

**As you are now the owner of this document which should have come to you for free, please consider making a donation of £1 or more for the upkeep of the (Radar) website which holds this document. I give my time for free, but it costs me around £300 a year to bring this document to you. You can donate here <https://blunham.com/Radar>, thank you.**

**Do not upload this copyright pdf document to any other website. Breaching copyright may result in a criminal conviction and large payment for Royalties.**

This document was generated by me, Colin Hinson, from a document held at R.A.F. Henlow Signals Museum which is believed to be out of copyright or Crown Copyright. It is presented here (for free) under the Open Government Licence (O.G.L.) if under Crown Copyright and this version of the document is my copyright (along with the Crown Copyright) in much the same way as a photograph would be. It should be noted that most of the pages are identifiable as having been processed by me. If you believe the original document to be under copyright, please contact me.

The document should have been downloaded from my website <https://blunham.com/Radar>, or any mirror site named on that site. If you downloaded it from elsewhere, please let me know (particularly if you were charged for it). You can contact me via my Genuki email page: <https://www.genuki.org.uk/big/eng/YKS/various?recipient=colin>

**You may not copy the file for onward transmission of the data nor attempt to make monetary gain by the use of these files. If you want someone else to have a copy of the file, point them at the website (<https://blunham.com/Radar>). Please do not point them at the file itself as it may move or the site may be updated.**

---

I put a lot of time into producing these files which is why you are met with this page when you open the file.

In order to generate this file, I need to scan the pages, split the double pages and remove any edge marks such as punch holes, clean up the pages, set the relevant pages to be all the same size and alignment. I then run Omnipage (OCR) to generate the searchable text and then generate the pdf file.

Hopefully after all that, I end up with a presentable file. If you find missing pages, pages in the wrong order, anything else wrong with the file or simply want to make a comment, please drop me a line (see above).

If you find the file(s) of use to you, you might like to make a donation for the upkeep of the website – see <https://blunham.com/Radar> for a link to do so.

*Colin Hinson*

*In the village of Blunham, Bedfordshire, UK.*

AIR PUBLICATION

**116L-0401-1**

(formerly A.P. 116M-0325-1)

**PAPER TAPE READER**  
**(ELLIOTT TYPE TRM 500/1000 SERIES)**

**or**

**(ICL TYPE 1916/9)**

**GENERAL AND TECHNICAL INFORMATION**

BY COMMAND OF THE DEFENCE COUNCIL



---

Ministry of Defence

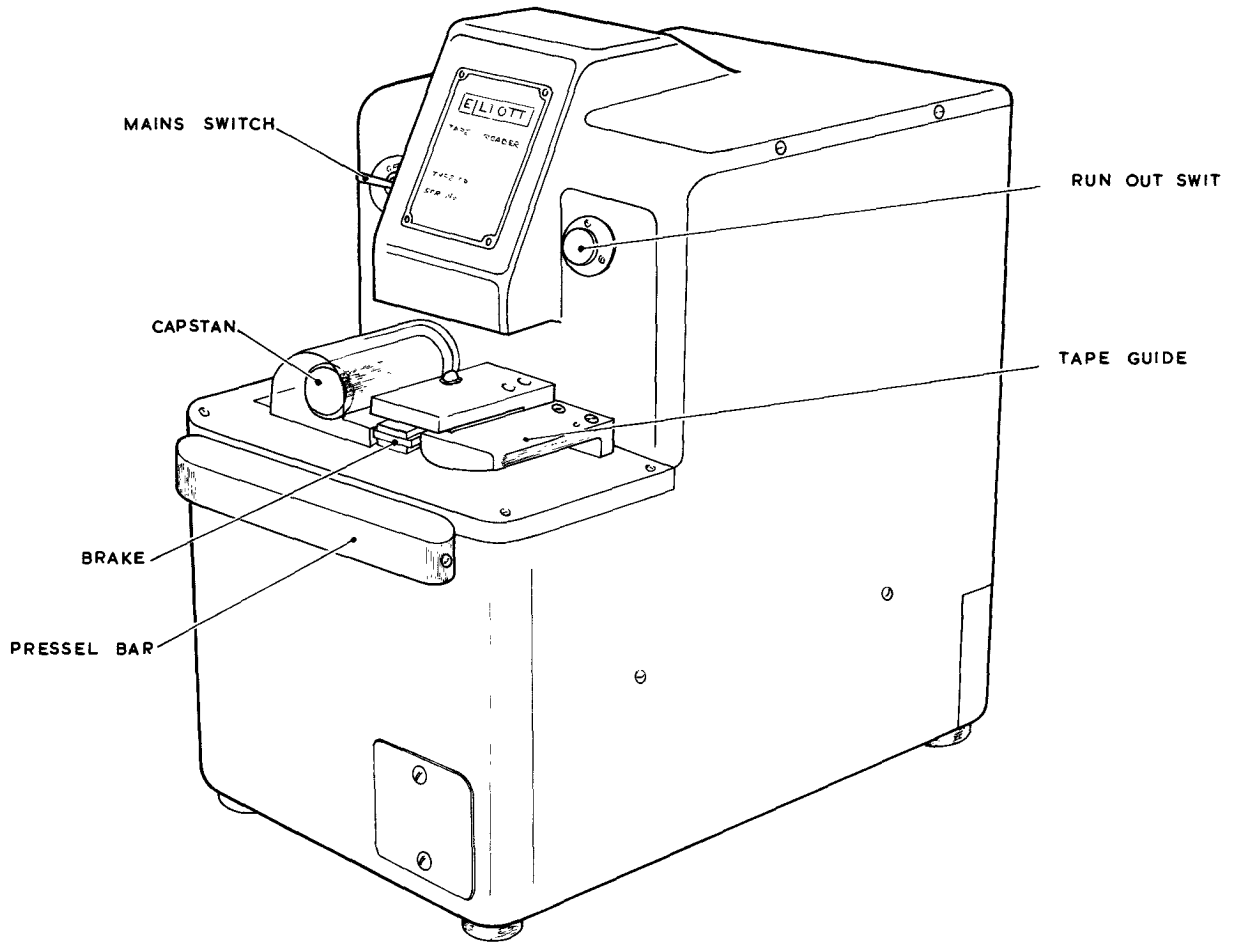
FOR USE IN THE  
ROYAL AIR FORCE

## PREFACE

This publication contains information on the following types of Elliott (now ICL) high-speed paper tape readers:-

- (1) TRM 500/2 (ICL No. 1916/9).
- (2) TRM 500/3 (ICL No. 1916/9).
- \* (3) TRM 500/5
- \* (4) TRM 1000/2 (ICL No. 1916/9).
- (5) TRM 1000/4 (ICL No. 1916/9).
- (6) TRM 1000/5 (ICL No. 1916/9).

\* These two tape readers differ with respect to the motor power supply and they have extra or different components to the others. These differences are given in Appendices 2 (TRM 1000/2) and 3 (TRM 500/5) to this publication.



Frontispiece

TAPE READER TYPE TRM500/1000

## CONTENTS

	Page
Chapter 1: INTRODUCTION	
1.1 General ... ..	1
1.2 Operation ... ..	1
Chapter 2: TECHNICAL SPECIFICATION	
2.1 Tape Widths ... ..	3
2.2 Tape Standard ... ..	3
2.3 Speed of Operation ... ..	3
2.4 Output Signals ... ..	4
2.5 Acceleration ... ..	5
2.6 Power Requirements ... ..	5
2.7 Clutch Coil Impedance ... ..	5
2.8 Brake Coil Impedance ... ..	5
2.9 Connectors ... ..	6
2.10 Overall Dimensions ... ..	6
2.11 Weight ... ..	6
2.12 Colour ... ..	6
2.13 Temperature Range ... ..	6
2.14 Humidity Range ... ..	6
Chapter 3: INSTALLATION	
3.1 Acceptance ... ..	7
3.2 Unpacking ... ..	7
3.3 Post-delivery inspection ... ..	7
3.4 External Connections ... ..	8
3.5 Ventilation ... ..	9
Chapter 4: OPERATING INSTRUCTIONS	
4.1 On/Off Switch ... ..	11
4.2 Tape Width Adjustment ... ..	11

## CONTENTS (Contd.)

	Page
4.3	Tape Loading ... .. 11
4.4	Tape Run-Out ... .. 11
4.5	Tape Removal ... .. 11
4.6	Tape Splicing ... .. 12
4.7	Tape Repairing ... .. 12
Chapter 5: ROUTINE MAINTENANCE	
5.1	General ... .. 13
5.2	Daily Maintenance ... .. 13
5.3	Monthly Maintenance ... .. 13
5.4	Quarterly Maintenance ... .. 14
Chapter 6: PRINCIPLES OF OPERATION	
6.1	Introduction ... .. 17
6.2	Circuit Operation ... .. 19
6.3	Output Waveforms ... .. 23
6.4	Acceleration ... .. 24
6.5	Monitor Points ... .. 25
Chapter 7: SERVICING	
7.1	Tools and Materials ... .. 27
7.2	Dismantling ... .. 28
7.3	Assembly ... .. 36
7.4	Clutch Force Measurement ... .. 45
7.5	Brake Adjustment ... .. 46
7.6	Lubrication ... .. 46
7.7	Operational Test ... .. 48
7.8	Fault Finding ... .. 48

## CONTENTS (Contd.)

	Page
Chapter 8: TABLES	
8.1 Table 1 - Parts List ... ..	51
8.2 Table 2 - Tools and Materials - routine maintainance	62
8.3 Table 3 - Special Tools ... ..	62

## ILLUSTRATIONS

Tape reader Type TRM 500/1000... ..	Frontispiece
-------------------------------------	--------------

NOTE: The following illustrations are included at the rear of the text

	Fig.
Tape reader Type 500/1000 with covers removed	1
Internal Control Circuits ... ..	2
Clutch and Brake Control - Recommended Circuit ... ..	3
Typical Tape and Output Waveforms ... ..	4
Voltage Stabilizer - Component Layout ... ..	5
Voltage Stabilizer - Circuit ... ..	6
Amplifiers - Component Layout ... ..	7
Amplifiers - Circuit ... ..	8
Data Circuit Interconnections ... ..	9
Tape Acceleration Diagrams ... ..	10
Light Mask Alignment ... ..	11
Illustrated Parts List ... ..	12

APPENDIX 1: Use of Clutch roller/spindle set

APPENDIX 2: Tape Reader Mechanism TRM 1000/2

APPENDIX 3: Tape Reader Mechanism TRM 500/5

## Chapter 1: INTRODUCTION

### 1.1 General

The Tape Readers Type TRM 500 and 1000 are designed to read punched tape at speeds up to 500 or 1000 characters per second and can stop on any selected character. The tape information is sensed by silicon photovoltaic cells and is converted into electrical signals suitable for transmission to a computer or similar equipment. Standard tape widths from 11/16in. to 1in. may be accommodated in the readers. The tape may be punched with data in any 5, 6, 7 or 8 channel code. Each reader is a light, compact unit capable of efficient working over a temperature range of +5°C to +45°C.

### 1.2 Operation

The tape is drawn through the reader by a pair of rollers, the upper roller being fixed on the end of a motor shaft. The position of the lower roller is controlled by an electromagnet, the amount of movement being sufficient to remove the drive from the tape, when desired. The tape also passes between two flat surfaces, the pressure between these being controlled by a second electromagnet to provide a braking action on the tape.

The instrument comprises lamp, driving motor, clutch and brake electromagnet assemblies, optical system, photosensor assembly and amplifier circuits, but does not include electronic control circuits. The supplies required are 200 - 250 volts 50c/s, or 100 - 125 volts 60c/s, for the motor, a 9.5 volt a. c. or d. c. supply for the lamp, and two stabilised supplies of 6 to 10 volts for the photosensors and amplifier circuits. The electromagnet coils, which each have a resistance of approximately 0.5 ohms, will operate correctly on 1.0 ampere d. c.

## Chapter 2: TECHNICAL SPECIFICATION

### 2.1 Tape Widths

Any standard width of tape, up to one inch, punched with sprocket holes and up to eight data channels, may be used.

### 2.2 Tape Standard

Any tape conforming to BS. 3880 or ECMA 10. The recommended alternatives and suppliers are:

#### ASCOM TAPE

Thames Paper Supplies Ltd.,  
13-21, Curtain Road,  
London, E.C.2.

#### TYPE A1 TAPE

Waterlow Automation Services Ltd.,  
P.O. Box 10,  
Dunstable,  
Beds.

#### ASCOM TAPE

Rollco Papers Ltd.,  
11-16 Leigh Hunt Road,  
London, S.E.1.

In addition to Waterlow A1 and Ascom Tapes, Premier C has been found to give satisfactory operation in the reading and punching equipment. It does however, produce more fluff, necessitating more frequent cleaning of the equipment. Premier C is obtainable from:

Percy Boyden & Co. Ltd.,  
5, Commerce Way,  
Wadden,  
Croydon,  
Surrey.

If any other tape standard is used, then the settings quoted in this manual will change.

### 2.3 Speed of Operation

Type TRM 500. The maximum speed of operation lies in the range 500  $\pm$  50 characters per second.

Type TRM 1000. The maximum speed of operation lies in the range 1000  $\pm$ 100 characters per second.

Either model will operate at any speed up to its maximum.

## 2.4 Output Signals

2.4.1 Polarity: Logical '0' -0.2 volts  $\pm$ 0.2 volts.

Logical '1' V volts, on open circuit, where V is the negative voltage applied to PL2 pin L.

2.4.2 Waveform:

Type: Square wave, as shown in Fig. 4

	Nominal	Permitted Range
Mark/Space ratio (a) Sprocket	70:30 light/dark	68:32 to 72:28
(b) Data	47:53 light/dark	45:55 to 49:51

### NOTE:

(1) These ratios are measured at a d. c. level of 0.5V  $\pm$ 0.5volt, where V is the negative voltage applied to PL2 pin L.

(2) The tape used for displaying the above waveforms should be punched as shown in Fig. 4, and should be run through the reader at the maximum speed.

(c) Rise time (negative - going edge) 5 $\mu$ s max.

(d) Fall time (positive - going edge) 5 $\mu$ s max.

2.4.3 (a) When any sensor is illuminated, the output impedance of the associated amplifier is 560 ohms  $\pm$ 10% to the negative supply connected to PL2 pin L. An output current not greater than 20 mA may be drawn from this supply to an external point connected to the 0V line, via the output connection of the amplifier.

(b) When any sensor is not illuminated, an output current not greater than 25 mA may be drawn from an external load connected to a suitable external negative supply, to the 0V line via the output connection of the associated amplifier.

(c) The amplifier circuit is shown in Fig. 8.

## 2.5 Acceleration

- 2.5.1 TRM 500 Time from rest to first character: 6 ms max.  
 Time intervals between first and subsequent characters Correspond to max. speed of reader, in the range quoted in 2.3 above.
- 2.5.2 TRM 1000 Time from rest to third character: 10 ms max.  
 Time intervals between seventh and subsequent characters Correspond to max. speed of reader, in the range quoted in 2.3

## 2.6 Power Requirements

Assembly	Voltage	Current	Max. Ripple
Motor	200 - 250V, 50c/s $\pm$ 2c/s or 100 - 125V, 60c/s $\pm$ 2c/s	500 mA max.	-
Lamp	9.5V a. c. / d. c.	3.5A	
*Printed Circuit Boards	{ +6V to +10V nominal voltage -6V to -10V ranges	150 mA max. at + 10V 300 mA max. at - 10V	100 mV p-p 100 mV p-p
Clutch	+20V d. c. if recommended circuit is used	1A	2V p-p
Brake	+20V d. c. if recommended circuit is used	1A	2V p-p

### \*NOTE:

The positive and negative voltages should be equal within  $\pm 5\%$  of the same nominal value.

## 2.7 Clutch Coil Impedance

0.5 ohms (resistive) and 16 mH.

## 2.8 Brake Coil Impedance

0.5 ohms (resistive) and 18 mH.

2.9 Connectors

Plessey Mk. 4 12-way and 18-way connectors.

2.10 Overall Dimensions

Height	Width	Depth
10.0 in. (25.4 cm)	6.3 in. (16.0 cm)	10.3 in. (26.2 cm)

2.11 Weight

18 lb (8.2kg) approx.

2.12 Colour

Light grey (Gloss)

2.13 Temperature Range

+5°C to +45°C

2.14 Humidity Range

40 to 90% R. H.

## Chapter 3: INSTALLATION

### 3.1 Acceptance

Inspect the container for signs of damage which may have occurred during transit. If damage is evident, the carrier and insurer must be notified within seven days. Unpacking must not proceed until the insurer has given consent.

### 3.2 Unpacking

Unpack the reader following the instructions given in para. 3.2.1. It may be advantageous to save all packing material for future reshipment of the reader.

3.2.1 Remove the outer wrapping of corrugated paper. Open the top of the cardboard box and remove the cardboard or polystyrene packing. Check the contents of the box against the check list. Carefully remove the reader from the box. Remove the plastic dust cover from the reader.

### 3.3 Post-Delivery Inspection

The performance of the reader is checked prior to transit. However, a visual inspection should be carried out to ensure that no subsequent damage has occurred.

3.3.1 Remove the covers (see Section 7 para. 7.2.1) and inspect the reader, paying particular attention to the following points.

Ensure that all components are secure.

Ensure that the printed circuit boards are intact and firmly pressed into their connector sockets.

Ensure that the motor spindle rotates freely, without play.

Ensure that the clutch pinch roller assembly is positioned correctly on the pivot, and that when the armature is pulled towards the core faces, the gap between the pinch roller and the capstan is reduced.

Ensure that the pressel bar can be depressed and that it returns to normal when released.

Ensure that, when the pressel bar is pulled out or pushed in, the outer guide rollers also move.

Ensure that the brake pads and top plate are clean and free from grease.

Ensure that all wiring is correctly terminated.  
Refit the covers.

### 3.4 External Connections

3.4.1 All external connections to the reader are made through two Plessey plugs situated at the rear of the reader. The connections, and their functions, are given below.

3.4.2 The power supplies for, and the output signals from, the signal circuits, are taken via a 12-way Plessey plug, PL2. The pin connections are as follows:-

Pin	Function	Monitor Point (see para. 6.5)
A	Data output 1	A5
B	Data output 2	A4
C	Data output 3	A3
D	Data output 4	A2
E	Data output 5	A1
F	Data output 6	B5
G	Data output 7	B4
H	Data output 8	B3
J	Data output 9	B2
K	+ve DC supply	B1
L	-ve DC supply	C5
M	0V	C4

3.4.3 The motor, clutch, brake and lamp supplies, together with the control switch circuits, are taken via an 18-way Plessey plug, PL1. The pin connections are as follows:-

Pin	Function	Monitor Point
A	Clutch	C1
B	Clutch	
C	Brake	C2
D	Run-out Switch (Common)	
E	Pressel Bar Front Switch (Common)	
F	Pressel Bar Front Switch (N.C.)	
G	Pressel Bar Front Switch (N.O.)	
H	Run-out Switch (N.C.)	
J	Run-out Switch (N.O.)	
K	Pressel Bar Rear Switch (N.C.)	
L	Pressel Bar Rear Switch (Common)	

Pin	Function	Monitor Point
M	Pressel Bar Rear Switch (N.O.)	
N	Spare	
O	Brake	
P	Lamp (Chassis Connection)	
Q	Motor Supply (Neutral)	
R	Lamp Supply	C3
S	Motor Supply (Line)	

### 3.5 Ventilation

3.5.1 The flow of air from the exhaust fan must not be obstructed as this would cause overheating of the equipment.

## Chapter 4: OPERATING INSTRUCTIONS

### 4.1 On/Off Switch

The ON/OFF switch is situated to the left of the prism cover and controls the supplies for the motor and the lamp. With the external connections made, this switch must be set to ON before the reader will operate.

### 4.2 Tape Width Adjustment

The guide pin rollers locate the tape in the reader. The inner rollers are mounted on the top plate under the tape guide and capstan guard. The outer rollers are mounted on the pressel bar assembly, which is adjustable for differing tape widths by moving backward or forward to the desired position. Two balls and spring clips on the pressel bar assembly selector arm guides hold the assembly in position.

### 4.3 Tape Loading

Load the tape as follows:-

4.3.1 Adjust the pressel bar assembly on the correct tape width setting.

4.3.2 Press down on the pressel bar to lower the outer guide pin rollers, and slide the tape in sideways under the motor capstan, tape guide and brake armature.

4.3.3 Release the pressel bar when the rear edge of the tape has reached the inner guide pin rollers

### 4.4 Tape Run-Out

Clutch and brake operation is normally controlled external to the reader. If the RUN-OUT press-button is incorporated in the external system, as recommended, depression of this button overrides the external clutch and brake control circuit, makes the brake inoperative and causes the clutch assembly to feed tape through the reader at the maximum speed.

### 4.5 Tape Removal

Depress the pressel bar and slide the tape out sideways from under

the motor capstan, tape guide and brake armature.

#### 4.6 Tape Splicing

Proceed as follows:-

- 4.6.1 Overlap the two ends of the tape and align the sprocket holes.
- 4.6.2 Cut through the double thickness of tape with a sharp knife. If possible make a diagonal cut.
- 4.6.3 Remove the loose tape end from the upper surface.
- 4.6.4 Without changing the position of the cut tape ends, apply a strip of adhesive tape across the butt ends. A suitable adhesive tape is opaque black Sellotape not greater than 0.002 in. thick.
- 4.6.5 Trim the ends of the adhesive tape with a sharp knife so that the adhesive tape does not protrude beyond the edges of the paper tape.
- 4.6.6 Completely clear all holes in the paper tape obscured by the adhesive tape and ensure that light does not pass through the join.

#### 4.7 Tape Repairing

Proceed as follows:-

- 4.7.1 Butt the two ends of the tape, ensuring that uniform sprocket-hole spacing is maintained.
- 4.7.2 Apply a strip of adhesive tape across the rear. A suitable tape is opaque black Sellotape not greater than 0.002 in. thick.
- 4.7.3 Perform operations 4.6.5 and 4.6.6 above.

Use of the MONOPUNCH TYPE MTP1 will ensure that tape splices and repair are carried out quickly and correctly.

## Chapter 5: ROUTINE MAINTENANCE

### 5.1 General

The routine maintenance on the reader consists of carrying out cleaning, inspection and lubrication at the recommended intervals. As the inspection and lubrication listed in para. 5.4 necessitates the dismantling of certain parts of the reader, the details of this work are given in Chapter 7. which covers all servicing procedures. The appropriate paragraphs are referenced.

### 5.2 Daily Maintenance

5.2.1 The following tools and materials are required:-

- (1) Cleaning cloth
- (2) Soft polishing cloth
- (3) Small stiff brush (13076)
- (4) Screwdriver (small)
- (5) Hexagon wrench,  $\frac{3}{32}$  in.A.F.

5.2.2 Remove all dust and dirt from the covers of the reader.

5.2.3 Use a clean cloth to remove all dust and dirt from the tape track, including the glass window.

5.2.4 Remove the top cover and the upper section of the brake assembly, and brush out the brake pad in the lower section.

5.2.5 Clean the exposed surface of the prism, using the soft polishing cloth.

5.2.6 Ensure that the connecting sockets are secure in the two Plessey plugs at the rear of the reader.

### 5.3 Monthly Maintenance

5.3.1 The following tools and materials are required:-

- (1) Cleaning cloth
- (2) Soft polishing cloth
- (3) Small stiff brush (13076)
- (4) Screwdriver (small)
- (5) Hexagon Wrench,  $\frac{3}{32}$  in.A.F.
- (6) I.C.I. Perspex Polish No. 3.

- 5.3.2 Carry out the daily maintenance, excepting para. 5.2.5.
- 5.3.3 Remove the top cover, as detailed in para. 7.2.1
- 5.3.4 Clean the lamp envelope, using the polishing cloth.
- 5.3.5 Clean the prism with I.C.I. Perspex Polish No. 3 using the polishing cloth.

#### 5.4 Quarterly Maintenance

##### 5.4.1 The following tools and materials are required:-

- (1) Cleaning cloth
- (2) Soft polishing cloth
- (3) I.C.I. Perspex Polish No. 3.
- (4) Soft brush  $\frac{1}{2}$  in. wide (10014)
- (5) Small stiff brush (13076)
- (6) Feeler gauges (2020) Moore and Wright 492
- (7) Screwdrivers
- (8) Hexagon Wrench set (Fractional sizes)
- (9) Hexagon Wrench, 0.050 in. A.F. (2034)
- (10) Castrol S.A.E. 140 oil
- (11) Shell Nerita Grease No. 3
- (12) B.P. CS65 oil
- (13) Dermic oiler (4306)

##### 5.4.2 Carry out the daily and monthly maintenance.

5.4.3 Remove dust and dirt from all surfaces using a soft brush, clean cloth or compressed air (pressure not exceeding 60 p. s. i.) as appropriate. Take care that the air jet is not directed towards the mask or photocells.

5.4.4 Ensure that all components are secure.

5.4.5 Ensure that all wiring is secure.

5.4.6 Ensure that the printed circuit boards are not damaged and are correctly inserted into their connectors.

5.4.7 Ensure that the optical system produces uniform illumination of the apertures under the top plate window. (see para. 7.3.3.).

5.4.8 Ensure that the capstan and pinch rollers are parallel in the horizontal direction. (see paras. 7.3.5 to 7.3.5.4).

- 5.4.9 Ensure that, with the clutch released, the clearance between the capstan and pinch rollers is not less than 0.006 in. and not greater than 0.007 in. over the entire length of the capstan (see paras. 7.3.5.5. and 7.3.5.6).
- 5.4.10 Ensure that, when the clutch is operated manually, and the clearance between the capstan and pinch rollers is held at 0.003 in. by the insertion of a feeler gauge, the clearance between the armature and the polefaces is in the range 0.008 in. to 0.012 in. (see para. 7.3.5.7).
- 5.4.11 Ensure that the clearance between the brake armature and polefaces is in the range 0.0015 in. to 0.0025 in. (see para. 7.5.1).
- 5.4.12 Ensure that the guide pin rollers do not nip the tape and, using the specified gauge, check that the tape guide rollers are correctly set. (see para. 7.3.6).
- 5.4.13 Lubricate the clutch pinch roller bracket pivot (see para. 7.6.2).
- 5.4.14 Lubricate the clutch pinch rollers, (see para. 7.6.1) and re-check operation 5.4.9 after re-assembly.
- 5.4.15 Lubricate the guide pin rollers, (see para. 7.6.3) and re-check operation 5.4.12.
- 5.4.16 Lubricate the motor bearings (see para. 7.6.5).
- 5.4.17 Ensure that the clutch force is in the range 340 to 380 gm. (see para. 7.4).
- 5.4.18 Ensure that the residual brake force, due to the spring, is in the range 45 to 55 gm. (see paras. 7.5.2 to 7.5.4)
- 5.4.19 Ensure that the output waveforms exhibit the correct characteristics. (see Para. 6.3 and fig. 5).

## Chapter 6: PRINCIPLES OF OPERATION

### 6.1 Introduction

#### 6.1.1 General Description

Tape reading is effected by an optical system in conjunction with photocells, and tape drive and braking are by friction. An external control system is used to actuate the friction drive and braking. The drive comprises an electromagnetic clutch whose armature controls the position of a pinch roller. This roller rises and holds the tape against a rotating capstan. The brake comprises two pads, the lower pad forming part of the brake electro-magnet assembly and the upper pad forming the armature. When the electro-magnet is energised the armature is attracted to the polefaces of the electro-magnet and a frictional force is applied to the tape. This force is capable of stopping the tape on a selected character. The read function is performed by a bank of nine photosensors, each of which feeds into an output amplifier. The amplifiers are carried on printed circuit boards. Operator controls comprise an ON/OFF toggle switch for the motor and lamp supplies, a tape RUN-OUT button and two microswitches operated by the pressel bar assembly, for use with the external clutch and brake control circuit. All electrical connections to the reader are made by two Plessey plugs fitted to the rear. A view of the reader with the covers removed is shown in Fig. 1. The assemblies described in the following paragraphs are shown in this illustration.

#### 6.1.2 Motor Drive Assembly

The motor drive assembly consists of a split-phase induction motor with the spindle extended at both ends, and a phase-splitting capacitor. The rear end of the motor spindle supports an exhaust fan to cool the interior of the reader. The front end of the spindle carries a capstan for driving the tape. Four models are described in this manual. Two of these are included under the type number TRM 500, and two under TRM 1000. The motors fitted to the TRM 500 models give a maximum tape speed of 500 characters per second. The motors fitted to the TRM 1000 give a maximum tape speed of 1000 characters per second. One model of each pair is driven by a 50 c/s supply and the other by a 60 c/s supply. To ensure that both models of a pair have the same maximum tape speed, the capstans on the models for 50 c/s operation are larger than the capstans on the models for 60 c/s operation.

### 6.1.3 Clutch Assembly

The clutch assembly consists of an electromagnet which controls the movement of a pinch roller. When the magnet is energised by an external signal, the tape is gripped between the pinch roller and the motor capstan, and drawn through the reader. With the clutch released, the distance between the pinch roller and the motor capstan is such that insufficient friction exists to draw the tape through the reader, even where tape splicing occurs.

### 6.1.4 Brake Assembly

The punched paper tape passes between two pads which produce the braking action. The lower pad is inset into the tape track and forms part of the electromagnet assembly. The upper pad acts as the armature and is pulled towards the lower pad when the electromagnet is energised. The pressure between the two pads, and hence the frictional force on the tape, is adjustable by shimming the height of the lower pad. A tension spring above the upper brake pad gives a nominal frictional force, sufficient to maintain a slight tension in the tape. This prevents the tape lifting away from the reading head when the electromagnet brake is not energised.

### 6.1.5 Optical System

The optical system comprises lamp, focussing prism, window, light mask and photosensors. The lamp is a 12 volt, 48 watt prefocus type, run 9.5 volts for reliability coupled with long life. The prism is positioned such that its spherical face receives light from the lamp and focusses it into a nearly parallel beam. This beam is reflected internally onto the cylindrical face, which forms a vertical beam focussed on the apertures under the glass window in the top plate. The glass window is inset in the top plate just below the tape track. It prevents dust accumulating on the light mask and photosensors. The light mask is attached to the photosensors assembly and contains shaped apertures aligned with the photosensors, which are silicon photovoltaic cells. The assembly is a replaceable plug-in unit.

### 6.1.6 Printed Circuit Boards

Two identical plug-in printed circuit boards carry amplifiers to convert the photosensor outputs into negative-going low impedance output signals. Each board carried a voltage stabiliser network and five identical amplifiers. The boards are located near the base of the reader. Nine of the

amplifiers are used, one for each of the nine photosensors. One amplifier on the lower board is not used.

### 6.1.7 Pressel Bar Assembly

The operating bar of the pressel bar assembly may be depressed or moved in and out. The outer tape guide rollers are secured to the assembly and are set to suit the standard tape widths by moving the operating bar. An extension of the pressel bar assembly actuates two microswitches. These switches are used to control, via the external circuit, the operation of the clutch and brake assemblies.

## 6.2 Circuit Operation

### 6.2.1 Switch Circuits

**ON/OFF.** The ON/OFF toggle switch controls the 200-250 volt, 50c/s or 100-125 volt, 60c/s supply to the motor and the 9.5 volt a. c. or d. c. supply to the lamp. The circuit arrangement is shown in Fig. 3.

**RUN-OUT.** The RUN-OUT press-button is wired direct to the 18-way Plessey plug and may be connected externally to the clutch and brake control circuit. Normally the press-button switch connections would be arranged so that depression of the button causes continuous operation of the clutch assembly and prevents operation of the brake assembly. The internal circuit arrangement is shown in Fig. 2.

**PRESSEL BAR SWITCHES.** An extension of the pressel bar is used to actuate two microswitches. In the normal position, one microswitch is operated and the other non-operated. When the pressel operating bar is depressed, the microswitch states are reversed. The contacts are wired direct to the 18-way Plessey plug. Normally the external connections would be arranged to allow the brake or clutch to operate when the pressel bar assembly is normal and to prevent their operation when the pressel bar is depressed. The internal circuit arrangement is shown in Fig. 2.

### 6.2.2 Clutch and Brake Control

The internal circuit arrangement of the clutch and brake coils is shown in Fig. 2.

The recommended Clutch and Brake Control circuit is shown in Fig. 3 This circuit is external to the Reader and requires four d. c. supplies: 20V, +10V, 0V and -10V.

The signal inputs to the clutch and brake drive circuits are such that, when the brake coil is energised the clutch is released and vice versa.

The clutch and brake drive circuits are similar but, in the Model 1000, extra brake circuitry is included to provide a rapid transfer of current to the brake windings thus increasing the efficiency of the braking system.

To assist in understanding the operation of the circuits a description of the clutch driver follows.

When input 3 is positive (+6V minimum to ensure saturation of VT4), a positive potential is applied to the base of VT6, causing it to conduct. The resultant current flow through R12 will cause VT5 to conduct heavily through R9 thus switching VT4 on. As VT4 saturates, a 1 amp current flows through the clutch winding, the clutch is energised and tape is drawn through the reader. The current in the clutch coil is limited to 1 amp by R8.

When input 3 is zero (+1 volt maximum to ensure VT4 off), VT6 is switched off. VT5 and VT4 receive no base current and do not switch on, in addition, the base-emitter resistor R11 (VT5) and the diode/resistor combination MR6 and R10 (VT4) will hold the transistors firmly off. No current will flow in the clutch winding and tape will no longer be drawn through the reader. MR6 and R10 will create a reverse bias current at the base of VT4 which will hasten the switch off thus giving more positive control.

The brake drive circuit operation is similar to that of the Clutch drive but its input signal (input 1) is the inverse of input 3. Thus, when the clutch is energised (to draw tape through the reader) the brake is de-energised (permitting tape movement) and vice versa.

The Type 1000 has extra braking circuitry to compensate for its higher speed. This circuitry is similar to the brake circuit and is connected to the H. T. end of the brake coil. It is operated by a signal on input 2 which is the inverse of input 1, i. e. the same as input 3, the clutch signal. An inductance L1 is connected between the +20V supply and the junction of the brake resistor R7 and the resistor R21 in the extra brake circuit.

When input 1 goes positive to operate the brake, input 2 goes negative thus switching VT9 off. The rapid decay of current through R21 and L1 produces a large back E.M.F. which, being generated at the junction of R7

and R21, assists in the operation of the brake, bringing the tape to a stop within 0.7 ms of the stop signal being generated by the leading edge of the feed hole output. This means that approximately 0.034 in. of tape pass through the reader during the time taken to pass from full speed to stop.

Zener diodes MR2, MR5 and MR4 are connected across the output transistors VT3, VT4 and VT9 respectively to limit voltage surge at the collectors to a safe value of approximately 80V.

### 6.2.3 Information Channel Circuits

#### 6.2.3.1 Introduction

As the tape passes over the window in the top plate, each line of holes, representing one character, allows the light to pass through to the apertures in the light mask. Nine identical photosensors are fitted in the read head assembly to detect the punched tape information, and each photosensor is connected to an amplifier mounted on one of the two identical printed circuit boards. The photosensors respond to the light falling on them and convert this energy into electrical signals. The photosensor amplifiers will switch when approximately 20% of the aperture area is illuminated by direct light through a hole. The shape of the apertures reduces the amount of diffused light which reaches the photosensors after being transmitted through unperforated tape, and thereby reduces the photosensor outputs to a level which will not switch the amplifiers. Each character on the tape comprises up to eight information or data holes, plus a sprocket hole. An illustration showing the relationship of the output signal to data and sprocket holes is given in Fig. 4. The layout of the boards is shown in Fig. 5 and 7, and the circuits are shown in Fig. 6 and 8. Each printed circuit board carries a voltage stabilising circuit and five identical amplifiers. On the board mounted nearest the bottom cover, only four of the amplifiers are in use.

#### 6.2.3.2 Voltage Stabilising Circuit (Fig. 6)

#### NOTE...

In the text which follows, and also para. 6.2.3.3 the voltage levels stated are not madatory and should be used as a guide only.

The +ve and -ve d.c. supplies for the printed circuit boards are connected to the reader via the 12-way Plessey plug, PL2. The 0 V line is also connected via PL2. From the Plessey plug, the supplies are connected direct to the printed circuit board sockets SK1 and SK2. For test purposes, the supplies are also connected to monitor points B1 and C5, and the 0 V

line to monitor point C4. The +ve and -ve supplies may vary over the range +6 V to +10 V and -6 V to -10 V respectively, but both should be within  $\pm 5\%$  of the same nominal value chosen.

Resistors R12 and R13 in parallel, Zener diodes MR1 and MR2, and resistors R14 and R15 in parallel, are connected in series across the +ve and -ve supplies. The junction of MR1 and MR2 is connected to the 0V line. Zener diodes MR1 and MR2 have a Zener voltage of approximately 3.3V. The stabilised supplies are taken from the junctions of the diodes and resistors, giving values of approximately +3.3V and -3.3V.

Resistor R16, diodes MR3 and MR4 and resistor R17 are connected in series across the stabilised supply lines. The voltage drop across the diodes (in series) is approximately 1.1V, giving a reference voltage at the junction of MR3 and R16 of approximately +0.5V and, at the junction of MR4 and R17, a reference voltage of approximately -0.6V. Therefore, at the junction of R18 and R19, i.e. the base of VT6, a reference voltage of approximately +0.1V is obtained. The emitter of VT6 drives a load connected to the negative stabilised line. The base/emitter voltage of VT6 is approximately 0.6V giving an emitter voltage of approximately -0.5V. This is used as a bias voltage for the photovoltaic cells.

The stabilised +ve and -ve supplies are connected to the amplifier via pins 5 and 33 respectively of SK1 and SK2, except for the stabilised +ve supply for amplifier A, which is connected direct on the printed circuit board. The emitter voltage of VT6 is used as the bias voltage for the photosensors, and is connected via pin 34 of SK1 and SK2 and the 104-way plug and socket.

### 6.2.3.3 Amplifiers (Fig. 8)

Under normal 'dark' conditions, there is no output from the photosensors.

Transistor VT1 has a base voltage of approximately -0.6V and is therefore conducting but, its collector voltage of -0.3V is not sufficient to trigger VT2. The voltage divider chain R4, R5 and R6 gives a potential on the base of VT3 sufficient to make it conduct, causing its emitter voltage, and that of VT2, to fall to -1.9V thus holding VT2 firmly off. With VT2 cut off, its collector voltage rises towards -3.3V and carries the base of VT4 with it. VT4 is an emitter follower and its load resistors R9 and R10

consistute a voltage divider. The output of this is applied to the base of VT5, and is held at approximately  $-0.6\text{V}$  by the emitter/base junction, since VT5 will switch on. The amplifier output is taken from VT5 collector, whose voltage under these conditions is just below  $0\text{V}$ . When light falls on the photosensors, the current generated by the photosensor increases the standing current in R1 and RV1. Therefore the voltage applied to VT1 base rises above  $0\text{V}$  and VT1 is cut off. VT1 collector voltage, and thus the base voltage of VT2, fall until they reach approximately  $-2.5\text{V}$ . At this point, the base of VT2 is now negative with respect to the emitter, sufficiently enough to cause VT2 to conduct. This causes VT2 collector voltage to rise and so VT3 switches off, as its base is fed from VT2 collector by R5 and R6, and its emitter potential is falling as the current in VT2 increases. The output of the Schmitt trigger circuit, taken from the collector of VT2, rises to approximately  $-1.3\text{V}$  and is applied to the base of the emitter follower VT4. The consequent fall in VT4 emitter current produces a rise in voltage at the junction of R9 and R10, and VT5 is cut off. With VT5 cut off, its collector voltage approaches the -ve supply, and the voltage given at the amplifier output is wholly dependent on the output current drawn from the negative supply via R11, the  $560\text{ ohm}$  load.

When the light is removed from the photosensor, the collector potential of VT1 returns to approximately  $-0.3\text{V}$ . As it passes a potential of approximately  $1.6\text{V}$ , VT2 will commence to switch off, and the circuit then returns to its original state. The method of connection of VT2 and VT3 results in the output signal changing state in either direction in approximately  $5\text{ microseconds}$ , regardless of the rate at which the photosensor switches VT1.

The potentiometer RV1 is used to adjust the input parameters to the characteristics of the associated photosensor.

### 6.3 Output Waveforms

The output waveform obtained from each amplifier is dependant upon the size of the hole, i. e. data or sprocket, and the setting of a potentiometer in the amplifier circuit. To adjust the waveforms, first remove the bottom cover, as described in para. 7.2.1.1. this will expose the potentiometers. These are situated on the circuit boards, and may be operated from the rear of the reader.

Insert a tape punched with the pattern shown in Fig. 4. This illustration shows a 5-channel tape. The punching pattern should be extended to cover the number of channels being used. Run the tape through the reader at the maximum rate, and observe each output waveform at the corresponding

monitor point. The monitor points are shown in Fig. 9, and may be exposed as described in section 6.5.

Each waveform should be set to the correct mark/space ratio, as shown in Fig. 4, by adjusting the corresponding potentiometer. The illustration depicts nominal settings, and shows the ideal relative timing of the data and sprocket output waveforms. The timing will be affected by any inaccuracies in the tape punching, the accuracy to which the waveforms have been set and, to a small extent, by the positioning of the read head. To provide the maximum accuracy in reading, the data signals should be strobed with a pulse which appears after the leading edge of the sprocket signal. For a reader type TRM 500 the delay should be 120 microseconds. The corresponding figure for a reader type TRM 1000 is 60 microseconds.

## 6.4 Acceleration

### 6.4.1 Acceleration Characteristics

- (a) Reader type TRM 500.  
When a tape is accelerated from rest, the sprocket signal relating to the first character will appear on the appropriate output line after not more than 6ms. The signals from all further characters will appear after intervals corresponding to the maximum speed of the reader.
- (b) Reader type TRM 1000.  
When a tape is accelerated from rest, the sprocket signal relating to the third character will appear on the appropriate 10 ms. The interval between the signals from the seventh and subsequent characters will correspond to the maximum speed of the reader.

### 6.4.2 Waveforms

Typical waveforms for both of the above types are given in Fig. 10. Each of these illustrations depicts the acceleration characteristics of a reader whose maximum speed of operation lies at the mid-point of the appropriate range quoted in para. 2.3. To achieve the results shown, the clutch and brake should be driven by the circuit shown in Fig. 3.

The rest position of the tape at zero time is the position at which the tape will come to rest if commanded to stop on a character, when moving at

the maximum speed of the reader. The stop signal, which switches the clutch off and switches the brake on, should always appear at the same instant as the leading edge of the signal from a sprocket hole.

## 6.5 Monitor Points

On Fig. 2, 6, 8 and 9 certain points on the circuit are annotated "MP". This indicates that these points are wired to the monitor plug. An illustration showing the pin arrangement on the monitor plug is given on Fig. 9. To obtain access to the monitor plug, remove the monitor point assembly by releasing the two Dzus fasteners at the front of the reader.

## Chapter 7: SERVICING

## 7.1 Tools and Materials

7.1.1 The following tools are required to complete the servicing described in this Section.

Feeler gauges (2020)  
 Correx Tension Gauge Measuring 50-500 gm, (7065)  
 Brake and Clutch Test Tape Clamp (1(2/4)A120212)  
 Salter 32oz. Compression Spring Gauge (13797)  
 Square Block (1(2/4)A50014)  
 Capstan Height Gauge (1(2/4)B157022)  
 Mask Setting Gauge (1(2/4)B50145)  
 Tape Width Gauge (1(2/4)B50146)  $1\frac{1}{16}$  in.  
 or  
 Tape Width Gauge (1(2/4)A50246) 1 in.  
 AMP Extractor No. 465195-2(13798)  
 Offset Hole Gauge (1(2/4)A120195)  
 Dermic oiler (4306)  
 Correx Spring Tension Gauge (10-100 gm)  
 0.0575 in. Slip Gauge (1(2/4)A157023) } if motor is for  
 0.115 in. Slip Gauge (1(2/4)A157026) } 60 c/s operation  
 Capstan Alignment Gauge (1(2/4)A50694) - for 50 c/s Motor  
 Capstan Alignment Gauge (1(2/4)A50693) - for 60 c/s Motor

7.1.2 The following materials are required to complete the servicing described in this Section.

Clear adhesive (Durofix)  
 Unperforated 1 in. wide paper tape  
 Castrol S. A. E. 140 oil  
 Shell Nerita Grease No. 3  
 B. P. CS65 oil

## NOTE:

In the paragraphs which follow, the numbers quoted in brackets immediately following a part description, refer to item numbers on the Illustrated Parts List Fig. 12. The parts are listed under these numbers, in numerical order, in the Parts List, Section 8.1, Table 1.

## 7.2 Dismantling

**WARNING: BEFORE COMMENCING TO DISMANTLE THE READER DISCONNECT THE MAINS SUPPLY BY REMOVING THE 18-WAY PLESSEY PLUG.**

### NOTE:

Where dismantling is required to rectify a fault, or for servicing purposes, avoid dismantling sub-assemblies unnecessarily.

### 7.2.1 Covers

#### 7.2.1.1 Bottom Cover

Place the reader on its side and remove four screws (33). Collect bottom cover assembly (32). Place the reader upright.

#### 7.2.1.2 Top Cover Assembly

Remove four screws (13) and lift off the top cover assembly (1 to 12). Remove circlip (9) and collect push button (7) complete with push spring (8). Unfasten five nuts (5) and collect five washers (6), five screws (4), the push housing (3), and the switch plate (2).

#### 7.2.1.3 Side Cover

Remove five screws (35). Invert the reader and slide off the side cover assembly (34) complete with monitor point cover assembly (196).

### 7.2.2 PV Cell Reading Head Assembly

Remove the bottom cover. Place the reader on its side and unfasten the jack screw male (193) and female (N.S.). Withdraw the 104-way block (191) to the fullest extent of the wiring, taking care to avoid disconnecting the pins (192). Remove the four screws (195) and withdraw the PV cell reading head assembly (194).

### 7.2.3 Printed Circuit Board Assemblies and Supports

#### 7.2.3.1 Remove the bottom cover

#### 7.2.3.2 Printed Circuit Board Assemblies

With the reader remaining on its side withdraw the two printed circuit board assemblies (171) from their sockets (172) and through the guides in the two rear base supports (176 and one not shown).

#### 7.2.3.3 Printed Circuit Socket Assemblies

Remove the four screws (179) and withdraw the two socket assemblies (176) to the fullest extent of the wiring, taking care that the electrical connections are not damaged. Disconnect the wiring, by removing the terminals from the housing using an AMP extractor type 465195-2. (Cat. No. 13798).

#### 7.2.3.4 Printed Circuit Socket Support Brackets

Remove the four screws (179) and collect the two circuit board support brackets(176).

### 7.2.4 Lamp and Prism Mounting Bracket Assembly

Remove top cover.

#### 7.2.4.1 Lamp

Remove screw (16) to release lamp connecting lead. Collect washer (17) and lamp contact (15). Remove two screws (21), releasing lamp earth lead, lift off lamp retaining plate (20) and extract lamp (26) from lamp and prism mounting bracket (14).

#### 7.2.4.2 Prism

Unfasten two nuts (30) and collect two washers (31). Withdraw the prism (27) from the lamp and prism mounting bracket(14) complete with two screws (28) and two washers (29), taking care not to scratch the prism surfaces against metal edges.

7.2.4.3 Remove screw (22) and collect washer (23). Remove two screws (24), collect two washers (25) and lift off the lamp and prism mounting bracket (14) complete with contact post (18). Remove two screws (19) and collect contact post.

#### 7.2.5 Capstan Guard

Remove two screws (41) and collect capstan guard (40).

#### 7.2.6 Tape Guide

Remove two screws (43) and collect tape guide (42).

#### 7.2.7 Top Plate Assembly

Remove tape guide (42) and capstan guard (40).

7.2.7.1 Remove four screws (47). Pull out the operating bar (64) of the pressel bar assembly (51 to 70), to the setting for 1 inch tape. Then depress the bar to prevent the two front tape guides fouling the top plate assembly (44 to 48), and detach the top plate assembly (44 to 48) by lifting the front end and sliding it out.

#### 7.2.7.2 Rear Tape Guide Rollers

Remove two guide pins (51).

#### NOTE:

On later models, the tape guide pin rollers are replaced by solid pins. Washers and guide pin screws are not fitted.

#### 7.2.8 Baffle Plate Assembly

Remove top cover, bottom cover and side cover.

Remove the two nuts and two washers (part of 73 and 77). Withdraw the plugs (73 and 77) to the fullest extent of the wiring taking care to avoid damaging the electrical connections. Remove three screws (84) and collect three washers (85) and baffle plate assembly (77 to 83). Remove four nuts

(81) and collect four washers (80). Withdraw the fan cowl assembly (77) complete with four screws (78) and four washers (79) from the baffle plate (83).

#### 7.2.9 Fan Assembly

Remove top cover, side cover, bottom cover and baffle plate. Remove grub screw (98) and withdraw fan assembly (97) from spindle of motor (86).

#### 7.2.10 Motor Assembly

Remove top cover, bottom cover, side cover, baffle plate and fan.

7.2.10.1 Disconnect the reader wiring and motor leads from the flexible terminal block (89). Remove four screws (95) and collect four washers (96). Lift the motor assembly (86) off the base (87) and collect motor shims (94). Note the position of each shim to ensure that on assembly they are replaced in their correct positions.

#### 7.2.10.2 Flexible Terminal Block and Bracket

Remove two screws (90) and collect two washers (91) and flexible terminal block (89). Remove three screws (part of 86) and slide terminal bracket (88) off the shaft of the motor (86). Refit the three screws to the motor.

#### 7.2.11 Capacitor

Remove top cover, bottom cover and side cover.

7.2.11.1 Disconnect the reader wiring from the capacitor (164). Loosen the clamping screw on the capacitor mounting clip (165) and lift out the capacitor.

#### NOTE:

Certain types of reader are fitted with a capacitor of the rectangular metal can type, with integral fixing feet. There will not be a clip on these types.

#### 7.2.11.2 Capacitor Mounting Clip (when fitted)

Remove the two screws (166) and collect two washers (167) and capacitor mounting clip (165).

#### 7.2.12 ON/OFF Switch and RUN-OUT Press Button

Remove top cover.

7.2.12.1 Disconnect the wiring of the reader from the toggle switch (37) and press button microswitch (36). Remove the locking nuts and withdraw the switches (36) and (37) from the mounted bracket (38).

#### 7.2.12.2 Mounting Bracket

Remove screw (16), and one screw (21), to release lamp leads. Remove two screws (24), washers (25), one screw (22) and washer (23). Lift off Lamp and Prism Mounting Bracket Assembly. Remove four screws (39) and lift the mounting bracket (38) off the reader base (181).

#### 7.2.13 Pressel Bar Assembly

7.2.13.1 Remove top cover, bottom cover, side cover, capstan guard, tape guide and top plate.

Remove the return spring (70). Support the pressel bar assembly (51 to 69) and remove the two pivot arms (48). Collect two small washers (49), two large washers (50) and remove the pressel bar assembly (51 to 69).

#### 7.2.13.2 Operating Bar

Remove the two screws (65) and pull the operating bar (64) off the two selector arms (59).

#### 7.2.13.3 Front Tape Guides

Extract the two spring clips (60) off the two selector arm guides (62) and collect the two balls (61). Slide out the left-hand selector arm (59) complete with guide pin (51), guide pin mounting (52), washer (55) and guide pin mounting screw (53). Remove the guide pin mounting screw and collect

washer (55) and the guide pin mounting. Slide out the right-hand selector arm (59) complete with guide pin (51), guided pin mounting (52), washer (55), guide pin mounting screw (54), guide pin extension (56), screw (57) and washer (58).

Remove the guide pin mounting screw and collect washer (55) and the guide pin mounting. Remove the screw (57) and collect washer (58) and the guide pin extension.

Remove the four screws (63) and collect the two selector arm guides.

#### 7.2.13.4 Spring Post

Remove the nut (68) from the guide pin lever (66) and collect washer (69) and spring post (67).

#### 7.2.14 Clutch Assembly

7.2.14.1 Remove top cover, bottom cover, side cover, capstan guard, tape guide, top plate and pressel bar assembly.

Unsolder the permanent wiring of the reader from the tags on the tagboard assembly (129). Place the reader on its side, support the clutch assembly (99 to 131) and remove the four screws (133).

Collect four washers (134) and withdraw the clutch assembly sufficiently far to give access to the tagboard assembly (129). Unsolder the wiring of the reader from the tagboard. Remove the clutch assembly and collect the clutch bracket shims (132) and 132A).

#### 7.2.14.2 Pinch Rollers

Remove the two screws (121) and collect locking plate (120). Slide out clutch roller shaft (116) collecting pinch rollers (117) and roller spacers (118) as the shaft is withdrawn. Note the order of collection of the rollers and spacers and the individual arrangement of each, so that on re-assembly they can be replaced with the correct arrangement, i. e. in the correct order and with none reversed.

### 7.2.14.3 Clutch Armature

Unfasten the two locknuts (113) to relieve the tension on the clutch spring (114). Remove the clutch spring (114) and slide out the adjusting stud (112) complete with locknuts (113). Remove the two screws (125) and collect two washers (126). Withdraw the clutch roller bracket (115) and collect clutch armature shims (123). Note the number and thickness of shims. Withdraw the clutch armature (122), loosen the locking nuts (128) and remove the grub screws (127).

### 7.2.14.4 Coils

Unsolder the coil connections from the tags on the tagboard assembly (129). Remove the two bolts (109) and collect the two nuts (110), washers (111) and lower lamination clamp (108). Remove the lamination assembly (107) complete with coils (106) from the clutch bracket (99). Slide the coils off the lamination assembly.

### 7.2.14.5 Stop Block

Remove the two screws (103) and collect the stop block (102). The adjusting grub screw (104) may be removed after loosening the locking screw (105).

#### NOTE:

On some models the screws (103) are fitted from the opposite side of the clutch bracket (99).

### 7.2.14.6 Clutch Roller Bracket Pivot

Remove the two screws (101) and collect the clutch roller bracket pivot (100).

### 7.2.14.7 Tagboard Assembly

Remove the two screws (131) and collect the tagboard assembly (129) and insulator (130).

### 7.2.15 Brake Assembly

7.2.15.1 Remove top cover, bottom cover, side cover, capstan guard, tape guide and top plate.

Unsolder the wiring of the reader from the tags on the tagboard assembly (144). Place the reader on its side, support the brake assembly (135 to 163) and remove the four screws (162). Collect four washers (163) and withdraw the brake assembly. Collect the brake bracket shim (161).

### 7.2.15.2 Brake Armature

Remove two screws (136) and collect armature bracket (135) complete with adjusting screw (142), setting nut (143) and two locating pins (141). Collect pressure spring (140), armature carrier (139), damping pad (138) and brake armature (137).

### 7.2.15.3 Brake Pad

Remove screw (149) and extract brake pad (147) and brake pad shims (148). Note the number of thickness of shims removed.

### 7.2.15.4 Coils

Unsolder the coil connections from the tags on the tagboard assembly (144). Remove the two screws (160) and collect upper lamination clamp (159) and two parallel pins (151). Remove two bolts (156) and collect two nuts (157), two washers (158) and lower lamination clamp (155). Remove the lamination assembly (154) complete with coil assemblies (150) from the brake bracket (153). Slide the coils off the lamination assembly.

### 7.2.15.5 Tagboard Assembly

Remove the two screws (146) and collect the tagboard assembly (144) and insulator (145).

### 7.2.16 Base Supports

Remove top cover, bottom cover, side cover and printed circuit boards. Remove the four screws (190) and polythene feet (189)- these items

are part of the base assembly (181 to 190). Remove the four screws (179) and collect four washers (180), two base support left-hand assemblies (176, one not shown), and one base support right-hand assembly (not shown). Withdraw the monitor point plug sub-assembly (177) to the fullest extent of the wiring, taking care not to damage the electrical connections to the plug or resistors (178). Unsolder the wiring.

### 7.2.17 Base Assembly

#### 7.2.17.1 Remove all covers and sub-assemblies detailed above.

Unfasten the two spring posts (187 and 188).

#### 7.2.17.2 Microswitches

Disconnect the wiring from the two microswitches (183). Unfasten four nuts (185) and collect four washers (186). Withdraw four screws (184) and collect two microswitches (183) and switch insulator (182).

## 7.3 Assembly

### NOTE:

Assembly is, in general, the reverse procedure to dismantling. Special procedures to be followed for alignment and adjustment, during or following assembly, are covered in the following sections.

#### 7.3.1 Wiring Connections

When connecting the wiring, ensure that the correct connections are made (refer to Fig.9), and that there are no dry joints and that the sleeving and components are not overheated.

#### 7.3.2 Printed Circuit Boards

When inserting the printed circuit boards, ensure that neither the socket nor the components are damaged.

### 7.3.3 Optical System

#### 7.3.3.1 Uniformity of Illumination

Check that the illumination provided by the lamp is evenly distributed over the apertures below the window in the top plate. A uniform distribution may be obtained by adjusting the lamp and/or the prism.

#### 7.3.3.2 Prism Adjustment

Elongated holes in the lamp and prism mounting bracket (14) permit longitudinal movement of the lamp and prism relative to the window, whilst maintaining the position of the lamp relative to the prism. The prism may also be adjusted relative to the mounting bracket to facilitate lateral positioning of the illuminated zone. Remove the top cover (1). Loosen the lamp and prism mounting bracket securing screws (22 and 24). Position the bracket so that the apertures under the window are evenly illuminated. Tighten the securing screws. If lateral movement of the illuminated zone is required, slacken the two screws (28) and nuts (30) securing the prism to the lamp and prism mounting bracket, and rotate the prism to position the illuminated zone correctly. Tighten the securing screws (28).

#### 7.3.3.3 Lamp Adjustment

The uniformity of illumination of the apertures also depends on the position of the lamp filament. Check the lamp filament for sagging and renew the lamp if necessary.

Remove the top cover (1). Loosen the screws (21) securing the lamp retaining plate (20) to the lamp and prism mounting bracket.

Position the lamp (26) to ensure that the light pattern on the collimator block covers all of the apertures and is evenly distributed. Tighten the securing screws and refit the top cover.

#### NOTE:

The normal position of the lamp is such that the lamp filament support and the prism are on opposite sides of the filament, so that the filament support does not cast a shadow on the prism.

#### 7.3.3.4 Replacement of the Light Mask

NOTE:

Before fitting a new mask, clean off the underface using fine wet and dry paper, used dry. Clean the surface until bright. Clean off the top face of the collimator block in a similar manner.

Detach the reading head as detailed in para. 7.2.2. Place the Mask Setting Gauge (1(2/4)B50145) over the reading head, either way round, and position it so that one end of the slot is against the datum end of the head, i.e. the end with the engraved line. Place mask in slot in gauge, after the underface has been thinly coated with a minimum quantity of Durofix, so that the end with the red dot is against the end of the slot placed against the datum end of the head. The sides of the slot will align the mask correctly.

#### 7.3.3.5 Replacement of Photosensors

- CAUTION: 1. THE PHOTSENSORS ARE SUPPLIED COMPLETE WITH LEADS. DO NOT APPLY A SOLDERING IRON DIRECT TO THE CONNECTIONS ON THE BASE OF THE SENSOR.
2. THE READING HEAD MUST NOT BE DISMANTLED BEYOND THE REMOVAL OF THE COLLIMATOR BLOCK, PHOTSENSOR RETAINER AND PHOTOSENSORS. THE POSITIONS OF OTHER PARTS MUST NOT BE DISTURBED.

Detach the reading head as detailed in para. 7.2.2. Unsolder the signal lead of the faulty photosensor from the tagstrip, and remove the sleeve. Cut the other lead, supplying the bias voltage, just below the connection on the base of the sensor. Withdraw the lead downwards through the sleeve containing the bias leads to the other sensors, and cut it from the tag on the tagstrip. Take care that no other connections are disturbed.

Remove the two screws which secure the Tufnol photosensor retainer. It may be necessary to remove the collimator block in order to reach the screws holding the retainer. To release the collimator block, remove the two countersunk screws in the top surface. Note which way round the collimator block is fitted. It must not be reversed on re-assembly. DO NOT DISTURB ANY OTHER SCREWS OR PARTS OF THE READING HEAD.

## NOTE:

When the collimator block securing screws are removed, IT IS ABSOLUTELY ESSENTIAL THAT THE SUPPORTING PILLARS ARE HELD SECURELY to prevent any rotation and consequent loss of adjustment. If the position of either pillar is disturbed, it will be impossible to replace the collimator block in the correct position without re-setting the complete assembly.

When the collimator block securing screws have been removed, ease the block sideways away from the support pillars, taking care not to place any strain on the connecting leads to the sensors. The two screws securing the photosensor retainer may then be removed, and the retainer eased sideways from under the collimator block. The sensors will remain attached to the retainer. Remove the faulty sensor, and insert a new sensor by feeding the leads through the two holes in the retainer. Take care to insert the sensor the correct way round, so that the positive pin on the base is in line with the positive pins on the other sensors. Replace the retainer under the collimator block, and replace the two securing screws. Feed the leads through their respective sleeves, one of which was removed from the faulty sensor, and solder to the appropriate points on the tagstrip.

## 7.3.3.6 Photosensor Outputs

After replacement of a photosensor, the output of the new sensor should be checked. If either the lamp or prism has been readjusted, or the lamp, prism or mask has been replaced, the output of each photosensor should be checked.

To check the output of a photosensor, first remove the bottom cover and then withdraw the 104-way block (191) as described in para. 7.2.2. Connect the lamp supply, and ensure that the lamp voltage, measured at the lamp, is  $9.5V \pm 0.1V$ . Connect a 2,000 ohm load between the appropriate pins on SK3. This socket forms the base of the reading head. The pin connections for each cell are shown in Fig.9.

The current supplied to the 2,000 ohm load by the cell must be not less than 120 microamps.

## NOTE:

The resistance of an Avometer Model 8, when switched to the 250 microamp range, is 2,000 ohms. A Model 8 may therefore be used as the load, when switched to this range. Whichever meter is used, the internal resistance must be included as part of the load.

7.3.3.7 Set the Avometer to the  $250\ \mu\text{A}$  D.C. range and connect it across the sprocket-hole (Channel 4) photosensor output.

Set the tape guides to 1 in. and switch the reader on. With the clutch de-energised, insert the Offset Hole Gauge into the tape channel ensuring that the small test holes are in the Channel 4 position.

Draw the Gauge slowly across the window and note the maximum current reading when the +0.015 in. offset hole presses over the collimator. Continue to draw the Gauge across the window and note the maximum reading when the -0.015 in. offset hole passes over the collimator. The smaller reading should be not less than 85% of the larger.

If the smaller reading is less than 85% of the larger, the position of the reading head may be adjusted after slackening the four screws (190) securing the 104-way socket (191) 7.3.3.8. If it is found necessary to move the reading head to satisfy 7.3.3.7., the photosensor outputs should be re-checked as detailed in 7.3.3.6.

#### 7.3.4 Motor Replacement and Alignment

##### 7.3.4.1 Motor Replacement

Remove the top plate assembly as detailed in para. 7.2.7. Remove the old motor as detailed in para. 7.2.10. Place the replacement motor in approximately the correct position and secure by means of four fixing screws (95) and washers(96).

##### 7.3.4.2 Motor Height Adjustment

Place the Capstan Height Gauge (1(2/4)B157022) on the ground faces of the base plate (181) in place of the top plate assembly. Measure the distance between the gauge and the top of the motor capstan as follows:-

If the motor to be fitted is for 50 c/s mains operation, position the height gauge so that the larger recessed section is over capstan. Use feeler gauges to measure the gap between the recessed section and the capstan. The gap should be 0.002 in. to 0.003 in.

If the motor to be fitted is for 60 c/s mains operation, position the height gauge so that the larger recessed section is over capstan. Hold a 0.115 in. slip gauge, (1(2/4)A157026) over the capstan and against the

underface of the height gauge, and use feeler gauges to measure the gap between the slip gauge and the capstan. The gap should be 0.002 in. to 0.003 in.

In neither case should the gap vary by more than 0.0005 in. over the length of the capstan.

If the gaps measured do not comply with the dimensions given, add shims (94) as required under the motor base plate (87).

NOTE:

When adding shims always shim both front, or both rear points by the same amount, to prevent strain on any of the parts involved.

If, at any time, it is suspected that the clutch roller and capstan are not parallel, the Square Block (1(2/4)A50014) may be used to give a quick check.

Hold the block so that it is in contact with the whole length of the clutch roller and the capstan. Using a feeler gauge, measure the gaps between the block and the ends of the capstan. The maximum difference permitted is 0.0005 in.

If the capstan and roller are not parallel it will be necessary to re-align them as detailed in para. 7.3.5.

7.3.4.3 Refit the Top Plate, complete with rear tape guides. Place the Alignment Gauge (1(2/4)A50693 (60 c/s) or (1(2/4)A50694 (50 c/s) on the Top Plate held firmly against the tape guides and positioned against the right hand guide.

Measure the gap between the capstan and the gauge. This should be between 0.008 in. and 0.012 in. and should not vary by more than 0.0005 in. over the length of the capstan.

7.3.4.4 To achieve these conditions, slacken the four motor base securing screws (95) slightly, and adjust the motor position to give the correct gap alongside the capstan. Sufficient clearance exists about the securing screws (95) to allow this to be done. Tighten the screws when the motor is correctly set, and re-check setting.

7.3.4.5 After positioning the motor correctly, the alignment of the capstan and the clutch pinch rollers must be reset, as stated in section 7.3.5.

The adjustment must be achieved by positioning the clutch assembly correctly. Do not make further adjustments to the position of the motor, unless the clearances round the clutch assembly securing screws (134) do not permit the required movement of the clutch. If this condition is reached, the motor should be moved in the appropriate direction, and reset as detailed in para. 7.3.4.3.

NOTE:

If both motor and clutch have been removed for any reason, the procedure detailed in para. 7.3.4.3 must be followed. This will establish the correct position of the motor, using the rear tape guides as a datum. The clutch can then be aligned to the capstan as detailed in para. 7.3.5.2.

### 7.3.5 Clutch Pinch Roller Alignment

NOTE:

When adjustments are made to the position of the clutch assembly, as in para. 7.3.5.2 and 7.3.5.3 below, care must be exercised so that the clutch roller bracket (115) is not lifted off the pivot (100). To counteract the tendency of the bracket to lift, the two grub-screws (127) may be screwed down gently onto the polefaces of the solenoid, and locked in position by the nuts (128). Return the screws to their original positions before adjusting the Capstan/Pinch Roller gap and the Clutch Armature gap (paras. 7.3.5.5 to 7.3.5.7).

7.3.5.1 The clutch pinch rollers must be correctly positioned relative to the motor capstan. The alignment of these two parts should be checked after a new motor or clutch assembly has been fitted, or after any work which has involved disturbing the motor or the pinch rollers.

7.3.5.2 With the motor correctly positioned as in para. 7.3.4.3 et seq., loosen the clutch assembly securing screws (134) and move the clutch until the gap between the capstan and the clutch rollers is between 0.006 in. and 0.007 in. and does not vary more than 0.0005 in. over the length of the capstan.

7.3.5.3 If these tolerances cannot be achieved proceed as in paras. 7.3.5.5 and 7.3.5.6 below.

7.3.5.4 Tighten the securing screws and re-check the gap to ensure that the clutch has not moved. Repeat the adjustment if necessary.

### 7.3.5.5 Capstan/Pinch Roller Gap

Remove the Capstan and Clutch Alignment Gauge. Use feeler gauges to measure the gap between the capstan and the clutch pinch rollers, with the clutch in the de-energised state. The gap should be 0.006 in. to 0.0007 in. and should not vary more than 0.0005 in. over the length of the rollers. If the gap variation is greater than this, lower the appropriate end of the clutch roller bracket pivot (100), to reduce the variation to a permissible figure. A light tap, on the unused portion of the knife edge, will produce the required effect. When the gap variation is within the required limits, the gap may be adjusted as in the next paragraph.

7.3.5.6 To adjust the gap, slacken the locking screw (105) and turn the stop screw (104) to give the correct conditions. When the gap is 0.006 in. to 0.007 in., re-tighten the locking screw. If the amount of correction required cannot be achieved by adjusting the stop screw (104), insert shims (123) and (124) as required, between the clutch assembly and the reader base.

To insert shims (123) and (124) it is necessary to remove four screws (125). Therefore, the conditions of para. 7.3.5.3 will be lost, and the clutch assembly must be reset as stated in paras. 7.3.5.2 and 7.3.5.3.

#### NOTE:

Item 123 is laminated, each layer being 0.002 in. thick.

### 7.3.5.7 Clutch Armature Gap

With the clutch operated, and the clearance between the capstan and the pinch rollers held at 0.003 in., the clearance between the armature and the polefaces of the clutch must lie between 0.008 in. and 0.012 in.

Insert a 0.003 in. feeler gauge between the capstan and pinch rollers and operate the clutch by hand. Use feeler gauges to measure the gap between the armature and the polefaces. If the clearance is not within the limits, release the clutch armature (122) from the clutch roller bracket assembly (115) by removing the screws (125) and washers (126). Increase or decrease the number of clutch armature shims (123) as necessary, to give the required clearance. Re-assemble the clutch armature, and re-check the clearance. Reset the two grub screws (127) as stated in para. 7.3.5.8.

NOTE:

The armature shims (123) are available in two thicknesses, 0.001 in. and 0.005 in.

### 7.3.5.8 Pinch Roller Travel Limiting Screws

Slacken the two locking nuts (128). Hold the armature down so that the grub screws (127) are in contact with the polefaces, and adjust the grub screws so that a small gap is present between the pinch rollers and the capstan. This gap must not be greater than 0.002 in. Ensure that both grub screws touch their respective polefaces at the same time. Tighten the nuts and re-check the setting.

NOTE:

For adjustment of pinch roller end float, see section 7.6.1.

### 7.3.5.9 Clutch Spring Tension

Apply a compression spring gauge to one of the two clutch armature retaining screws (125) situated at the yoke end of the clutch roller bracket assembly (115). Check that the clutch armature just starts to move towards the polefaces, when a pressure of 22oz.  $\pm$  2 oz. is applied. If the pressure measured lies outside the limits stated, loosen the locking nuts (113) and increase or decrease the tension in the spring (114) accordingly. Tighten the locking nuts (113) and re-check the pressure.

NOTE:

It is necessary to remove the reading head assembly (194) to gain access to the locking nuts (113).

### 7.3.6 Adjustment of Tape Guides

7.3.6.1 Tape should pass through the reader without either excessive side play or binding on the tape guides, with the pressel bar adjusted for the appropriate tape width.

7.3.6.2 Remove the capstan guard and tape guide (42) as detailed in para. 7.2.5 and 7.2.6. Use the Tape Width Gauge (1(2/4)A50146) or (1(2/4)A50246) to check the distance between each pair of tape guides, at the intermediate pressel bar position. The 'GO' and 'NO GO' sections of the gauge should be

used to check that the setting is within the required range.

7.3.6.3 If the left-hand guides are incorrectly set, remove the top, bottom and side covers. Slacken the hexagon-headed guide pin mounting screw (53) and move the tape guide backward or forward as required. Re-tighten the mounting screw (53) and check the setting with the Tape Width Gauge.

7.3.6.4 If the right-hand guides are incorrectly set, remove the top plate and slacken the screw (57) securing the guide pin extension (56). The tape guide pin can then be adjusted as necessary. After adjustment, tighten the screw (57), replace the top plate, and re-check the setting with the Tape Width Gauge (1(2/4)A50146) or (1(2/4)A50246). Check for positive location in all three positions.

#### 7.4 Clutch Force Measurement

##### NOTE:

During this measurement, the upper section of the brake assembly should be removed.

7.4.1 With the clutch energised and the motor running, the force required to keep an unperforated length of 1 in. wide paper tape just moving backwards through the reader must be not less than 340 gm. and not greater than 380 gm.

7.4.2 Insert a length of unperforated 1 in. wide paper tape into the reader. Secure the right-hand end (viewed from the front of the reader) to a Correx Spring Tension Gauge (50-500 gm) with the Brake and Clutch Test Tape Clamp (1(2/4)A120212). Start the motor and operate the clutch. Draw the tape slowly backwards through the reader, keeping the gauge arm at right angles to the tape, and the tape horizontal. Check that the force required to keep the tape just moving lies within the limits stated. If the reading is not within the limits, add or remove shims between the armature and clutch bracket as described in section 7.3.5.7.

##### NOTE:

The gap of 0.008 - 0.012in. set as in para. 7.3.5.7 may be lost when this force setting is achieved. This is acceptable as the original figure was a datum from which to start.

Run a loop of new unpunched tape through the reader for at least 15 minutes at full speed. Re-check the clutch force and re-adjust if necessary.

The removal or addition of one clutch armature shim (113) will alter the clutch force by approximately 50 gm.

CAUTION: WHEN THE READER IS OPERATING, CARE MUST BE TAKEN TO AVOID DRAWING THE CLAMP INTO THE READER.

## 7.5 Brake Force Adjustment

7.5.1 When the brake is energised and there is no tape in the reader, the gap between each poleface and the armature should be 0.0015 in. to 0.0025 in. The two gaps should not differ by more than 0.0005 in. and may be set correctly by placing the appropriate number of shims under the brake pad.

7.5.2 With the clutch and brake released, the force required to keep an unperforated 1 in. wide length of paper tape just moving forwards through the reader must be not less than 45 gm. and not more than 55 gm.

7.5.3 To check the brake force, insert a length of unperforated 1 in. wide paper tape into the reader. Secure the left-hand end (viewed from the front of the reader) to a Correx Spring Tension Gauge (10-100 gm.) using the Brake and Clutch Test Tape Clamp (1(2/4)A120212). Release the brake and clutch. Draw the tape slowly forwards through the reader, taking care to keep the gauge arm at right angles to the tape and the tape horizontal. Check that the force required to keep the tape just moving lies within the limits given in para. 7.5.2.

7.5.4 If the gauge reading in para. 7.5.3 is not within the limits stated, loosen the nut (143) on the armature bracket (135) and adjust the screw (142) to increase or decrease the tension in the pressure spring (140) as necessary. Tighten the setting nut (143) and re-check the reading.

## 7.6 Lubrication

### 7.6.1 Pinch Rollers

7.6.1.1 Remove the top, bottom and side covers, capstan guard, tape guide (42) and top plate. Remove the two screws (121) and the locking plate (120). Slide the clutch roller shaft (116) out of the clutch roller bracket assembly (115) and collect the pinch rollers (117) and roller spacers (118), noting the order of removal and the individual arrangement of each, so that on

re-assembly they can be replaced with the correct arrangement, i.e. in the correct order and with none reversed.

7.6.1.2 Clean off all oil and dirt from the parts, and temporarily re-assemble in the correct order without lubricant. Check that the gap between any two rollers is 0.006 in. to 0.009 in. Check that the rollers spin freely.

7.6.1.3 Remove the rollers and spacers and lubricate inside each roller with three drops of B.P. CS65 oil from the dermic oiler.

7.6.1.4 Re-assemble the pinch rollers and spacers in the correct order on the shaft, and secure in place, (see para. 7.6.1.1).

**NOTE:**

If a replacement pinch roller (117) or clutch roller shaft (116) is required, a new shaft complete with three new rollers must be fitted. These are supplied as a set, Part No. A7462. For the correct use of this set, see Appendix 1.

**7.6.2 Pinch Roller Bracket Pivot**

7.6.2.1 Remove the top, bottom and side covers, capstan guard, tape guide (42) and top plate. Place the reader on its back. Place one drop of S.A.E. 140 oil on the exposed end of the knife edge pivot, using the dermic oiler. Allow the oil to run down the knife edge, before restoring the reader to its base. Note that this is only practicable if the pinch roller bracket has been removed from the assembly.

**7.6.3 Tape Guide Pin Rollers**

Put one drop of S.A.E. 140 oil on the exposed end of each tape guide using the dermic oiler. Allow the oil to disperse into the guide pin rollers.

**NOTE:**

On later models with fixed guide rollers, lubrication is no longer required.

**7.6.4 Pressel Bar**

Remove the capstan guard, tape guide (42) and top plate. Put a small amount of S.A.E. 140 oil on the arm pivots (48) and on the two selector arm

guides (62) using the Dermic oiler. Allow the oil to disperse into the bearings.

### 7.6.5 Motor Bearings

7.6.5.1 Remove the top cover and capstan guard. Remove the grub screws at the top of each end of the motor casing to reveal the greasing points.

7.6.5.2 Inject a small amount of Shell Nerita Grease No.3 into each greasing point using the Dermic oiler (4306). Wipe off any excess grease.

7.6.5.3 Replace the grub screws, top cover and capstan guard.

### 7.7 Operational Test

7.7.1 Prepare a 1 in. wide length of paper tape containing approximately 500 characters, and splice the two ends together as in para. 4.6. Place the loop in the reader. Run the loop at the maximum speed, with the clutch held on continuously and the brake switched off. Check that the tape speed is correct by observing the sprocket waveform on an oscilloscope. The sprocket hole signals from a TRM 500 model should appear every 2 msec., and those from a TRM 1000 model every millisecond.

7.7.2 If the tape speed is not correct, check the clutch adjustment as detailed in section 7.4 and brake adjustment as detailed in para. 7.5.2. A small adjustment of one of these forces, within the limits quoted, will enable the correct maximum speed to be achieved.

### 7.8 Fault Finding

SYMPTOM	PROBABLE CAUSE	REMEDY
1. Tape slipping, or not stopping in correct position	Clutch out of adjustment Brake pads dirty, or out of adjustment Capstan Dirty	Check and adjust Clean, check and adjust Clean
2. No output signals	Dirty window or mask Optical misalignment Light mask out of position	Clean Re-align Refasten

## Fault Finding (cont'd)

SYMPTOM	PROBABLE CAUSE	REMEDY
3. No output on one channel	Photosensor or printed circuit board faulty	Change over printed circuit boards and locate faulty component
	Non-uniform illumination of mask apertures	Re-align prism and lamp
4. Tape damaged in reader	Seized rollers Burred brake pad.	Clean and lubricate Replace.

## Chapter 8: TABLES

### 8.1 Table 1 - Parts List

#### 8.1.1 Introduction

The method of presentation used in this list is as follows:-

- |                        |                                       |
|------------------------|---------------------------------------|
| (1) Assembled sub-unit | Part Description not indented         |
| (2) Component of (1)   | Part Description indented one space.  |
| (3) Component of (2)   | Part Description indented two spaces. |

The Item Numbers are shown on the Illustrated Parts List Fig. 12.

#### NOTES...

1. The quantities of screws, nuts, and washers listed in the spares column represent the recommended total numbers of each type and are entered against the first appearance of each type in the table.
2. When ordering spare parts, always quote the Part Number, never the Item Number, and give the type and serial numbers of the reader (s) for which the parts are required.

Item No.	Part No.	Description	No. off	Recommended Spares
-	1(2/4)D38532	TAPE READER TYPE TRM 500 Model 2	Ref	
-	1(2/4)D38575	TAPE READER TYPE TRM 500 Model 3	Ref	
-	1(2/4)D38528	TAPE READER TYPE TRM 1000 Model 4	Ref	
-	1(2/4)D38544	TAPE READER TYPE TRM 1000 Model 5	Ref	
-	1(2/4)B120088	Top Cover Assembly	1	
1	1(2/4)C120036	Top Cover	1	
2	1(2/4)A120131	Switch Plate	1	
3	1(2/4)A120084	Push Housing	1	
4	Y13256	Screw 8 BA x <sup>3</sup> / <sub>16</sub> in. Inst. Hd.	5	2
5	V1632	Nut 8 BA Full	5	2
6	V1558	Washer 8 BA Plain	5	3
7	1(2/4)A120085	Push Button	1	
8	1(2/4)A120086	Push Spring	1	
9	1373	Circlip, Clip No. E147	1	
10	1(2/4)A120054	Nameplate	1	
11	Y1637	Screw S/T No. 2 x <sup>3</sup> / <sub>16</sub> in. Rd. Csk.	4	
12	13370	Extruded PVC Beading (Black) 2 <sup>1</sup> / <sub>4</sub> in. long	1	
NS	4621	Bostick Clear Adhesive	A/R	
13	Y13264	Screw 6 BA x <sup>3</sup> / <sub>8</sub> in. Mush. Hd.	4	3
-	1(2/4)B120280	Lamp and Prism Mounting Bkt. Assy.	1	
14	1(2/4)B120278	Lamp and Prism Mounting Bkt.	1	
15	1(2/4)A120050	Lamp Contact	1	
16	V1841	Screw 4 BA x <sup>3</sup> / <sub>8</sub> in. Ch. Hd.	1	1
17	V1584	Washer 4 BA Plain	1	1

## 8.1.2 Parts List (Cont)

Item No.	Part No.	Description	No. off	Recommended Spares
18	1(2/4)A120049	Contact Post	1	
19	V1873	Screw 6 BA x $\frac{3}{8}$ in. Csk. Hd.	2	1
20	1(2/4)A120412	Lamp Retaining Plate	1	
21	V1842	Screw 4 BA x $\frac{5}{16}$ in. Ch. Hd.	2	2
22	V13262	Screw 4 BA x $\frac{1}{4}$ in Pan. Hd.	1	1
23	V1547	Washer 4 BA Large	1	3
24	V1842	Screw 4 BA x $\frac{5}{16}$ in. Ch. Hd.	2	
25	V1547	Washer 4 BA Large	2	
26	7499	Lamp 12 V 48 W	1	3
27	1(2/4)A120061	Prism	1	
28	V1886	Screw 6 BA x $\frac{9}{16}$ in. Ch. Hd.	2	2
29	V1557	Washer 6 BA Small	2	4
30	V1633	Nut 6 BA	2	2
31	V1557	Washer 6 BA Small	2	
32	1(2/4)A120665	Bottom Cover Assembly	1	
33	V13379	Screw 6 BA $\frac{5}{32}$ in. Ch. Hd.	4	2
34	1(2/4)B120663	Side Cover Assembly	1	
35	Y7567	Screw 6 BA x $\frac{1}{4}$ in. Mush. Hd.	5	3
36	4396	Microswitch (SW1)	1	1
37	2566	Toggle Switch (SW4)	1	
38	1(2/4)B120081	Mounting Bracket	1	
39	V1832	Screw 4 BA x $\frac{1}{4}$ in. Csk. Hd.	4	2
40	1(2/4)B120712	Capstan Guard	1	
41	Y13378	Screw 8 BA x $\frac{7}{16}$ in. Inst. Hd. Chrome	2	1
42	1(2/4)A120024	Tape Guide	1	
43	Y13265	Screw 6 BA x $\frac{5}{8}$ in. Inst. Hd.	2	4
-	1(2/4)B120261	Top Plate Assembly	1	

## 8.1.2 Parts List (Cont)

Item No.	Part No.	Description	No. off	Recom- mended Spares
44	1(2/4)C120413	Top Plate	1	
45	1(2/4)A156773	Guide Pin	2	2
46	1(2/4)A120200	Window	1	2
NS	2742	Durofix Adhesive	A/R	
47	Y13265	Screw 6 BA x $\frac{5}{8}$ in. Inst. Hd.	4	
48	1(2/4)A120002	Arm Pivot	2	
49	V1542	Washer 2 BA Small	2	3
50	V1541	Washer 2 BA Large	2	2
-	1(2/4)B120245	Pressel Bar Assembly	1	
51	1(2/4)A156773	Guide Pin	2	
52	1(2/4)A120008	Guide Pin Mounting	2	
53	1(2/4)A120691	Guide Pin Mounting Screw	1	
54	1(2/4)A120217	Guide Pin Mounting Screw	1	
55	V1558	Washer 8 BA Plain	2	
56	1(2/4)A120011	Guide Pin Extension	1	
57	V3086	Screw 8 BA x $\frac{1}{4}$ in. Ch. Hd.	1	1
58	V1558	Washer 8 BA Plain	1	
59	1(2/4)A120004	Selector Arm	2	
60	1(2/4)A120060	Spring Clip	2	2
61	13383	Ball $\frac{1}{8}$ in. dia.	2	2
62	1(2/4)A120005	Selector Arm Guide	2	
63	V1891	Screw 6 BA x $\frac{1}{4}$ in. Ch. Hd.	4	4
64	1(2/4)A120704 } or 1(2/4)A120015 }	Operating Bar	1	
65	13365	Screw 4 BA x $\frac{1}{2}$ in. Skt. Hd. (use with 1(2/4)A120704)	2	1
	or V1850	Screw 4 BA x $\frac{1}{2}$ in. grub (use with 1(2/4)A120015)	2	1

## 8.1.2 Part List (Cont)

Item No.	Part No.	Description	No. off	Recommended Spares
-	1(2/4)A120055	Guide Pin Lever Assy	1	
66	1(2/4)A120010	Guide Pin Lever	1	
67	1(2/4)A120121	Spring Post	1	
68	V1620	Nut 4 BA	1	3
69	1546	Washer 4 BA Shakeproof	1	6
70	1(2/4)A120076	Return Spring	1	1
-	1(2/4)A120268	Accessory Set and Socket Assy.	1	
71	808	Socket	1	
72	6546	Outlet Accessory Set	1	
73	5892	Plug - 18-way	1	
-	1(2/4)A120267	Accessory Set and Socket Assy.	1	
74	13239	Socket	1	
75	5950	Outlet Accessory Set	1	
76	12234	Plug - 12-way	1	
-	1(2/4)B120029	Baffle Plate Assembly	1	
77	1(2/4)A120184	Fan Cowl Assembly	1	
78	V1842	Screw 4 BA x <sup>5</sup> / <sub>16</sub> in. Ch. Hd.	4	
79	V1547	Washer 4 BA Plain	4	2
80	1546	Washer 4 BA Shakeproof	4	
81	V1621	Nut 4BA Full	4	2
82	13363	Grommet	1	
83	1(2/4)B120091	Baffle Plate	1	
84	V1841	Screw 4 BA x <sup>3</sup> / <sub>8</sub> in. Ch. Hd.	3	3
85	V1548	Washer 4 BA Small	3	2
86	1(2/4)B120165	Motor Assembly for TRM 500, 240 V 50 c/s supply	1	
	1(2/4)B120177	Motor Assembly for TRM 500, 115 V 60 c/s supply		

## 8.1.2 Parts List (Cont)

Item No.	Part No.	Description	No. off	Recom- mended Spares
87	1(2/4)B120117	Motor Assembly for TRM 1000, 240 V, 50 c/s supply	1	
	1(2/4)B120118	Motor Assembly for TRM 1000, 115 V, 60 c/s supply		
87	-	Motor Base	1	
88	1(2/4)A120154	Terminal Bracket	1	
89	13656	Flexible Terminal Block - 4-way	1	
90	V1887	Screw 6 BA x $\frac{1}{2}$ in. Ch. Hd.	2	
91	V1557	Washer 6 BA Plain Small	2	
92	13241	Terminal Pin, Crimped	4	
93	13388	Sleeve 2mm x $\frac{3}{4}$ in. Pink	4	
94	1(2/4)A120281	Motor Shim	4	
95	V1802	Screw 2 BA x $\frac{1}{2}$ in. Ch. Hd.	4	1
96	V1542	Washer 2 BA Small	4	
97	1(2/4)A120071	Fan Assembly	1	
98	V1850	Screw 4 BA x $\frac{1}{4}$ in. Grub	1	1
* -	1(2/4)B50837	Clutch Assembly	1	1
99	1(2/4)B120030	Clutch Bracket	1	
*100	1(2/4)A120012	Clutch Roller Bracket Pivot	1	
101	V1889	Screw 6 BA x $\frac{3}{8}$ in. Ch. Hd.	2	2
102	1(2/4)B120293	Stop Block	1	
103	V1886	Screw 6 BA x $\frac{9}{16}$ in. Ch. Hd.	2	
104	13269	Screw 4 BA x $\frac{3}{16}$ in. Grub	1	1
105	V1900	Screw 8 BA x $\frac{1}{4}$ in. Csk. Hd.	1	1
*106	1(2/4)A50835	Coil	2	2
107	PL1(2/4)A120078	Lamination Assembly	1	
108	1(2/4)120046	Lower Lmaination Clamp	1	
109	1(2/4)A120063	Bolt 2 BA	2	1

## 8.1.2 Parts List (Cont)

Item No.	Part No.	Description	No. off	Recommended Spares
110	V1616	Nut 2 BA	2	2
111	V1542	Washer 2 BA	2	1
112	1(2/4)A120034	Adjusting Stud 4 BA	1	
113	V1620	Nut 4 BA	2	
114	1(2/4)A120143	Clutch Spring	1	1
115	1(2/4)A120150	Clutch Roller Bracket Assy.	1	
†116	1(2/4)A120166	Clutch Roller Shaft	1	
†117	1(2/4)A120173	Pinch Roller	3	
	1(2/4)A120161	Roller Spacer	A/R	
118	1(2/4)A120162	Roller Spacer	A/R	
119	1(2/4)A120128	Roller Spacer	A/R	
120	1(2/4)A120027	Locking Plate	1	
121	V13268	Screw 10 BA x $3/32$ in. Csk. Hd.	2	2
122	1(2/4)A120013	Clutch Armature	1	
123	1(2/4)A120116	Clutch Armature Shim (0.001 in.)	A/R	6
124	1(2/4)A120680	Clutch Armature Shim (0.005 in.)	A/R	1
125	V1899	Screw 8 BA x $3/16$ in. Ch. Hd.	2	2
126	1560	Washer 8 BA Shakeproof	2	2
127	9328	Screw 8 BA x $1/4$ in. Grub, Brass	2	2
128	6862	Nut 8 BA Brass	2	2
129	1(2/4)A120077	Tagboard Assembly	1	
130	1(2/4)A120057	Insulator	1	
131	V1873	Screw 6 BA x $3/8$ in. Csk. Hd.	2	1
132	1(2/4)A120251	Clutch Bracket Shim	A/R	

†For replacement parts, a clutch roller/spindle set, consisting of a clutch roller shaft and three selected pinch rollers, is supplied. The part number is 1(2/4)A157462. See Appendix 1 for use of this set.

## 8.1.2 Parts List (Cont)

Item No.	Part No.	Description	No. off	Recommended Spares
132A	1(2/4)A157548	Clutch Bracket Half Shim	A/R	
133	V1839	Screw 4 BA x $\frac{1}{2}$ in. Ch. Hd.	4	4
134	1546	Washer 4 BA Shakeproof	4	
* -	1(2/4)B50836	Brake Bracket Assembly	1	
135	1(2/4)A120019	Armature Bracket	1	
136	13259	Screw 4 BA x $\frac{5}{8}$ in. Soc. Hd.	2	2
137	1(2/4)A120040	Brake Armature	1	
138	1(2/4)A120073	Damping Pad	1	1
139	1(2/4)A120067	Armature Carrier	1	
140	1(2/4)A120171	Pressure Spring	1	1
141	1(2/4)A120170	Locating Pin	2	
142	13258	Screw 6 BA x $\frac{3}{8}$ in. Soc. Set	1	1
142	1(2/4)A120129	Setting Nut	1	1
144	1(2/4)A120077	Tagboard Assy.	1	
145	1(2/4)A120057	Insulator	1	
146	V1873	Screw 6 BA x $\frac{3}{8}$ in. Csk. Hd.	2	
147	1(2/4)A120041	Brake Pad	1	1
148	1(2/4)A120093	Brake Pad Shim	A/R	6
149	V1875	Screw 6 BA x $\frac{1}{4}$ in. Csk. Hd.	1	1
*150	1(2/4)A50835	Coil	2	
151	13373	Parallel Pin $\frac{1}{16}$ in. dia x $\frac{1}{2}$ in.	2	
153	1(2/4)B120031	Brake Bracket	1	
154	PL1(2/4)A120078	Lamination Assembly	1	
155	PL1(2/4)A120046	Lower Lamination Clamp	1	
156	1(2/4)A120063	Bolt 2 BA	2	
157	V1616	Nut 2 BA	2	
158	V1542	Washer 2 BA	2	1

## 8.1.2 Parts List (Cont)

Item No.	Part No.	Description	No. off	Recom- mended Spares	
159	1(2/4)A120045	Upper Lamination Clamp	1		
160	V1876	Screw 6 BA x $\frac{1}{2}$ in. Csk. Hd.	2		
161	1(2/4)A120250	Brake Bracket Shim	1		
162	V1839	Screw 4 BA x $\frac{1}{2}$ in. Ch. Hd.	4	1	
163	1546	Washer 4 BA Shakeproof	4		
164	13377	Capacitor 1 $\mu$ F, for 240 V 50 c/s motor in TRM 1000	1		
	13386				Capacitor 3 $\mu$ F, for 240 V 50 c/s motor in TRM 500
	13387				Capacitor 6 $\mu$ F, for 115 V 60 c/s motor in TRM 500 or TRM 1000
165	13234	Capacitor Mounting Clip, for 1 $\mu$ F.	1		
	680				Capacitor Mounting Clip, for 3 $\mu$ F.
166	V1842	Screw )or accord- 4 BA x $\frac{5}{16}$ in. Ch. Hd.)ing to	2		
167	V1548	Washer )capacitor 4 BA Small ) type	2		
168	835	Plasklip	2		
169	V1889	Screw 6 BA x $\frac{3}{8}$ in. Ch. Hd.	2		
170	V1557	Washer 6 BA Small	2		
171	1(2/4)C120690	Printed Circuit Board Assy.	2	1	
172	1(2/4)A120685	Socket Assy. (SK1 and SK2)	2		
173	V6296	Screw 8-32 UNC x $\frac{7}{16}$ in. Ch. Hd.	4	2	
174	1(2/4)A120644	Circuit Board Support Bracket	2		
175	V1841	Screw 4 BA x $\frac{3}{8}$ in. Ch. Hd.	4		
176	1(2/4)A120697	Base Support Left -Hand Assembly (L. H. front and R. H. rear).	2		

## 8.1.2 Parts List (Cont)

Item No.	Part No.	Description	No. off	Recommended Spares
177	1(2/4)A120659	Monitor Point Plug Sub-Assembly	1	
178	4422	Resistor 1K $1/8$ W 10%	14	
NS	1(2/4)A120695	Base Support Right-Hand Assembly (L.H. rear).	1	
179	13263	Screw 4 BA x $3/8$ in. Soc.Hd. Cap	4	2
180	V1547	Washer 4 BA Large	4	
-	1(2/4)C120694	Base Assembly	1	
181	1(2/4)D120652	Base	1	
182	1(2/4)A120147	Switch Insulator	1	
183	4395	Micro Switchette (SW2, SW3)	2	
184	V1884	Screw 6 BA x $3/4$ in. Ch. Hd.	4	1
185	V1633	Nut 6 BA Full	4	
186	V1557	Washer 6 BA Small	4	
187	1(2/4)A120033	Spring Post	1	
188	1(2/4)A120142	Spring Post	1	
189	13254	Polythene Foot	4	
190	Y1843	Screw 4 BA x $1/4$ in. Ch. Hd.	4	2
191	13244	Block 104 way	1	
192	13245	Pin	11	
193	15020	Jack Screw, male	1	
NS	15021	Jack Screw, female	1	
194	1(2/4)B120681	PV Cell Reading Head Assembly	1	1
NS	7384	Photovoltaic Cell	9	2
195	V1891	Screw 6 BA x $1/4$ in. Ch. Hd.	4	
196	1(2/4)A120677	Monitor Point Cover Assembly	1	
NS	1(2/4)C120683	PL1 Cableform Assembly	1	
NS	1(2/4)C120682	PL2 Cableform Assembly	1	

## 8.1.2 Parts List (Cont)

Item No.	Part No.	Description	No. off	Recommended Spares
NS	1(2/4)C120692	PL3 Cableform Assembly	1	
NS	1(2/4)A120641	Reading Head Mask	1	

In some earlier models the parts indicated thus \*may have part numbers as shown below. The new items are fully interchangeable.

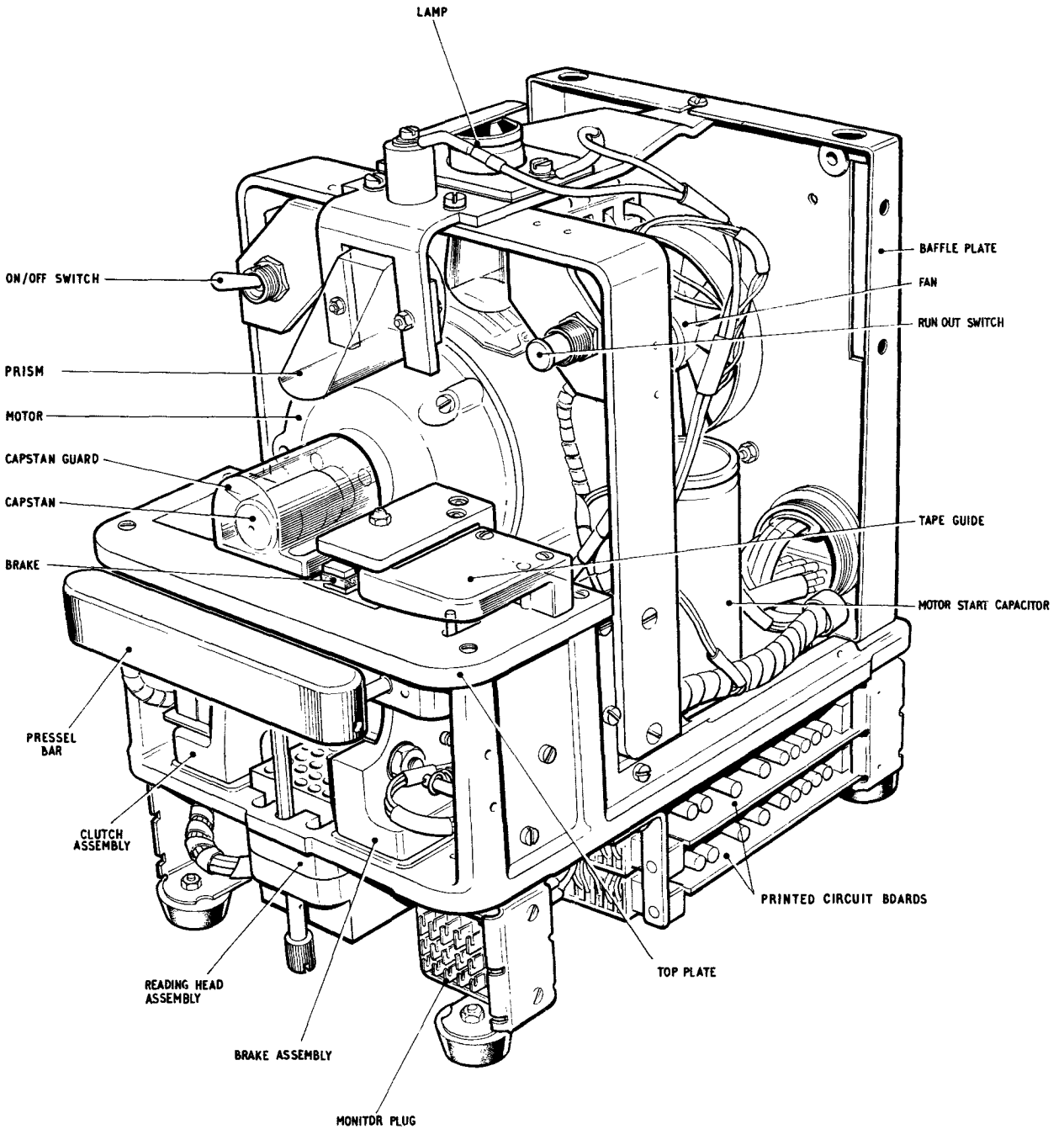
-	1(2/4)B120110	Clutch Assembly		
106	1(2/4)A120108	Coil		
-	1(2/4)B50836	Brake Bracket Assembly		
150	1(2/4)A120108	Coil		

## 8.2 Table 2 - Tools and Materials - routine maintenance

1. Cleaning cloth
2. Soft polishing cloth
3. I. C. I. perspex polish No. 3.
4. Soft brush  $1/2$  in. wide (10014)
5. Small stiff brush (13076)
6. Feeler gauges (2020) Moore and Wright 492
7. Screwdrivers
8. Hexagon wrench set (Fractional sizes)
9. Hexagon wrench 0.05 in. A. F. (2034)
10. Castrol S. A. E. 140 oil
11. B. P. CS65 oil
12. Shell Nerita Grease No. 3
13. Dermic oiler (4306)

## 8.3 Table 3 - Special Tools

1. AMP Extractor No. 465195-2 (13798)
2. Correx Tension Gauge measuring 50-500 gm (7065)
3. Salter 32 oz. Compression Spring Gauge (13797)
4. Brake and Clutch Test Tape Clamp (1(2/4)A120212)
5. Capstan Height Gauge (1(2/4)B157022)
6. Slip Gauge (1(2/4)A157023) } If motor is for 60 c/s
7. Slip Gauge (1(2/4)A157026) } operation.
8. Mask Setting Gauge (1(2/4)B50145)
9. Tape Width Gauge (1(2/4)B50146)  $11/16$  in.
10. Tape Width Gauge (1(2/4)A50246) 1 in.
11. Square Block (1(2/4)A50014)
12. Offset Hole Gauge (1(2/4)A120195)
13. Correx Spring Tension Gauge (10-100 gm)
14. Clutch alignment gauge (1(2/4))
15. Capstan alignment gauge for 50 c/s 1(2/4)A50694
16. Capstan alignment gauge for 60 c/s 1(2/4)A50693



TAPE READER WITH COVERS REMOVED

Figure 1

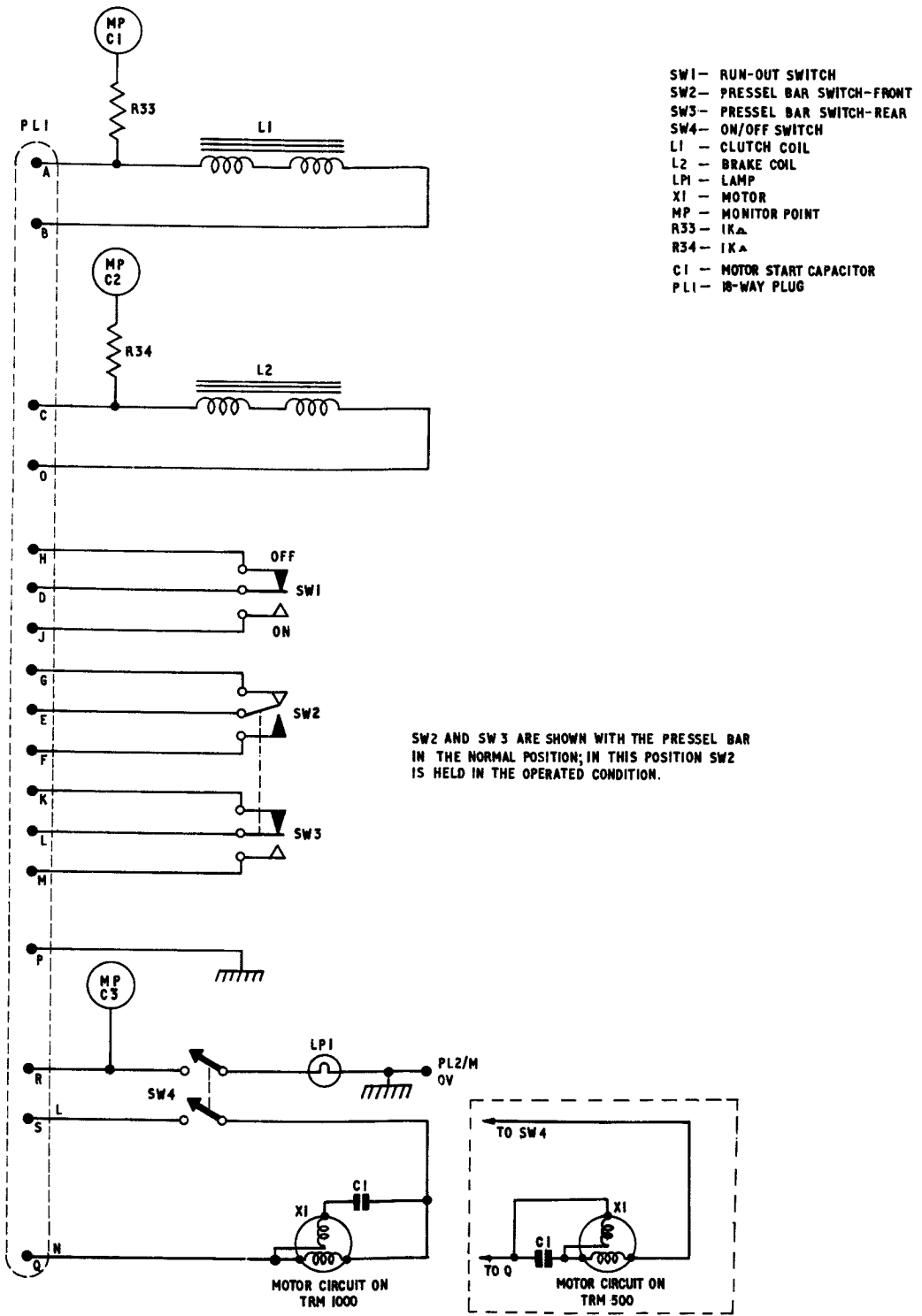
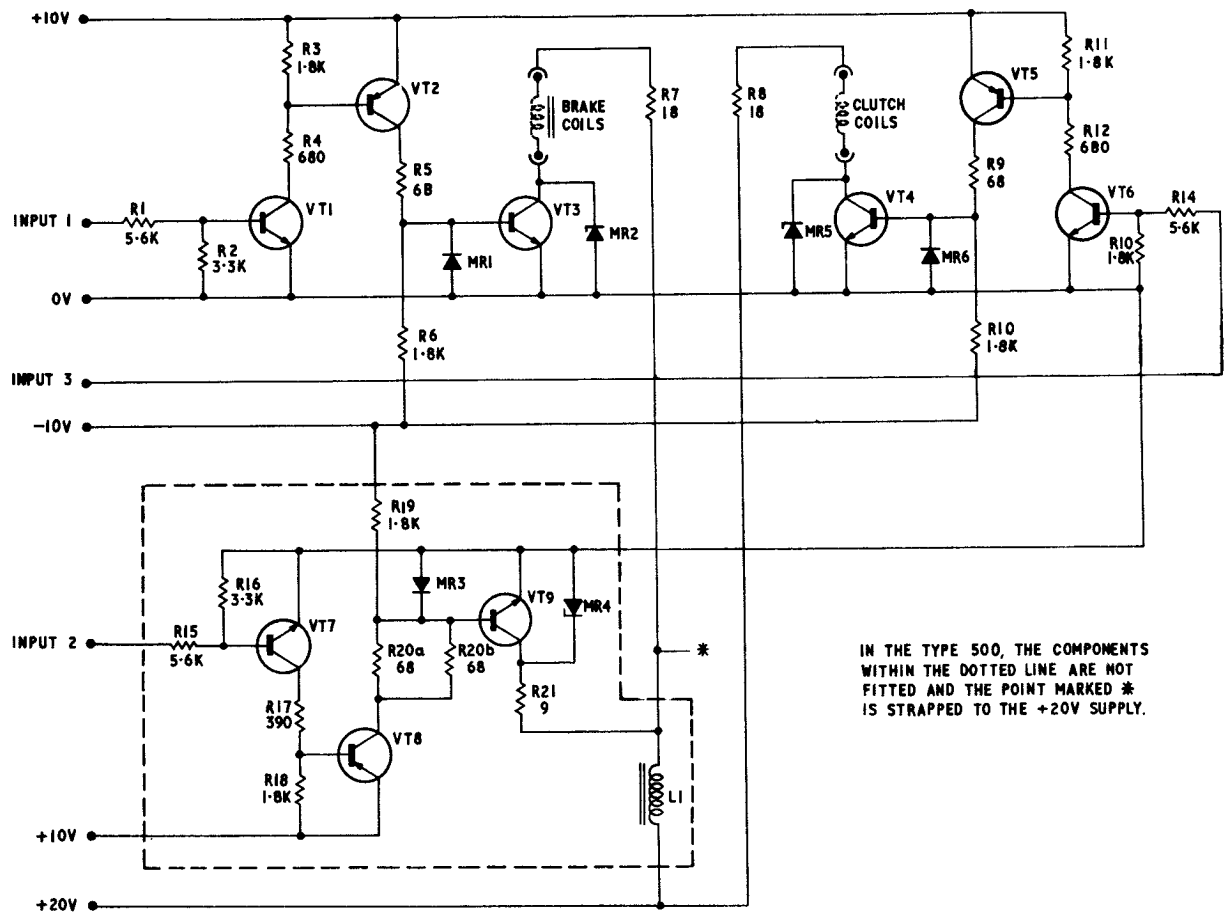


Figure 2

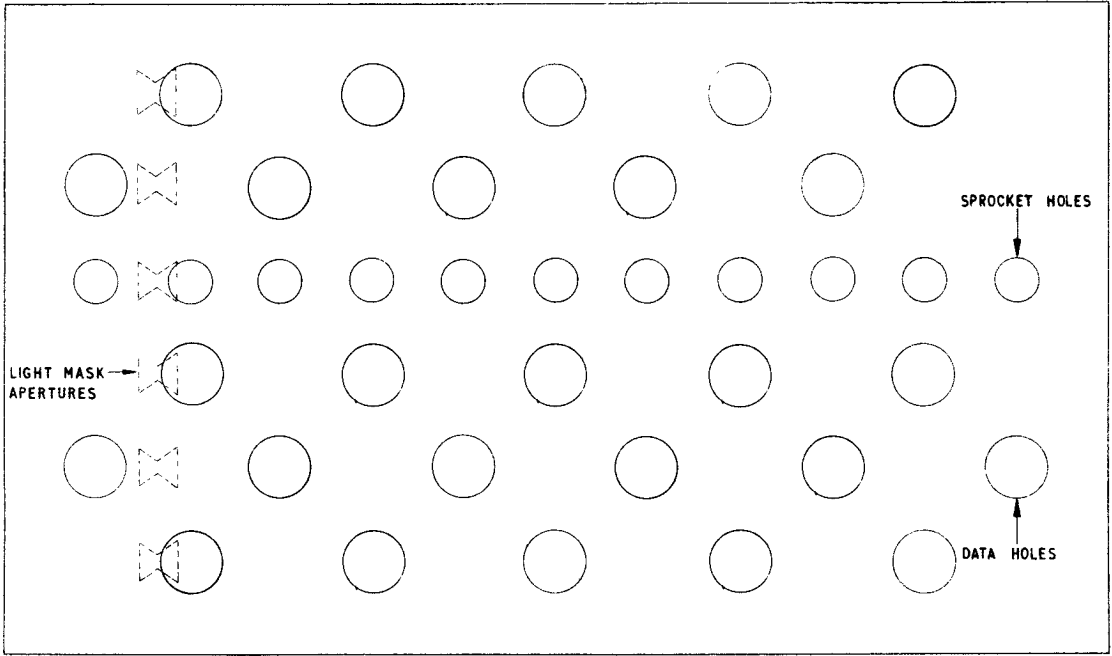


IN THE TYPE 500, THE COMPONENTS WITHIN THE DOTTED LINE ARE NOT FITTED AND THE POINT MARKED \* IS STRAPPED TO THE +20V SUPPLY.

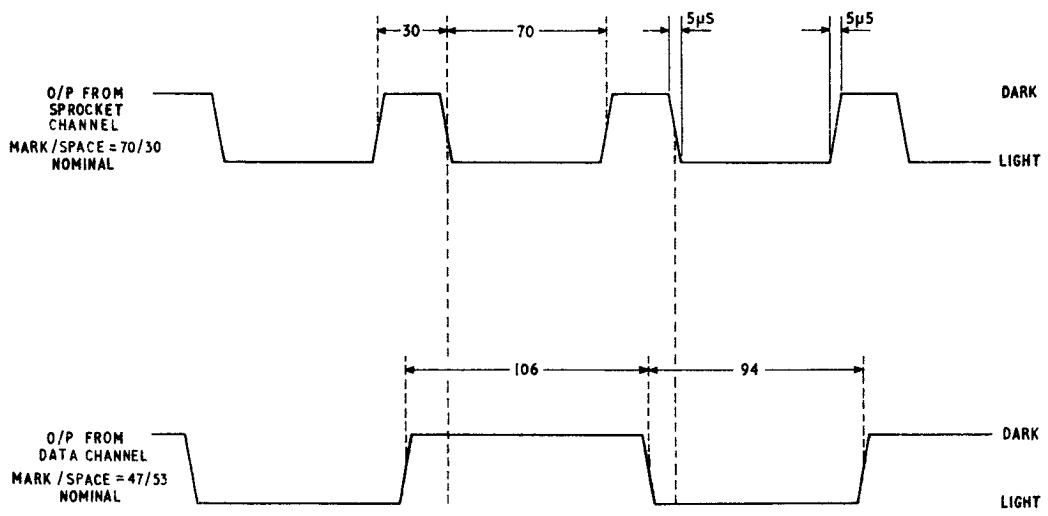
REFERENCE	VALUE OR TYPE NO.	TOL. %	RATING	REFERENCE	VALUE OR TYPE NO.	TOL. %	RATING
R1	1-8K	10%	1/4W	VT1	ZTX302	FERRANTI	
R2	3-3K	10%	1/4W	VT2	2N1614	MOTOROLA	
R3	1-8K	10%	1/4W	VT3 & VT4	2N3055	R.C.A.	
R4	68D	10%	1/4W	VT5	2N1614	MOTOROLA	
R5	68	10%	1W	VT6 & VT7	ZTX302	FERRANTI	
R6	1-8K	10%	1/4W	VT8	2N1614	MOTOROLA	
R7 & R8	18	10%	20W	VT9	2N3055	R.C.A.	
R9	68	10%	1W				
R10 & R11	1-8K	10%	1/4W				
R12	680	10%	1/4W	MR1	0A202		
R13	3-3K	10%	1/4W	MR2	82V ZENER		10W
R14 & R15	5-6K	10%	1/4W	MR3	0A202		
R16	3-3K	10%	1/4W	MR4 & MR5	82V ZENER		10W
R17	390	10%	1/4W	MR6	0A202		
R18 & R19	1-8K	10%	1/4W				
R20a, R20b	68	10%	1/4W				
R21	9	10%	40W	L1	10mH		2A

CLUTCH AND BRAKE CONTROL - RECOMMENDED CIRCUIT

Figure 3



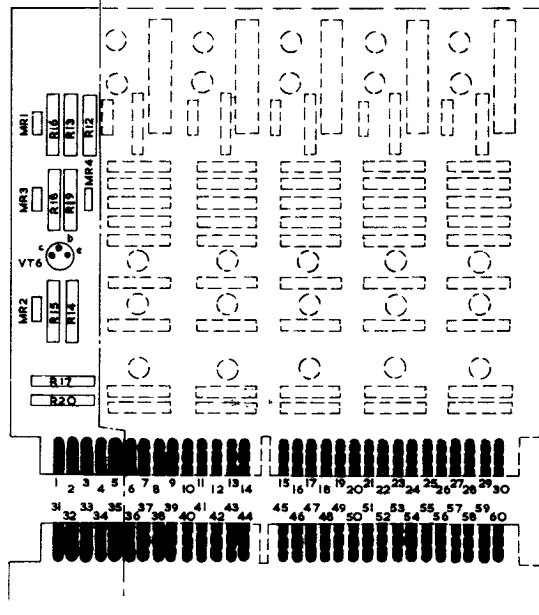
SECTION OF TYPICAL PUNCHED TAPE



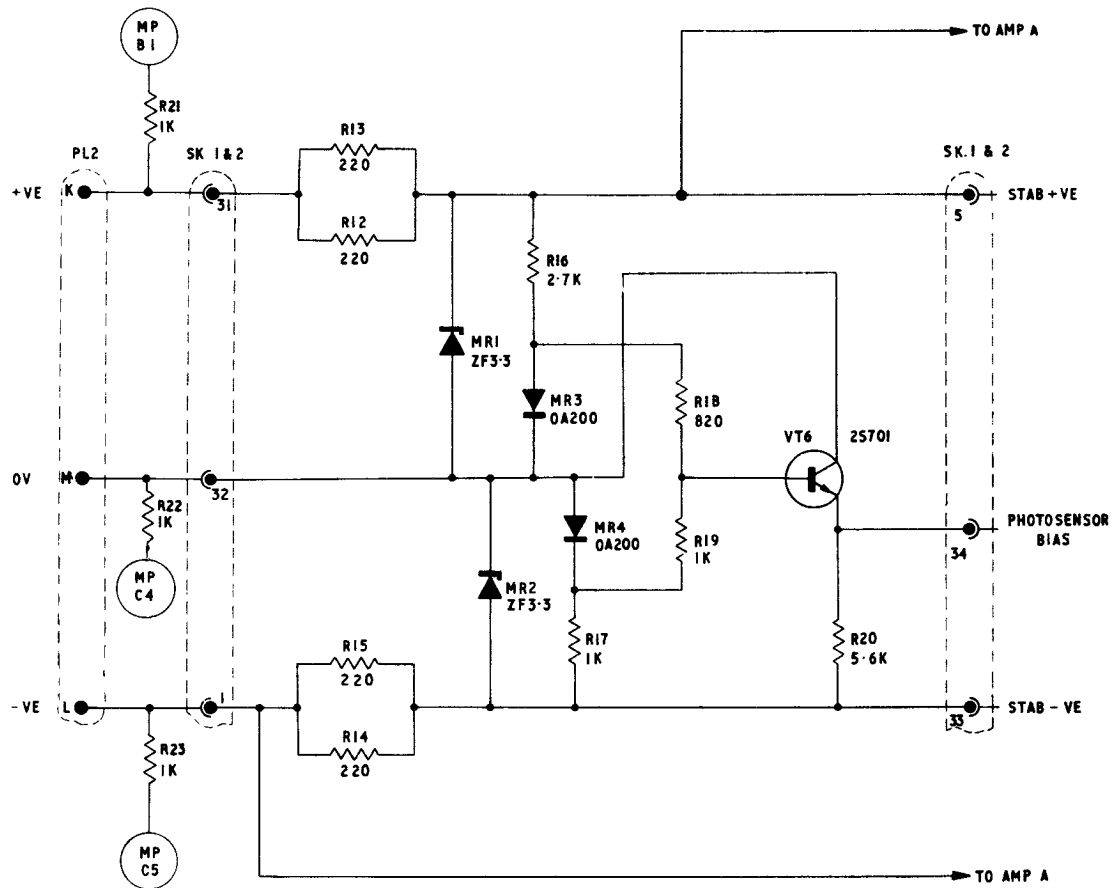
TYPICAL OUTPUT WAVEFORMS FROM TAPE PUNCHED AS SHOWN

Figure 4

TYPICAL TAPE AND OUTPUT WAVEFORM



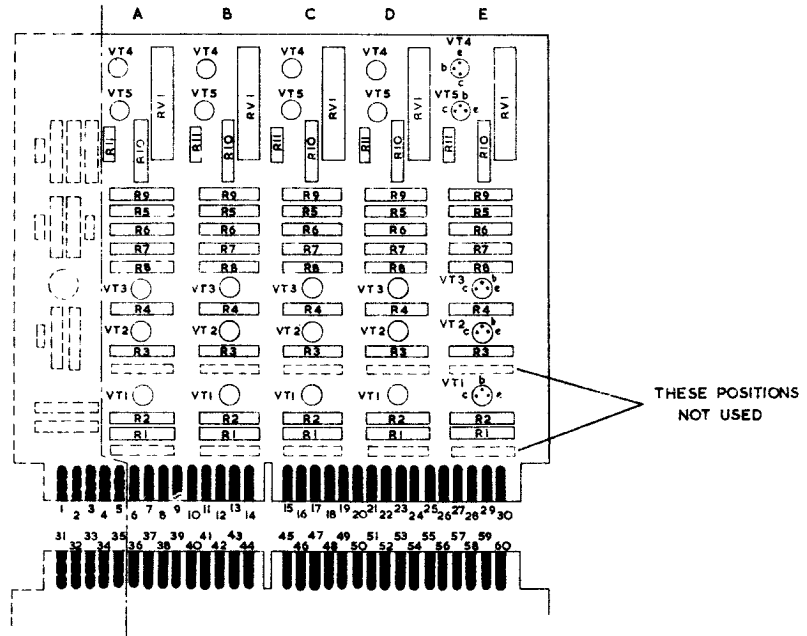
REFERENCE	VALUE OR TYPE No.	TOL %	RATING	PART No.
R12	220	3	1/2W	13146
R13	220	3	1/2W	13146
R14	220	3	1/2W	13146
R15	220	3	1/2W	13146
R16	27K	3	1/2W	7020
R17	1K	3	1/2W	13158
R18	820	3	1/2W	13156
R19	1K	3	1/2W	13158
R20	5.6K	3	1/2W	13173
R21-23	1K	10	1/8W	4422
MR1	ZF3-3			13235
MR2	ZF3-3			13235
MR3	OA200			4670
MR4	OA200			4670
VT6	2S701			13366
MR3 & 4	ZS120	ALTERNATIVE TYPE		D4/6/1401



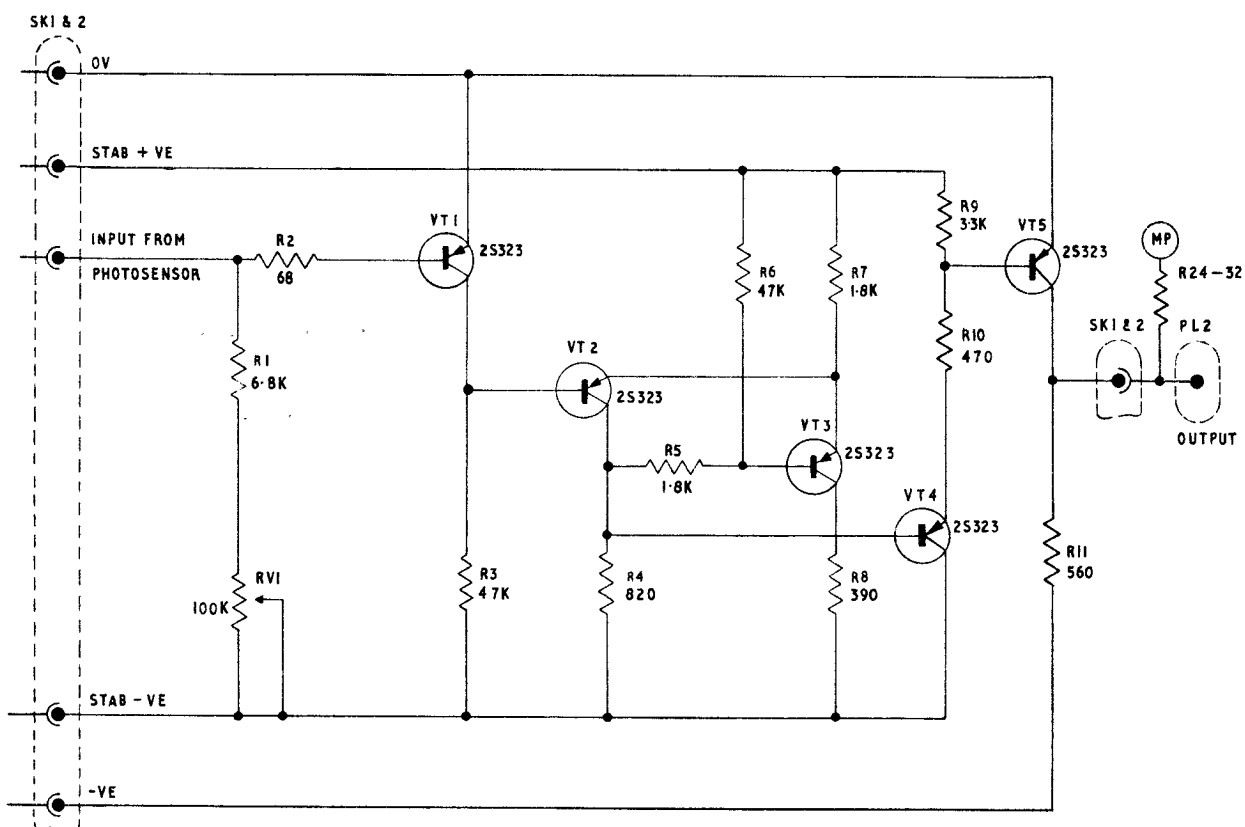
- SK 1 - } PRINTED CIRCUIT
- SK 2 - } BOARD SOCKETS
- PL 2 - 12 WAY PLUG
- MP -- MONITOR POINT
- R21 TO 25 - MONITOR POINT RESISTORS.

Figure 6

VOLTAGE STABILISER - CIRCUIT



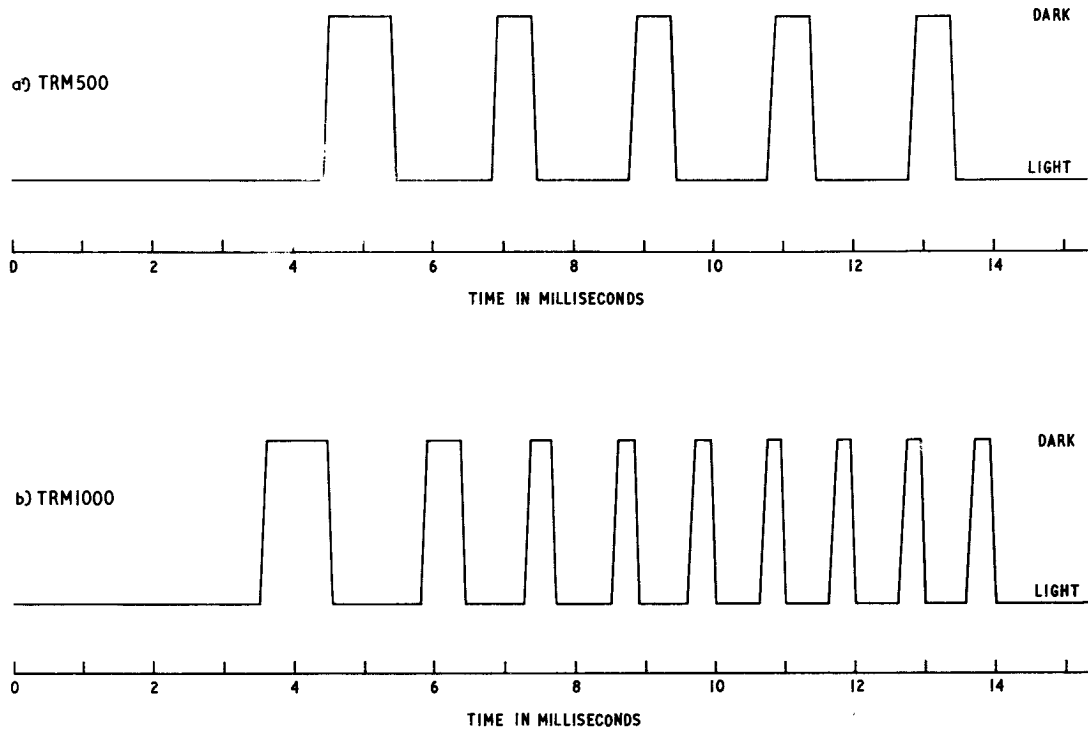
REFERENCE	VALUE OR TYPE No	TOL%o	RATING	PART No
R1	6.8K	3	1/2W	7369
R2	68	3	1/2W	13138
R3	4.7K	3	1/2W	7368
R4	820	3	1/2W	13156
R5	1.8K	3	1/2W	7210
R6	4.7K	3	1/2W	13187
R7	1.8K	3	1/2W	7210
R8	390	3	1/2W	6989
R9	3.3K	3	1/2W	13168
R10	470	3	1/2W	6990
R11	560	3	1/2W	13152
R24-32	1K	10	1/2W	4422
RV1	100K			PS451
VT1-VT5	253230	ALTERNATIVE TYPES		13367



SK1- } PRINTED CIRCUIT  
 SK2- } BOARD SOCKETS  
 PL2- 12-WAY PLUG  
 MP - MONITOR POINT  
 R24 TO 32 - MONITOR POINT  
 RESISTORS.

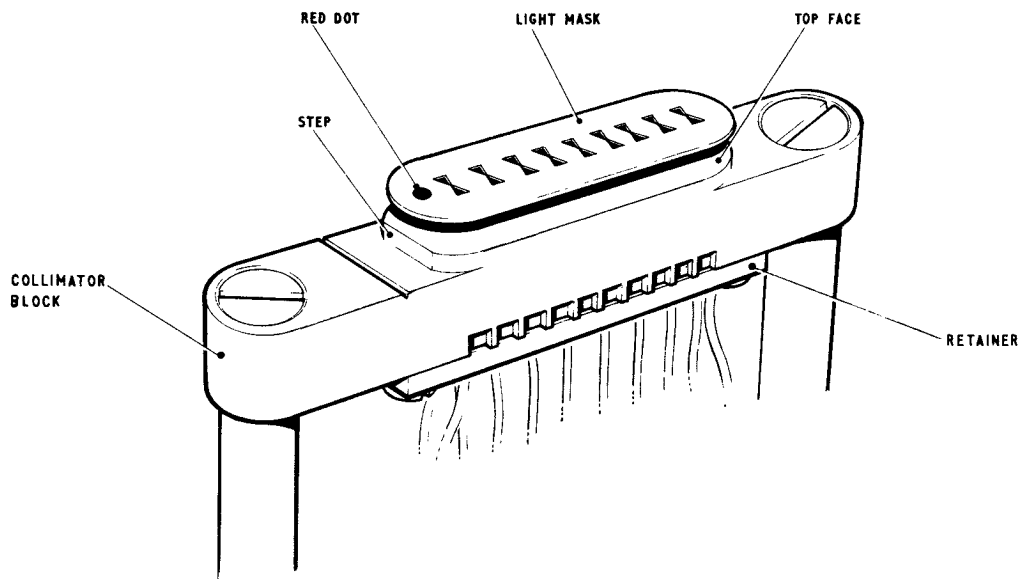
## NOTE

ON EARLIER MODELS R1 WAS 33K, AND RV1 WAS 50K,  
 OR R1 WAS 15K, AND RV1 WAS 100K.



NOTES.—

1. EACH DIAGRAM SHOWS THE WAVEFORM FROM THE SPROCKET AMPLIFIER WHEN THE CLUTCH IS ENERGISED AND THE BRAKE DE-ENERGISED AT THE ZERO POINT ON THE TIME SCALE.
2. THE CLUTCH AND BRAKE ARE ENERGISED BY THE CIRCUIT SHOWN IN FIG.4. THE CLUTCH ENERGISING CURRENT IS MAINTAINED THROUGHOUT THE PERIOD SHOWN, AND THE BRAKE IS DE-ENERGISED.
3. THE POSITION OF THE TAPE AT ZERO TIME IS AS DESCRIBED IN PARA. 6.4.





## APPENDIX 1: Use of Clutch Roller/spindle Set

If a replacement clutch pinch roller (125) or clutch roller shaft (124) is required, a new shaft, complete with three new rollers, must be fitted. These are supplied as a set, Part No. A.7462. The rollers are mounted on the shaft in the correct order and orientation when packed for transit, and this arrangement must be maintained when the parts are fitted in a clutch assembly.

When the set is required for use, the rollers should be removed from the shaft for lubrication, (see para.7.6.1.3) and then replaced in their original positions as the shaft is inserted into the clutch roller bracket (123). New spacers (126) should also be fitted, as required, so that the gap between any two rollers is 0.004 in. to 0.006 in. When the correct spacers have been fitted, re-assemble the remainder of the reader.

An unpunched loop of tape should then be inserted in the reader, and run at the maximum speed of the reader for a period of four hours. At the end of this time dismantle the clutch pinch roller shaft and rollers, and carry out the procedures given in paras. 7.6.1.2. to 7.6.1.4. Note that the gap between any two rollers should now be in the range quoted in para. 7.6.1.2.

## APPENDIX 2: TRM 1000/2

## CONTENTS

	Page
1. Introduction . . . . .	1
2. Covers . . . . .	1
3. Reading Head Assembly . . . . .	1
4. Printed Circuit Board . . . . .	2
5. Clutch Assembly Adjustments . . . . .	2

## ILLUSTRATIONS

	Fig.
Circuit Board-component layout TRM 1000/2	1
TRM 1000/2 Circuit diagram	2

## 1. INTRODUCTION

The TRM 1000/2 is basically the same as the TRM 1000/4 described in this manual except for the following items:

- (1) Covers
- (2) Reading Head Assembly
- (3) Printed circuit board
- (4) Clutch Assembly Adjustments

## 2. COVERS

The TRM 1000/2 is supplied with alternative covers when the reader forms part of the 4100 System. In this configuration the capstan guard is attached to the upper front cover by two screws.

## 3. READING HEAD ASSEMBLY

The Reading Head Assembly, item 194, complete with the Monitor Point, item 177, is replaced on the TRM 1000/2 by a new Reading Head Part No. 1(2/4)B120410 with no monitor point.

#### 4. PRINTED CIRCUIT BOARD

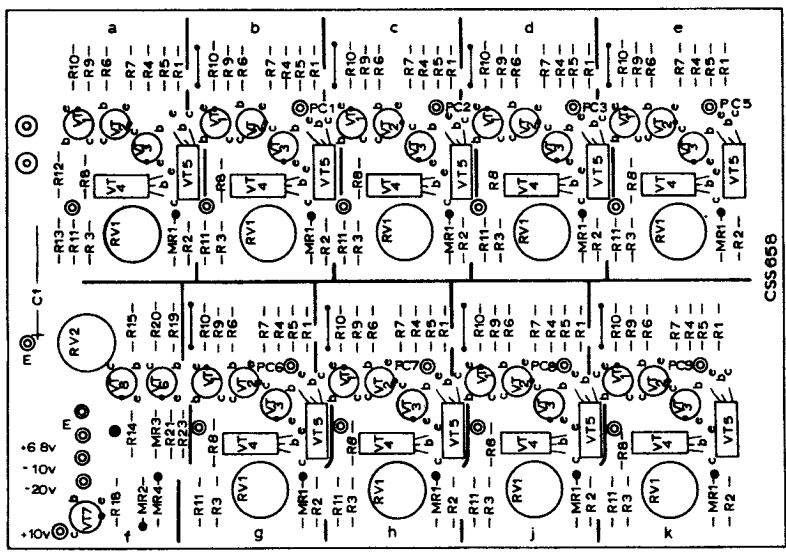
The two Printed Circuit Boards, item 171, and their associated edge connectors, are replaced on TRM 1000/2 by one Printed Circuit Board Part No. 1(2/4)C120430 which is screwed to the underside of the Reader and covered by the base plate. All connections to this board are soldered.

#### 5. CLUTCH ASSEMBLY ADJUSTMENTS

The clutch assembly adjustments on TRM 1000/2 are as follows:

- (1) Fit the clutch roller bracket assembly to the coil assembly and attach the two locknuts to the spring anchor pin. Ensure that the screws securing the roller bracket are tight. Remove the lower front cover. Slacken the locking screw on the split arm which holds the roller bracket adjusting screw. As a preliminary adjustment, set the lower face of the bracket directly under the clutch roller spindle until it is at 90° to the vertical face of the clutch coil casting. This condition is achieved by adjustment of the roller bracket adjustment screw. Position the arm of the Salter compression spring gauge (13797) on the armature end of the roller bracket and set the pressure of the return spring to  $22 \pm 2$  oz by means of the adjusting nuts. The 90° setting must remain unchanged.
- (2) Position the coil assembly in the reader and, using the Capstan and Clutch Alignment gauge (1(2/4)A50696), position the assembly so that the centre line of the roller spindle is directly beneath the centre line of the drive capstan.
- (3) Check that the capstan and the clutch pinch rollers are parallel using the Square Block (1(2/4)A50014). Hold the block so that it is in contact with the whole length of the clutch roller and the capstan. Using a feeler gauge, measure the gaps between the block and the two ends of the capstan. The maximum difference between these measurements should be 0.0005 in. Adjust the clutch assembly until this condition is met, then tighten the clutch assembly screws.
- (4) Using a feeler gauge measure the gap between the capstan and the clutch rollers, this should be  $0.0065 \pm 0.0005$ . If any discrepancy is found, adjust the roller bracket adjusting screw.

- (5) Place a 0.003 in. feeler gauge between the capstan and the pinch rollers. Press the armature down until the feeler gauge is nipped firmly by the rollers, taking care to apply the pressure evenly. Now measure the gap between the armature and the polefaces of the magnets. This should be  $0.010 \pm 0.002$  in. Correct any error by placing suitable shims between the armature and the coil bracket.
- (6) The pinch roller travel limiting stops must now be adjusted. Energise the clutch and measure the gap between the pinch roller and the capstan, this must not be greater than 0.002 in. Adjust the stops until this condition is satisfied ensuring that both stops contact their pole pieces at the same time.



TRM 1000/2 COMPONENT TABLE			
	Value	Tol ± %	Cat. No.
R			
1a	100K	5TE	6466
1b, c, d, e, g, h, j, k	150K	5TE	5875
2a, b, c, d, e, g, h, j, k	330	5TE	6328
3a	27K	5TE	12208
3b, c, d, e, g, h, j, k, & 21 & 22f	10K	5TE	5871
4a, b, c, d, e, g, h, j, k, & 5a	220K	5TE	7385
5b, c, d, e, g, h, j, k	270K	5TE	6003
6a, b, c, d, e, g, h, j, k	1K	5TE	5671
7a, b, c, d, e, g, h, j, k	22K	5TE	7443
8a & 19f	2.7K	5TE	5677
8b, c, d, e, g, h, j, k	4.7K	5TE	5680
9a, b, c, d, e, g, h, j, k	3 3K	5TE	5869
10a	2 2K	5TE	6017
10b, c, d, e, g, h, j, k	5.1K	5TE	7934

TRM 1000/2 COMPONENT TABLE				
	Value	Tol ± %	Cat. No.	
12a	270	5TE	6340	
13a & 20f	100	5TE	5662	
14f	470	5TE	5666	
15f	680	5TE	5867	
18f	820	5TE	5868	
RV				
1a, b, c, d, e, g, h, j, k	100K		13764	
2f	1K		7390	
C				
1	6.4µf	+50	16V	7643
MR				
1a, b, c, d, e, g, h, j, k	OA202		2721	
& 3f				
2f	OAZ244		6980	
4f	OAZ247		7933	
VT				
1a, b, c, d, e, g, h, j, k	ASY26		7932	
2a, b, c, d, e, g, h, j, k	2N1305		7152	
& 8f				
3a, b, c, d, e, g, h, j, k & 7f	2N1306		7644	
4a, b, c, d, e, g, h, j, k	25324		14280	
5a, b, c, d, e, g, h, j, k & 6f	2N337		7389	
Socket (Black)			7860	
Socket (Red)			7861	

## APPENDIX 3: TRM 500/5 (Formerly TRM 500/214/1)

## CONTENTS

	Page
1. Introduction . . . . .	1
2. Power Requirements . . . . .	1
3. Lamp assembly . . . . .	2
4. Motor circuit . . . . .	2
5. Stripping and assembly . . . . .	2

## ILLUSTRATIONS

	Fig.
Tape Reader Type TRM 500/5 with covers removed	1
Internal control circuits	2
Extract from illustrated parts list showing additional parts	3

## TABLES

	Table
List of parts special to TRM 500/5	1

## 1. INTRODUCTION

The TRM 500/5 (formerly TRM 500/214/1) is basically the same as the TRM 500/2 described in this manual except for the following:-

- (1) Power requirements
- (2) Lamp assembly
- (3) Extra components in the motor circuit

## 2. POWER REQUIREMENTS

These are as for the TRM 500/2 except that maximum ripple is 10 mV p-p and voltage for the clutch and brake becomes -20V d. c.

### 3. LAMP ASSEMBLY

A lamp insulator (20A) has been fitted in this model as shown in Fig. 3.

### 4. MOTOR CIRCUIT

Resistors and capacitors have been fitted in the motor circuit to reduce the interference caused by switching surges. Figs.1 and 3 show where components are fitted, while Fig.2 shows the altered circuit.

### 5. STRIPPING AND ASSEMBLY

Due to the above alterations certain stripping and assembly operations will be affected. These are listed below giving the reference to position in the text of the manual.

### 6. Switch Circuits

ON/OFF. The ON/OFF toggle switch controls the 200-250 volt 50 c/s supply to the motor, and the 9.5 volt supply to the lamp. The motor circuit includes components for the reduction of interference caused by switching surges. The circuit arrangement is shown in Fig.2.

RUN-OUT press-button is wired direct to the 18-way Plessey plug and should be connected externally to the clutch and brake control circuit. Normally the press-button switch connections would be arranged so that depression of the button causes continuous operation of the clutch assembly and prevents operation of the brake assembly. The internal circuit arrangement is shown in Fig.2.

PRESSEL BAR SWITCHES. An extension of the Pressel Bar is used to actuate two microswitches. In the normal position, one set of microswitch contacts is open and one set closed. When the Pressel Operating Bar is depressed, the microswitch states are reversed. The contacts are wired direct to the 18-way Plessey plug. Normally the external connections would be arranged to allow the brake or clutch to operate when the Pressel Bar assembly is normal and to prevent their operation when the Pressel Operating Bar is depressed. The internal circuit arrangement is shown in Fig.2.

### 7. Lamp (7.2.4.1 in manual)

Remove screw (16) to release lamp connecting lead. Collect washer (17) and lamp contact (15). Remove two screws (21), releasing lamp earth lead, lift off lamp retaining plate (20), and extract lamp (26) and lamp insulator (20A) from the lamp and prism mounting bracket (14).

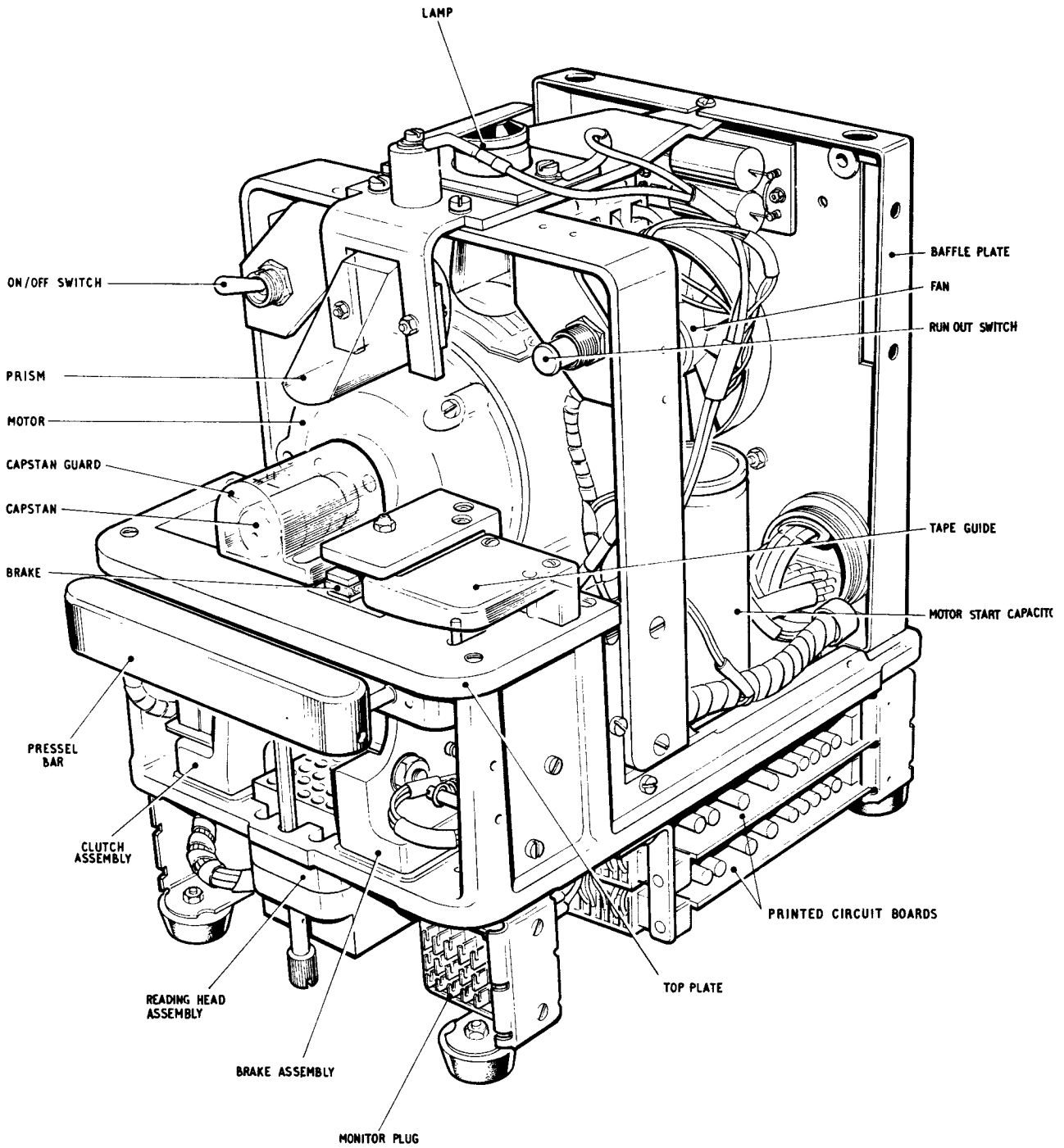
## 8. Baffle plate assembly (7.2.8 in manual)

Remove top, bottom and side covers. Remove the two nuts and washers (part of 73 and 77). Withdraw the plugs (73-77) to the fullest extent of the wiring taking care not to damage the electrical connections. Disconnect the wiring from the tagboard (197). Remove the two screws (199), nuts (201) and washers (200), then the tagboard and the insulator plate (198). Remove the three securing screws (84), washers (85) and the baffle plate assembly (77 to 83). Remove the four nuts (81) and washers (80). Withdraw the fan cowl assembly (77) complete with four screws (78) and washers (79) from the baffle plate (83).

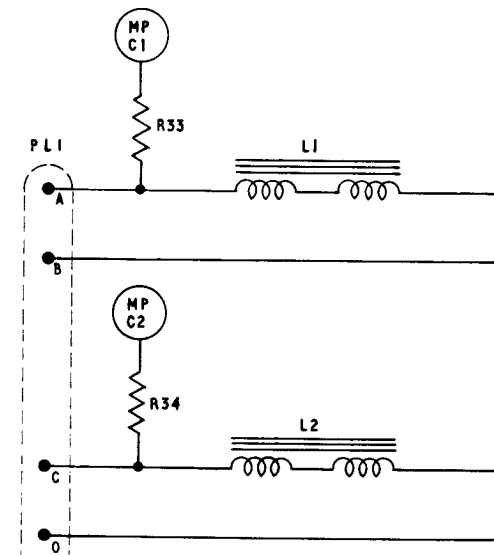
The spare parts listed below are special to the Tape Reader Type TRM 500/5 (formerly TRM 500/214/1).

TABLE 1

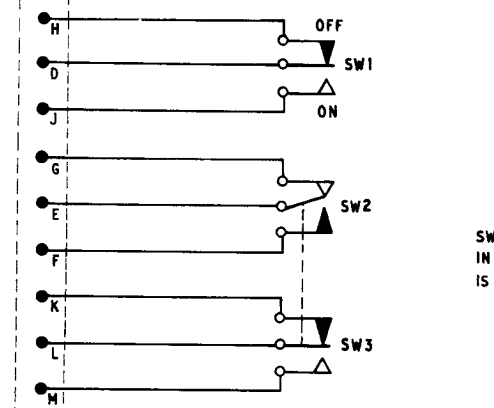
Item	Part No.	Description	No. off	Recommended Spares
20A	T-A710	Lamp insulator	1	
21	5/436	Screw 4BA x $\frac{3}{8}$ ch. hd. nylon	2	1
197	T-A707	Tagboard assembly	1	
198	D4/22/A102	Insulator plate	1	
199	V1891	Screw 6BA x $\frac{1}{4}$ ch. hd.	2	
200	V1557	Washer 6BA small	2	
201	V1663	Nut 6BA	2	



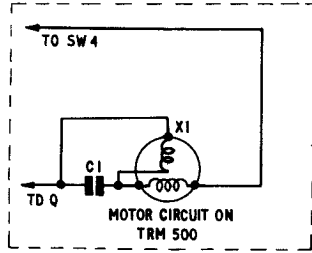
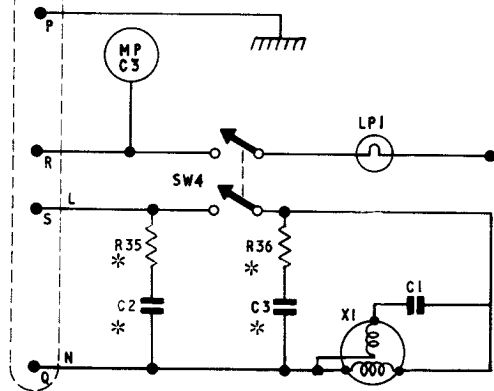
TAPE READER TYPE TRM 500/5 WITH COVERS REMOVED



- SW1- RUN-OUT SWITCH
- SW2- PRESSEL BAR SWITCH-FRONT
- SW3- PRESSEL BAR SWITCH-REAR
- SW4- ON/OFF SWITCH
- L1 - CLUTCH COIL
- L2 - BRAKE COIL
- LPI - LAMP
- X1 - MOTOR
- MP - MONITOR POINT
- R33 - 1K $\Omega$
- R34 - 1K $\Omega$
- C1 - MOTOR START CAPACITOR
- PL1- 18-WAY PLUG
- C2 - 0.1 $\mu$ F, 1000V
- C3 - 0.1 $\mu$ F, 1000V
- R35 - 100 $\Omega$  1/8 W
- R36 - 100 $\Omega$  1/8 W

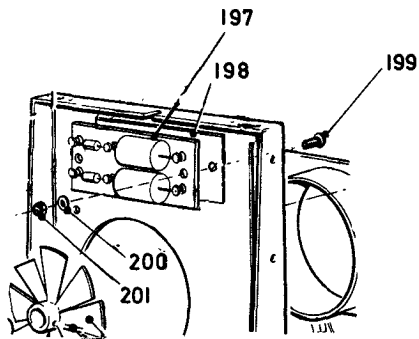
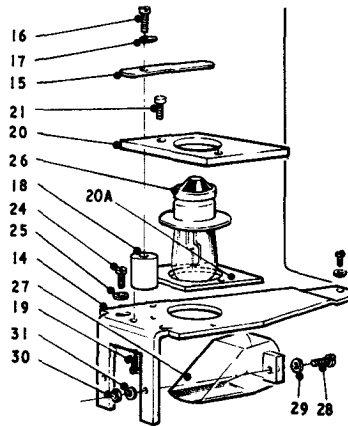


SW2 AND SW 3 ARE SHOWN WITH THE PRESSEL BAR IN THE NORMAL POSITION, IN THIS POSITION SW 2 IS HELD IN THE OPERATED CONDITION.



\* Components thus marked are fitted on 500/5 only.

INTERNAL CONTROL CIRCUITS



EXTRACT FROM ILLUSTRATED PARTS LIST  
SHOWING ADDITIONAL PARTS