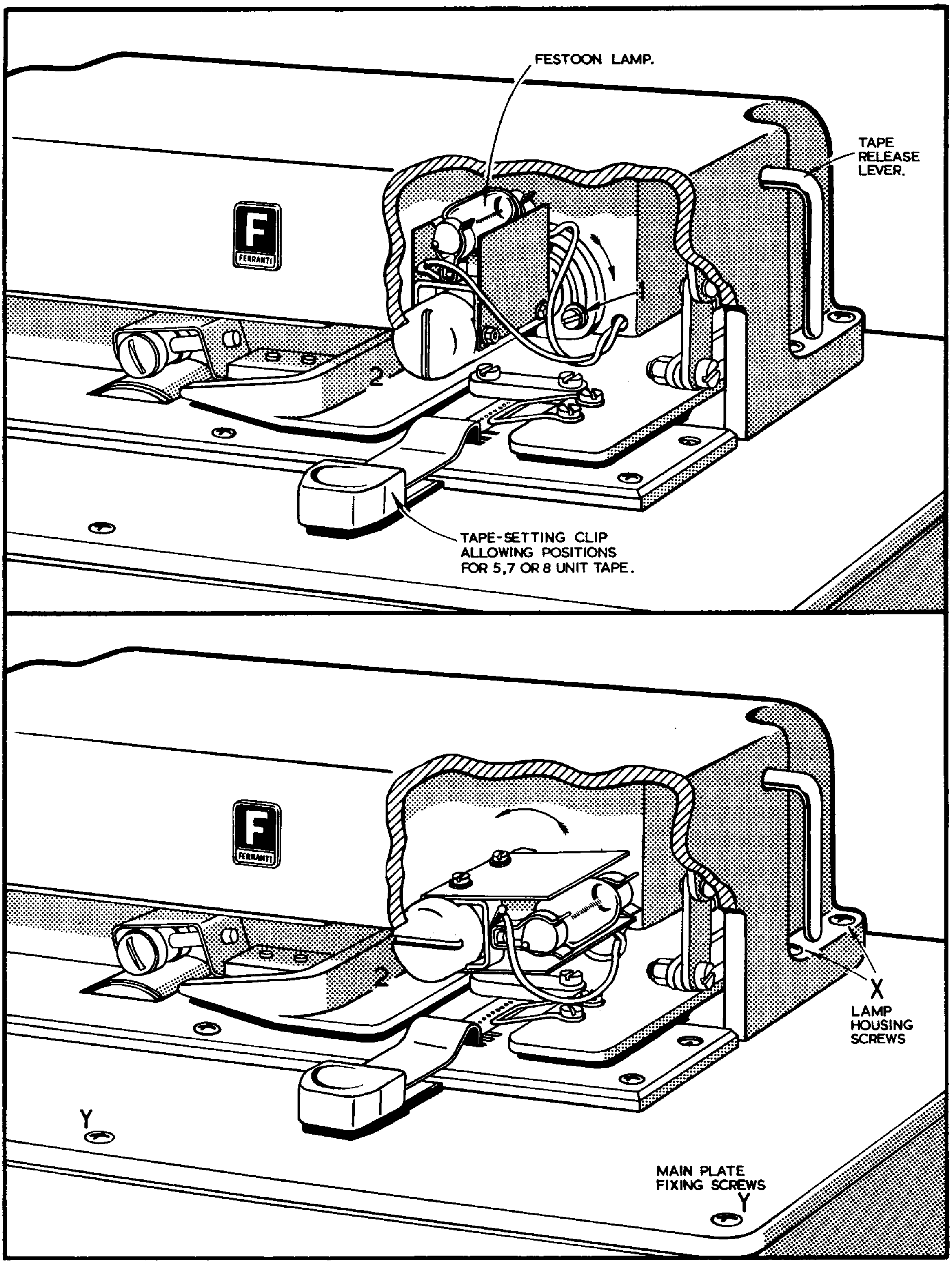


DIAGRAM. I. CUT-AWAY VIEWS OF THE TAPE READER.

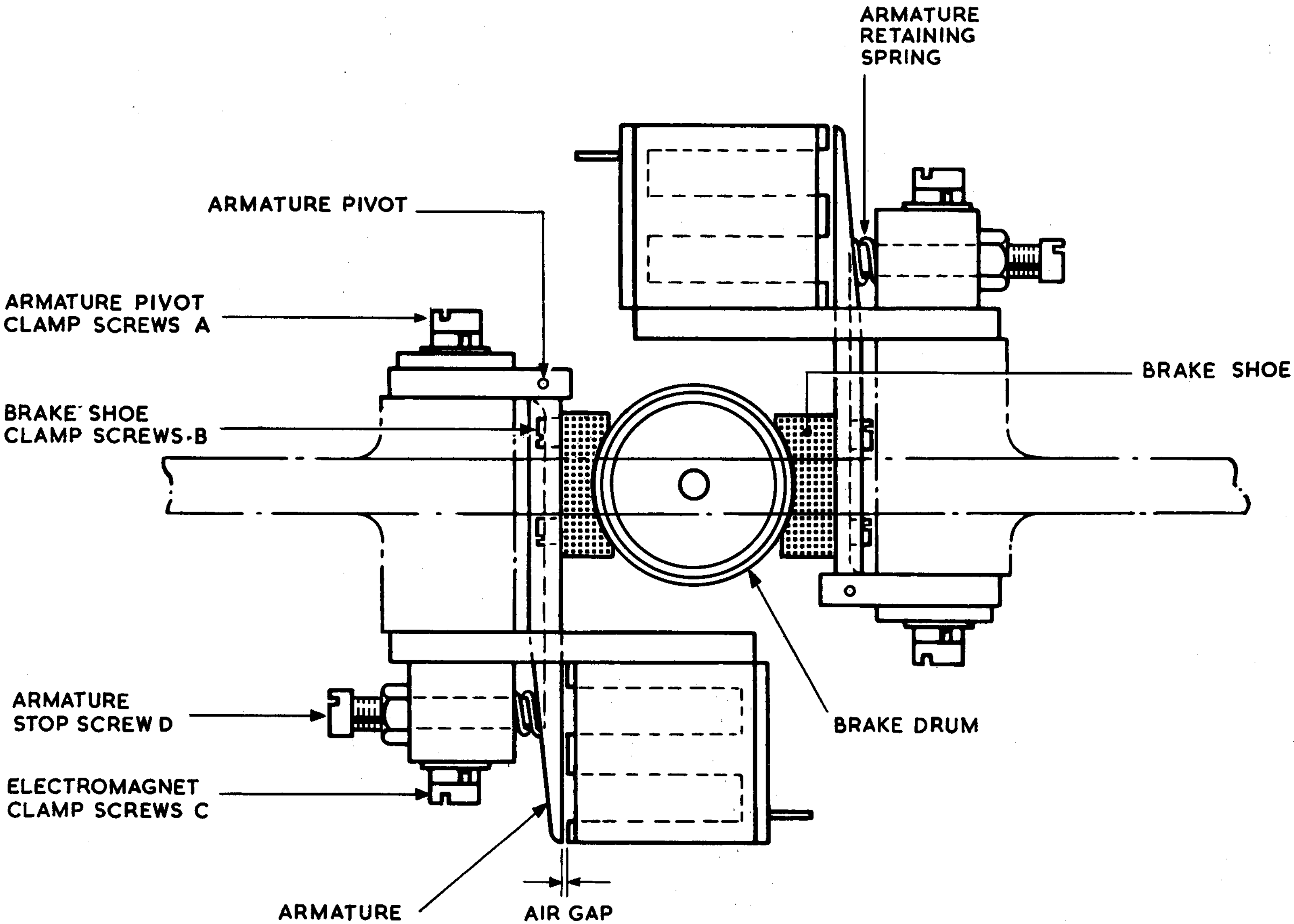


DIAGRAM 2. BRAKE MECHANISM

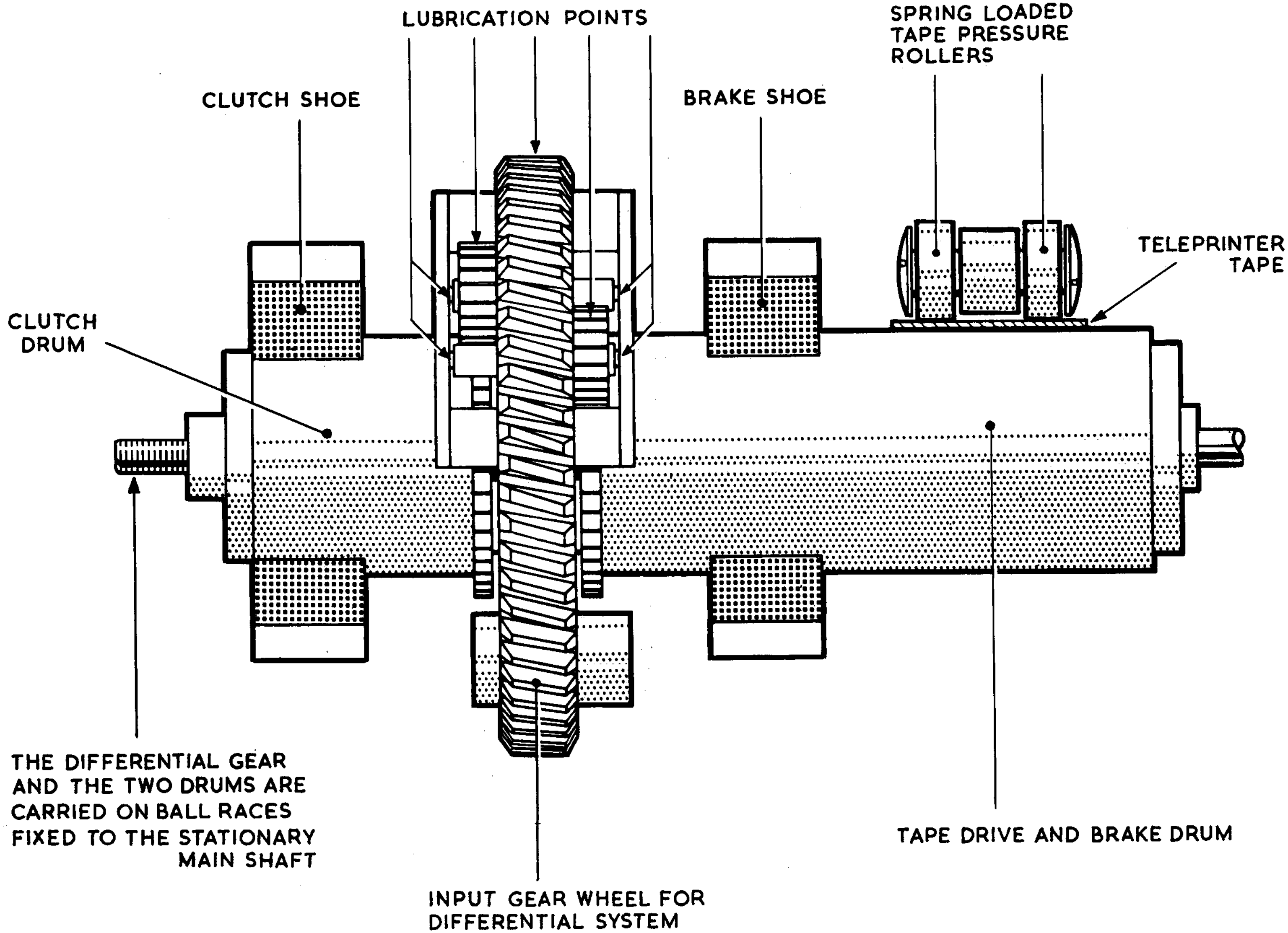


DIAGRAM 3. TAPE FEED MECHANISM

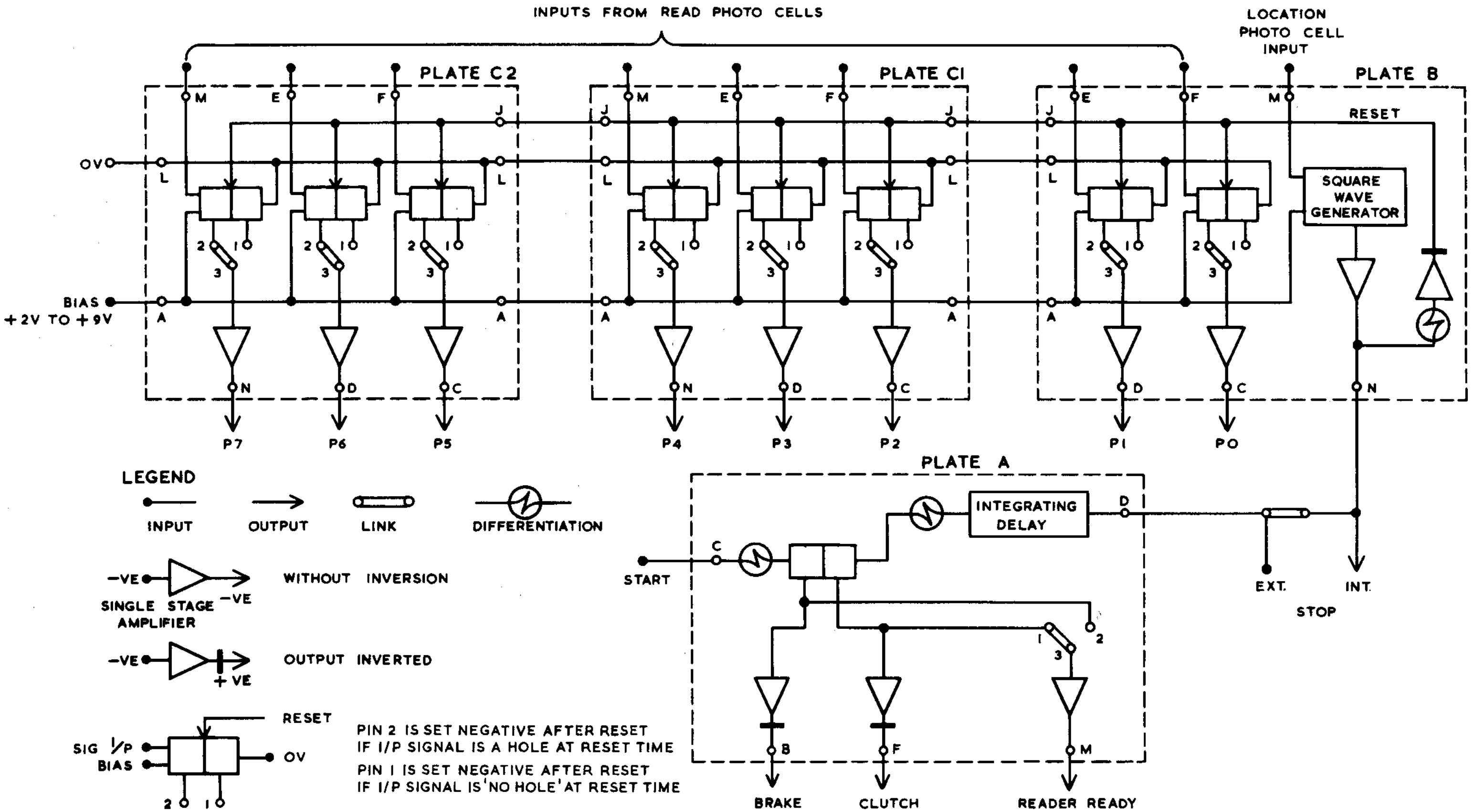


DIAGRAM 4. LOGICAL OPERATION

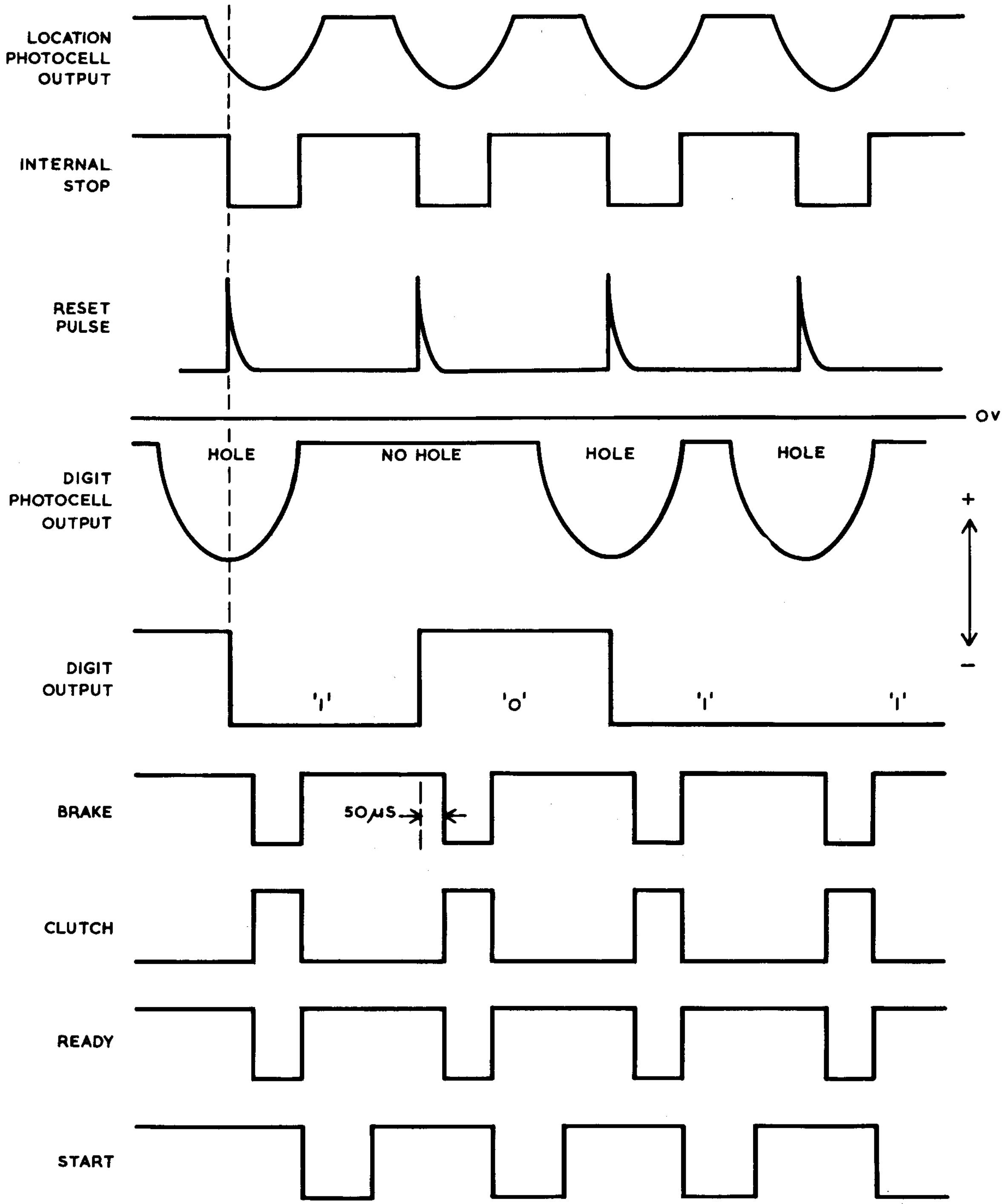


DIAGRAM 5. IDEALISED WAVEFORMS

COMPONENTS LIST

PLATE A Control (Brake and Clutch) Bistable and Ready

1. Resistors	Value	Type	Tolerance
R 1	2.2KΩ	Dubilier B.T.S.	± 10%
R 2	100Ω	" "	± 5%
R 3	330Ω	3W.W.W.	± 5%
R 4	4.7KΩ	Dubilier B.T.S.	± 10%
R 5	15KΩ	" "	"
R 6	10KΩ	" "	"
R 7	3.3KΩ	" "	"
R 8	3.3KΩ	" "	"
R 9	10KΩ	" "	"
R10	1.5KΩ	" "	"
R11	330Ω	3W.W.W.	± 5%
R12	15KΩ	Dubilier B.T.S.	± 10%
R13	100Ω	" "	± 5%
R14	2.2KΩ	" "	± 10%
R15	22KΩ	" "	"
R16	22KΩ	" "	"
R17	820Ω	" "	"
R18	100Ω	" "	± 5%
R19	10KΩ	" "	± 10%
R20	47KΩ	" "	± 5%
R21	47KΩ	" "	± 5%
R22	10KΩ	" "	± 10%
R23	15KΩ	" "	"
R24	4.7KΩ	" "	"
R25	10KΩ	" "	"
R26	4.7KΩ	" "	"
R27	10KΩ	" "	"
R28	4.7KΩ	" "	"

COMPONENTS LIST (Cont.)

PLATE A Control (Brake and Clutch) Bistable and Ready

1. Resistors (cont).	Value	Type	Tolerance
R29	4.7KΩ	Dubilier B.T.S.	± 10%
R30	47KΩ	" "	± 5%
R31	15KΩ	" "	± 10%
R32	100KΩ	" "	"
R33	2.7KΩ	" "	"

2. Capacitors	Value	Type	Tolerance
C1	1μF	Plessey CE41/1	± 20%
C2	680pF	G.E.C. or Suflex	± 10%
C3	0.002μF	Hunts CPM5	± 20%
C4	0.02μF	Hunts CPM5	± 10%
C5	150pF	G.E.C. or Suflex	± 2½%
C6	150pF	" "	± 2½%
C7	680pF	" "	± 10%
C8	680pF	" "	± 10%
C9	0.002μF	Hunts CPM5	± 20%

3. Transistors	Type
V1, V5	GET 103 G.E.C.
V2, V3, V4, V6, V7, V8	OC42 Mullard.

4. Diodes	Type
D1-D5	OA91 Mullard.

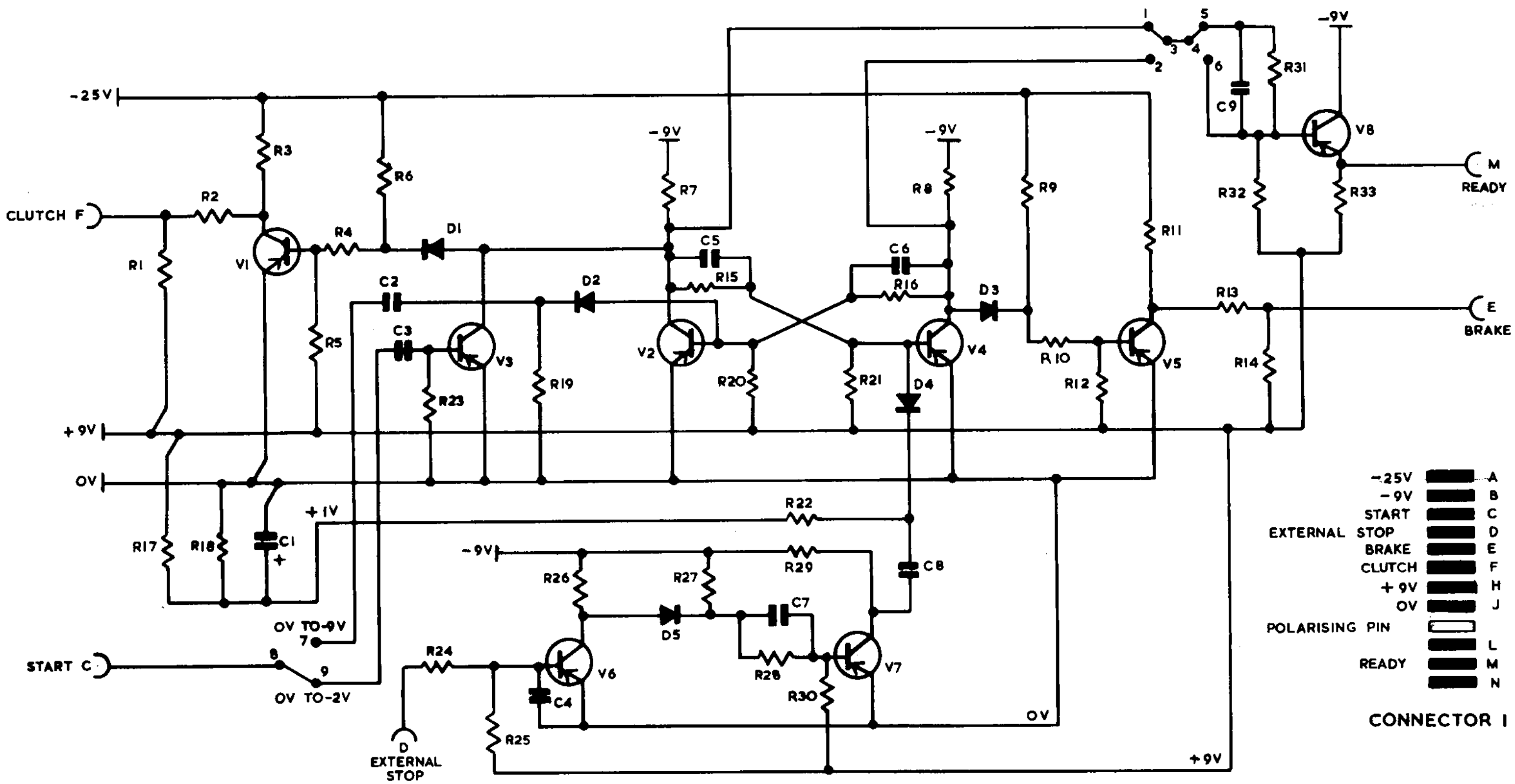
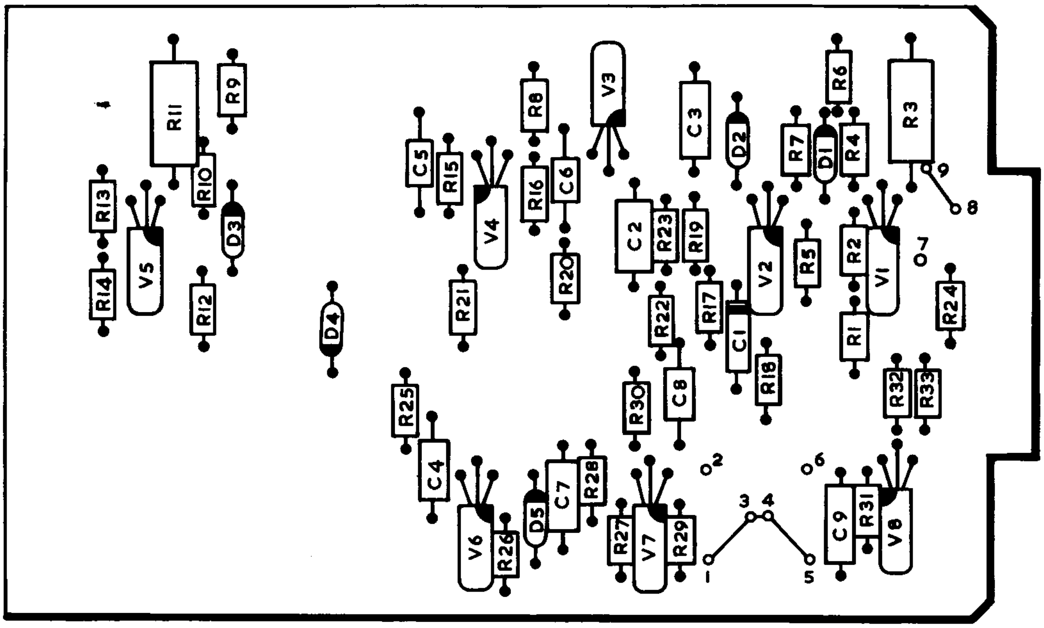
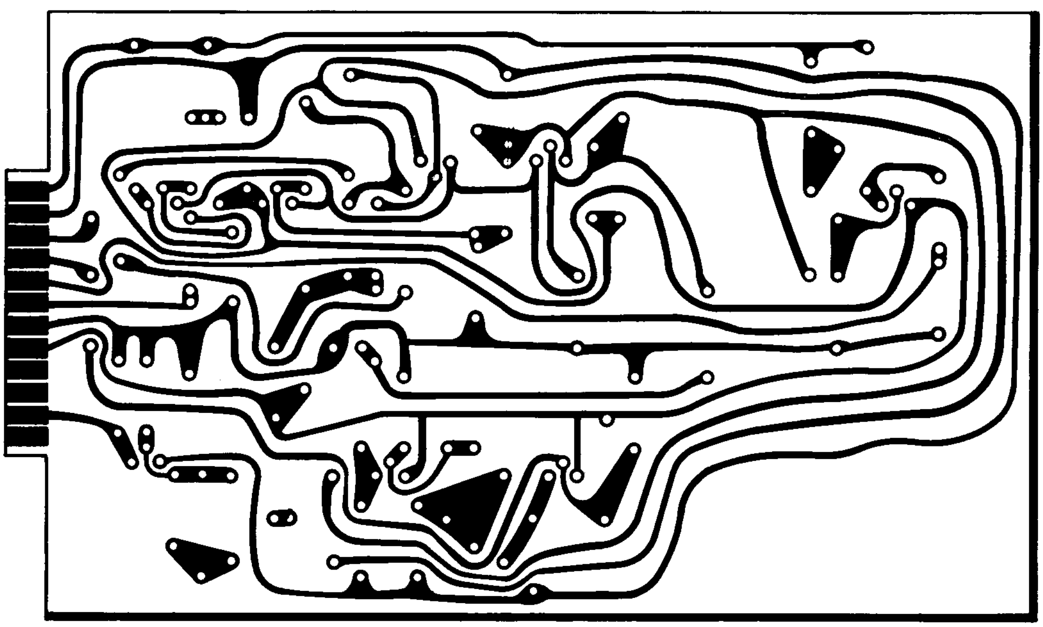


DIAGRAM 6. PLATE A. CONTROL (BRAKE & CLUTCH) BISTABLE AND READY CIRCUIT.



COMPONENT LAYOUT



OPPOSITE SIDE OF PANEL. PRINTED CIRCUIT

DIAGRAM 7. PLATE A. COMPONENT LAYOUT AND PRINTED CIRCUIT

COMPONENTS LIST

PLATE B. Location & Digit Bistables

1. Resistors. All resistors are Dubilier B.T S. type with a tolerance of ± 10%.

Resistor	Value	Resistor	Value
R 1	3.3KΩ	R19	3.3KΩ
R 2	22KΩ	R20	22KΩ
R 3	47KΩ	R21	47KΩ
R 4	10KΩ	R22	47KΩ
R 5	10KΩ	R23	4.7KΩ
R 6	3.3KΩ	R24	15KΩ
R 7	22KΩ	R25	100KΩ
R 8	47KΩ	R26	2.7KΩ
R 9	47KΩ	R27	10KΩ
R10	4.7KΩ	R28	220KΩ
R11	15KΩ	R29	47KΩ
R12	100KΩ	R30	4.7KΩ
R13	2.7KΩ	R31	22KΩ
R14	3.3KΩ	R32	47KΩ
R15	22KΩ	R33	2.7KΩ
R16	47KΩ	R34	3.3KΩ
R17	10KΩ	R35	4.7KΩ
R18	10KΩ		

2. Capacitors

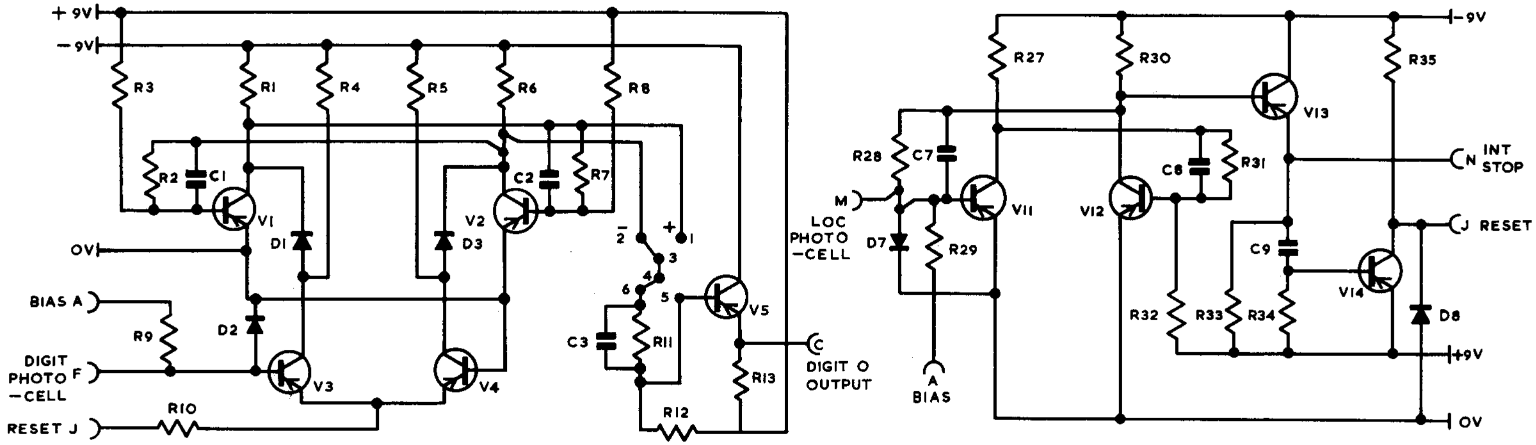
Capacitors	Value	Type	Tolerance
C1, C2, C4, C5	330pF	G.E.C. or Suflex	± 2½%
C7, C8, C9,	150pF	G.E.C. or Suflex	± 2½%
C3, C6.	0.002μF	Hunts CPM5	± 20%

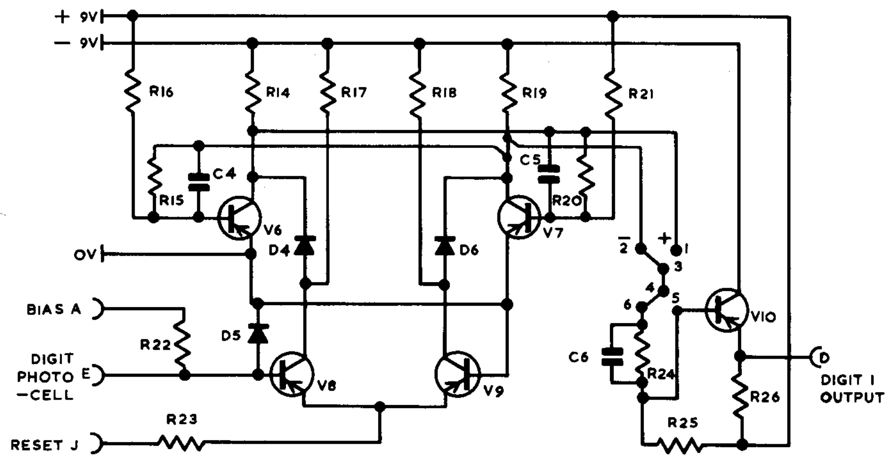
3. Transistors

Transistors	Type
V1-V14	OC42 Mullard

4. Diodes

D1-D8	OA91 Mullard

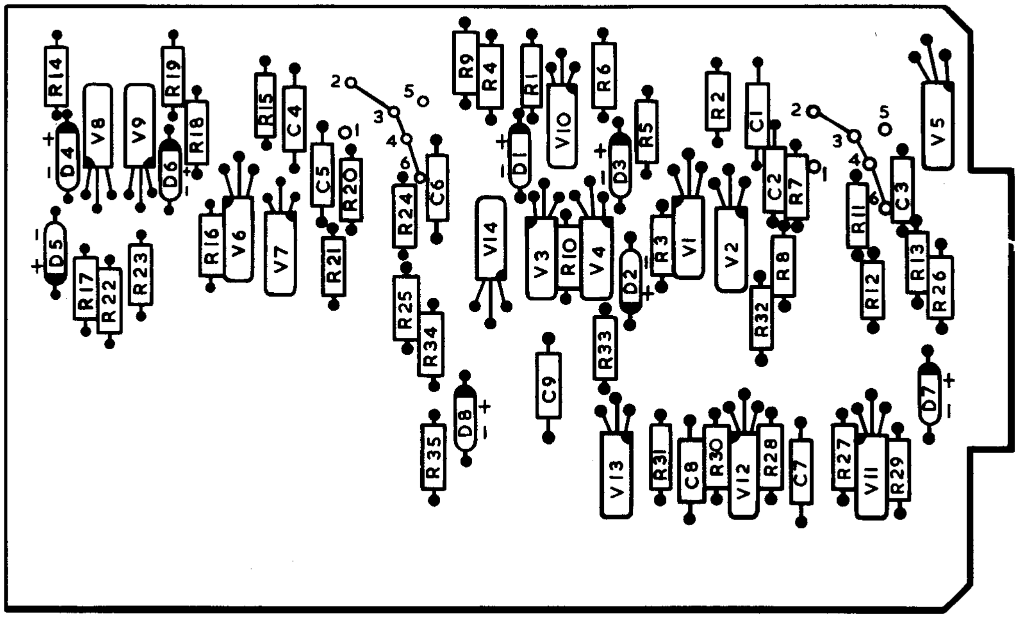




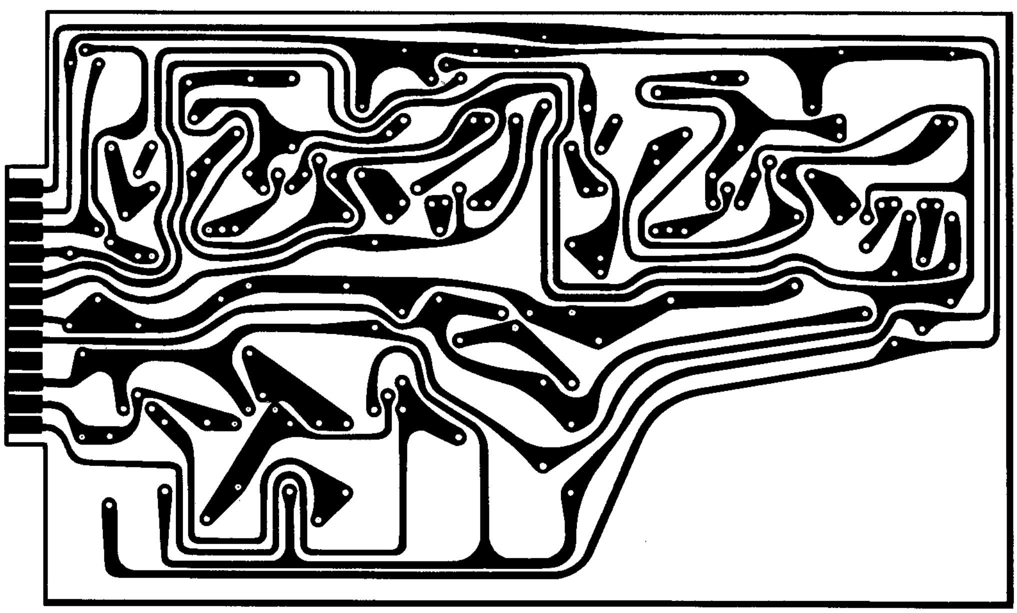
BIAS	A
-9V	B
PO	C
PI	D
P.C.I	E
P.C.O	F
+9V	H
RESET	J
POLARISING PIN	K
OV	L
PC LOC INPUT	M
INT STOP	N

CONNECTOR 2

DIAGRAM 8. PLATE B. DIGIT BISTABLES P_0 AND P_1 AND RESET



COMPONENT LAYOUT.



OPPOSITE SIDE OF PANEL — PRINTED CIRCUIT

DIAGRAM 9. PLATE B. COMPONENT LAYOUT AND PRINTED CIRCUIT

COMPONENTS LIST

PLATE C. Digit Bistables.

1. Resistors. All resistors are Dubilier B.T.S. type with a tolerance of ± 10%.

Resistor	Value	Resistor	Value
R 1	3.3KΩ	R21	3.3KΩ
R 2	22KΩ	R22	22KΩ
R 3	47KΩ	R23	47KΩ
R 4	47KΩ	R24	15KΩ
R 5	4.7KΩ	R25	100KΩ
R 6	10KΩ	R26	2.7KΩ
R 7	10KΩ	R27	3.3KΩ
R 8	3.3KΩ	R28	22KΩ
R 9	22KΩ	R29	47KΩ
R10	47KΩ	R30	47KΩ
R11	15KΩ	R31	4.7KΩ
R12	100KΩ	R32	10KΩ
R13	2.7KΩ	R33	10KΩ
R14	3.3KΩ	R34	3.3KΩ
R15	22KΩ	R35	22KΩ
R16	47KΩ	R36	47KΩ
R17	47KΩ	R37	15KΩ
R18	4.7KΩ	R38	100KΩ
R19	10KΩ	R39	2.7KΩ
R20	10KΩ		

2. Capacitors

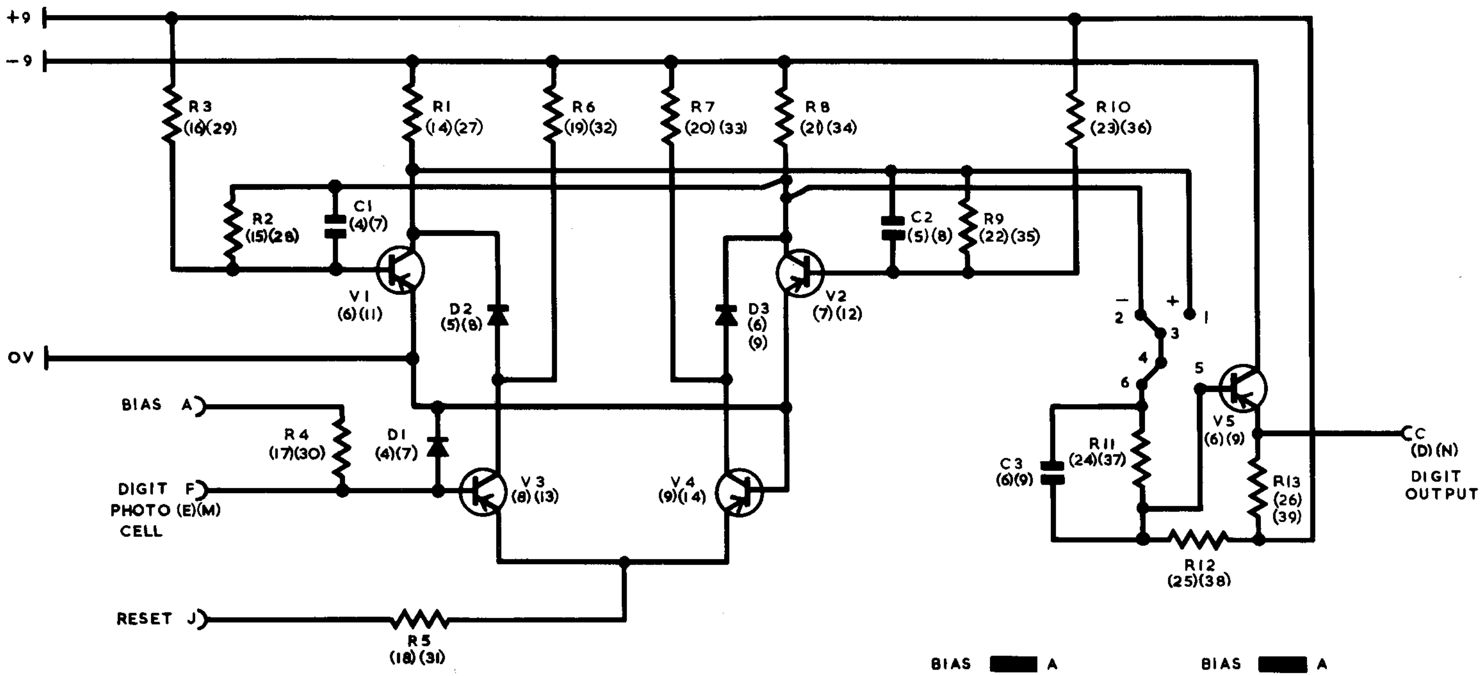
Capacitors	Value	Type	Tolerance
C1, C2, C4, C5, C7, C8,	330pF	G.E.C. or Suflex 2837-035	± 2½%
C3, C6, C9,	0.002μF	Hunts CPM5	± 20%

3. Transistors

Transistors	Type
V1-V15	OC42 Mullard

4. Diodes

Diodes	Type
D1-D9	OA91 Mullard



Connector 3	
BIAS	A
−9V	B
P2	C
P3	D
P.C.3	E
P.C.2	F
+9 V.	H
RESET	J
POLARISING PIN	
OV.	L
P.C.4	M
P4	N

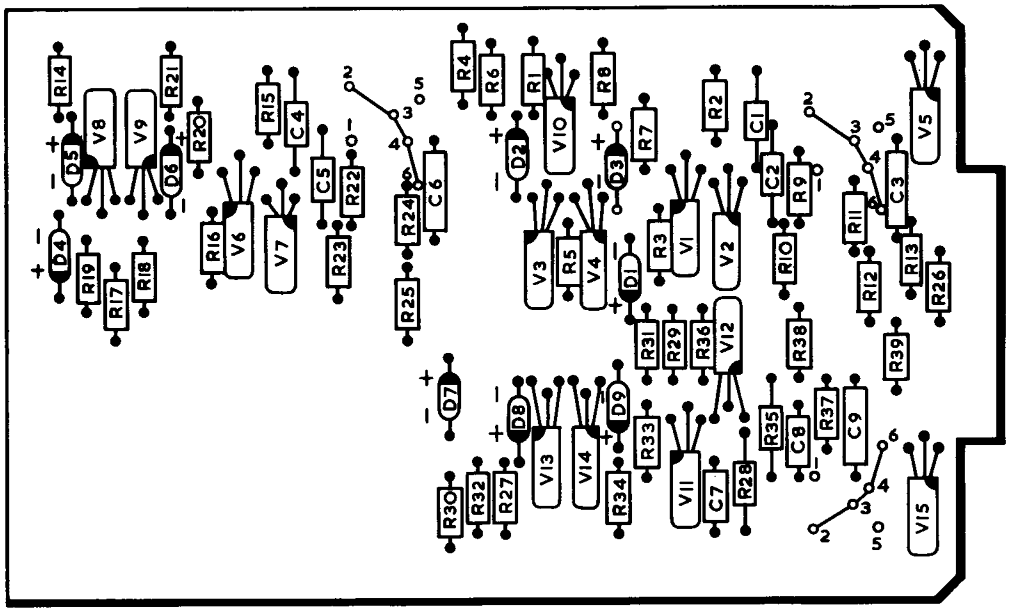
CONNECTOR 3

Connector 4	
BIAS	A
−9V	B
P5	C
P6	D
P.C.6	E
P.C.5	F
+9 V.	H
RESET	J
POLARISING PIN	
OV.	L
P.C.7	M
P7	N

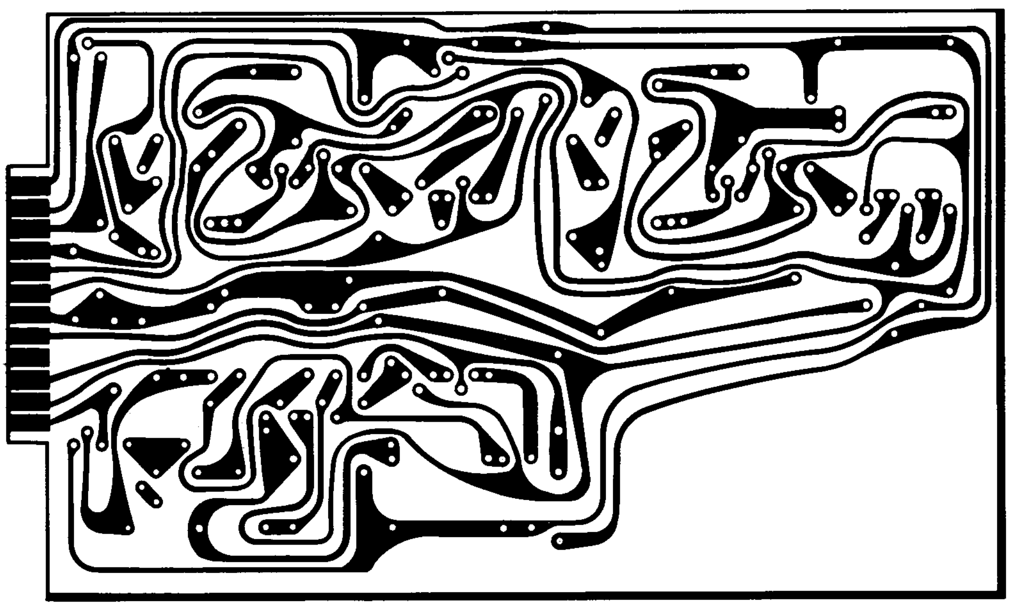
CONNECTOR 4

NOTE :-
FIGURES IN BRACKETS REFER TO BISTABLES P3 AND P4.
BISTABLES P5, P6 AND P7 NOT SHOWN.

DIAGRAM 10. PLATE C. DIGIT BISTABLES P_2 TO P_7



COMPONENT LAYOUT



OPPOSITE SIDE OF PANEL - PRINTED CIRCUIT

DIAGRAM II. PLATE C. COMPONENT LAYOUT AND PRINTED CIRCUIT

COMPONENTS LIST

Power Supplies and Brake and Clutch Circuit

230v Capacitor - start motor. Tapped - primary transformers.

1. Resistors

Resistors	Value	Type	Tolerance
R1	3.3Ω	3W	± 5%
R2	3.3Ω	3W	± 5%
R3	50Ω	25W Erie Style W.	± 10%
R4	220Ω	0.5W	± 10%
R6	220Ω	4.5W	± 5%
R7	220Ω	4.5W	± 5%
RV1	500Ω (Variable)	Colvern Type 1106/95	

2. Capacitors

Capacitors	Value	Voltage	Type
C1	3000μF	25V	Hunt KB62KZ
C2, C3, C4, C5,	1000μF	12V	Plessey CE 4058/9
C6	50μF	25V	Plessey CE 1201/1

3. Transistors

Transistors	Type
V1, V2	OC35 Mullard

4. Diodes

Diodes	Type
D1-D10	GJ3M A.E.I.

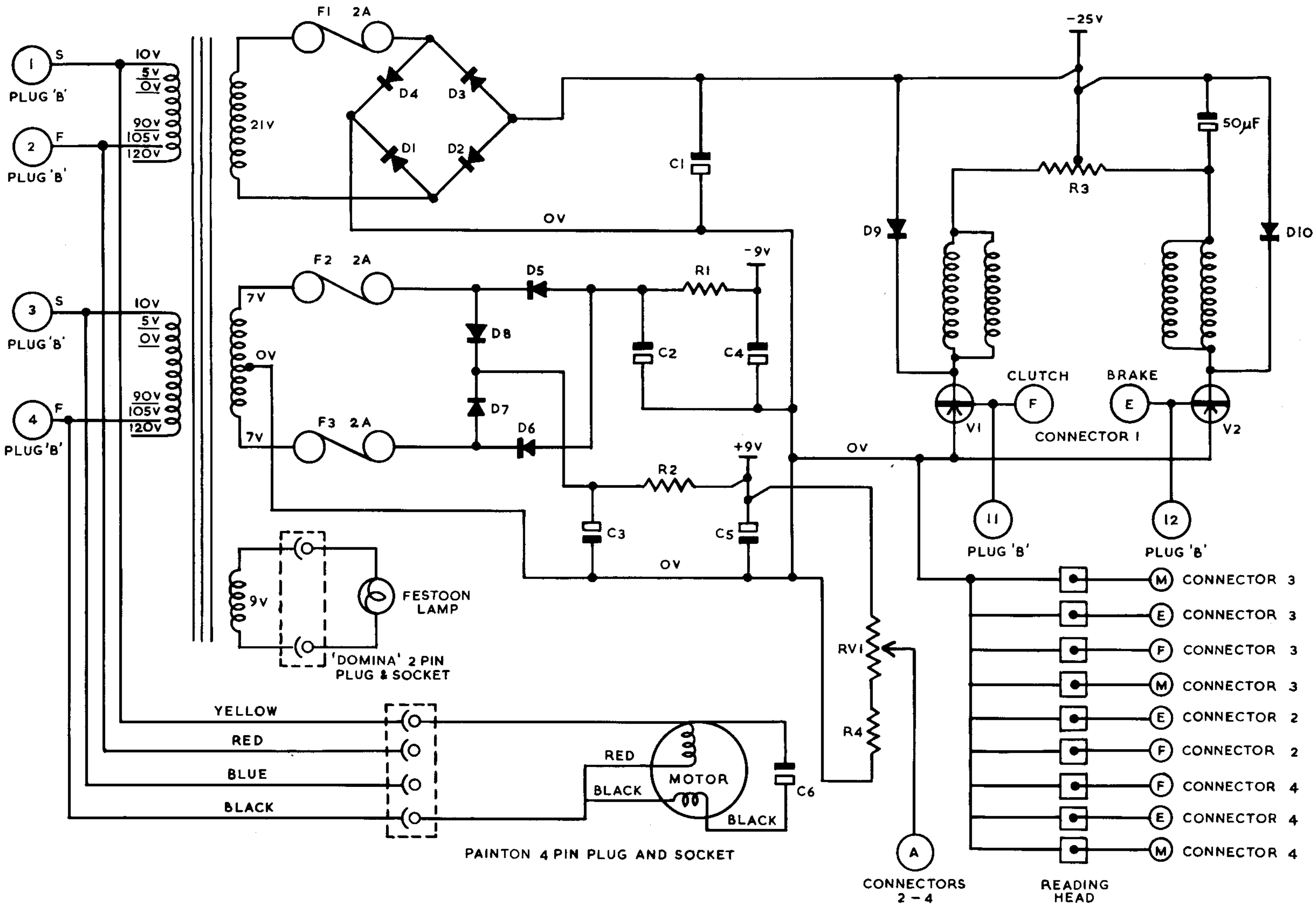


DIAGRAM 12. POWER SUPPLIES AND BRAKE AND CLUTCH CIRCUIT (COMPONENT PANEL)

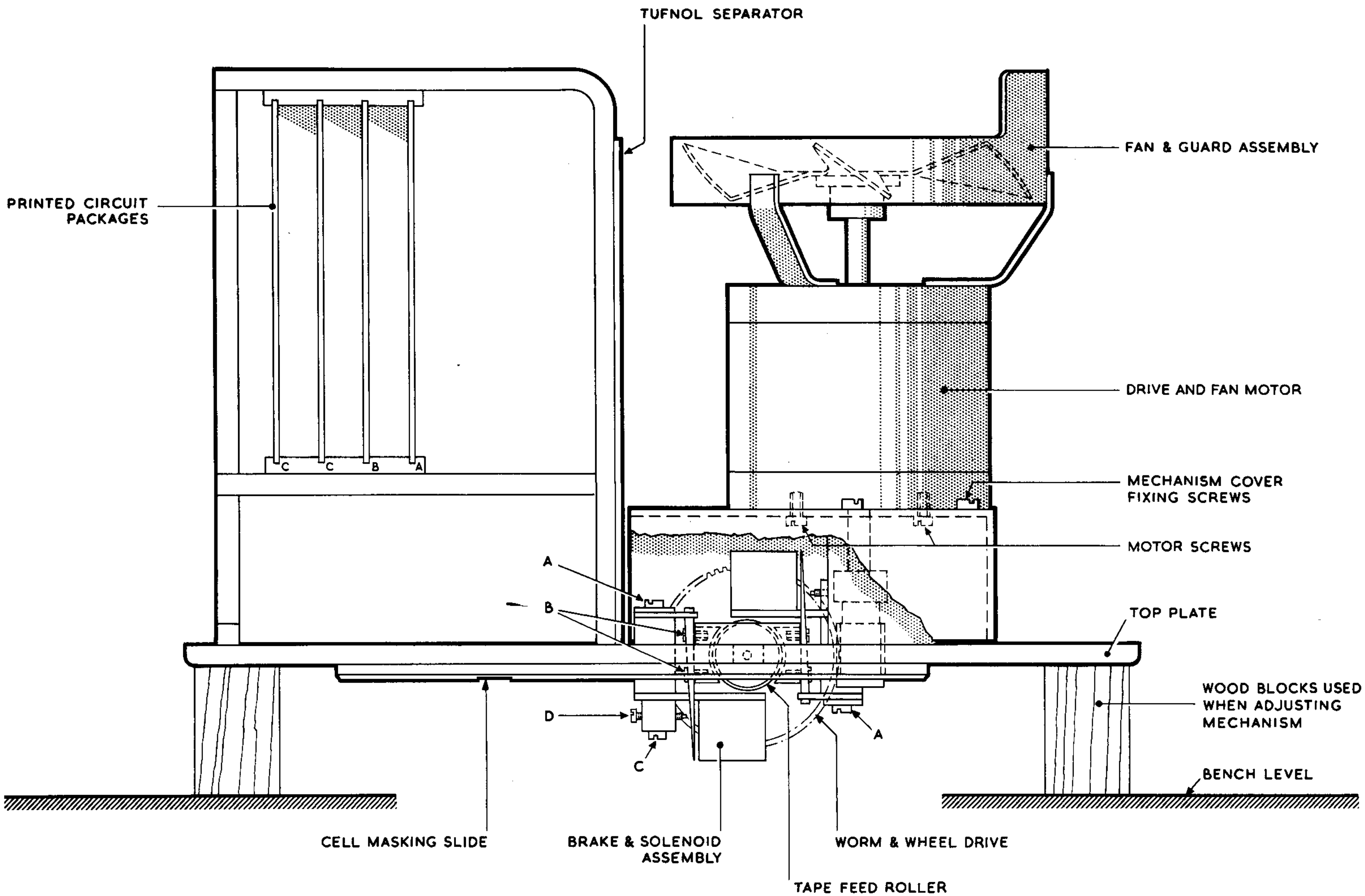


DIAGRAM 13. TAPE READER IN POSITION FOR ELECTROMAGNET ADJUSTMENT.

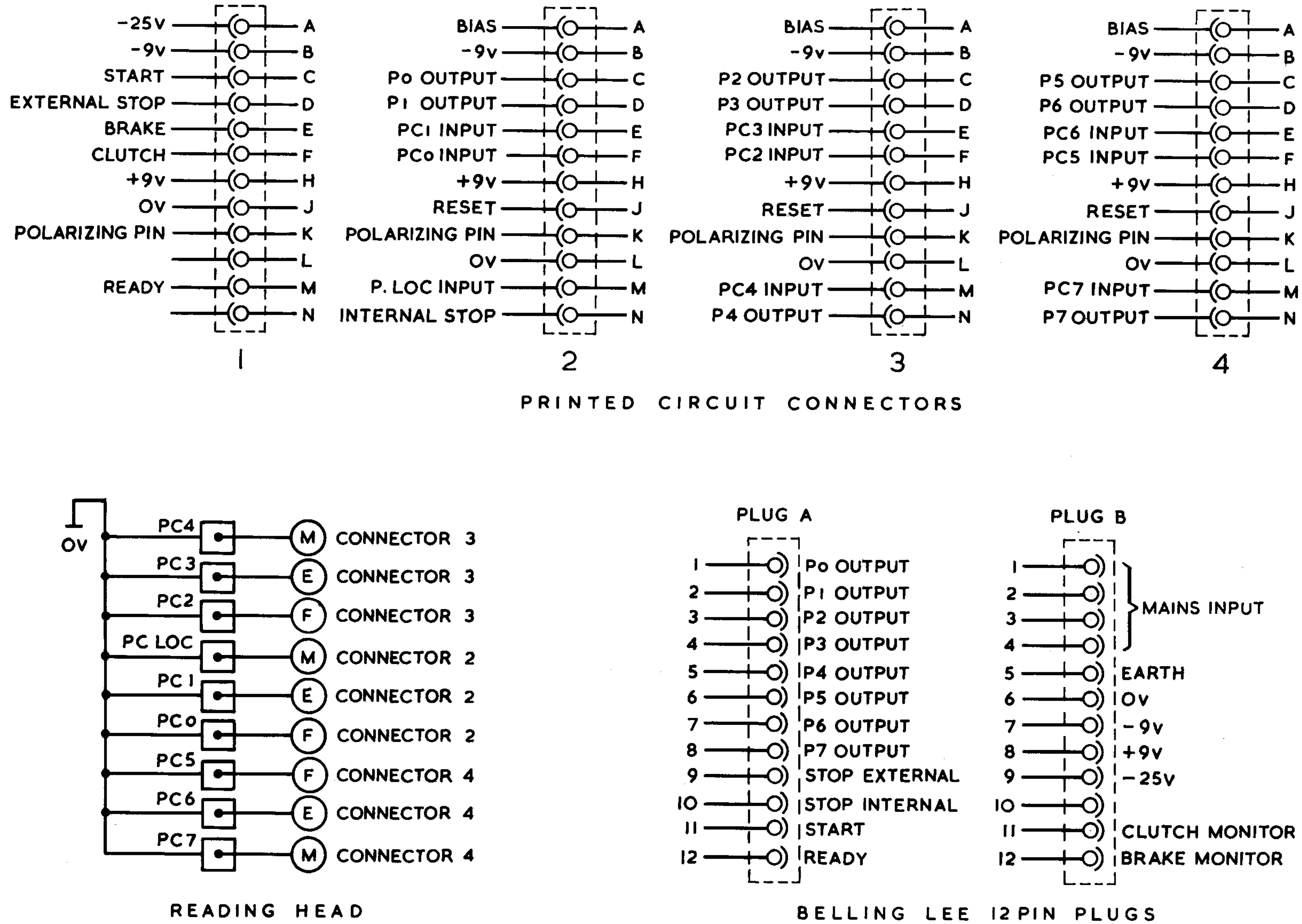


DIAGRAM 14. PRINTED BOARD AND PLUG CONNECTIONS.

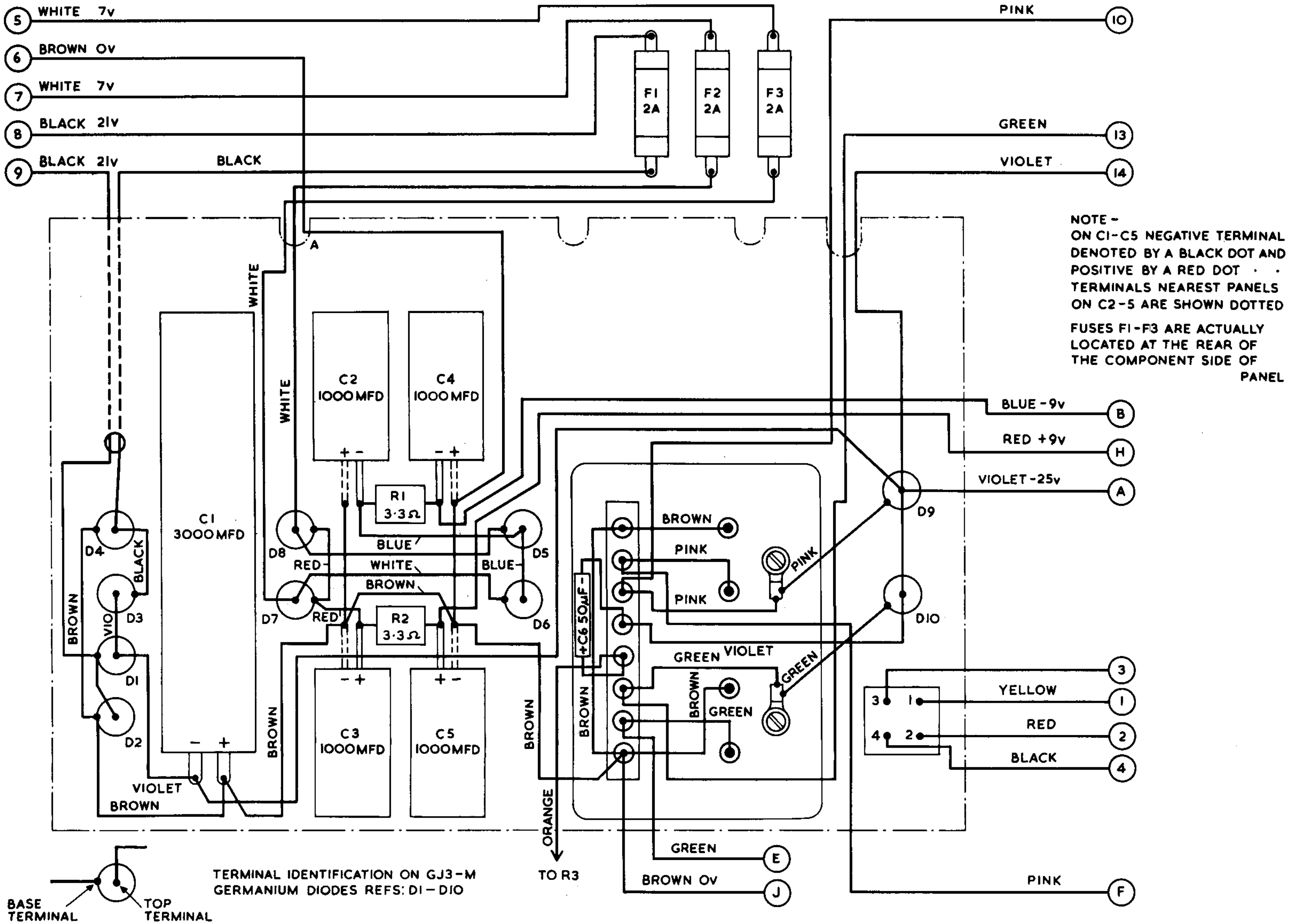
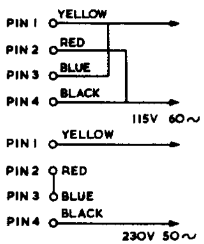


DIAGRAM 15. COMPONENT PANEL WIRING DIAGRAM.



EXTERNAL CONNECTIONS TO PLUG B

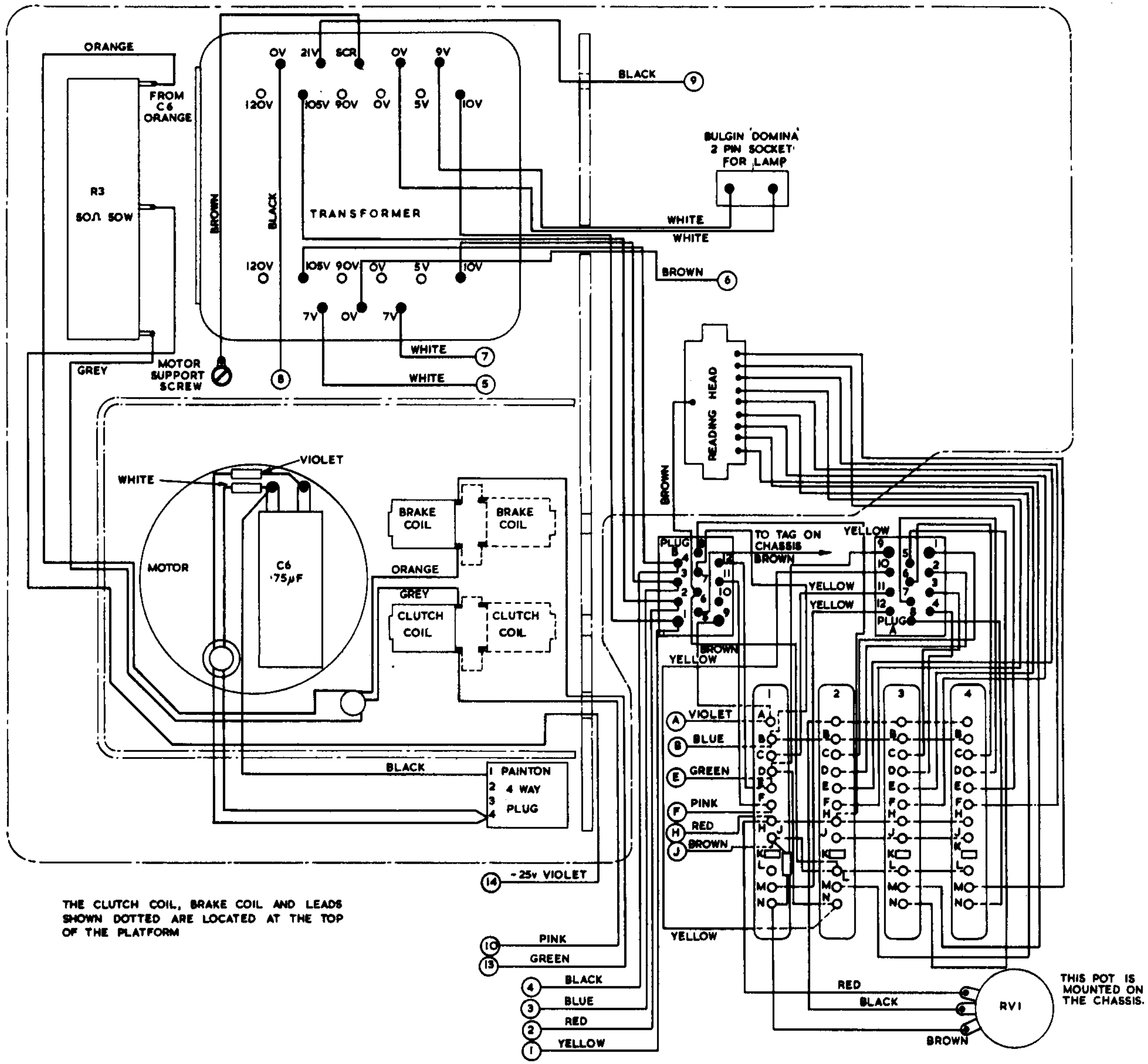


DIAGRAM 16 GENERAL WIRING DIAGRAM

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