TPU 62 02 02

Nr 97

FACIT PE 1500

HIGH SPEED TAPE PUNCH MANUAL

FACIT electronics ab
SOLNA 1 · SWEDEN

CONTENTS

GENERAL

The Facit PE 1500 high speed tape punch is intended for use as an output device for electronic data processing machines or as terminal equipment for high speed data transmission links. However, high speed reliability, and compact construction combine to assure excellent adaptability to other data-recording applications.

The Facit PE 1500 comprises a mechanical unit containing the tape supply reel, the feed and punch mechanism, and an electronic unit containing all synchronizing, tape feed and punch circuitry.

The punch is easily convertible for 5, 6, 7 or 8 track standard tapes. Maximum punching speed is 150 characters per second. However, this can be externally controlled and tape can be stopped on a character within the entire speed range from 0 to 150 characters per second.

The Facit PE 1500 is a motor-driven punch. Punching is accomplished by a punch mechanism powered by a motor; punches are selected by solenoids.

Power for tape feed is supplied by the same motor. Solenoid action pinches the tape against a feed arm which carries it forward.

Transistors and printed circuit boards comprise the electronic unit, which also contains a power supply.

The Facit PE 1500 is available in a number of modifications (see table on next page). The general designation, Facit PE 1500, is applicable to all electronic and mechanical units. When referring to specific units, however, the designations in the table are used.

Designation	No. of tracks	Unit	Mains voltage	Mains frequency
FACIT PE 1501	5-8	Mechanical unit	220 V single-phase	50 cycles
FACIT PE 1502	5-8	Mechanical unit	220 V single-phase	60 cycles
FACIT PE 1503	5-8	Mechanical unit	115 V single-phase	50 cycles
FACIT PE 1504	5-8	Mechanical unit	115 V single-phase	60 cycles
FACIT PE 1505	5	Mechanical unit	220 V single-phase	50 cycles
FACIT PE 1507	5-8	Electronic unit	220 V single-phase	50-60 cycles
FACIT PE 1508	5-8	Electronic unit	115 V single-phase	50-60 cycles
FACIT SSE 126	5	Electronic unit	220 V single-phase	50-60 cycles

Mechanical and electronic units can be combined as follows:

Mechanical unit	Electronic unit
PE 1501	PE 1507 PE 1508
PE 1502	PE 1507 PE 1508
PE 1503	-
PE 1504	-
PE 1505	SSE 126

The Facit PE 1505 and SSE 126 are special units not discussed in detail in this manual. However, most sections dealing with instructions, operation and service of the mechanical unit also apply to these special units. Diagrams for the PE 1505 and SSE 126 are not presented in this handbook but are included with the units on delivery.

Illustrations

SPECIFICATIONS

2.1 THE TAPE

Type of tape: Paper, oiled paper, mylar, metallized mylar

Widths of tape: See Fig. 1

5-channel:	11/16 inch	17.5 mm
6-channel:	7/8 inch	22.2 mm
7-channel:	7/8 inch	22.2 mm
8-channel:	1 inch	25.4 mm

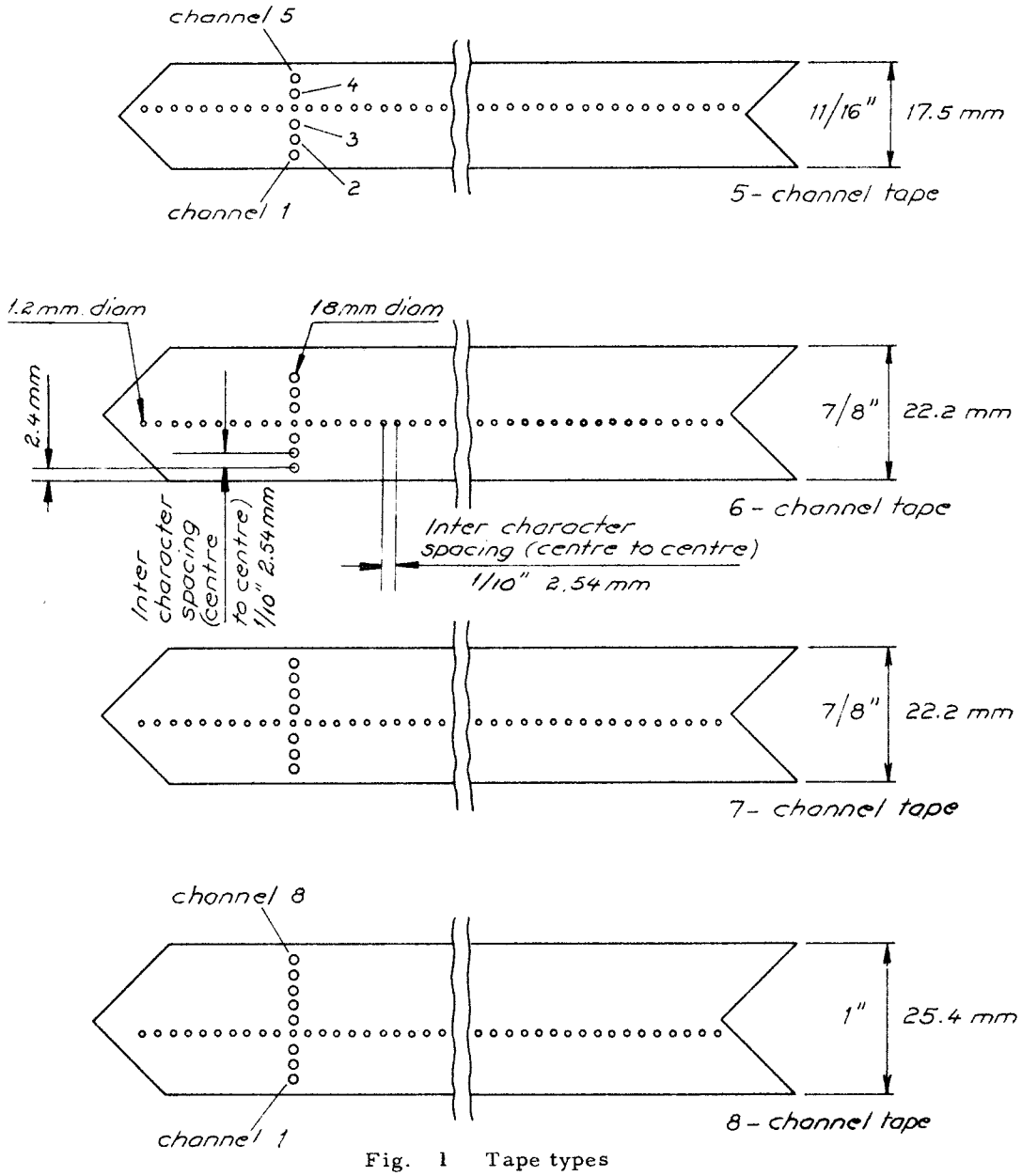


Fig. 1 Tape types

Thickness of tape:	Punch is adjusted for 0.08 mm (.003") tape thickness on delivery. Subsequent adjustment can be made for any tape thinner than approx. 0.12 mm (.005").
Inter character spacing:	2.54 mm (1/10").
Outer diameter of tape reel:	200 mm (8").
Inner diameter of tape reel:	50 mm (2").
Tape length:	Approx. 300 m (1000 feet) which corresponds to about 120,000 characters

2.2 ELECTRICAL DATA

Mains supply:	220 V ± 10%, single-phase; 50 ± 2 cycles 220 V ± 10%, single-phase; 60 ± 2 cycles 115 V ± 10%, single-phase; 50 ± 2 cycles 115 V ± 10%, single-phase; 60 ± 2 cycles PE 1501 – 1505: 90 W PE 1507, 1508 and SSE 126: 104 W
Start pulse:	Negative 0.1 - 3 ms. Upper level, min. +1 V, max. +25 V. Lower level, min. –4 V, max. –25 V. Input impedance 5 kohms.
Information lines:	5, 6, 7 or 8 parallel lines. DC voltage or negative incoming pulse at least 0.1 ms. long occurring simultaneously with start pulse. Upper level min. +1 V, max. +25 V for no hole. Lower level min. –4 V, max. –25 V for hole. Input impedance 5 kohms.
Output ready signal:	From –10 V to +1 V when information is stored in register. Max. rise time 10 μs. From +1 V to –10 V when punching is complete. Max. fall time 10 μs. Output impedance 500 ohms.
Buffer register:	Built in, stores one character.

2.3 MECHANICAL DATA

Punch speed:	Max. 150 characters per second.		
Tape feed:	Intermittent, externally controlled.		
Dimensions:	Mechanical unit:	Length	516 mm (approx. 20.3")
		Width	210 mm (approx. 8.3")
		Height	218 mm (approx. 8.6")

	Electronic unit:	Length	522 mm (approx. 20.5")
		Width	262 mm (approx. 10.3")
		Height	180 mm (approx. 7.1")
Weight:	Mechanical unit:	16.5 kg (36 lb.)	
	Electronic unit:	15 kg (33 lb.)	
Construction:	Punches and die of high-grade steel.		
	Chads fall through flexible plastic tube.		

2.4 CONTROL SUMMARY

2.4.1 Mechanical unit

Blank tape: When the toggle switch is set in the tape feed direction, tape runs out with only the sprocket hole punched. Tape run-out stops when the toggle switch is returned to the neutral position.

Mark combination: When the toggle switch is thrown in the opposite direction, tape is run out with the mark combination punched out.

On the PE 1505 the mark combination is punched in channel 2-5.

On the PE 1501 – PE 1504 the mark combination is not normally wired in.

Choice of combination on request.

2.4.2 Electronic unit

Mains voltage on: ON-OFF power switch.

Power on light: Red lamp, lights while mains voltage is on.

Mains voltage fuse: All electronic units, 3 Amps.

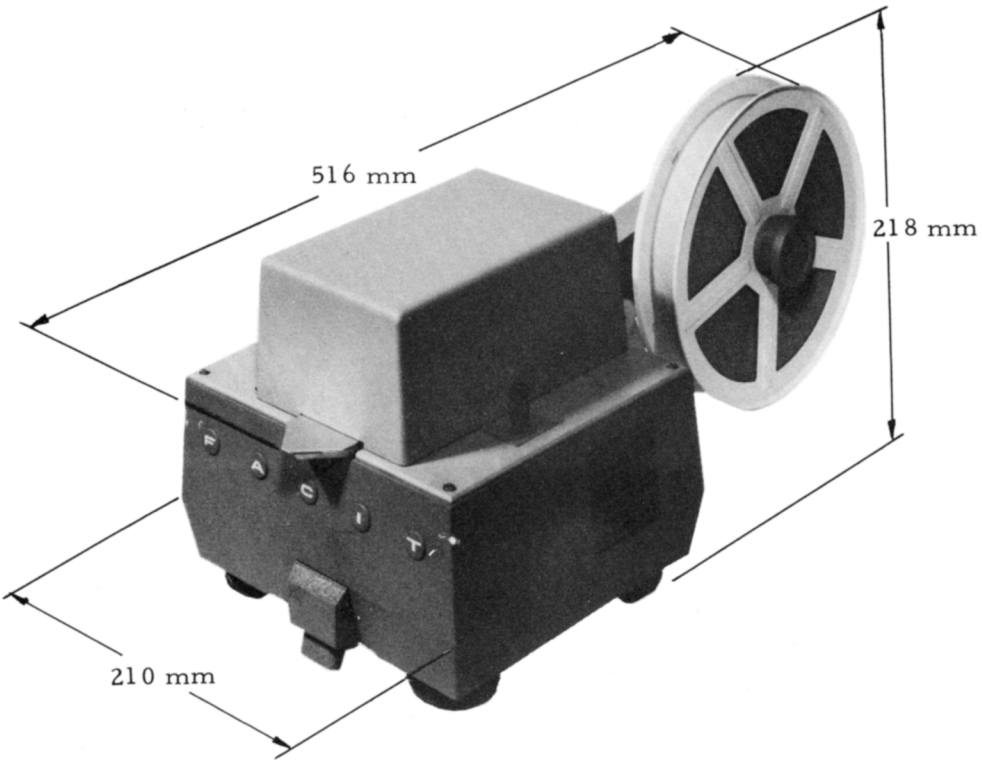
Channel selector switch: Selector switch with four positions on the PE 1507 and PE 1508.

Position 5 permits punching in channels 1-5 only;
position 6 – in channels 1-6 only;
position 7 – in channels 1-7 only;
position 8 – in channels 1-8.

MECHANICAL CONSTRUCTION

3.1 MECHANICAL UNIT

Fig. 2 shows the exterior of the mechanical unit. To the right is a reel holder loaded with a tape reel. At the bottom on the left is the tube for chads. At the top is a switch for feeding through either blank tape or tape punched with the mark combination. However, mark combination feed-through is wired in only on special request.



Weight: 16.5 kg. (36 lb.)

Fig. 2 Dimension drawing, mechanical unit

Cables are connected on the same side as the tape reel. Mains supply cable assemblies are of standard Swedish type without earth terminal. Other connections are made with a 30-pole socket type Tuchel L 2071.

The upper protective casing is easily lifted off. Beneath this casing at left (Fig. 3) is the punch mechanism. On each side of the punch mechanism can be seen the solenoids which implement punching. At the leading end of the tape is the top of the feed arm which moves tape one character spacing (1/10") each time it is punched. Just above the feed arm, shown in the raised position, is a casing beneath which are the solenoids for tape feed, and to the right is the lubrication system oil reservoir.

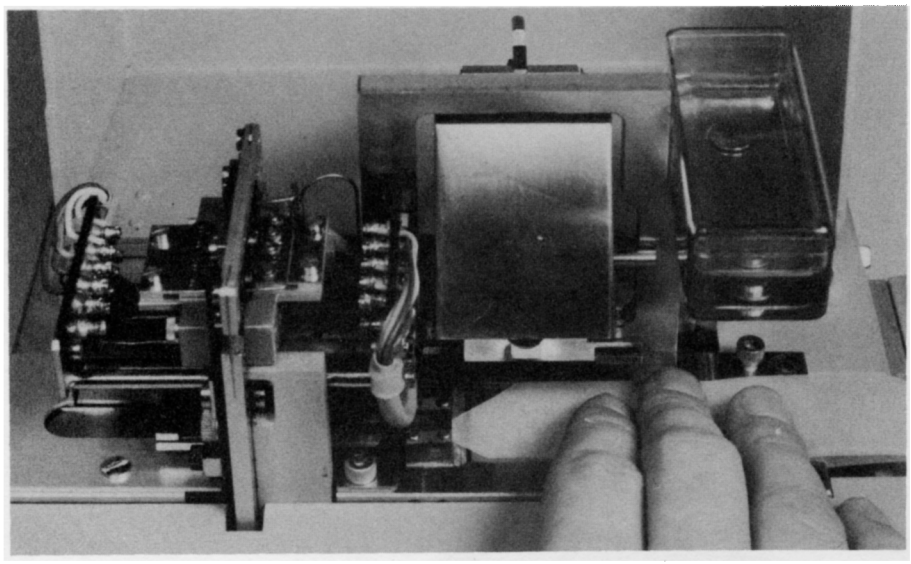


Fig. 3 Inserting tape

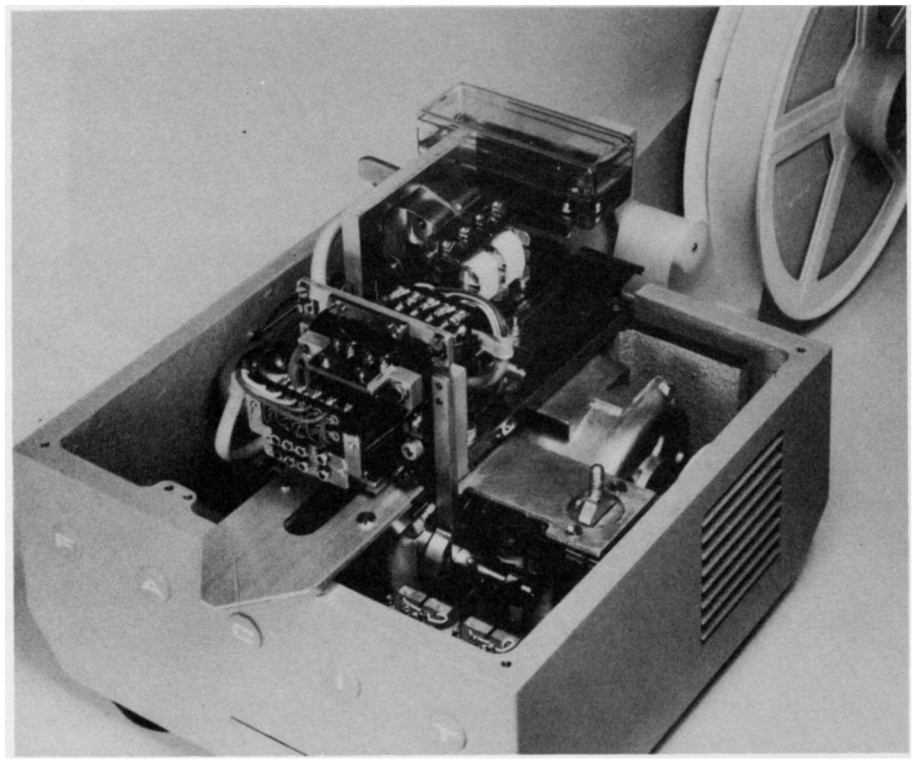
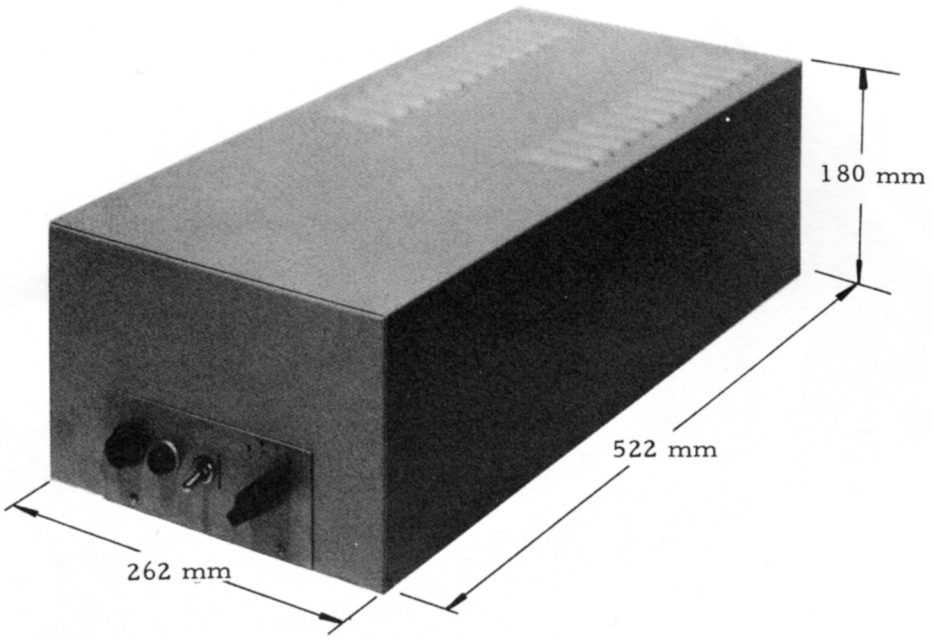


Fig. 4 Mechanical unit with upper protective plates removed

If the two protective plates on each side of the lower guide plate are removed (Fig. 4) three timing pulse transmitters can be seen at the right. At the bottom you see part of the chad outlet tube. The motor can be seen in the rear right hand corner of the casing. A link belt transmits power to the punch mechanism shaft. At the front and to the left can be seen part of the oil valve which regulates the supply of lubricant to three lubrication points.

3.2 ELECTRONIC UNIT

Included on the front panels of electronic units PE 1507 and 1508 (Fig. 5) are:
Mains supply fuse
Red "power-on" light that lights while maine voltage is on
ON-OFF power switch for mains voltage
Selector switch for choosing the number of channels to be punched



Weight: 15 kg. (33 lb.)

Fig. 5 Dimension drawing, electronic units PE 1507 and PE 1508

The following operating controls are located on the top of the SSE 126 electronic unit:

Fuse for mains voltage

Red "power-on" light that indicates that mains voltage is on

ON-OFF switch for mains voltage

The electronic unit comprises two sections (Fig. 6). The larger section contains seven printed circuit boards. The smaller section comprises a power supply which supplies both the mechanical and electronic units. The seven printed circuit boards contain:

Board 1 and 2:		eight register flip-flops with input gates
Board 3 and 4:		amplifiers with gates for punch solenoids
Board 5	:	start and stop circuits
Board 6	:	synchronizing circuits
Board 7	:	amplifier for feed and brake solenoids

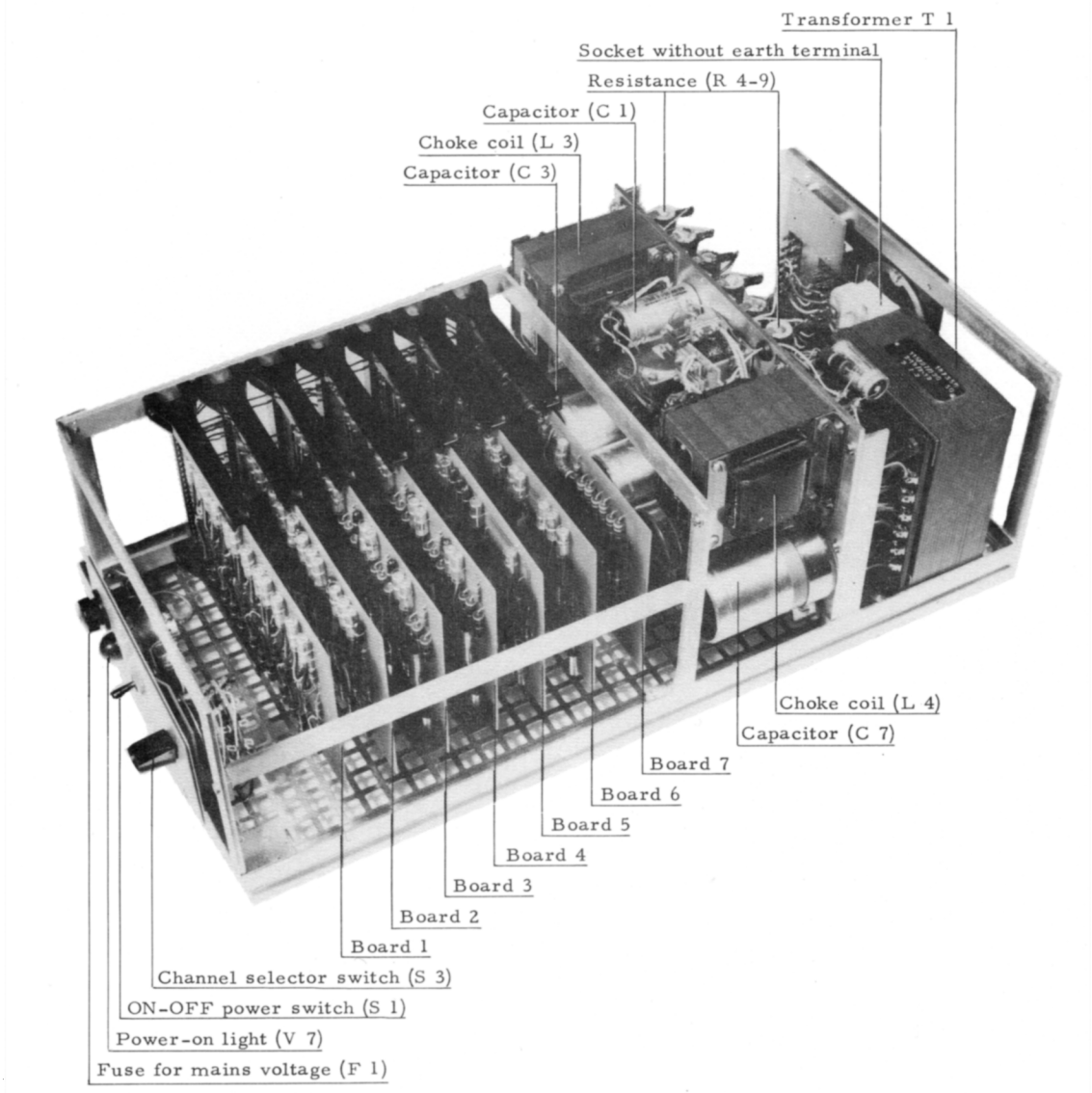


Fig. 6 Electronic unit, PE 1507 and PE 1508

Mains voltage is supplied to the electronic unit by a separate cable. Similarly, power is led from the electronic to the mechanical unit by a special cable.

The electronic unit is connected to the input device via a 30-conductor cable (for details see chapter 4). The same type of cable is used for signals between the electronic and mechanical unit. Multi-pole connections are made with Tuchel-type plugs L 2070 and L 2071. Cables to connect the mechanical and electronic units are included on delivery.

DESCRIPTION OF OPERATION

4.1 MECHANICAL UNIT

Unless otherwise stated, figures appearing in paragraphs 4.1.1, 4.1.2 and 4.1.3 refer to Fig. 32.

4.1.1 Tape-feed

Feed power is delivered to the main shaft (1) by the motor. On the main shaft is a connecting rod (2) with an eccentric bearing. The rod is connected to the feed arm (4) by a spring (3) and an adjustable screw (5). The feed arm is attached to the punch frame with another spring (6). The tape (7) is fed between the feed arm and brake plate (8) which is mounted on the feed arm. If the adjustable screw is set correctly the connecting rod causes the top of the feed arm to move 0.1 inch (inter character spacing).

For feed, the armature (9) is drawn to feed solenoid (10). This causes the feed screw (11) on feed rocker (12) to press down lug (13) on spring (14) against the brake plate (8) on the feed arm, thus pinching the tape between feed arm and brake plate. When the feed arm moves forward, the pinched tape must follow. When the forward motion is complete, current to the feed solenoid is interrupted. At the same instant the brake solenoid (15) is energized and the armature is drawn toward it. The feed rocker rotates swiftly on its shaft bearing (16). Brake screw (17) presses down the brake plate (18) which pinches the tape against the lower guide plate (19). Current flows through solenoid (15) while the tape is at rest. For the next feed, current to solenoid (15) is interrupted and current flows again to solenoid (10) when the eccentric is at position a (Fig. 7 and 8). When the eccentric is at position c current to solenoid (10) is interrupted and current flows to solenoid (15).

4.1.2 Punching

Power for punching is delivered to the main shaft (1) by the motor. Two connecting rods (20) are eccentrically mounted on the main shaft. These share a common crossarm (21) joined to them by two connecting rod springs (22), one attached to each connecting rod. The punches (23) are suspended on a guillotine (24) which is mounted in the crossarm. Vertical guillotine motion in a groove in the punch frame (25) is imparted by the eccentric connecting rod bearings. A front (27) and rear (28) beam are located on each side of the punch frame and fastened to it with two screws (26). Four

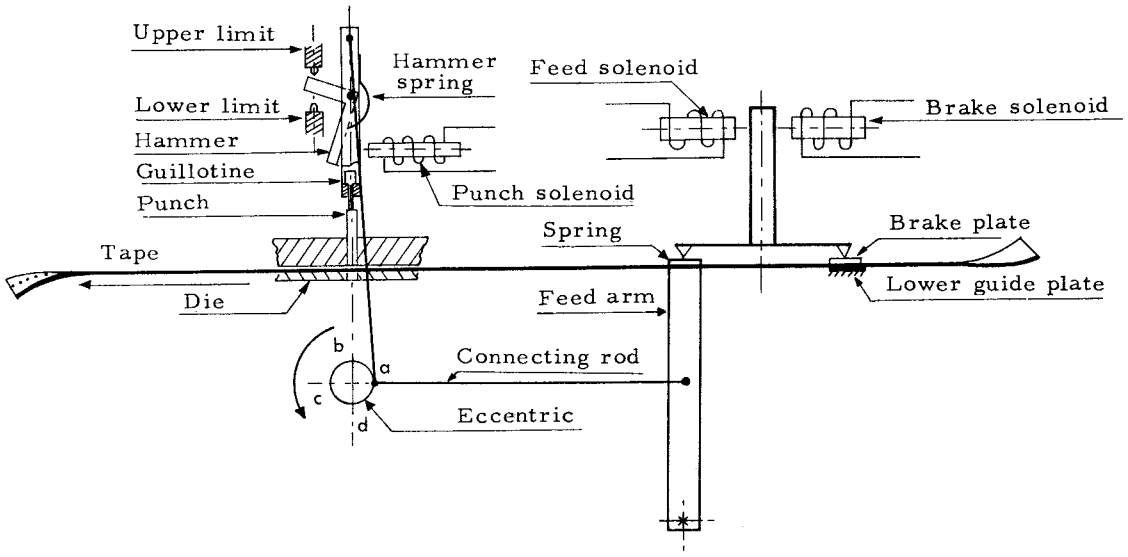


Fig. 7 Mechanical schematic

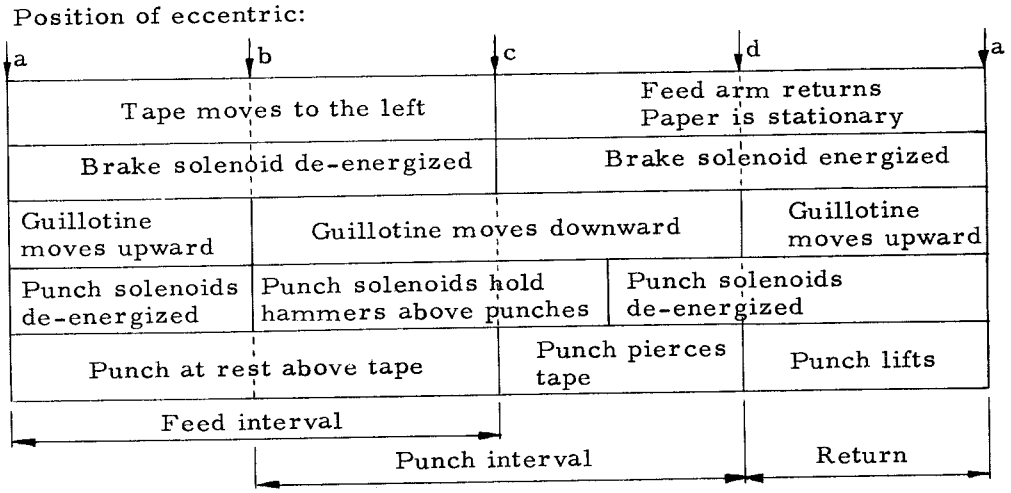


Fig. 8 Punching cycle

upper limit screws (29) and four lower limit screws (30) are mounted in each beam. Hammers (31) for each punch are located so that their shanks are positioned between an upper and a lower limit screw. Four hammer springs (32) are mounted on each side of the guillotine. Each of the eight springs is in contact with the rear side of one of the hammers. The eight hammers rotate on a common shaft (33). Hammer shanks are turned to the front and to the rear alternately. Eight punches are suspended in the lower guillotine crossarm - one for each hammer - and a fixed punch for the feed hole (34). Three punches are located on one side of the feed hole and five on the other. Two paired grooves have been milled in each punch, one pair at the top where punches are suspended in the guillotine, and one

pair at the bottom. These grooves are equal in length. A stop spring (35) in the lower grooves prevents the punch from lifting too high when the guillotine moves toward its top position.

When the guillotine is at its top position with the eccentric in position b (Fig. 7 and 8), the hammer shanks contact the upper limit screws, thus rotating the hammers into position above the punches. If no hole is to be punched, the hammer spring concerned rotates the hammer to the side of the punch as the guillotine moves downward (to eccentric positions c and d in Fig. 7 and 8). If a hole is to be punched, the punch solenoids concerned, both upper (37) and lower (36), are energized for part of half-revolution b-d (Fig. 7 and 8). When all the hammers are positioned above the punches by the upper limit screws which contact the hammer shanks as the guillotine passes through its top position, those hammers which are to punch holes are drawn to their respective punch solenoids. The magnetic effect of the punch solenoids now counteracts the force exerted by the respective hammer springs, which are thus unable to move the hammers to the side of the punches. As the guillotine moves downward, hammers which are attracted to their punch solenoids press their punches through the tape, which is now stationary on the die (38). Just before the guillotine reaches its bottom position (position d in Fig. 7 and 8), all the hammer shanks contact their respective lower limit screws, which force the solenoid-activated hammers to the side of the punches. When the guillotine moves upward it engages the punch heads, lifting the punches from the die.

4.1.3 Timing

Synchronization between the electronic system and the mechanical movements of the punch and feed mechanism is initiated by three timing pulse transmitters actuated by the main shaft (1) of the punch. Each timing pulse transmitter comprises an arm (40, 42 and 44) attached to the shaft and a pair of coils (39, 41 and 43). The coils have a premagnetized core with an air gap at the top. The arm on the main shaft passes the air gap once per revolution, causing a change in the magnetic circuit of the coils. This results in a voltage pulse across the pair of coils.

Thus the three timing pulse transmitters each send a signal to the electronic unit; at three separate main-shaft angles the following signals are sent:

G-start (39, 40) indicates the instant to start feed.

G-stop (41, 42) indicates the instant that feed is complete.

G-ready (43, 44) indicates the instant when punching is complete and the punch is ready to receive information for a new character.

4.2 ELECTRONIC UNIT

4.2.1 Introduction

The punching cycle is initiated by an incoming start pulse. Information to be punched (one character) is fed in simultaneously with the start pulse to an input register in the electronic unit. This information is transmitted to the punch solenoids after synchronization by the three timing pulse transmitters (G-start, G-stop, G-ready). A ready signal is fed out on a special line when the punching cycle reaches a certain point. This signal is for external use to indicate when the punch is ready to receive the next character. The start pulse, information in, and ready signal are illustrated in Fig. 9. Fig. 10 shows the relative timing of other internal, electronic-unit pulses.

4.2.2 Start

A start pulse (see Fig. 9 and Schematic drawing 24) is used to start the FACIT PE 1500. If the motor is running, the punch is ready to perform be-

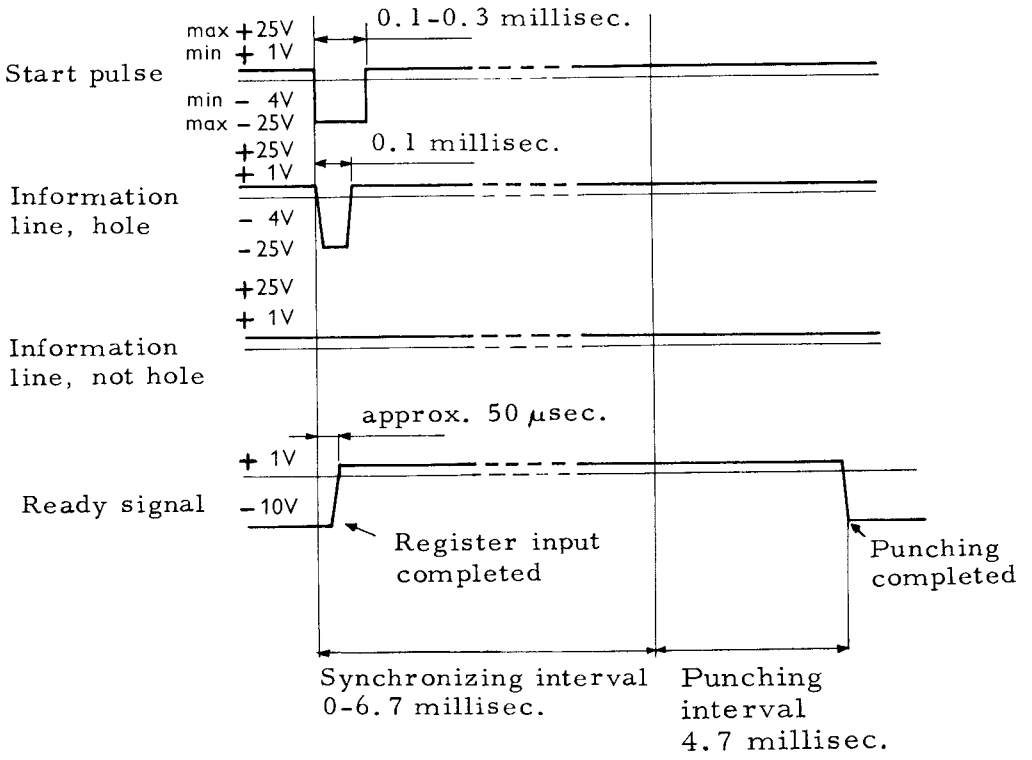


Fig. 9 Diagram of input and output signals

fore the main shaft has completed a single revolution - 6.7 millisec. maximum. Otherwise the motor must be started and come up to full speed. While the motor comes to full speed (approx. 0.4 sec.) the electronic circuitry of the punch is blocked. After punching is complete the motor runs at full speed for an additional 5 sec. If a new start pulse is received during this 5 sec. interval, punching will resume within an interval of 6.7 millisec. maximum. Thus the punch operates independently of start pulse timing. The three timing pulse transmitters on the main shaft, G-start, G-stop and G-ready, are used for synchronization.

4.2.3 Information input

Information is fed to the punch on 5, 6, 7 or 8 parallel lines simultaneously with the start pulse, either as DC voltages (an upper level for not hole and a lower level for hole) or as negative pulses on lines which are to actuate the punching. The leading edge of the start pulse triggers a 50 μsec. pulse (designated IP) which permits signals to enter the input register via the information lines (Fig. 24 and 25). Information must be available during this full period. Information is then held in the input register until punching is completed. Fig. 25 shows that register stages 6, 7 and 8 can be set at the 0 state by the track selector switch. If the selector switch is set at position five, all three stages are held at the 0 state. If the switch is set at position six, stages 7 and 8 are held at the 0 state, and at position seven only stage 8 is held.

4.2.4 Blocking of new start

The trailing edge of the IP pulse set ready-signal flip-flop V7 and V8 (Fig. 26) to the 1 state. As a result, the upper level is fed out on the ready-signal line thus indicating that punching is in progress and that neither start pulse nor information signals are any longer required.

The ready-signal is used internally in the electronic circuitry of the punch to start delay network V11-V16 (Fig. 26), which activates a relay that in turn supplies voltage to the motor. This network has a constant delay interval of 4 - 5 seconds during which the motor is kept running. Every new signal resets this network to its original condition, so that the motor is kept running for 4 - 5 seconds after the last ready signal.

The ready-signal positive transition can be suitably used externally to prevent a new start pulse from being sent to the unit before it is ready to receive one (i.e., after the ready signal becomes negative again).

4.2.5 Tape-feed start

The punching cycle cannot be permitted to start before the motor comes up to full speed which normally requires 0.4 - 0.6 seconds. While the motor is reaching full speed a monostable multivibrator (V2 and V3 in Fig. 27) is set to the 1 state for 0.4 - 0.6 seconds, during which the start of the punching cycle is blocked. A delay circuit, R13, R14 and C6, Fig. 27, prevents the start of the punching cycle before the 1 state setting of flip-flop V2 - V3, i.e. before this flip-flop causes blocking during motor run up. See Fig. 24, " Integrating circuit". After this interval, feed starts when the next synchronizing pulse, G-start, from the punch is gated in to set the feed flip-flop (V7 and V8 in Fig. 27) to the 1 state. The flip-flop energizes the feed solenoid via the amplifier (Fig. 28). See Fig. 10 for the relative timing of the synchronizing pulses "G-start", "G-stop" and "G-redy" and the pulses synchronized with them.

Transistor V17 (Fig. 27) provides direct reset of all flip-flops to the 0 state when the line voltage is turned on.

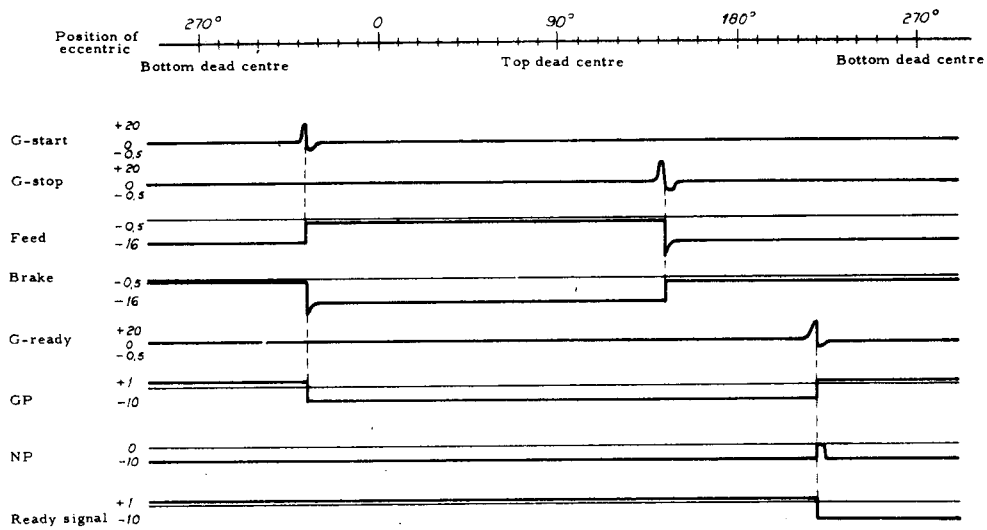


Fig. 10 Diagram of internal pulses

4.2.6 Operation of punch solenoids

The feed flip-flop sets flip-flop GP (V10, V11, Fig. 27) to the 1 state, which in turn gates out information from the input register to the punch solenoids. Punch solenoids corresponding to tracks where punching is to take place are energized. An amplifier (Fig. 29) is provided between input register and punch solenoids.

4.2.7 Completion of punching cycle

When feed is complete, i.e., after the main shaft has completed half a revolution (eccentric positions a-c, Fig. 8), current to the feed solenoid is interrupted by the feed flip-flop which is reset to the 0 state by the "G-stop" synchronizing pulse.

The brake solenoid now receives current instead and attracts the armature. However, the GP flip-flop remains in the 1 state until punching is fully completed and the "G-ready" pulse resets it to the 0 state. The differentiated trailing edge of the GP pulse, called NP, resets the register and ready-signal flip-flop to the 0 state. The low level is fed out on the ready signal line, indicating that the punching cycle is complete.

4.2.8 Blank tape

When the toggle switch is set in the feed direction (blank tape line, see Fig. 30) a pulse is sent out which sets the delay networks for motor start and stop to the 1 state (see also Fig. 24 and 26). The G-start pulse initiates feed as usual. When the GP flip-flop is set to the 1 state the gates admitting information to the punch solenoids open. However, since the start of feed and punching took place without any start pulse, no information could be gated into the input register (no IP pulse generated). Thus the register is set to the 0 state as information is fed to the punch solenoids. As a result, no holes can be punched (the feed hole is punched, however). Blank tape is fed out as long as the toggle switch is set in the feed direction. The ready-signal line is not at the high level during this operation.

4.2.9 Mark combinations

Mark combinations can be punched when the toggle switch is set opposite to the feed direction. Input register stages for tracks to be punched in accordance with the mark combination are set to the 1 state. Feed and punching are started in the same manner as described in paragraph 4.2.8.

4.2.10 Power supply

The power supply (Fig. 31) is permanently connected to the cable harness on the cassis. Primary windings on the transformer have tap changes for 115, 127 and 220 V. The motor is connected across the 220 V winding and thus receives 220 V even when mains voltage is 115 or 127 V.
-17 volts DC is used for punch solenoids, -16 volts DC for feed solenoid and brake solenoid; the rest of the circuitry takes -10 and +10 volts DC.

4.2.11 Cable connections

The cable from the input device to the electronic unit is connected via a Tuchel-type connector as follows:

Terminal

a 1 Start pulse
2 Ready signal
3 Earth
4-9 Not used
0 -10 V service

b 1-9 Not used
0 +1 V sercice

c 1 Information signal to track 1
2 " " " " 2
3 " " " " 3
4 " " " " 4
5 " " " " 5
6 " " " " 6
7 " " " " 7
8 " " " " 8
9 Not used
0 +10 V service

The cable joining the electronic and mechanical units is connected via a Tuchel-type connector as follows:

Terminal

a 1 G-start
2 G-stop
3 G-ready
4 Earth
5 -17 V (to punch solenoids)
6 -16 V (to brake and feed solenoids)
7 To feed solenoid "Feed"
8 To brake solenoid "Brake"
9 Not used
0 Not used

b 1 "Blank tape"
2 "Mark combination"
3-9 and 0 Not used

c 1 To punch solenoid for track 1
2 " " " " " 2
3 " " " " " 3
4 " " " " " 4
5 " " " " " 5
6 " " " " " 6
7 " " " " " 7
8 " " " " " 8
9 Not used
0 " "

OPERATING INSTRUCTIONS

5.1 INTRODUCTION

For the best results, follow all instructions carefully. It is vital that the tape should be prevented from jamming in the machine. For example: tape will jam if pulled forward when the guillotine is not lifted or if low quality tapes containing wood slivers or having ragged edges are used.

5.2 INSERTING TAPE

To insert tape, first raise the feed rocker (see Fig. 3). Cut tape end to form a blunt tip as illustrated. When the rocker is raised insert tape about 20 mm (3/4 in.) beneath the top plate on the feed arm. Now lower the rocker and feed tape through the machine by holding the toggle switch in the blank tape position (in the feed direction).

5.3 TEARING OFF PUNCHED TAPE

When punching is completed and you wish to tear off the tape, feed about 100 mm (4 in.) of blank tape through the machine using the toggle switch. Then tear off tape by pulling it straight down (see Fig. 11). DO NOT pull tape forward, out of the machine. If you do, the tape may break inside the punch mechanism and jam the next time it is fed forward.

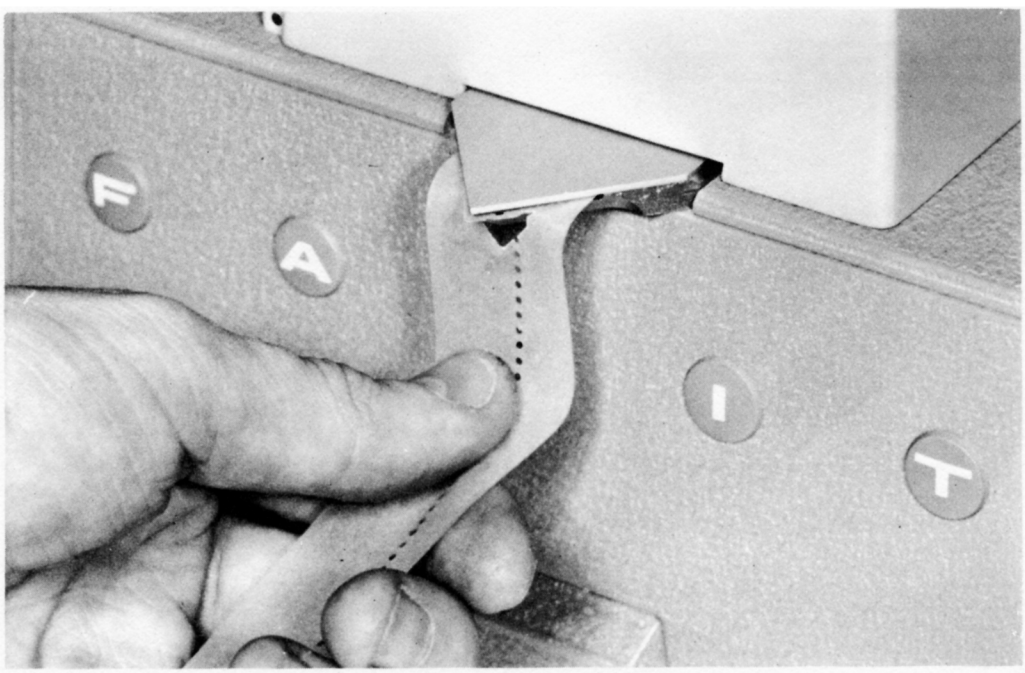


Fig. 11 Tearing off punched tape

5.4 REPLACING TAPE

When replacing tape, tear off the old tape at the reel. Move the toggle switch to the blank tape position and let the tape run out as far as it will go. Then carefully pull it from the punch mechanism, still holding the toggle switch in the blank tape position. NOTE: keep motor running while pulling out the tape. Otherwise it will jam in the machine.

5.5 CHECKING INTER-CHARACTER SPACING

Character spacing should be checked each time tape is replaced. Check character spacing using a conventional telex template (Fig. 12). Check both blank tape and punched tape. Normally, the tolerance of $\pm$ 1% should not be exceeded.

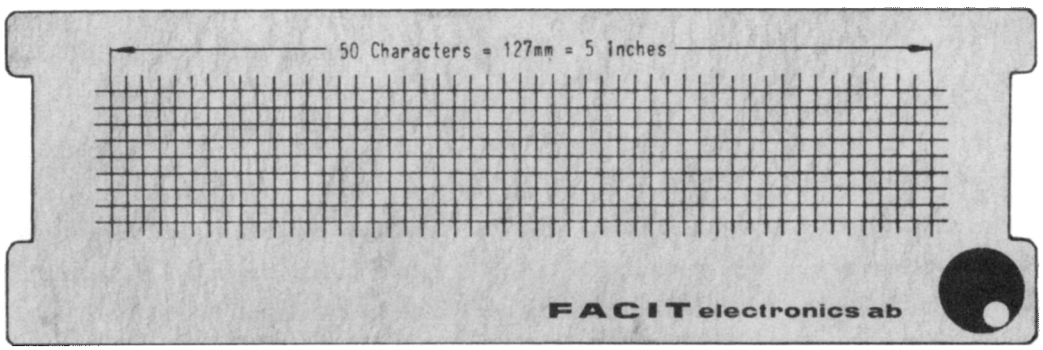


Fig. 12 Spacing template

5.6 CHANGEOVER TO DIFFERENT TAPE WIDTH

The punch can be changed over to accommodate different tape widths. 5-track 11/16" tape, 6-track and 7-track 7/8" tape and 8-track 1" tape can be used.

Changeover is accomplished by resetting the selector switch on the electronic unit and making adjustments on the mechanical unit. On the mechanical unit, (Fig. 13), the two upper guide plates must be replaced. They are available for the three different tape widths (6- and 7-track tapes have the same width). One plate is located at the front where the tape leaves the punch. It is attached with two screws. The other plate is located between the punch mechanism and the feed arm. In addition the tape fence (45, Fig. 32) which is located at the rear of the tape pathway must be repositioned. It is attached with one screw (46, Fig. 32).

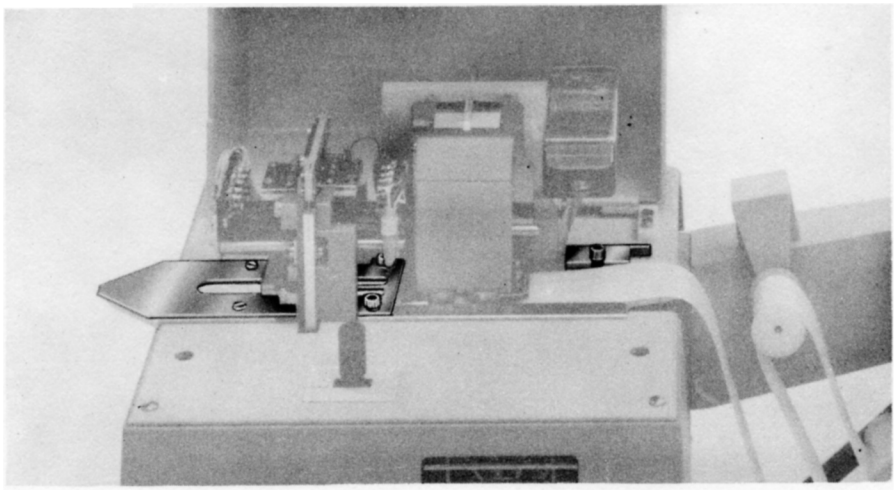


Fig. 13 Changeover to different tape width

Finally, set the tape holder by pressing in the hub plates and moving the holder axially. The tape holder has three positions, one for 5-track tape, one for 6-, 7-track tape and one for 8-track-tape.

5.7 LUBRICATION

Whenever the motor is running, the feed mechanism and guillotine are lubricated automatically. Make a visual lubrication check every time a tape reel is replaced. It is vital that an ample supply of oil should be kept in the oil reservoir continually. Refill when necessary or after every 100th reel. Mobiloil Vacuoline 1409 is suitable.

5.8 ELECTRONIC UNIT CONTROLS

The front panel of the electronic unit is provided with a 3 Amp. fuse and a red "power-on" light. The lamp has a bayonet fitting and can be changed after unscrewing the lens. The panel also has an ON-OFF power switch and a selector switch. The ON-OFF switch connects up mains voltage to both the electronic and the mechanical unit. Selector switch positions are marked 5, 6, 7 and 8, and the switch chooses the desired number of tracks. NOTE: to change over to a different tape width it is necessary to perform the steps listed in paragraph 5.6.

SERVICE

6.1 INTRODUCTION

This chapter includes a compilation of the mechanical checks which the serviceman normally should perform and the most frequently encountered mechanical adjustments. Some adjustments require no tools or equipment other than connection to the electronic unit. Other require special equipment which is listed prior to adjustment instructions. The final portion of this chapter is devoted to a listing of monitoring points for measuring the electronic unit pulses.

6.2 TEST EQUIPMENT

The following equipment is necessary for thorough checking and adjustment as instructed below.

Electronic unit, FACIT PE 1507 or PE 1508
Dial indicator with stand. E.g. 0.01 mm (.0004 in.) per graduation
Spring scale (tension type) 1 kg (2 lb.)
Feeler gauge 0.05 - 1 mm (.002 - .04 in.)
Power supply 0 - 50 V DC
Oscilloscope
Character spacing template
Variable voltage transformer

6.3 MECHANICAL CHECKS

6.3.1 Checking hammer deflection

(Feeler gauge)
If extra holes appear in a track the cause can be incomplete hammer deflection. The easiest check of hammer deflection is made by turning the main shaft until the guillotine reaches its bottom position. Distance between the bottom of the hammer shank and the lower limit screw should measure between 0.05 and 0.10 mm (.002 - .004 in.) (Fig. 14).

6.3.2 Checking hammer strike

If desired holes are not punched in a track it may be caused by play between the hammer shank and the top limit screw. Turn the main shaft until the guillotine reaches its top position. The hammer should

now contact the magnetic poles of the punch solenoids and its shank should press against the upper limit screw. The spring-mounted upper limit screw (See Fig. 15), should have a resilient play of 0.02 - 0.06 mm. Check the play of each hammer's upper limit screw using a dial indicator. The upper and lower limit screws for tracks 1, 3, 5 and 7 are located on the front beam; they are located on the rear beam for tracks 2, 4, 6 and 8. If further adjustment is necessary, see paragraph 6.4.2.

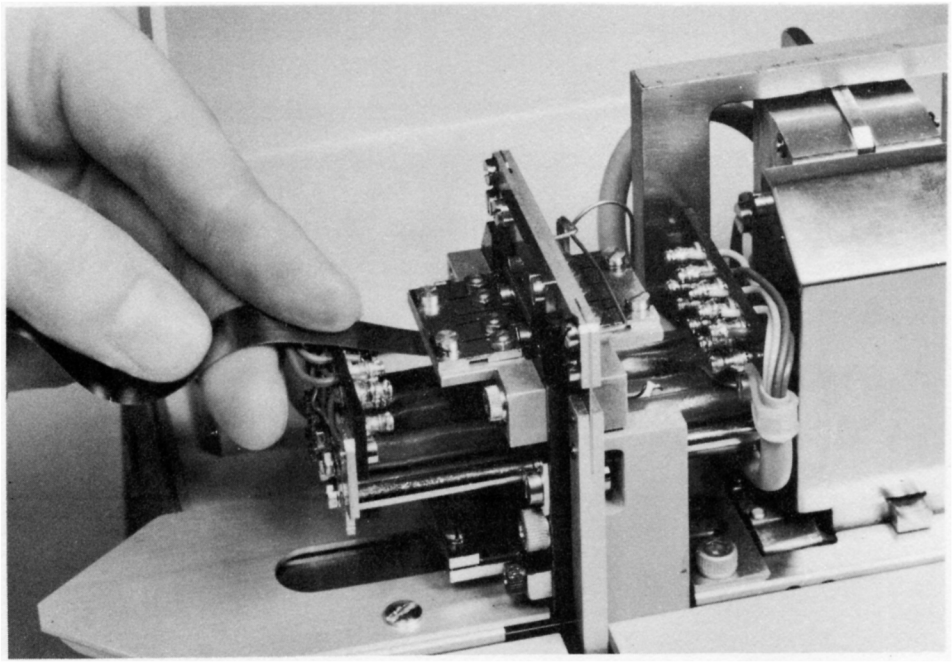


Fig. 14 Checking hammer deflection

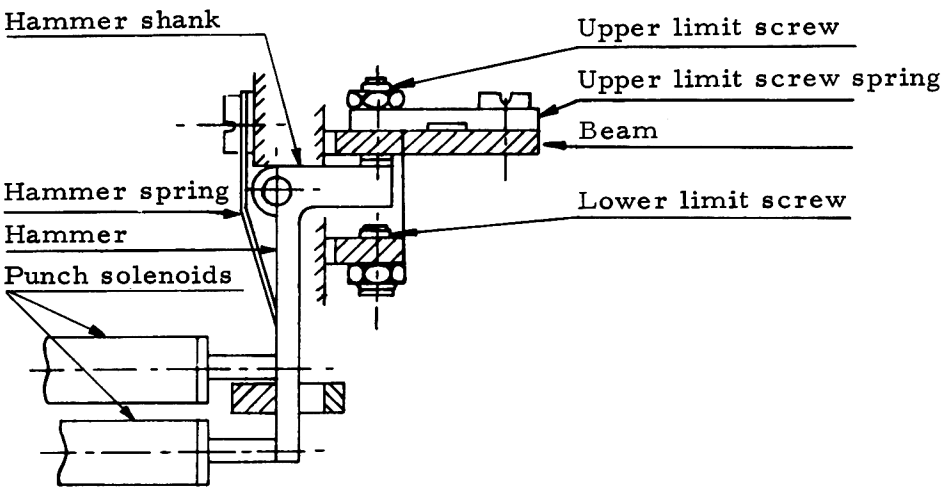


Fig. 15 Checking hammer strike

6.3.3 Checking feed and brake screws

(Spring scale)

First insert tape in the punch. Set the electronic-unit power switch on "ON" and lift the guillotine so that all punches are positioned above the tape (Fig. 16). A minimum of 1200 grams (42 oz.) (1200-2500 grams or 42 - 88 oz.) should now be required to pull tape forward. Feed

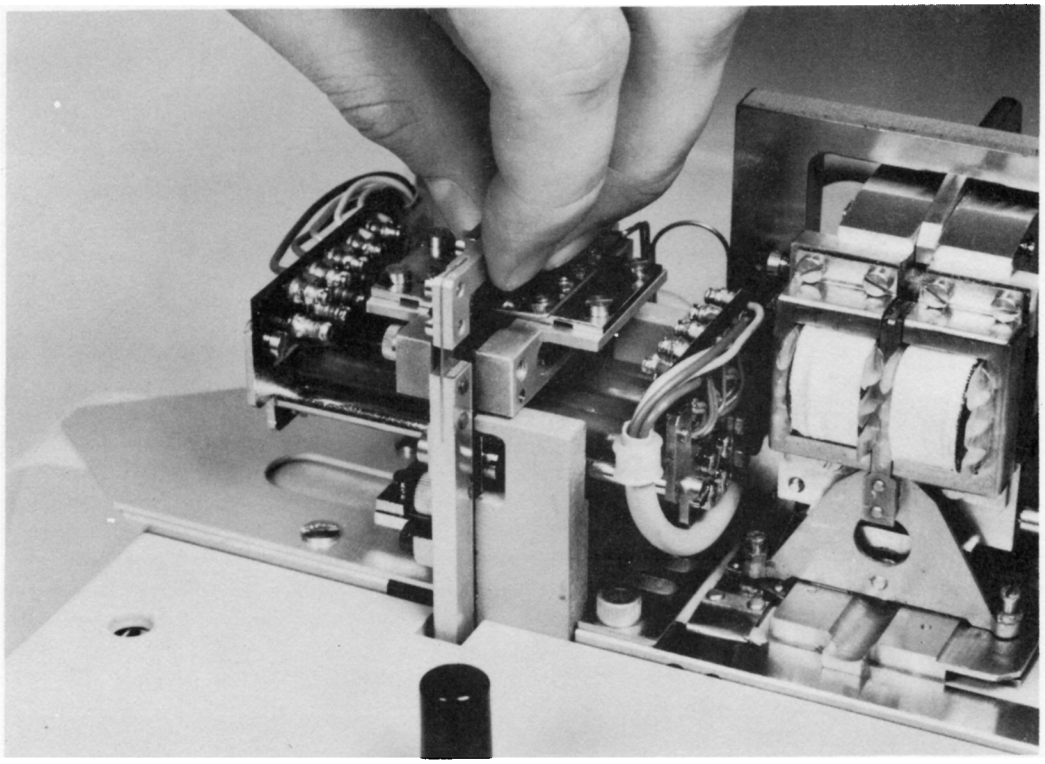


Fig. 16 Lifting the guillotine

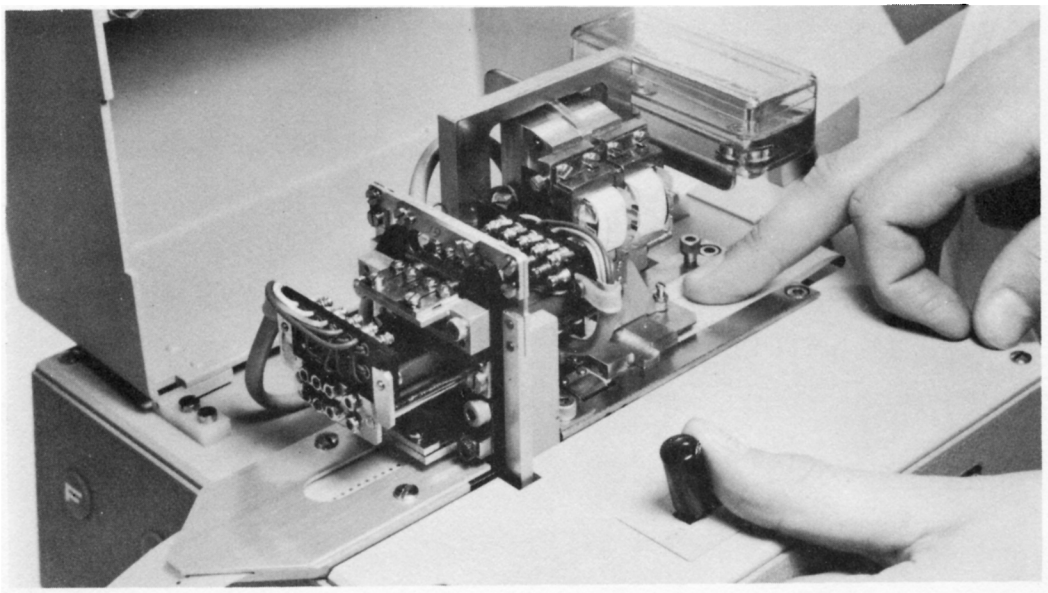


Fig. 17 Checking tape feed

stability is easily checked by gently braking the tape against the lower guide plate with one finger, while running out blank tape (Fig. 17).
If feed stability is satisfactory, a gentle pressure on the tape will have no effect on inter-character spacing. If adjustment is necessary, see paragraph 6.4.3.

6.3.4 Checking magnetization of timing pulse transmitters
(Oscilloscope)
Run motor at full speed and check that timing pulse transmitters deliver a minimum of 15 V peak-to-peak open circuit.

6.3.5 Checking lubrication system

Make certain there is always sufficient oil in the oil reservoir. Fill when necessary or after every hundredth reel. Run motor after changing reel and check visually that oil is reaching all three lubrication points.

6.3.6 Checking character spacing
(Spacing template)
Check character spacing every time tape is replaced. Use a conventional telex template (Fig. 12) for blank tape as well as punched tape. Normally, the tolerance of $\pm$ 1 % should not be exceeded.

Always check character spacing when changing over to a different quality of tape. If a different tape thickness is used make adjustment as instructed in paragraph 6.4.3.

6.3.7 Checking leaf spring

Make regular checks that the leaf spring over which the tape passes prior to reaching the punch does not reach its bottom limit during punching. NOTE: Character spacing inaccuracies can result if the leaf spring does not function properly.

6.3.8 Marginal checking
(Variable voltage transformer)
Make this check after every adjustment listed in paragraphs 6.4.1 and 6.4.2. Set the punch for 8 track tape and run out about 1/3 of a reel with 220 V AC applied to the electronic unit. Then make the same test with the electronic unit connected to 150 and 260 V AC. Check punched tapes carefully (e.g. by means of a high speed tape reader). If an extra hole appears in any track during any of the above tests the

hammer deflection should be checked as instructed in paragraph 6.4.1. If a hole is missing anywhere check hammer strike for the channel concerned as instructed in paragraph 6.4.2. If tape jams in the punch mecha nism the cause can be faulty hammer deflection or hammer strike.

6.4 MECHANICAL ADJUSTMENTS

6.4.1 Adjustment of hammer deflection

(Dial indicator, feeler gauge)

Pass a 200 mA current (approx 7 V) through each of terminals c 1 - c 8 in turn (for tracks 1-8) using a 5 as the common terminal (see paragraph 4.2.11). For each track that is connected up, turn the main shaft so the guillotine passes its top position, thus withdrawing the hammer. As you continue turning the main shaft the withdrawn hammer should be forced out (a soft "click" will be heard) 0.10 - 0.20 mm (0.004 - 0.008 in.) before the bottom position is reached. Measure with an indicator gauge with its measuring point at the top edge of the guillotine. Adjust tracks 1, 3, 5 and 7 with the lower limit screws on the front beam. Adjust tracks 2, 4, 6 and 8 with the corresponding limit screws on the rear beam. The beams must be removed to gain access to these screws. Both beams are loosened with the same screws (see Fig. 18). After adjusting; screw

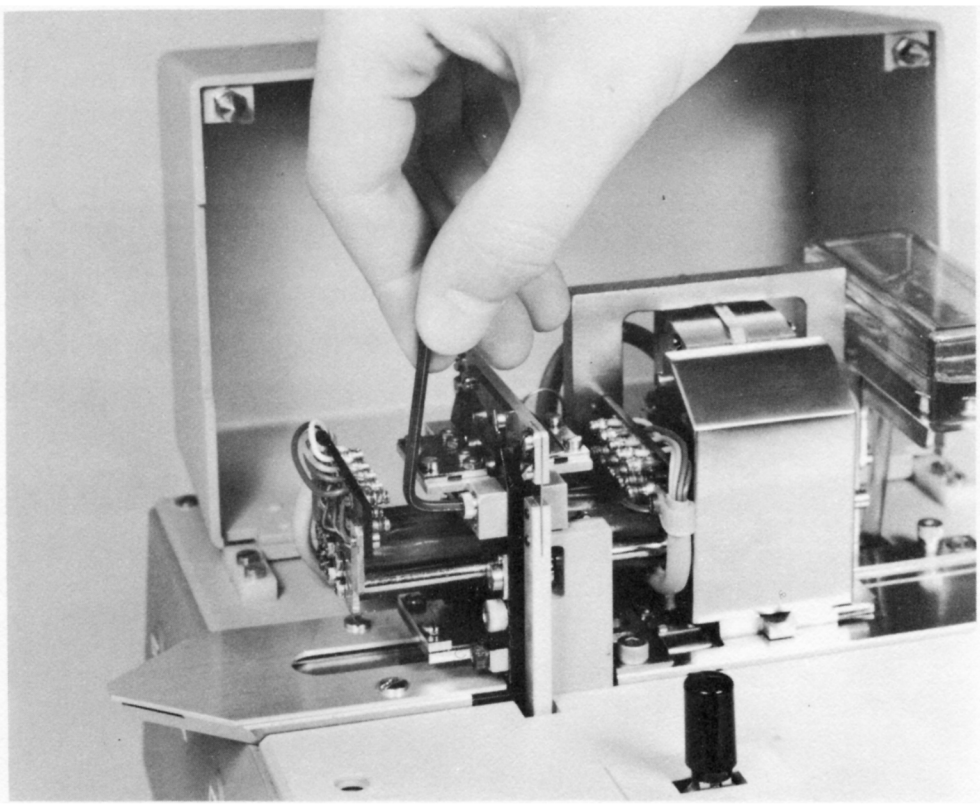


Fig. 18 Removal of beam for adjustment of hammer deflection

both beams in place and re-check the distance (see paragraph 6. 3. 1). Power should not be applied for longer than about 15 seconds to avoid overheating the solenoid coils.

Adjustment can also be made with a feeler gauge as follows: first make a coarse adjustment by tightening the lower limit screw only far enough to be sure it won't bind (thus avoiding risk of bending the hammer). Then use the feeler gauge to check the distance between the lower limit screw and the bottom of the shank with the guillotine at its bottom position. Finally, screw in the limit screw the measured distance minus 0. 05 mm (. 002 in.). Note that the pitch of the limit screw is 0. 4 mm (. 016 in.) and that tightening a screw through 90°, corresponds to a 0. 1 mm (. 004 in.) advance.

6. 4. 2. Adjustment of hammer strike

(Dial indicator)

Adjust hammer strike with the upper limit screw for the appropriate track. The upper limit screw for tracks 1, 3, 5 and 7 is located on the

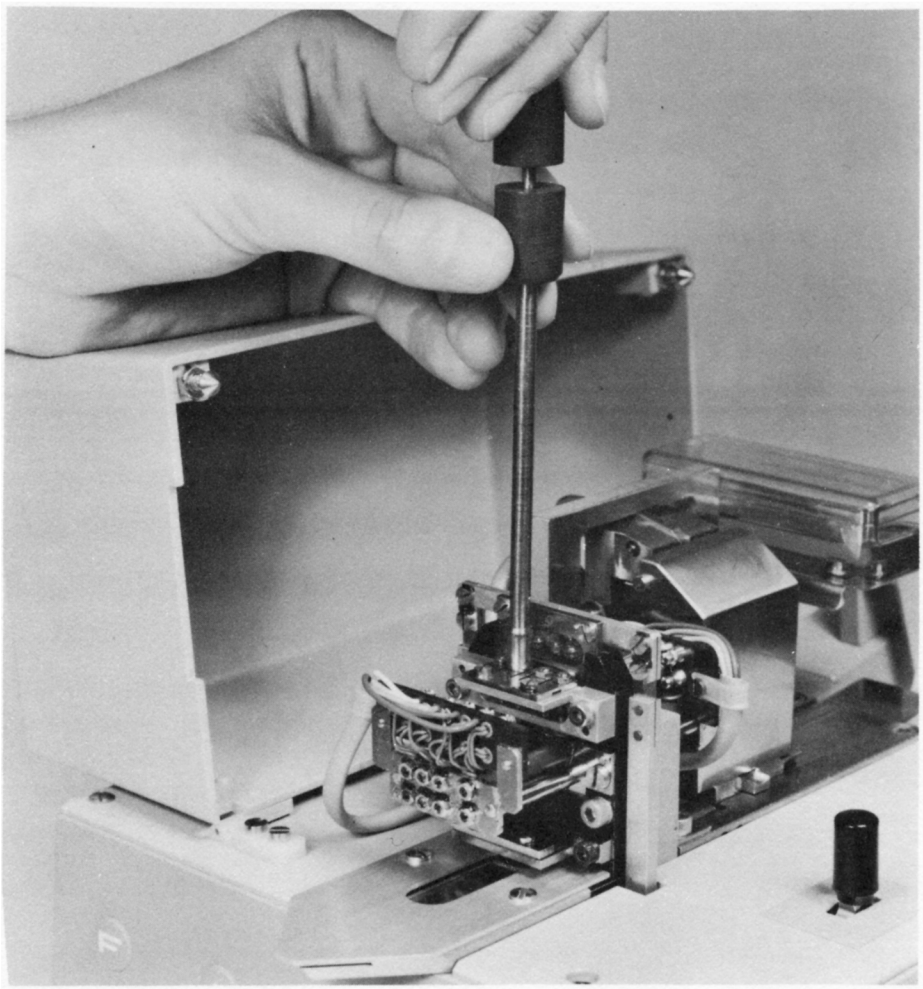


Fig. 19 Adjustment of hammer strike

front beam; for tracks 2, 4, 6 and 8 it is on the rear beam. Turning a limit screw 90° is equivalent to 0.1 mm (0.004 in.).

Put the indicator-gauge measuring point on the limit screw and turn the main shaft so that the guillotine swings back and forth through its top position. The resilient play of limit screw and spring should be between 0.02 and 0.06 mm (0.0008 and 0.0024 in.). If the limit screws lifts too far, screw it out (Fig. 19) the appropriate amount (see above). If it does not lift far enough, screw it in. If the limit screw and spring do not lift at all, there is play between the hammer shank and the limit screw (see paragraph 15). In such case, set the guillotine at its top position and carefully screw in the limit screw until the spring and limit screw can be seen to lift a little. (maximum 0.06 mm (0.0024 in.)). Then proceed as above.

6.4.3 Adjustment of feed and brake screws

First insert tape in the punch. Set the electronic-unit power switch to "ON". Lift the guillotine so that all the punches are positioned above the tape (see Fig. 16). Then adjust the brake screw (17, Fig. 32) so that the tape is firmly braked and cannot be pulled forward with a force of less than 1200 grams (42 oz) (1200 - 2500 grams (42 - 88 oz)). Feed tape with the toggle switch while simultaneously adjusting the feed screw (see Fig. 20) so that the maximum inter-character spacing

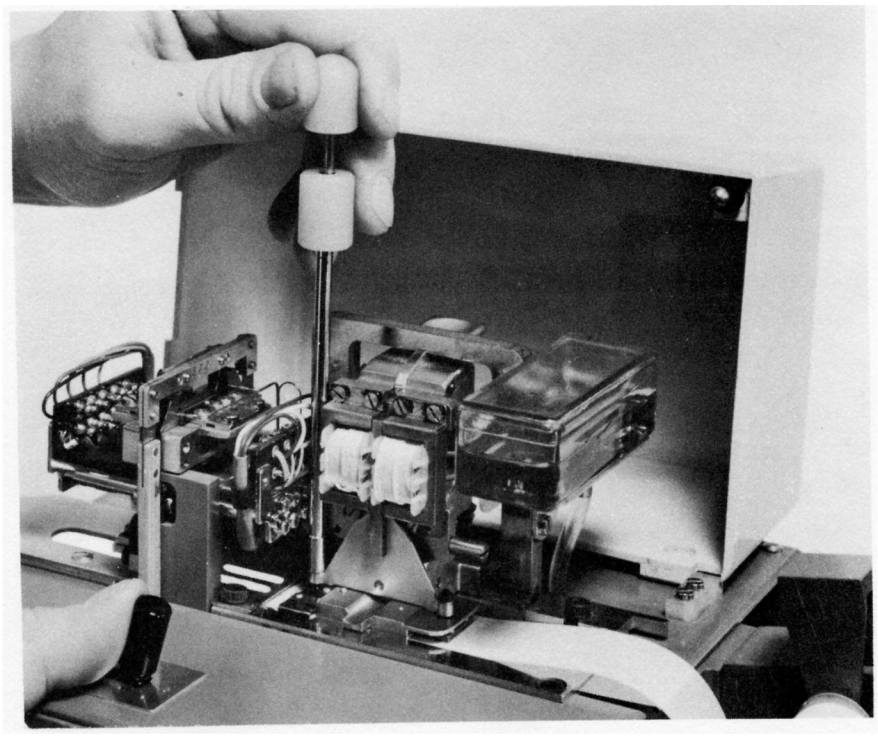


Fig. 20 Adjusting feed

is obtained. Then make a fine adjustment of the brake screw to provide maximum inter-character spacing. Check the inter-character spacing with the spacing template as instructed in paragraph 5. 5. On delivery, the feed arm is adjusted for 2. 54 mm (0. 1 in.), the correct spacing. Thus the adjustment procedure described above will provide the best the feed and brake screws settings.

Feed stability is checked by gently braking the tape against the lower guide plate with one finger as it is run out, see Fig. 17. If feed stability is satisfactory. a gentle pressure on the tape will have no effect on inter-character spacing. See paragraphs 6. 4. 7 and 6. 3. 6.

NOTE: When changing over to a different tape thickness readjustment must be made.

6. 4. 4 Adjustment of feed rocker

Figures in this paragraph refer to Fig. 32.

To adjust armature 9 and feed rocker 12, first loosen both the feed solenoid 10 and the brake solenoid 15 each of which are held in place with three screws. Now press the two solenoids towards each other and screw the feed solenoid firmly in place. Insert a 0. 15 mm (0. 006 in.) feeler gauge between the armature and the feed solenoid. Then press the brake solenoid firmly against the feeler gauge and feed solenoid, and screw it firmly in place.

6. 4. 5 Magnetizing timing pulse transmitters

(Power supply and oscilloscope)

Short circuit the timing pulse transmitter air gaps with a shunt of soft iron. Then connect up + 50 V across the outer terminals of the two coils with the minus pole connected to the earthed solder lugs (black cables). Apply voltage for a maximum of 10 seconds. Then check to see that when unloaded, the timing pulse transmitters deliver at least 15 V peak-to-peak with the motor running at full speed.

6. 4. 6 Coarse adjustment of timing pulse transmitters

(Dial indicator)

Timing pulse transmitters are positioned as follows: G-start at outer end of shaft, G-stop in the middle and G-ready closest to the punch mechanism.

G-start: The arm should be positioned in the centre of the air gap when the guillotine is approx. 0. 2 - 0. 3 mm (0. 0078 - 0. 0118 in.) past the bottom position and moving upward.

G-stop: The arm should be in the centre of the air gap when the guillotine is 0.2 - 0.3 mm (0.0078 - 0.0118 in.) past the top position and moving downward.

G-ready: The arm should be in the centre of the air gap when the guillotine is approx. 0.2 mm (0.0078 in.) from the bottom position and moving downward.

NOTE: The direction of shaft rotation must be correct. When the guillotine passes through the upper semi-circle the feed arm must move forward.

6.4.7 Fine adjustment of timing pulse transmitters

Punch a length of tape and check inter-character spacing. Then adjust the G-start timing pulse transmitter to the position which provides the greatest inter-character distance. Repeat for G-stop transmitter. If spacing is stable, it will not be noticeably affected by pinching the tape lightly as shown in Fig. 17.

6.4.8 Connecting up lubrication system

First remove the short hose connecting the oil valve to the three oil pipes. Leave the hose on the oil-pipe nipple. Fill the reservoir with oil (Mobiloil Vacuoline 1409). Connect 220 V AC to the punch so that the valve opens to permit oil to flow to the discharge nipple. Now fill the hose with oil which has dripped out. Shut off power to the punch and quickly fit the hose to the discharge nipple. Oil will then be forced into all three oil pipes. Reconnect voltage several times, checking that oil flows to all of the three lubrication points.

6.5 ELECTRONIC CHECKS

If mal-functioning is suspected in the electronic unit, it is wise to check the waveform of pulses which actuate essential operations using an oscilloscope. Pulses can be measured at the cable harnesses which connect the printed circuit boards in the electronic unit, after removing the casing. The location of the printed circuit boards and measuring points are shown in Fig. 21.

Fig. 22 and 23 are oscillogrames taken on the PE 1507 unit.

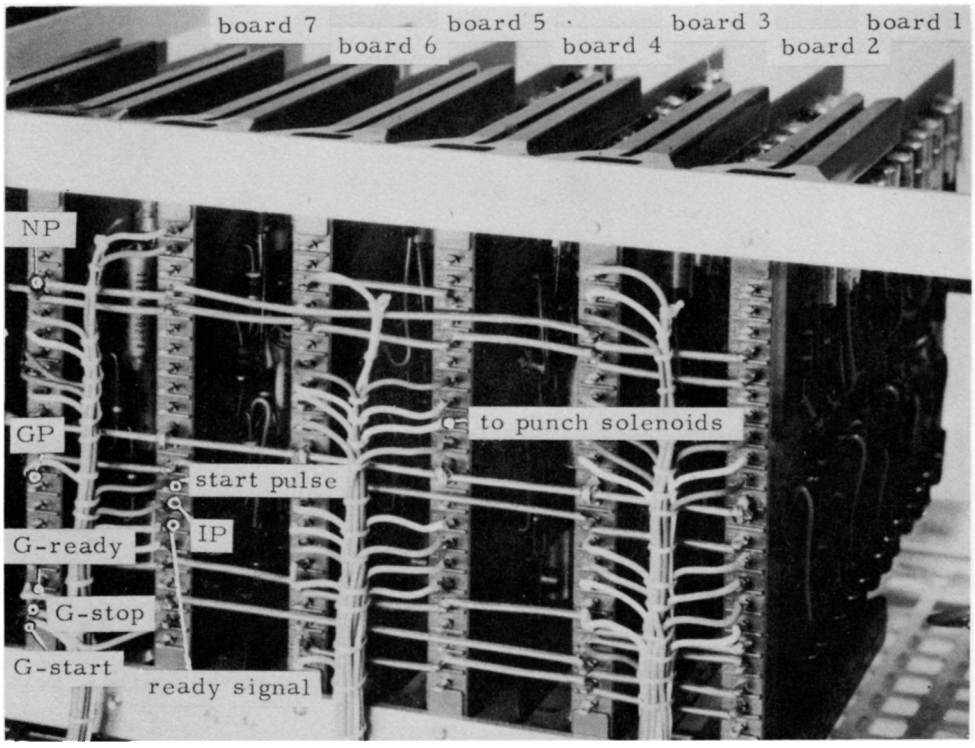
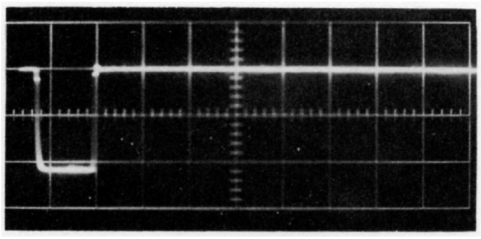
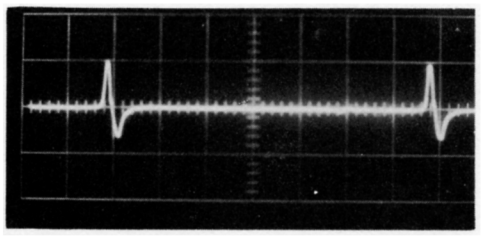


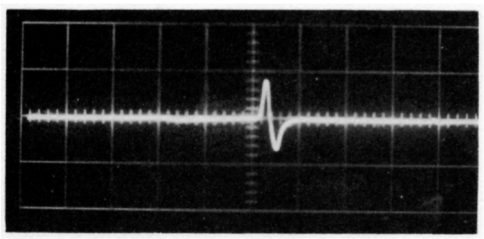
Fig. 21 Cable harnesses, electronic units PE 1507 and PE 1508



Pulse: IP
Monitoring point: 5-15
Scale: 5V/cm 50 µs/cm
Trigger: Start pulse
Connected to point: 5-14 ext. -

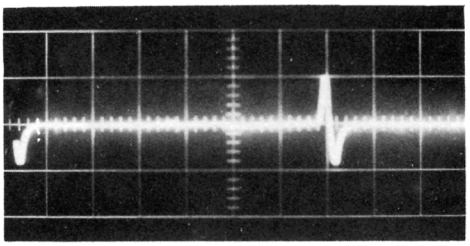


Pulse: G-start
Monitoring point: 6-22
Scale: 10V/cm 1 ms/cm
Trigger: Start pulse
Connected to point 5-14 ext. -

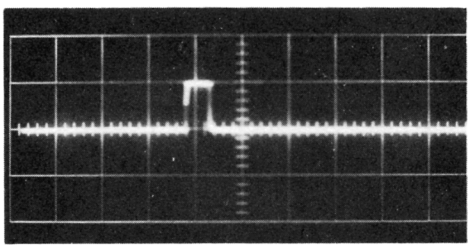


Pulse: G-stop
Monitoring point: 6-21
Scale 10V/cm 1 ms/cm
Trigger: Start pulse
Connected to point: 5-14 ext. -

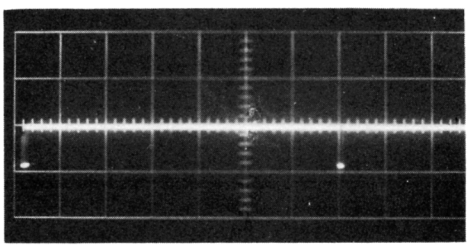
Fig. 22 Oscillograms, electronic unit PE 1507



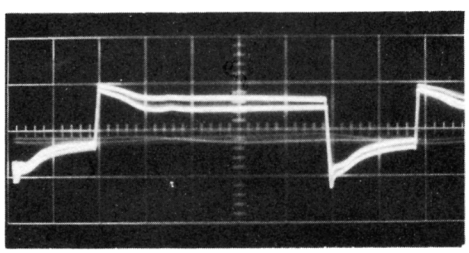
Pulse: G-ready
Monitoring point: 6-20
Scale: 10 V/cm 1 ms/cm
Trigger: Start pulse
Connected to point: 5-14 ext. -



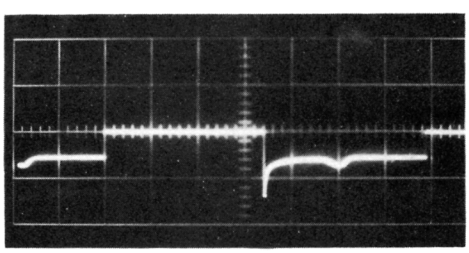
Pulse: NP
Monitoring point: 6-4
Scale: 10 V/cm 50µs/cm
Trigger: G-ready
Connected to point: 6-20 ext. +



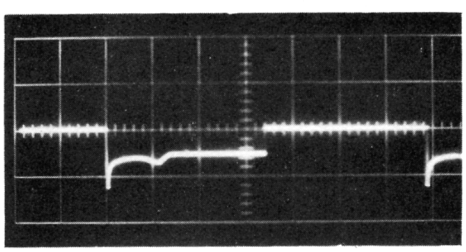
Pulse: Ready signal (continous punching)
Monitoring point: 5-16
Scale: 10 V/cm 1 ms/cm
Trigger: Start pulse
Connected to point: 5-14 ext. -



Pulse: To punch solenoid
(punching different characters)
Monitoring point: 3-9
Scale: 10 V/cm 1 ms/cm
Trigger: Start pulse
Connected to point: 5-14 ext. -



Pulse: To feed solenoid
Monitoring point: 7-20
Scale: 20 V/cm 1 ms/cm
Trigger: Start pulse
Connected to point: 5-14 ext. -



Pulse: To brake solenoid
Monitoring point: 7-6
Scale: 20 V/cm 1 ms/cm
Trigger: Start pulse
Connected to point: 5-14 ext. -

Fig. 23 Oscillograms, electronic unit PE 1507

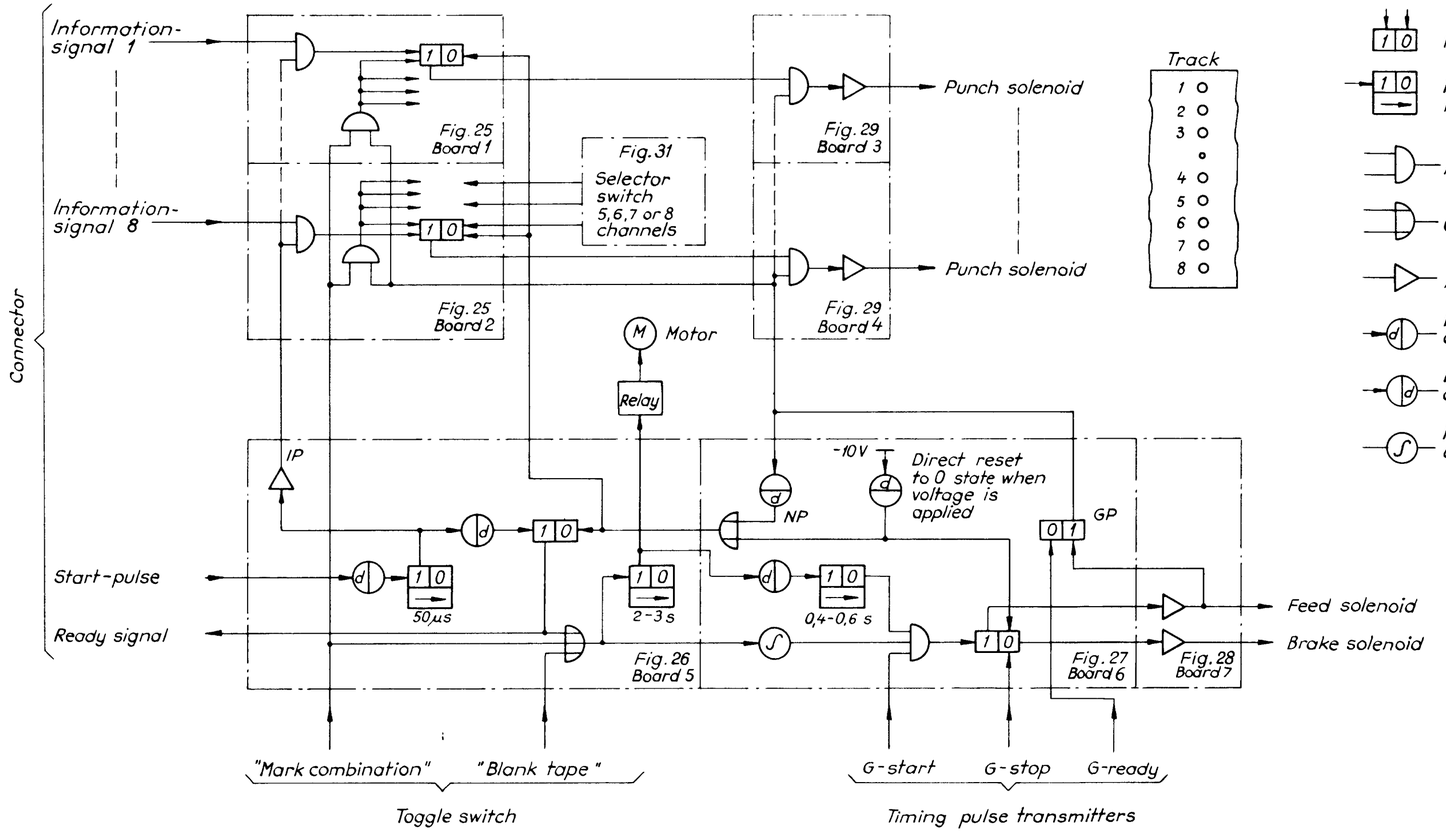
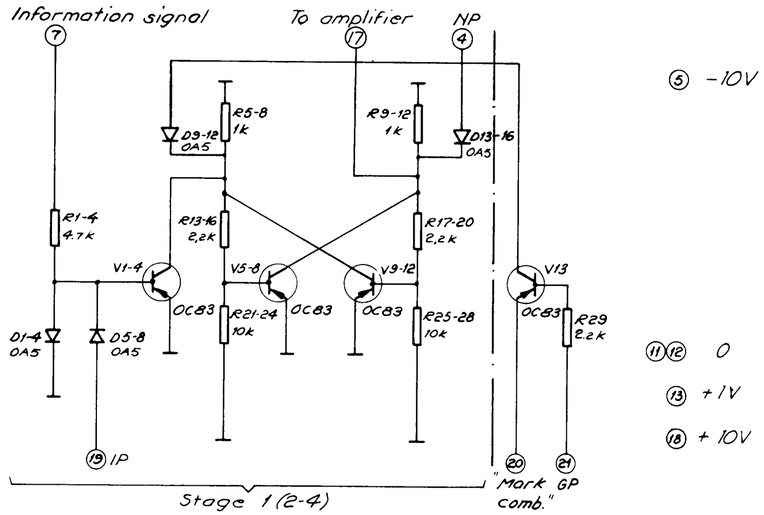
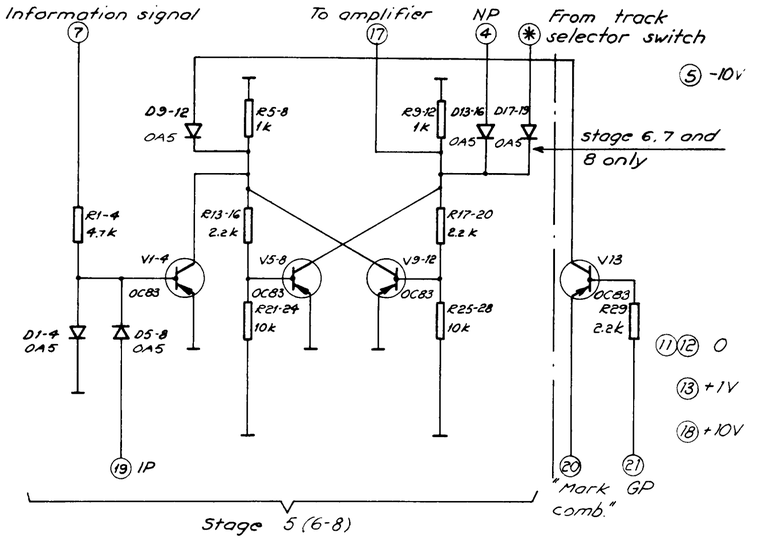


Fig. 24 Schematic drawing of logical functions, PE 1507 and PE 1508



Corresponding points in the various stages.			
Stage			
1	2	3	4
7	8	9	10
4	4	4	4
19	19	19	19
17	16	15	14

Fig. 25 a



Corresponding points in the various stages.			
Stage			
5	6	7	8
7	8	9	10
4	4	4	4
✱	3	2	1
19	19	19	19
17	16	15	14

Fig. 25 b

⑦ Designates board terminal

Fig. 25 Circuit diagram, register stages 1-4 (printed circuit board 1) and stages 5-8 (printed circuit board 2)

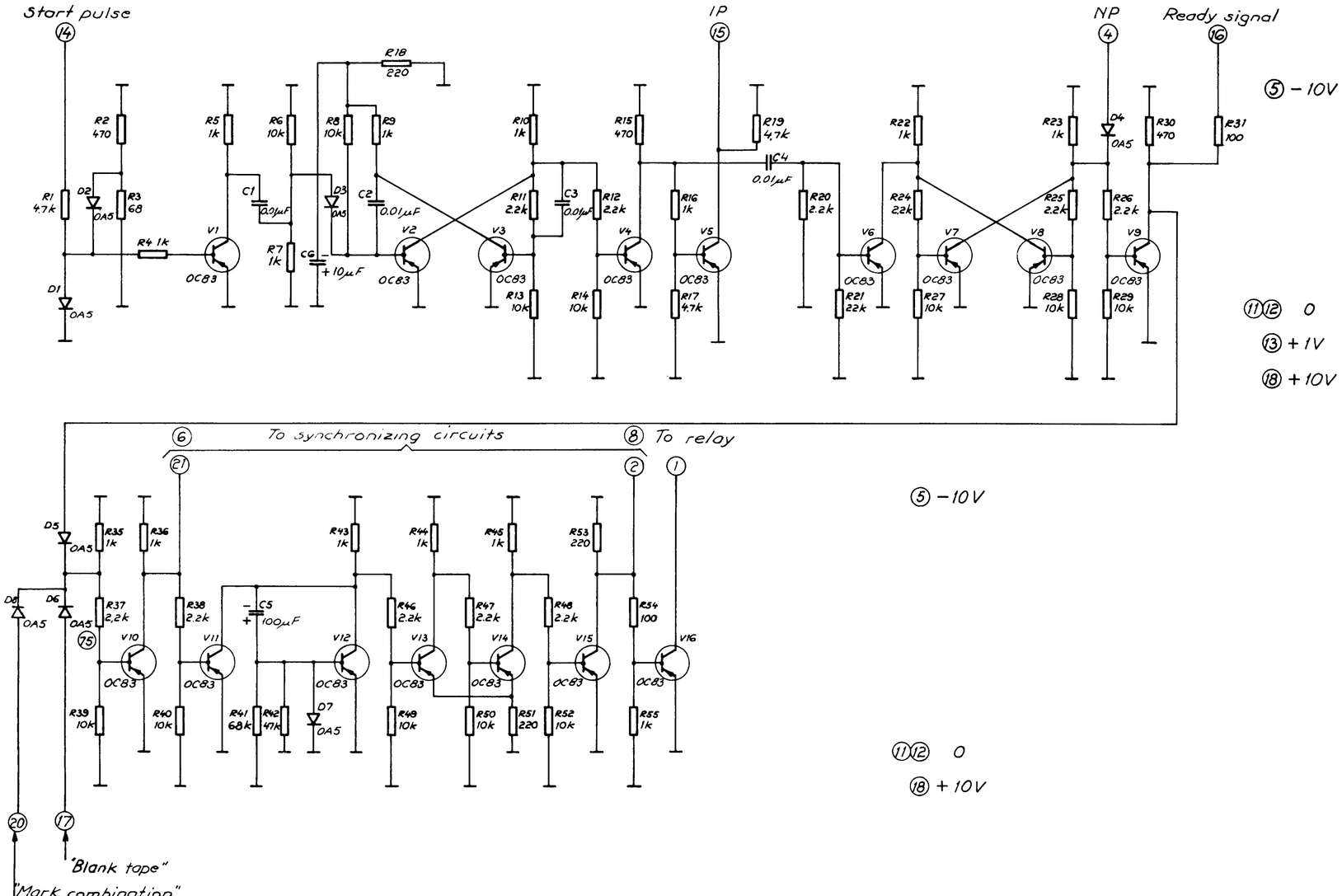


Fig. 26 Circuit diagram, start and stop circuits (printed circuit board 5)

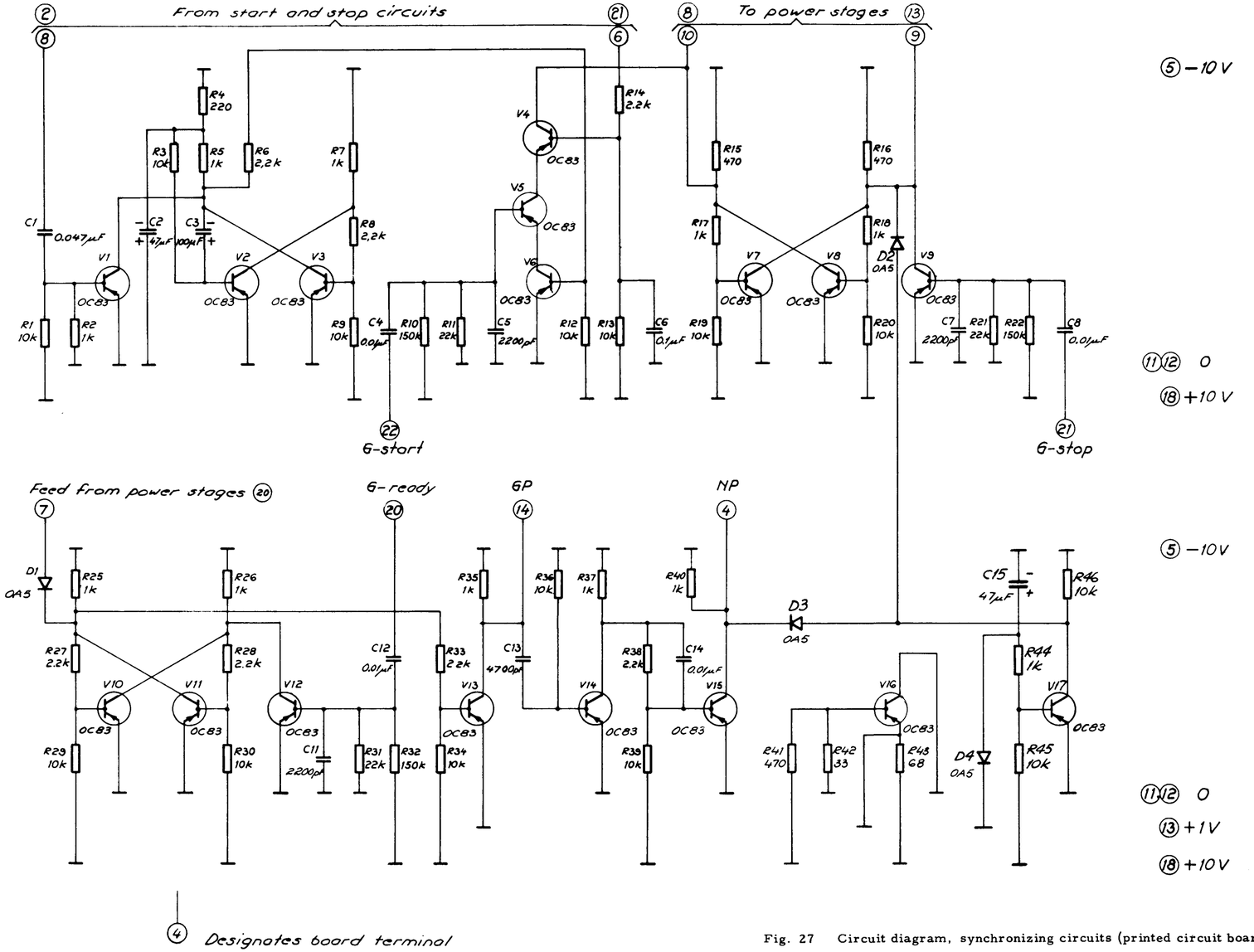


Fig. 27 Circuit diagram, synchronizing circuits (printed circuit board 6)

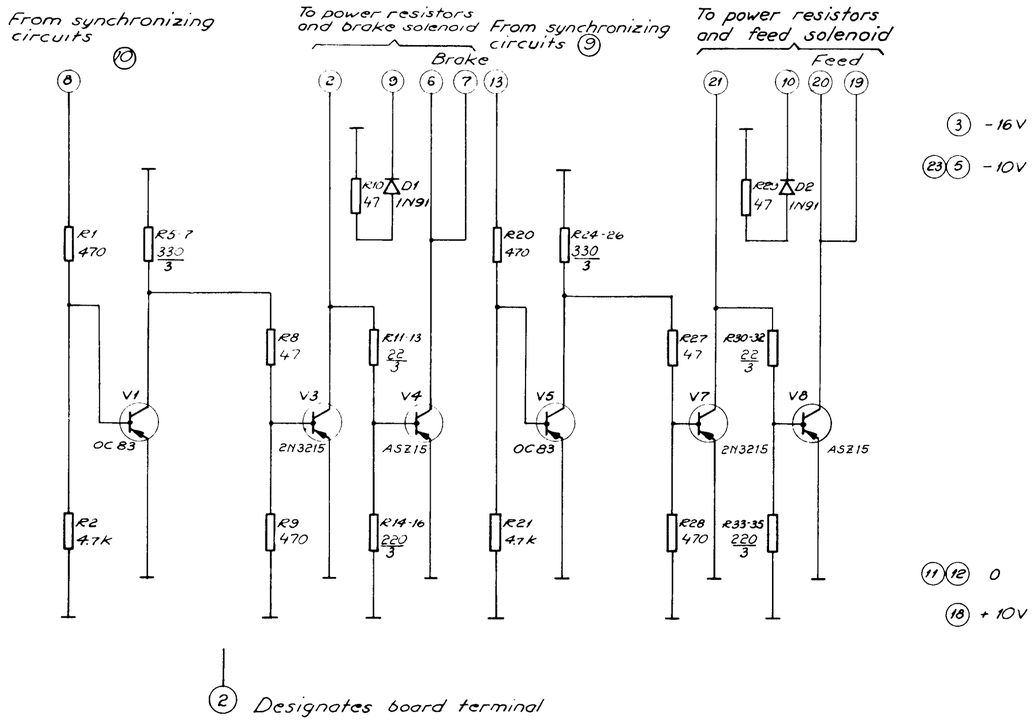
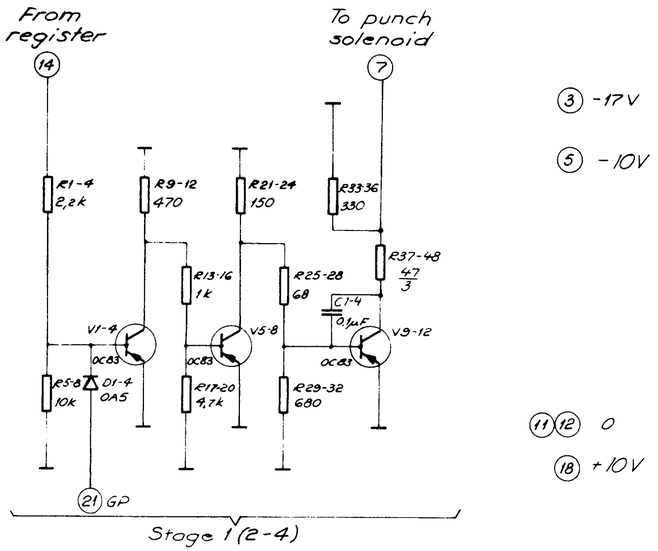
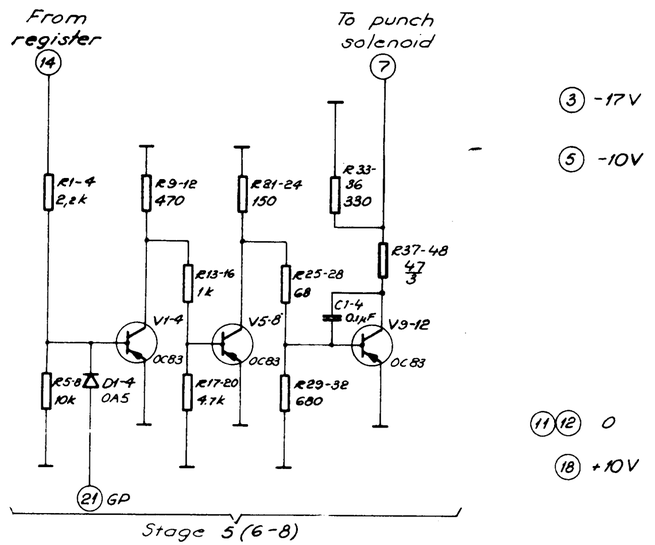


Fig. 28 Circuit diagram, power stages (printed cirucit board 7)



Corresponding points in the various stages			
Stage			
1	2	3	4
7	8	9	10
14	15	16	17
21	21	21	21

Fig. 29 a



Corresponding points in the various stages			
Stage			
5	6	7	8
7	8	9	10
14	15	16	17
21	21	21	21

Fig. 29 b

(7) Designates board terminal

Fig. 29 Circuit diagram, amplifier stages 1-4 (printed circuit board 3) and stages 5-8 (printed circuit board 4)

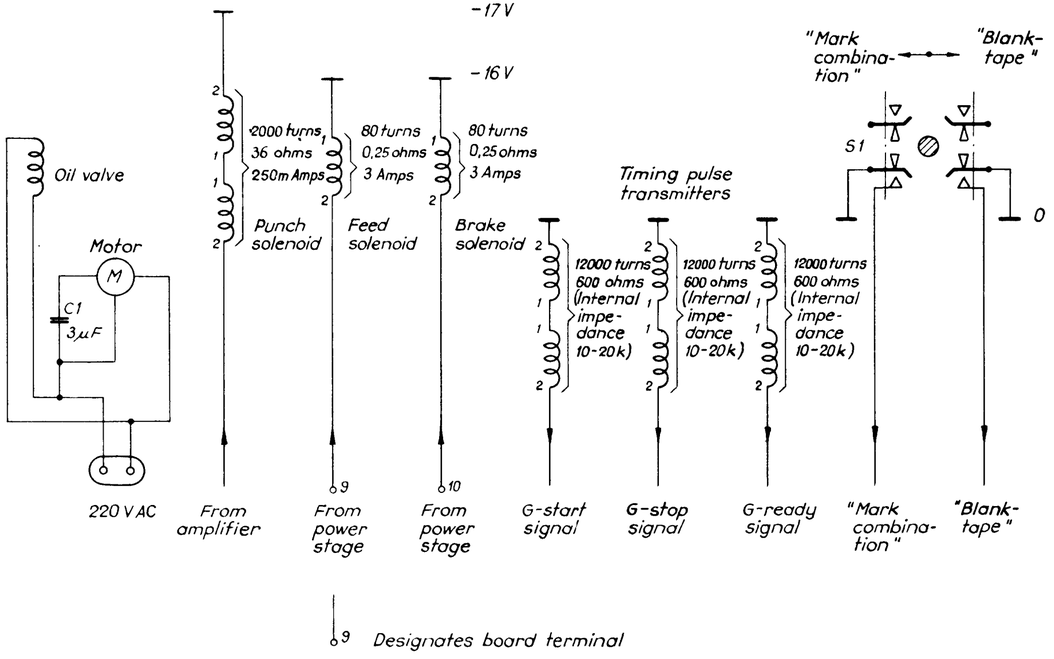
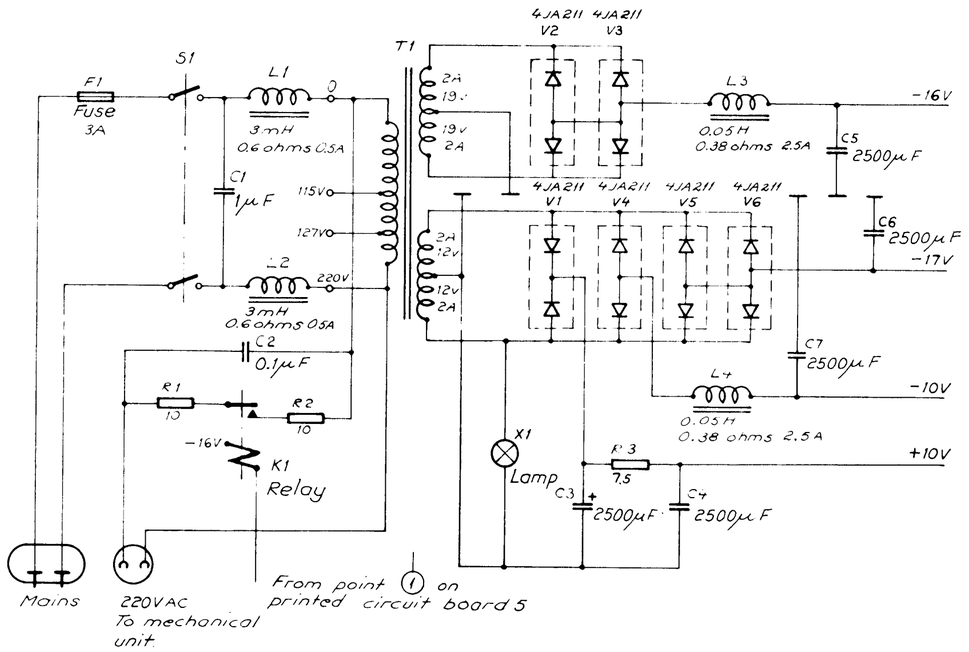
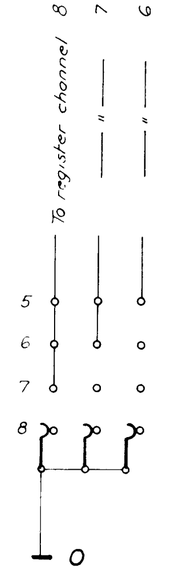


Fig. 30 Circuit diagram, mechanical units PE 1501-1504





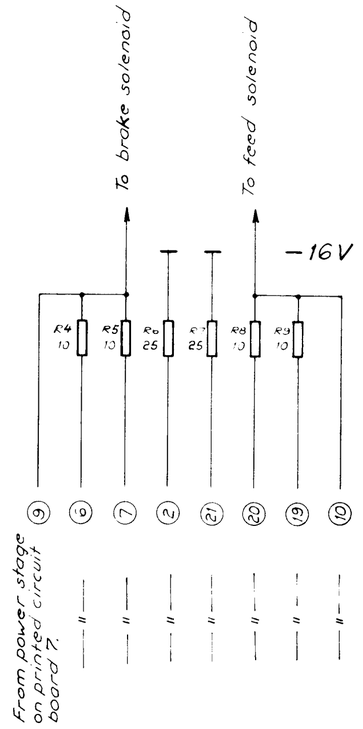


Fig. 31 Circuit diagram, power supply and channel selector switch (PE 1507 and PE 1508)

1 Main shaft
2 Connecting rod
3 Connecting rod spring
4 Feed arm
5 Adjustment screw
6 Spring
7 Tape
8 Brake plate
9 Armature
10 Feed solenoid
11 Feed screw
12 Feed rocker
13 Lug
14 Spring
15 Brake solenoid
16 Shaft (ball bearing)
17 Brake screw
18 Brake plate
19 Lower guide plate
20 Connecting rod
21 Connecting rod crossarm
22 Connecting rod springs
23 Punch
24 Guillotine
25 Punch frame
26 Screw
27 Front beam
28 Rear beam
29 Upper limit screw
30 Lower limit screw
31 Hammer
32 Hammer spring
33 Hammer shaft
34 Punch for sprocket hole
35 Stop spring
36 Lower punch solenoid
37 Upper punch solenoid
38 Die
39 G-start coils
40 Arm
41 G-stop coils
42 Arm
43 G-ready coils
44 Arm
45 Tape fence
46 Adjustment screw
47 Guide plate screw

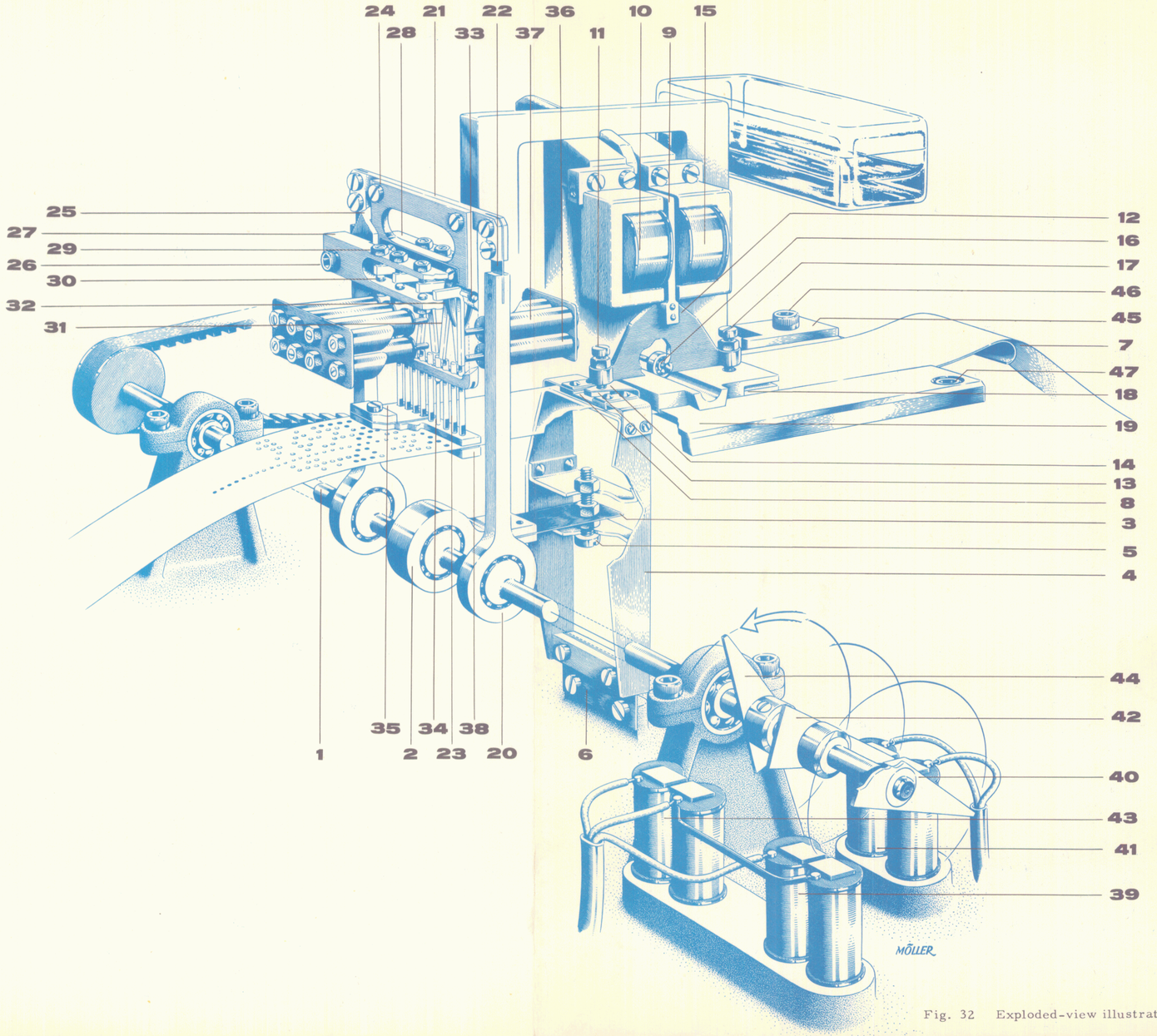


Fig. 32 Exploded-view illustration