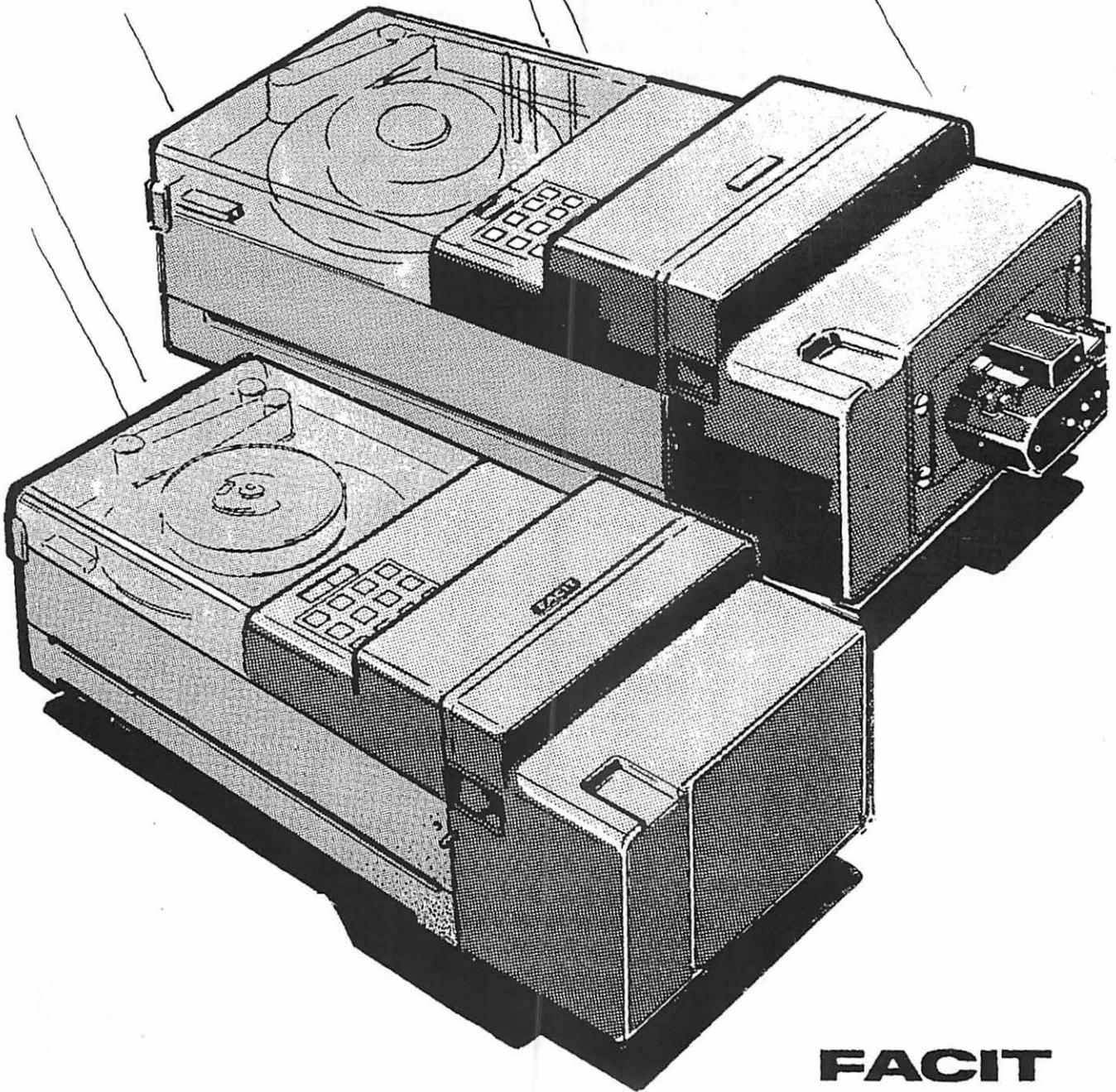


# Facit N4000

Punch/Reader-Punch

19 APR. 1989

## Service Manual Spare Parts List



**FACIT**

## Warning

### Explosion Hazard

This product is equipped with a LITHIUM battery.

Be careful not to:

- change polarity of the battery
- short circuit the battery
- expose to risk for mechanical deformation or mechanical shocks
- exceed +85°C

When replacing the battery, the same type of battery **MUST** always be installed.

## Scope

Other document associated with the Service Manual is:

User's Manual

LZT 125 0345

## List of Abbreviation

ACIA	Asynchronous Communication Interface Adapter
ASCII	American Standard Code for Information Interchange
BRDY	Buffer ReaDY
BSP	Back SPace
bsp	bit per second
CC	Character Clock
CCITT	Comité Consultatif International Télégraphique et Téléphonique
ch,CH	Character
CI	Current Inhibit
CFU	Central Processing Unit
CR	Carriage Return
DIR	DIRection
EIA	Electronic Industries Association
EOT	End Of Tape
FF	Forward Feed
FH	Feed Hole
GND	GrouND
IC	Integrated Circuit
I/O	Input/Output
ISO	International Organization for Standardization
LF	Line Feed
MR	Motor Release
NiCd	Nickel-Cadmium
NU	Not Used
PIA	Peripheral Interface Adapter
PIM	Programmable Timer Module
PWB	Printed Wire Board
Rn	Rotate n
RD	Receive Data
RI	Read Instruction
ROM	Read Only Memory
RWM	Read Write Memory
SD	Set Direction
SP	SPace
Tn	Tilt or Time
TE	Tape Error
TL	Tape Low
UC	Upper Case
WD	Watch Dog

## Contents

- 1 GENERAL
- 2 SPECIFICATIONS
  - 2.1 GENERAL
  - 2.2 TECHNICAL SPECIFICATIONS
  - 2.3 CONNECTORS
    - 2.3.1 INTERNAL CONNECTIONS
    - 2.3.2 EXTERNAL CONNECTIONS
- 3 CONSTRUCTION & DESIGN
  - 3.1 GENERAL
  - 3.2 DISASSEMBLING
- 4 FUNCTION
  - 4.1 GENERAL
  - 4.2 PUNCHING
  - 4.3 READING
  - 4.4 SERIAL CONTROL BOARD
  - 4.5 EXPLANATION
    - 4.5.1 GENERAL
    - 4.5.2 POWER CIRCUITS
    - 4.5.3 POWER DOWN/BATTERY BACK-UP CIRCUITS
    - 4.5.4 STEPPER MOTOR DRIVE
    - 4.5.5 PUNCH SOLENOID DRIVE
    - 4.5.6 INTERFACING CIRCUITS
    - 4.5.7 WATCH DOG
  - 4.6 READER
    - 4.6.1 GENERAL
    - 4.6.2 READING
    - 4.6.3 STEPPER MOTOR
- 5 SERVICE
  - 5.1 MECHANICAL CHECKS & ADJUSTMENTS
    - 5.1.1 PUNCH/FEED UNIT: REMOVAL & MOUNTING
    - 5.1.2 PUNCH SOLENOID DISASSEMBLING & CHECK
    - 5.1.3 PUNCH PIN DRIVER CHECK & REPLACEMENT
    - 5.1.4 PUNCH SOLENOID FITTING & ADJUSTMENT
    - 5.1.6 STEPPER MOTOR CHECK
    - 5.1.7 BRAKE SHOE REPLACEMENT
    - 5.1.8 MOTOR BRAKE CHECK
    - 5.1.9 CAPSTAN CHECK & REPLACEMENT
    - 5.1.10 STEPPER MOTOR/CAPSTAN TRANSMISSION CHECK
    - 5.1.11 PINCH ROLLER CHECK
    - 5.1.12 SUPPLY FLANGE BRAKING FORCE CHECK
    - 5.1.13 SENSOR ARM CHECK
    - 5.1.14 UNWINDING FORCE CHECK
    - 5.1.15 SPRING MOUNTED TAPE GUIDE CHECK & ADJUSTMENT
    - 5.1.16 TAPE FEED CHECK
    - 5.1.17 STEPPER MOTOR PULLING FORCE CHECK
    - 5.1.18 INTER-ROW SPACING CHECK
    - 5.1.19 END OF TAPE/TAPE LOW FUNCTION CHECK & ADJUSTMENT

- 5.2 PUNCH PERIODIC SERVICE
- 5.3 PUNCH FAULT TRACING
- 5.4 TAPE READER 4031
  - 5.4.1 MECHANICAL CHECKS & ADJUSTMENTS
  - 5.4.2 ELECTRICAL CHECKS & ADJUSTMENTS
  - 5.4.3 CONTROL PANEL DISASSEMBLY
  - 5.4.4 LIGHTHOUSE LID DISASSEMBLY
- 5.5 TESTS

- Appendix 1 SER. CONTROL BOARD, circuit diagram 1(4)
- Appendix 2 SER. CONTROL BOARD, circuit diagram 2(4)
- Appendix 3 SER. CONTROL BOARD, circuit diagram 3(4)
- Appendix 4 SER. CONTROL BOARD, circuit diagram 4(4)
- Appendix 5 READER 4031, circuit diagram

## 1 General

The N4000 is a unit that enables the direct preparation of telex tapes from one or two electronic typewriters or word processors.

It may be equipped with serial interfaces:

- serial interface according to CCITT V.24/EIA RS-232-C
- option: current loop adapter Facit 5165

It has two standard I/O ports.

It can accept ASCII coded data from two sources simultaneously and has a 9 kbyte buffer capable of storing two normal length telex messages.

The operations are controlled by a CPU type 6809.

All operating system parameters are entered from a small keyboard. A status display indicates the current operating status and shows also simple error messages.

N4000 includes a program for automatic sorting of typed text to adapt to the standard telex format.

Line lengths are adjusted without hyphenating words at line ends.

Formatted and tabulated text is repositioned to fit the telex format but the original layout is still preserved.

Code conversion from ASCII to any one of 12 national standard codes may be performed, selected by control codes programmed via the keyboard.

The unit has a backup battery on the interface to preserve the buffer memory content when the unit is turned off.

In N4000 a Facit 4031 reader is included. Data read from a punched tape are transmitted via channel 1 or 2.

When the reader is started from the keyboard, START key, data are always transmitted via channel 1.

When the reader is started by using the start reader code, data can be transmitted via channel 1 or 2 depending upon which channel was used to send the start reader code.

The channel not used by the reader can accept data for punching.

A tape in the reader may be directly copied by the punch ordered from the keyboard.

## 2 Specifications

### 2.1 General

Positive true logic is used. When negative true signals are used, this is written e.g.  $\bar{R}/\bar{W}$ , where W is true when LOW and R is true when HIGH.

### 2.2 Technical Specifications

See the Technical Description.

### 2.3 Connectors

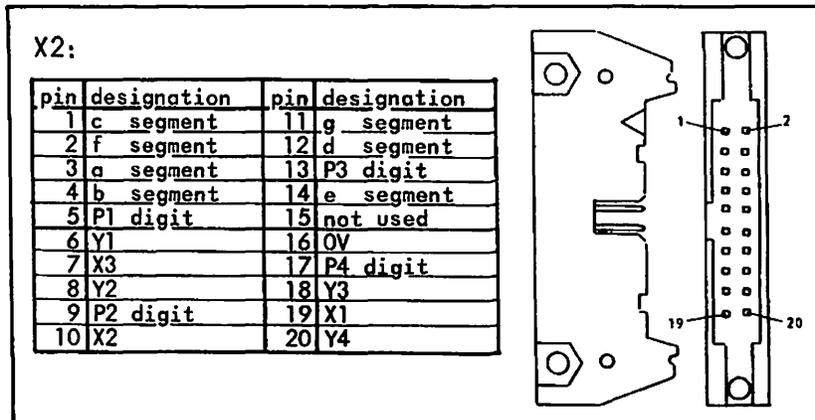
#### 2.3.1 Internal Connections

X1:

pos	A-side	B-side
1		CH 1
2		CH 2
3		CH 3
4		CH 4
5		CH 5
6		CH 6
7		CH 7
8		CH 8
9		CH 9
10		M 1
11		M 2
12		M 3
13		TE
14		TL
15		FAN
16		AC 1
17		AC 2
18		OV
19	+24V (F)	+24V (F)
20	OV (P)	OV (P)
21	SC	SC
22	OV (P)	OV (P)

X1: A double-sided board edge connector to the punch.

X2: A 20 pin connector for the CONTROL PANEL and the DISPLAY mounted on the board.



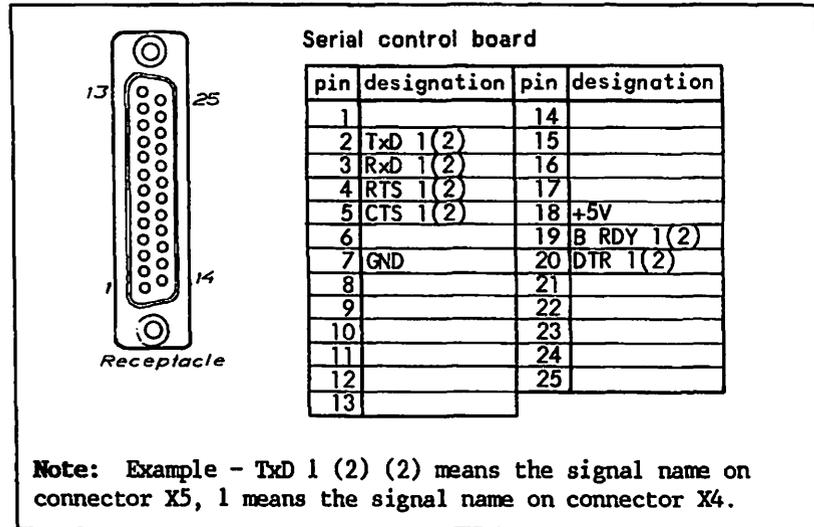
X3: A 20 pin connector for the READER with the same configuration as for X2

X3:

pin designation	pin design.
1 EOT	11 RI
2 RD 7	12 DIR
3 RD 6	13 NU
4 RD 5	14 not used
5 RD 4	15 +5V
6 RD 3	16 +5V
7 STROB	17 OV
8 RD 2	18 OV
9 RD 1	19 +24V
10 RD 0	20 +24V

### 2.3.2 External Connections

X4 & X5: External connectors for I/O ports channel 1 and channel 2. Input for two different sources.



### 3 Design

#### 3.1 General

N4000 is built up around the 4071 punch/feed unit.

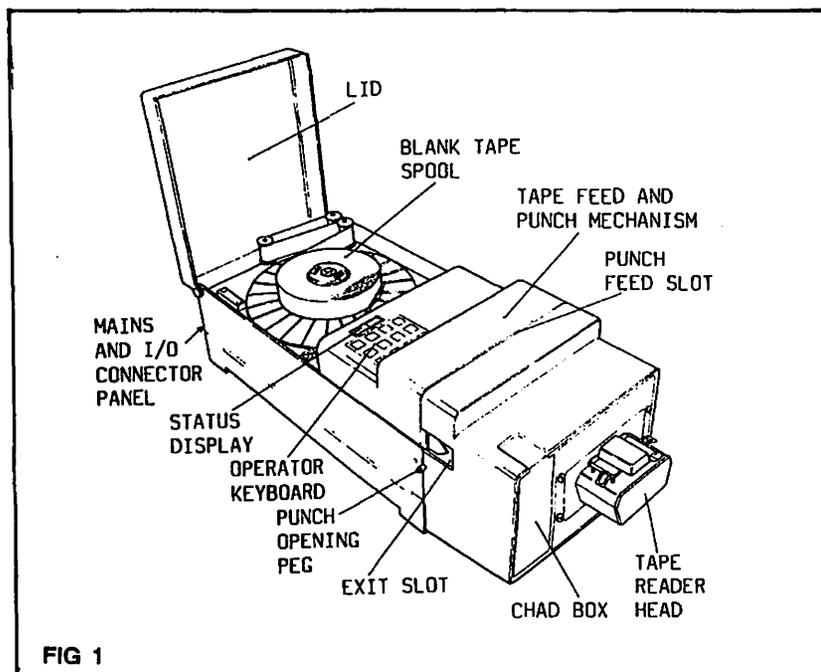
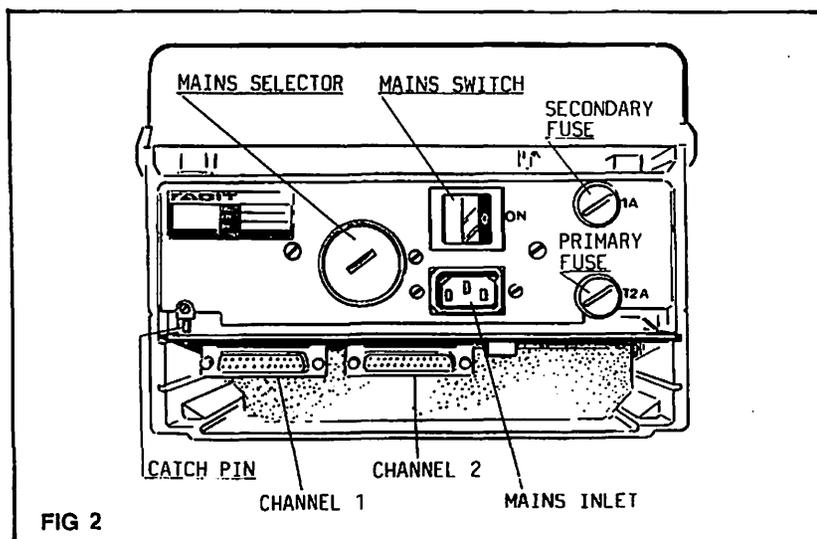


FIG.1 shows some of the main parts of the unit. The heavier parts, like the transformer, are mounted in the front end.

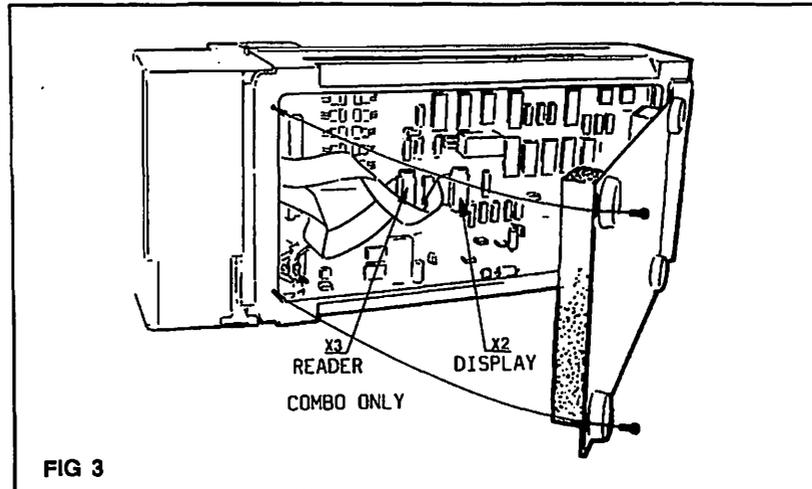
Located on the rear panel are the mains inlet, the mains switch ON/OFF, the mains voltage selector and the primary and secondary fuses.



The rear end of the control board is equipped with two input channel connectors.

The board is locked in its position with a catch pin tightened with a screw.

In order to change the control board or to make measurements on it, the bottom plate has to be removed.

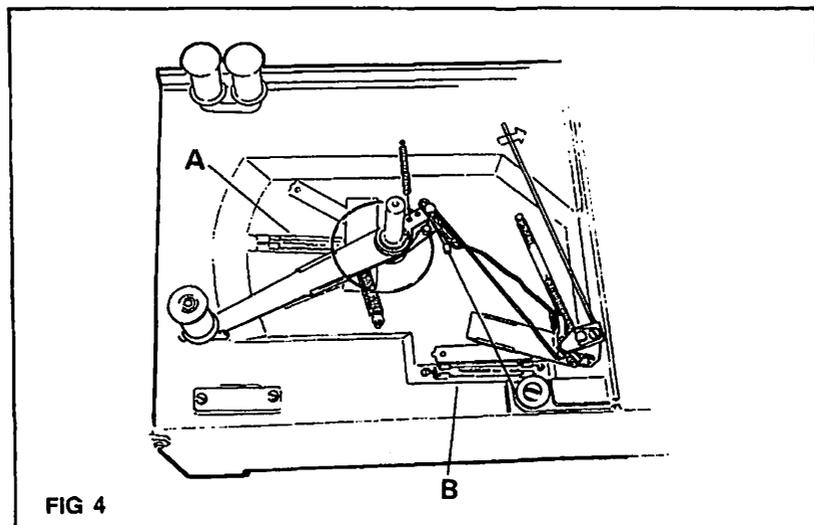


The plate is removed after that the two screws have been removed.

Note the location of the cable connectors on the board:

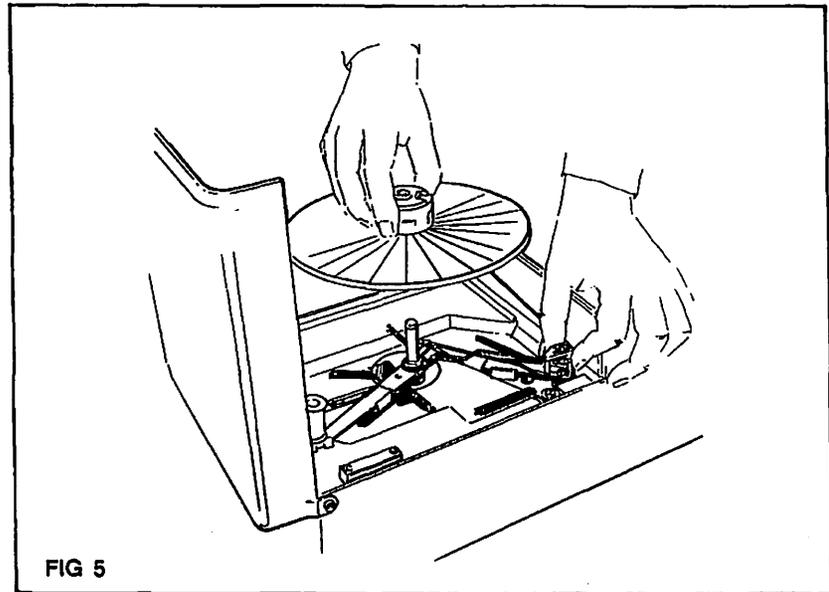
- one (X3) from the reader
- one (X2) from the keyboard and the display

The supply flange is removable giving access to the tape error (A) and the tape flow (B) detector.

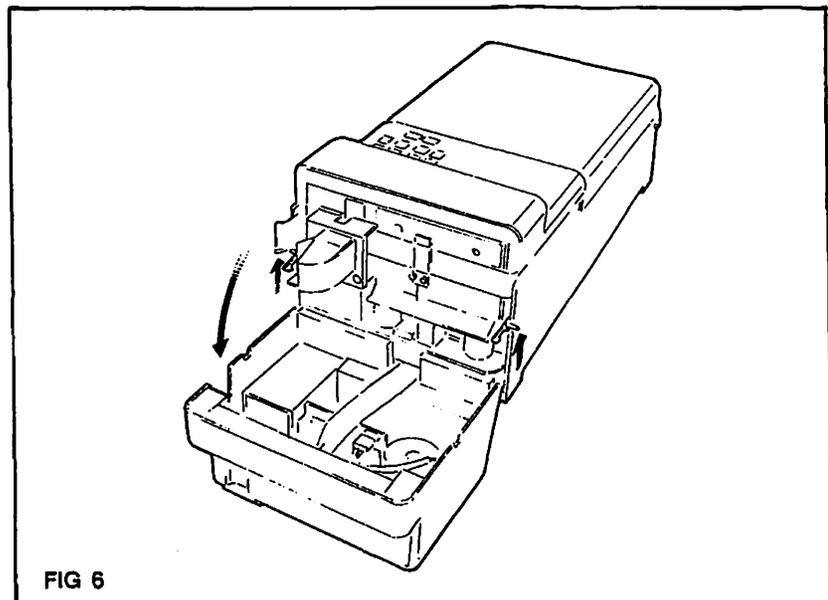


A retainer ring has to be removed first. When the tape low sensor arm has been moved aside the supply flange can be lifted up.

When mounting the supply flange not only the tape low sensor arm but also the brake has to be moved aside as shown in FIG. 5.

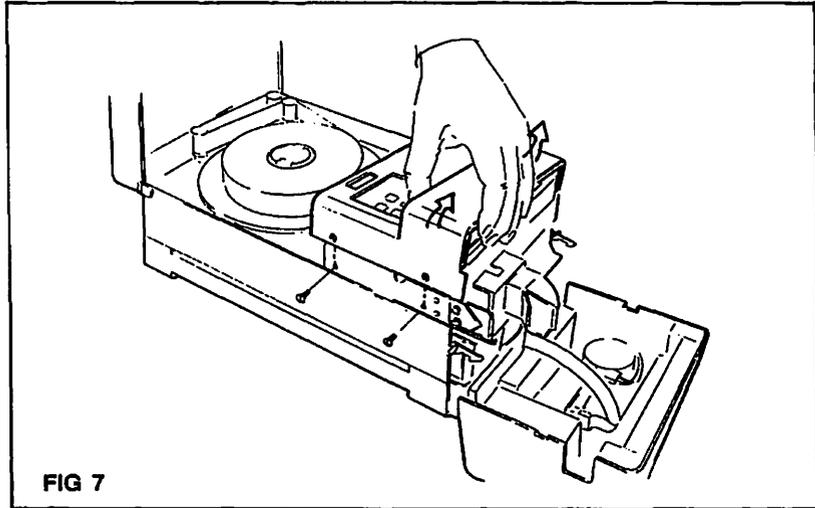


### 3.2 Disassembling



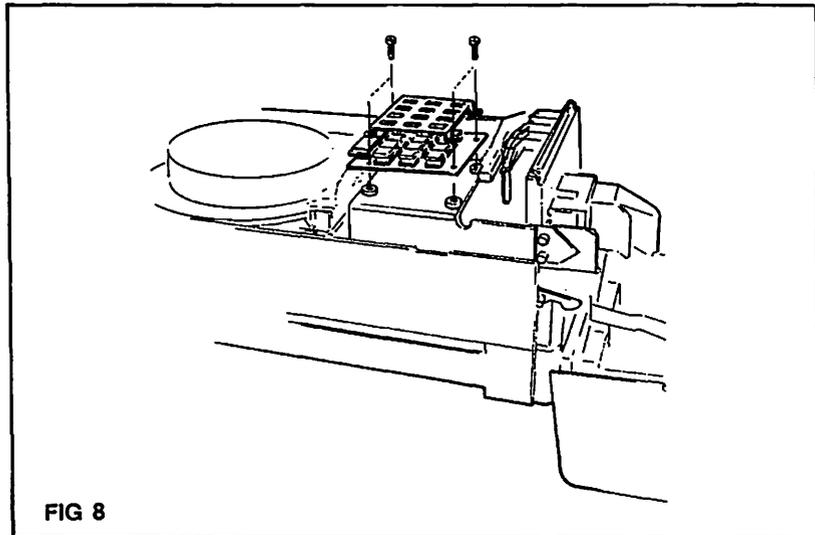
By lifting the two opening pegs or "catches" the front cover may be tilted forward. See FIG. 6.

By removing the two screws on the left side the keyboard cover can be removed. See FIG. 7.



There are two screws on the right side that are fitted into grooves. The cover has to be lifted gently and then pressed a little to the right in order to get the cover off.

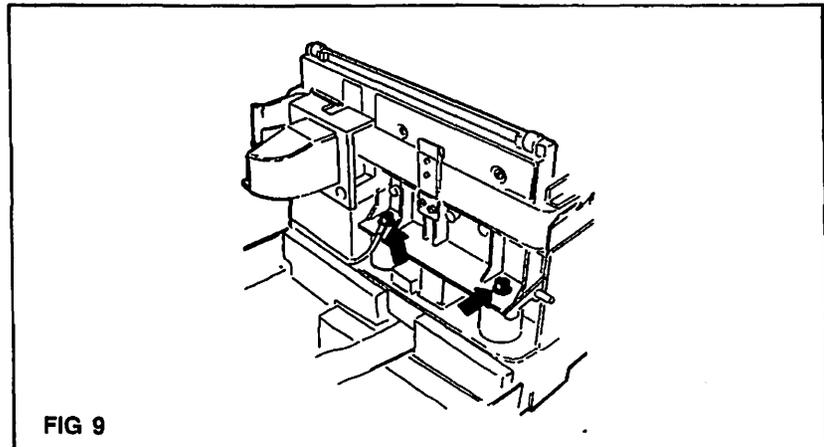
With the keyboard cover removed the keyboard is accessible.



Remove the four screws that hold the keyboard cover plate and the keyboard. See FIG. 8.

It is recommendable to glue the four spacers to the mounting angle. It makes it easier to mount the keyboard again and the spacers will not be lost.

In this position the keyboard is in a position where all kinds of test can be done.



By removing the two hexagon socket head cap screws the punch feed unit can be removed.

It is easy to work with the fuse board, for the stepper motor and the solenoids, in this position.

## 4 Function

### 4.1 General

The operations are controlled by the CPU with its program.

Here, explanations of certain circuits as well as of the general idea of punching and reading will be given.

While for the punch all the driving circuits for the motor and the punch solenoids are found on the control board the reader is a separate unit comprising motor, motor drive and reading circuits with buffer.

### 4.2 Punching

There are two phases in the punching cycle; feeding and punching.

Feeding is ordered with the motor drive signals M1-3 for the motor windings which will step the stepper motor.

The signals CH1-8 and FH are the punching signals to the drivers for the tracks and the feed hole.

During punching the motor doesn't move but keeps the tape fixed. Then the punching is performed once or twice as ordered.

The only feed back signals from the punch unit are the signals Tape Low and Tape Error.

### 4.3 Reading

Reading can be looked upon as three phases:

1. Order for tape feed
2. Feeding and reading
3. Transfer of data read to the acceptor

In the following, names within brackets are the names used in the reader diagram when they differ from those on the control board diagram.

The signal RI is sent by the CPU to the stepper motor ordering the motor to step one character.

The signal DIR (SD) determines direction of the stepper motor movement.

This combination moves the tape one character and the data holes are read into a buffer.



The data are converted into serial form before they are transmitted to a data acceptor on one of the channels.

The two channels; 1 (PORT 1) and 2 (PORT 2) can receive or transmit information simultaneously and with different baud rates.

The total capacity in the BUFFER MEMORY is 9kbyte divided between channel 1 and 2. The remaining area is used for storage of the parameters. The priority is controlled by the CPU via the address bus.

Programming parameters are entered via the KEYBOARD and are shown on the DISPLAY.

There is a WATCH DOG circuit that gives a general reset if a certain signal is not repeated within a time limit.

The transfer of data from the BUFFER MEMORY to the punch is done a whole line at a time, character by character. The transfer is executed whenever the control codes End Of Line, End Of Message or Stop Clear Text is detected.

The complete line preceding the code is punched out. This continues until End Of Message code is received.

The reading of tape is done from the reader to the BUFFER MEMORY, character by character, until either the tape is finished, or the BUFFER MEMORY is filled.

By obvious reasons one buffer at a time has to be punched out before a change is made to the other buffer to be punched out.

The priority of the buffers and the channels is that the first entered data are of the highest priority. When the corresponding buffer has been emptied the highest priority is transferred to the other buffer and so on.

If no End Of Message code is received within a preset time limit, the message being punched out is terminated so that the punch will not be blocked.

Buffer status signalling depends on the protocol chosen. If buffer Ready/Busy, corresponding pin 19 (BRDY 1 or 2) is set low when there is space for only 50 characters. Otherwise pin 19 is high.

If XON/XOFF is used, then signal XOFF is sent, when there is space for only 50 characters, and XON, when there is space for more characters.

The FIM carters for the counting of the different time limits used.



VT6 and R18 are the current limiting components for VT48. L2, C9 and C10 work as filter for +5V.

VT7 and V7 form an over-voltage protection circuit. When +5V arises high enough, VT7 will conduct and give current to V7 gate. V7 is turned ON and the +5V line is equal to the voltage drop across V7.

To turn V7 OFF again the voltage has to be turned off. The voltage protection circuit can be disconnected by removing jumper W1. See app. 1.

+24V is used as input voltage for the +12V regulator V28.

Two more voltages are used: +12V(C) and -12V(C).

They are used for the outgoing interface circuits.

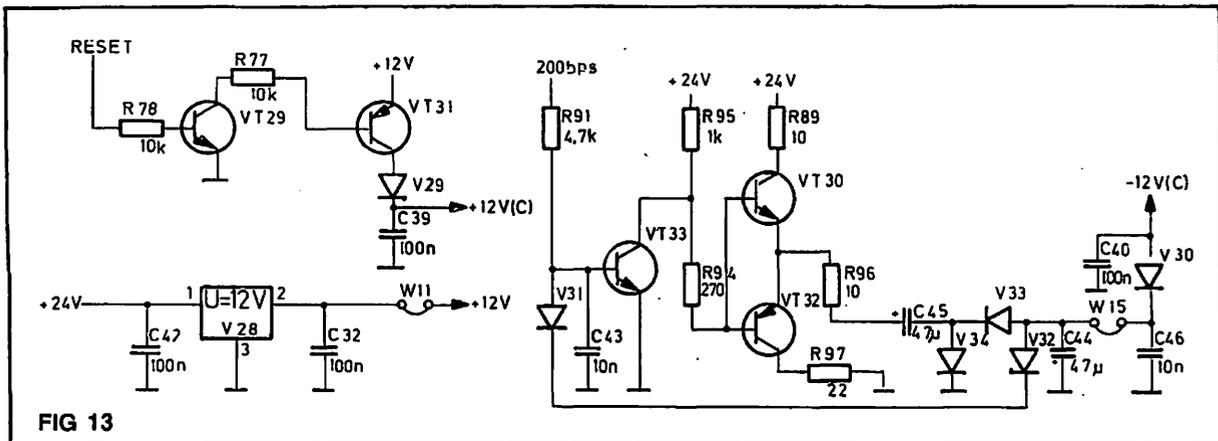


FIG 13

+12V is used to form +12V(C) via VT31 when there is no RESET to VT29.

+24V is also used to the switch regulated -12V(C) circuit together with pulses from the watchdog circuit. The 200bps gives  $f=3200\text{Hz}$ .

VT30 and VT32 are two switches controlled by VT33.

VT33 = OFF gives VT30 = ON, VT32 = OFF

VT33 = ON gives VT30 = OFF, VT32 = ON

VT30 = ON charges C45.

VT32 = ON discharges C45 but C45 can't be uncharged at once. There is a time constant and the negative plate of C45 becomes negative.

As a result V33 will conduct and C44 will be negatively charged.

The switching with VT30/VT32 continues until C44 has been charged more negative than the zener voltage of V32.

V32 conducts and sets VT33 OFF. VT33 remains OFF until  $-12V(C)$  is less negative than the zener voltage of V32 again.

When VT33 turns ON, the switching of VT30/VT32 starts again.

#### 4.5.3 Power Down/Battery Back-Up Circuits

The power down circuits (see app. 2) are working at two occasions:

1. At voltage on
2. At voltage off

1:

The power down circuits give RESET to CPU, PTM, CPT, DUART and PIA at voltage on in order to give the voltages time enough to be built up.

2:

At voltage off the circuits, together with the battery backup, will keep the buffer memory RWM going for a while in order to terminate writing that goes on in the RWM without losing information.

Note, that the battery backup is supplied only to the buffer memory and its associated circuits when writing.

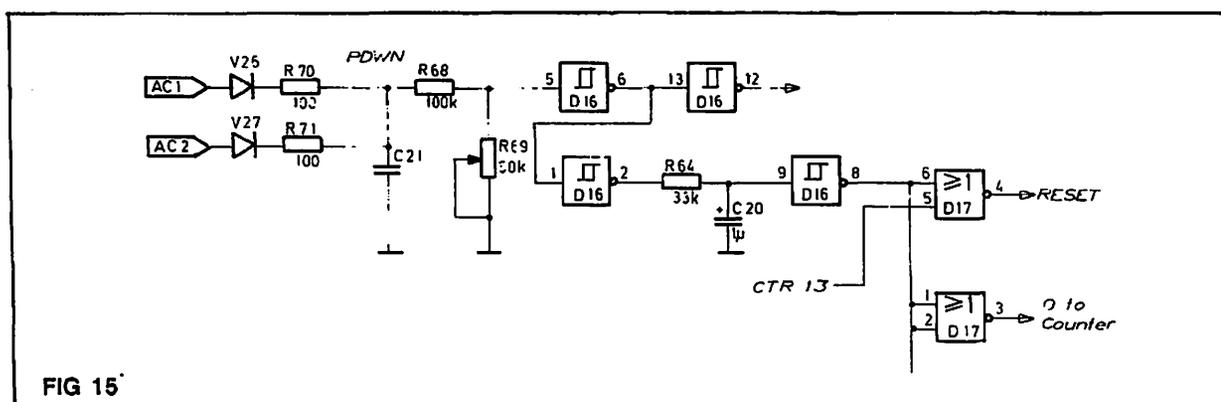


FIG 15

#### Function:

At voltage ON C21 has to be charged in order to get D16:6=L.

If D16:6=H, then D16:2=L and D16:8=H which makes D17:4=L i.e. RESET.

When C21 is charged, D16:6=L and D16:2=H.

After a time delay, C20 x R64, D16:8=L and RESET is no longer on D17:4.

C21 is charged from the AC voltage, AC1 & AC2, via V26 & V27 resp. R70 & R71.

The time constant for charging is short, approx. 15us, compared with the constant C20 x R64, approx. 22ms.

The control board uses a lithium battery, G2. +5V is normally fed via VT28 as BATT to the buffer memory (D23).

At voltage OFF, VT28 is turned off and the battery takes over. The battery is connected all the time and it will last for several years.

#### 4.5.4 Stepper Motor Drive

Three darlington amplifiers, VT38 - VT40 (see app. 3), are used as drivers for the stepper motor windings L10 - L12.

The ON/OFF operation is controlled by the CPU but the current is supervised by other circuits.

In the following the circuits associated with VT38 are used for explanations. VT39 and VT40 work in the same manner.

#### Current limitation:

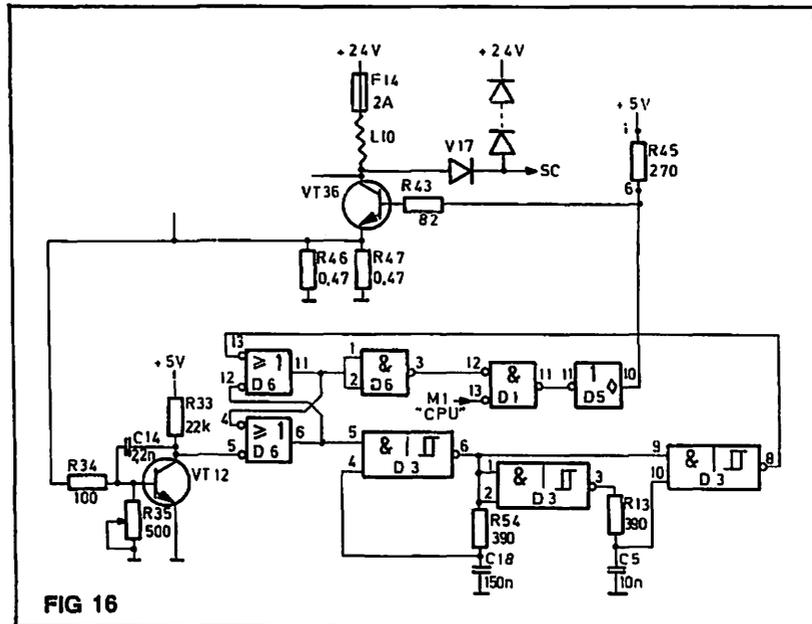
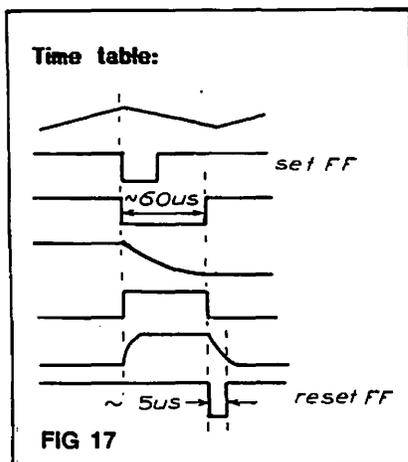


FIG 16



When the winding L10 is ordered to pull, this is done by the CPU, which gives signal M1.

M1 set VT38 ON and current starts to flow through the winding L10, VT38 and R46/R47.

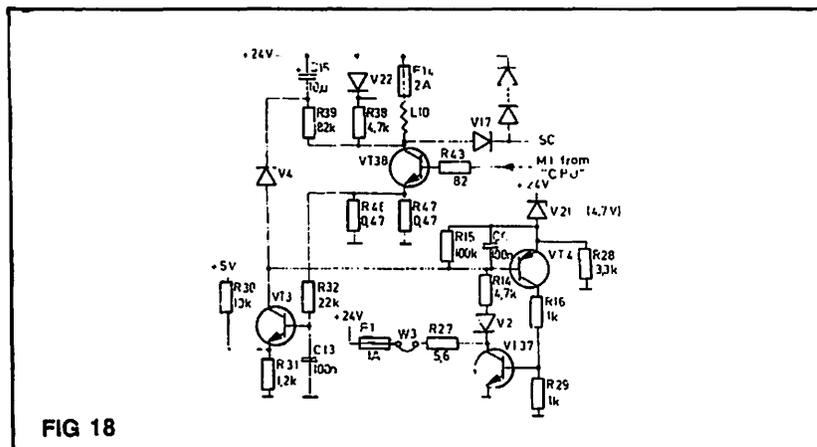
VT12 is adjusted with R35 to go ON when the current through R46/R47 is approx. 3,2A.

VT12 ON sets the FF and D6:3 goes H thus inhibiting M1 to VT38 which is set OFF.

The H on D6:6 is also fed to D3:5 where it results in a low pulse. This L to D3:4 is delayed through the time constant of R54 - C18. C18 has to be discharged through R54.

If VT12 continues to be ON longer than D3:6 is low, then the punch has to be turned off and started again. The reason is that something is faulty.

#### Motor winding protection:



To protect the windings from overheating, VT37 is used as a safety circuit.

If VT37 goes ON, then +24V is connected through R27 to GND, and the current will rise to approx. 4 - 5A. This makes the fuse F1 blow and +24V is removed from the circuit board.

There are two possibilities to turn on VT37:

1. By turning on VT4 with the help of C15, R39 and V4 (normal).
2. By turning on VT3 with the voltage over R46/R47.

When VT38 is OFF, C15 is discharged.

When VT38 goes ON, VT381C comes close to 0V, but as C15 is uncharged V4C remains at +24V in the beginning. Then C15 starts to charge through R39 and V4C becomes smaller than +24V.

VT4 is approx. (+24V - 4,7V) and when V4A has become less positive than VT4E, VT4 goes ON which turns ON VT37 and the fuse F1 blows. The time constant for this operation is approx. 200ms.

The result is that if a drive pulse last too long, or is repeated too often on a certain winding, then the circuit will blow fuse F1.

If this fails, then VT3 is used for the same purpose.

When the voltage across R46/R47 gets high enough, VT3 is turned ON which turns on VT4 and VT37. This will happen for a continuous current of approx. 4 - 5A when C13 has been charged.

All times, currents and voltages are calculated with the assumption that +24V is really +24V.

#### 4.5.5 Punch Solenoid Drive

VT34, 35, 41-47 (see app. 3) drive the punch solenoids. They are controlled by the CPU via the inverters D5 - D7. The control of when, how long and how much current, is totally done by the CPU.

The solenoids use +24V and each solenoid has its own fuse, 2A.

#### 4.5.6 Interfacing Circuits

##### Input signals:

The quad line receivers, 1489, are used for the input signals. All the circuits are designed alike and are mounted on the control board.

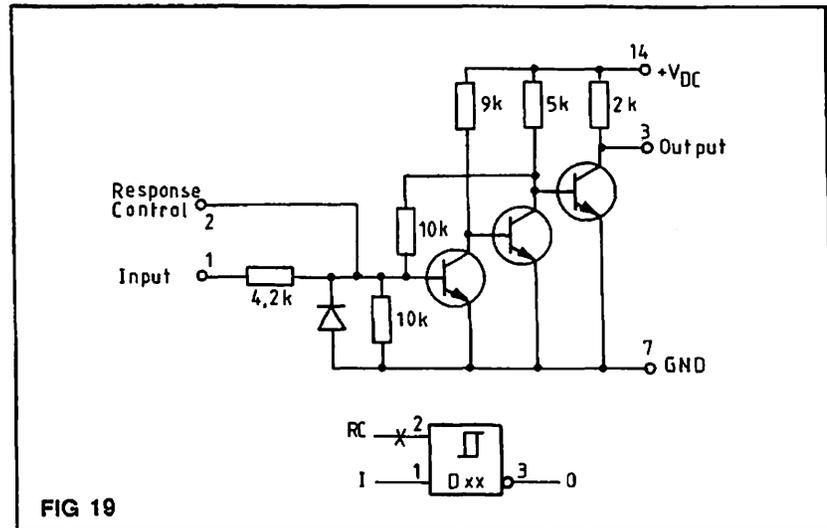


FIG 19

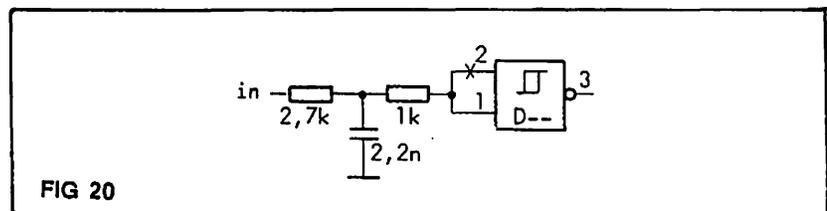
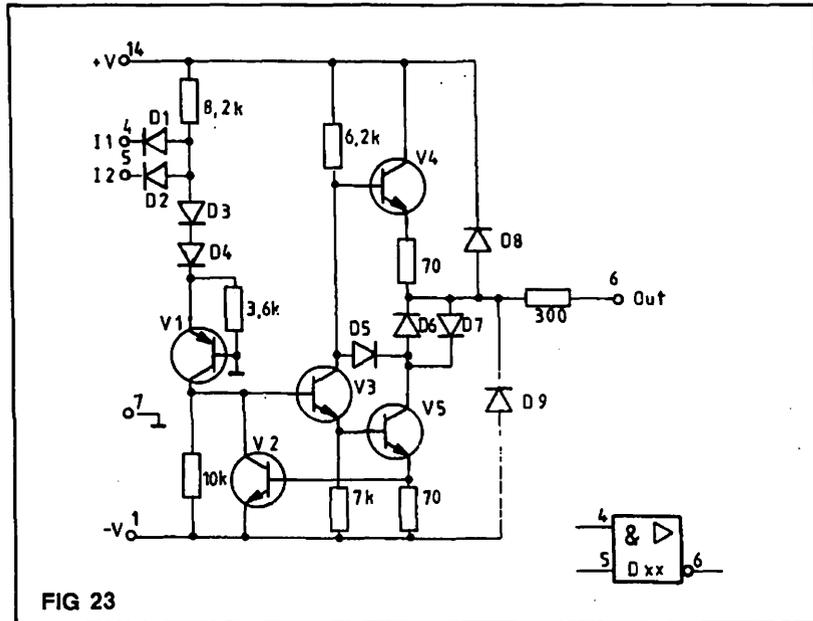


FIG 20

**Output signals:**

The quad line drivers, 1488, are used for the output signals and they are also mounted on the control board.



+V and -V are +12V(C) resp. -12V(C). This gives a better signal/noise ratio than with the standard +5V/GND but the acceptor must be able to handle these levels.

**4.5.7 Watch Dog**

A watch dog circuit is used that provides a main RESET under certain conditions.

The circuit is a counter (D101) clocked by a signal WD-CLOCK. If this counter is allowed to count up to 8192, then RESET is given.

The signal WD-CLOCK is taken from a counter (D100) and is 975Hz.

The reset of the counter is partly controlled by the power up/down circuits, partly by the CPU via PIA (12:19)L signal CB2. If this signal does not come in time then the watch dog gives RESET.



T2 gives a clock pulse to the data buffer to write data from the tape and have them accessible on the output data lines (see FIG 26) when the strobe pulse STROBEI, also made by T2, is transmitted.

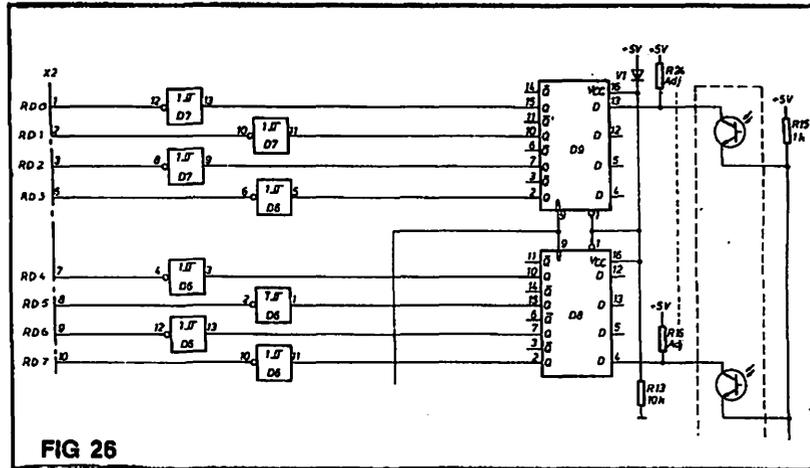


FIG 26

If there is no feed hole within 10ms (low speed) or 8ms (high speed), the RCC will signal time out error to the CPU.

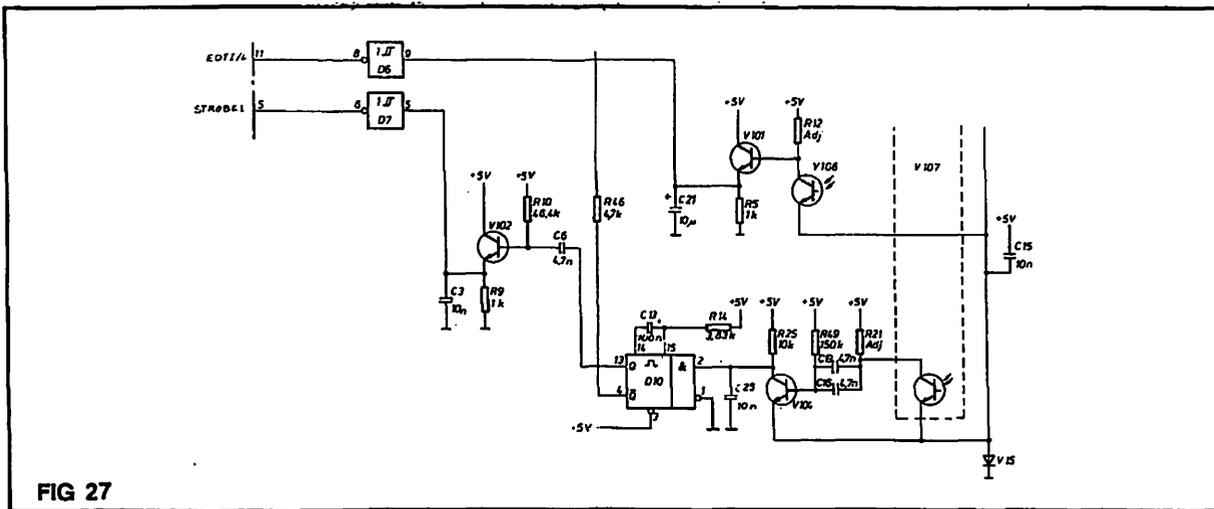


FIG 27

The paper opto detector signals EOTI when there is no paper. The detector is placed approx. 20mm ahead of the reading station, forward feeding direction.

4.6.3 Stepper Motor

V114 - V116 are driving the stepper motor. They are controlled by the D3 FF's or blocked by the signal MRO. See FIG 29.

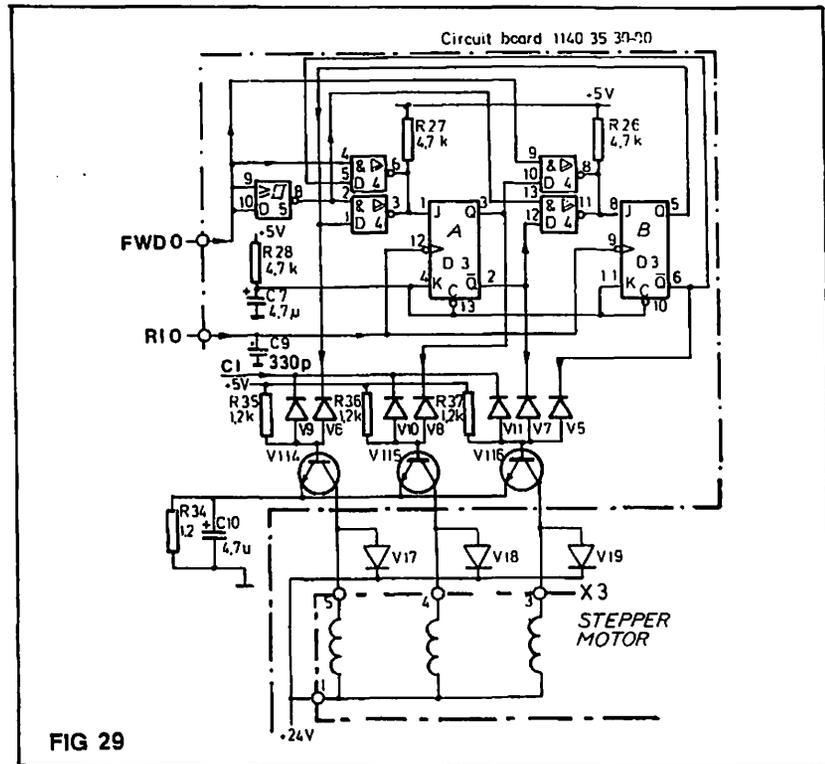


FIG 29

D3 is clocked by RII and controlled by FWD0 and the state of the FF's.

When input J gets high, the output changes its state. FWD0 determines the stepping direction.

BWD ⇒ SD(L)=L: V114 → V115 → V116 → V114  
 FWD ⇒ SD(L)=H: V116 → V115 → V114 → V116

No of RI	FF		working amplifier
	A	B	
	0	0	V116
BWD	1	0	V114
SD(L)=LOW	2	1	V115
	3	0	V116
	0	0	V116
FWD	1	1	V115
SD(L)=HIGH	2	0	V114
	3	0	V116

FIG 30

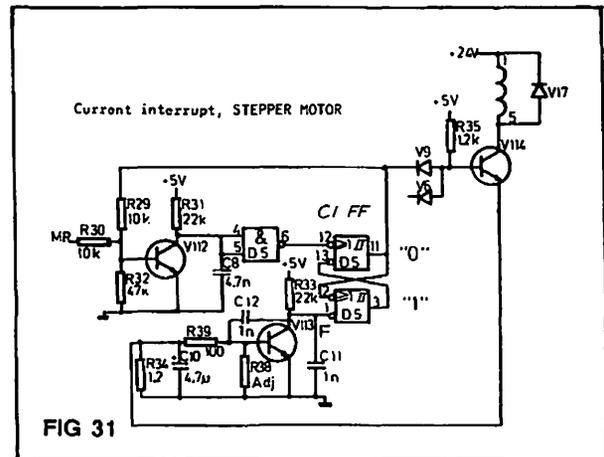


FIG 31

The current through the driving transistors is switch regulated by the current interrupt FF to approx. 340 - 380mA. It is adjusted with R38.

Exemple:  
See FIG 31.

At start CI FF=0 and current through V114 is initiated with a logic 1 on V6.

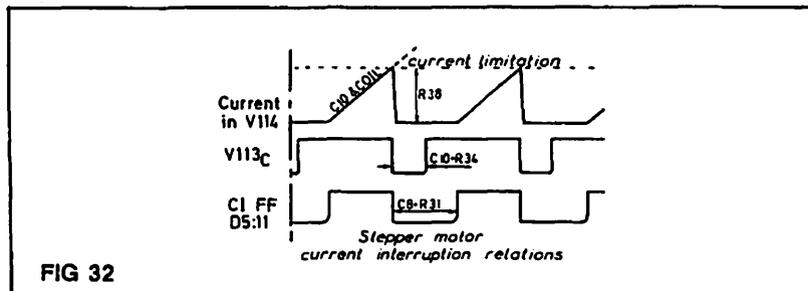
When current increases, V113 becomes conducting and CI changes to 1. This cuts off V114 & V112. C8 x R31 delays the change on V112C.

After the delay, CI changes back to 0 and the current increases again in V114.

When the current in V114 is cut off, V113 will also be cut off thus eliminating risks of disturbances in coils, when the current is cut off or turned on.

The time relations between CURRENT/no CURRENT are determined by the time constants of C8 x R31/C10 x COIL and the current peak value by R38. See FIG 32.

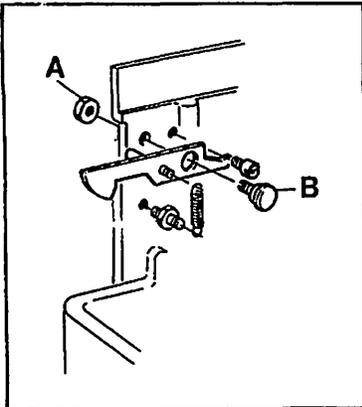
In this manner R38 controls the average current value in the driving transistors.



## 5 Service

### 5.1 Mechanical Checks & Adjustments

#### 5.1.1 Punch/Feed Unit: Removal & Mounting

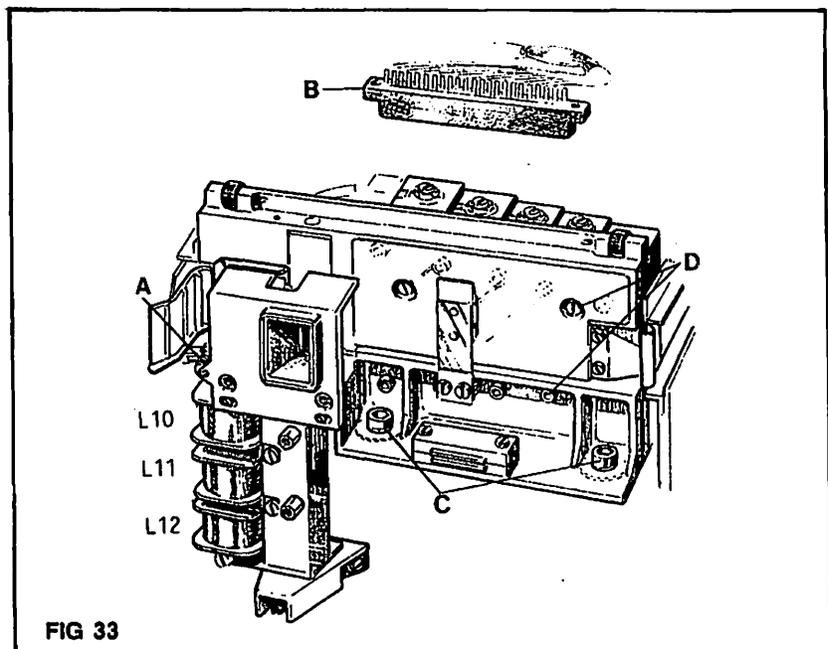


#### Front cover adjustment

Loosen nut A and turn the eccentric screw B until a proper retaining position of the front cover is obtained. Lock the eccentric screw B with nut A again.

#### Removal & mounting

When removing the punch/feed unit:



- remove the keyboard cover
- remove the wire from lever A
- remove connector B from the punch unit
- remove the screws C and carefully lift out the punch/feed unit

When mounting the punch/feed unit:

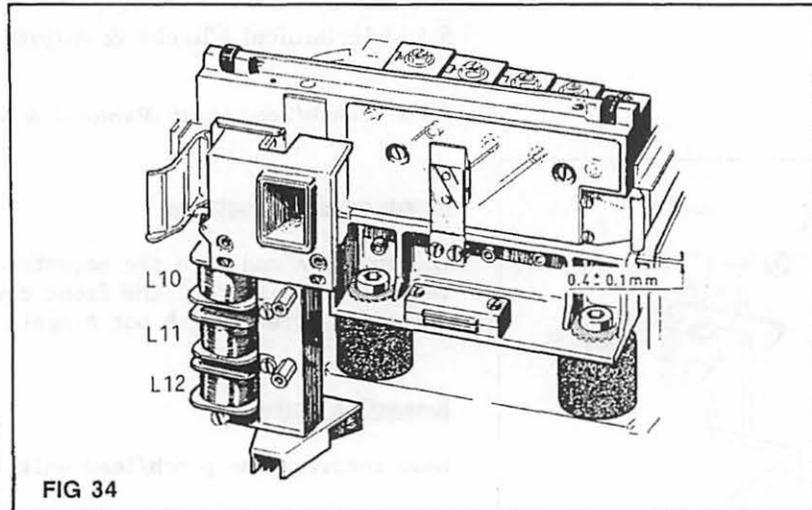


FIG 34

- check that its surge take-up spring is  $0,4 \pm 0,1$ mm above the reference edge of the tape slot in the right hand side-wall.

**Adjustment:**

Insert washers between the rubber shock mounts and the punch/feed unit.

**5.1.2 Punch Solenoid Disassembling & Check**

With the punch/feed unit removed (see FIG 35):

- remove the retaining screw(s) D (see FIG 33) for the solenoid(s) that will be checked.
- loosen the screw E
- remove spring F and push out the solenoid armature G.
- check that the spring attachments are not defective.  
Action: Replace the spring attachment.
- check that the axial play does not exceed  $0,02$ mm.  
Action: Replace the solenoid armature.
- check that the actuator rotates easily and does not bind when depressed.  
Action: Replace the solenoid armature.
- check that the spring eyes F are not defective.  
Action: Replace the spring F.

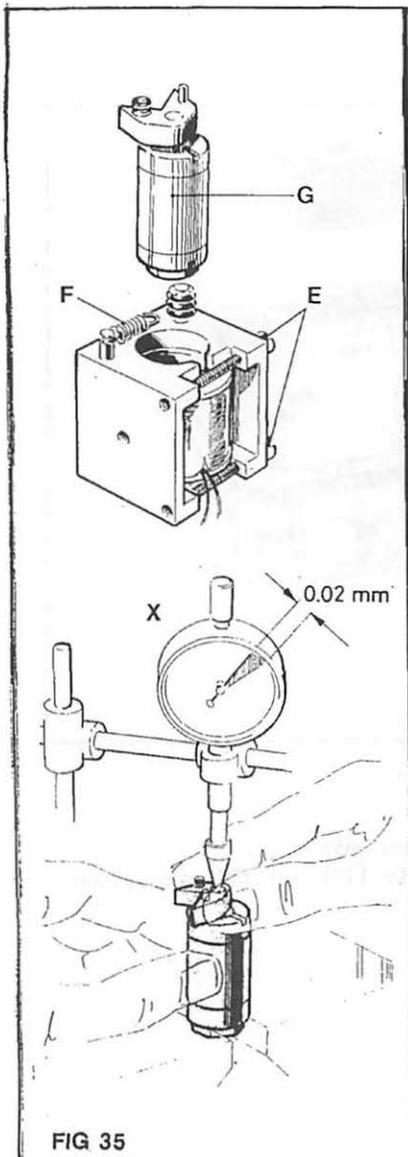


FIG 35

### 5.1.3 Punch Pin Drive Check & Replacement

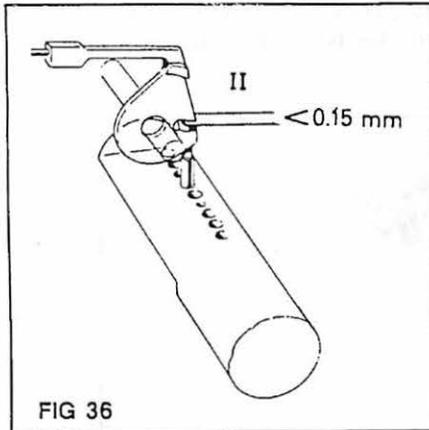


FIG 36

When checking the pin drivers with the punch/feed unit removed:

- check that the play between the punch pin and the pin driver is less than 0,15mm. Use the feeler gauge II. (FIG 36)  
Action: Replace defective pin drivers and those with excessive play.

When replacing punch pin drivers:

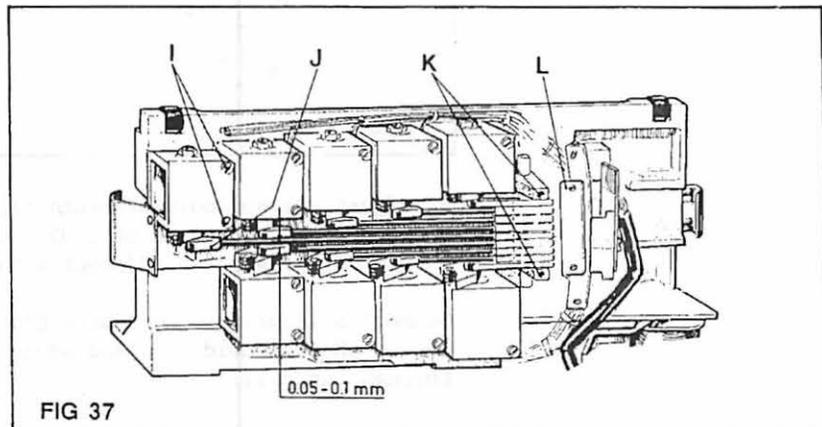
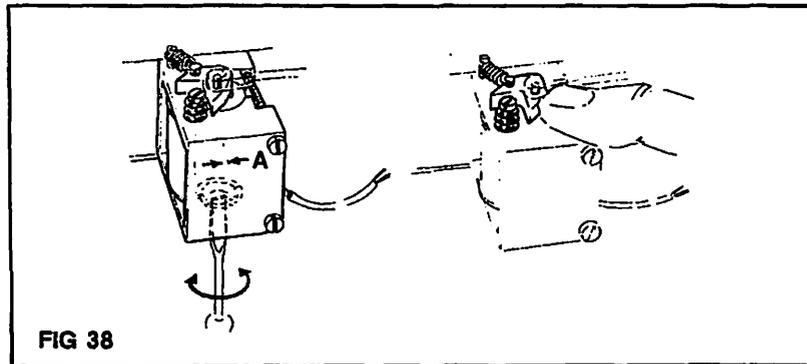


FIG 37

- remove the bracket L
- loosen the stop screws K for the punch pin drives and push out the shaft
- replace the punch pin drivers
- push in the punch pin driver shaft and tighten the stop screw K
- mount the bracket L

#### 5.1.4 Punch Solenoid Fitting & Adjustment

Place the punch solenoid into the punch/feed unit. Make sure that the pin on the actuator fits into the punch pin driver J. See FIG 37.



- adjust the solenoid armature axially in the solenoid until there is a clearance of 0,05 - 0,1mm (A) between the punch pin driver and the adjacent actuator.

Connect a stabilized DC source that can provide approx. 0 - 6V 2A, to the solenoid coil and adjust to a current of 1A +/-5% through the coil.

**NOTE:** When testing with current flowing, the current must only be allowed to be on for short periods in order to avoid overheating.

- turn the solenoid core, by using a screwdriver, until the actuator just leaves its resting position on the O-rings. See FIG 38.
- tighten the screws I. See FIG 37.

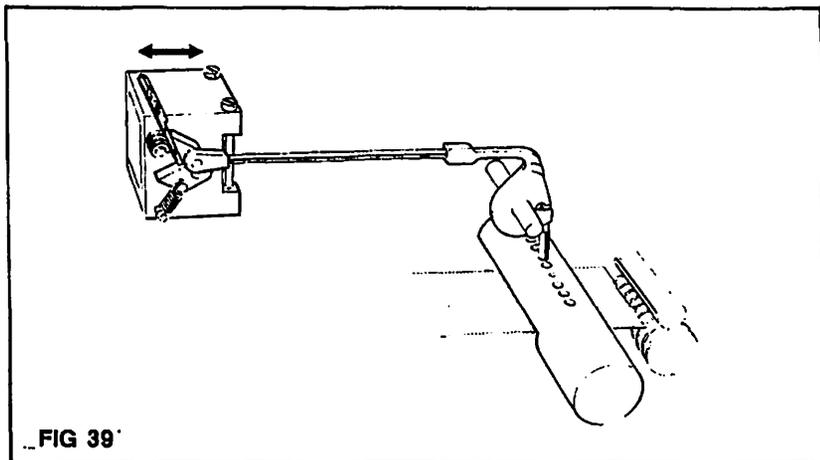
Adjust the stabilized DC source connected to the solenoid coil to a current of 2A +/-5% through the coil. **Note:** On, only for short periods.

- check that the actuator turns through its full stroke and make contact with the O-rings (a very small clearance is permissible).
- press the actuator back from the O-rings with a finger, if properly adjusted, an abrupt reduction in force should be felt as the actuator is pressed back to its initial position.

**Action:** If not, loosen the screws I, see FIG 37, and go back and change the stabilized DC source to 1A through the coil. Change the adjustment position slightly and recheck the axial play in the solenoid to a clearance of 0,05 - 0,1mm

If this has to be adjusted, the whole procedure must be repeated.

- tighten the screws I again.



..FIG 39'

Insert a piece of 0,1mm paper tape between the punch pin guide and the die.

Insert the feeler gauge III between the actuator and the O-rings. Use the 1,85mm end of the gauge for the data tracks and the 2,0mm end of the gauge for the feed hole track.

- adjust the longitudinal position of the solenoid until the punch pin presses the tape lightly against the die without cutting into the tape.

Move the feeler gauge III back and forth a little as the adjustment proceeds in order to get a stable position against the O-rings.

Lift the pinch roller and check by moving the tape back and forth.

- tighten the punch solenoid retaining screws.
- recheck that the actuator turn through its full stroke and make contact with the O-rings with a current of 2A through the coil.

### 5.1.5 Punch Head Replacement

With the punch/feed unit removed:

- remove the sound absorbing material fixed on the plate covering the stepper motor.
- remove the stepper motor (3 screws).
- remove the cover A. See FIG 44. See to that the chad exhaust is not pulled along.
- loosen the screw F. See FIG 41.

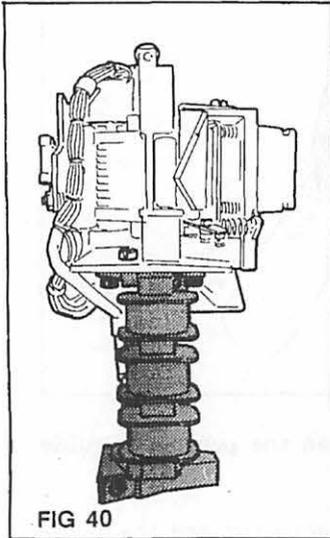


FIG 40

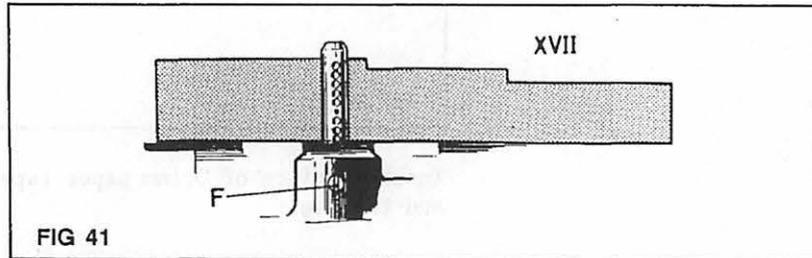


FIG 41

- put the special tool XV on the punch pin guide and loosen the screw B about 1mm to provide guidance for the tool. See FIG 42.

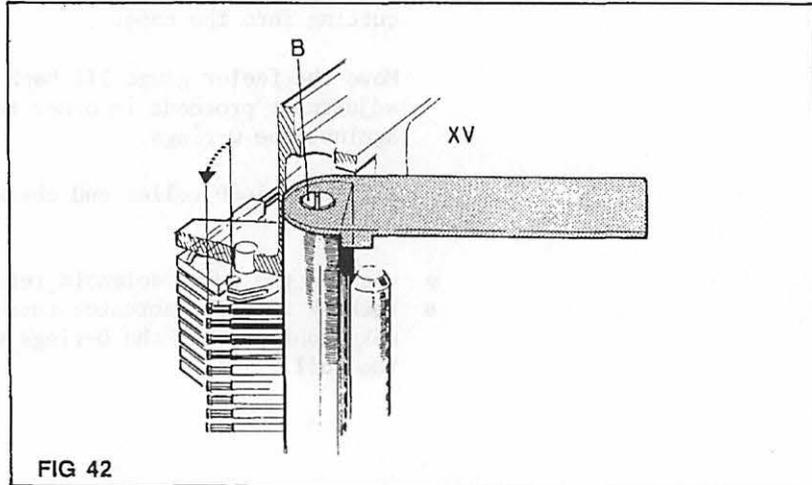


FIG 42

- turn the punch head until the punch pins disengage from the punch pin drivers.
- remove the punch pins.

**NOTE:** Be sure to mark their track position if they are to be used again in the old punch head. Pins and punch head are matched.

- push out the old punch head.
- remove the punch pins from the new punch head and mark their track position.

**IMPORTANT:** The pins are matched with the punch head.

- insert the new punch head.
- turn the punch head and insert the matching pins.
- turn the punch head back until the pinch pins engage with their punch pin drivers.
- align the ref. plane of the punch pin guide and the planes of the punch/feed unit by using the tool XVII as shown in FIG 41.
- lock the head with the screw F.
- check that there is grease in the punch pin guide by removing the screws B & C on the punch head.

**LUBRICATION:** Put the grease nipple XXI as shown. Insert the grease tube, Rocol MTS 2000, in the nipple and press in grease.

Continue pressing until all old grease is forced out on the opposite side. Remove all excess grease and mount the screws B & C.

- repeat the procedure in 5.1.4 from the text following FIG 39.
- check that the feed hole is  $9,96 \pm 0,1$ mm from the ref. edge by turning the solenoid armature manually in order to punch a bit of tape.

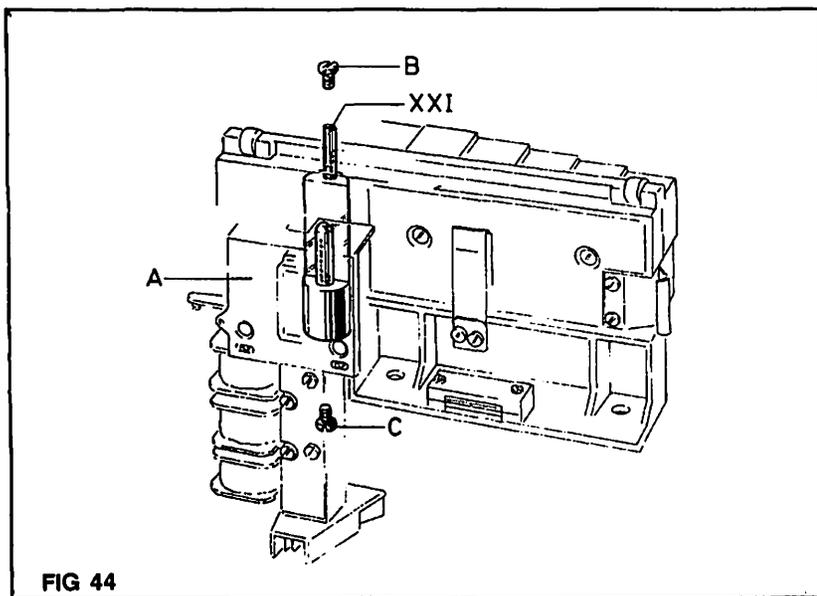
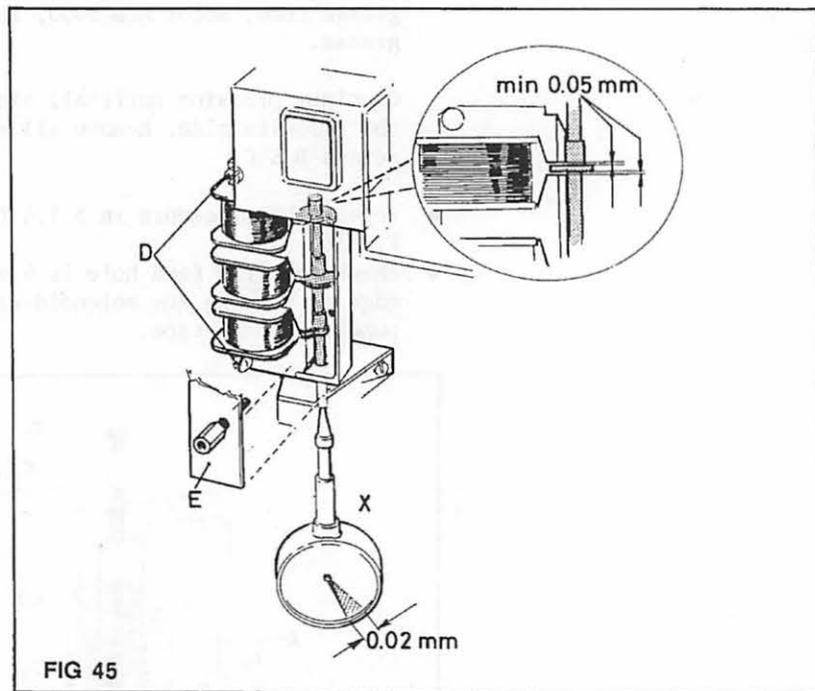


FIG 44

### 5.1.6 Stepper Motor Check

With the punch/feed unit removed and the sound absorbing coated stepper motor cover plate removed:

- remove the protective plate E.
- supply each individual motor winding, one at a time, in sequence with approx. 1A from a DC source.
- check that the clearance between the individual rotor vanes and the stator is not less than 0,05mm when the current is flowing.



**Adjustment:** Loosen the screws D. Make a rough adjustment by inserting a feeler gauge on each side of the rotor vane nearest the punch/feed unit so that the play between the stator and the rotor vane is entirely taken up (use e.g. a multiblade feeler gauge, 0,07mm and 0,08mm).

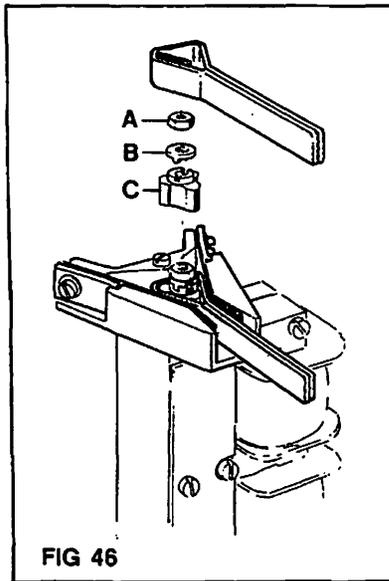
Press the stator and the motor mount together and tighten the screws D.

Repeat the two earlier steps and try to have the two air gaps as equal as possible.

- check the feeding accuracy between adjacent rows. Should be better than 3%.

**Action:** Replace the brake shoe.

### 5.1.7 Brake Shoe Replacement



With the punch/feed unit removed:

- place the holding tool on the brake shoe.
- remove the nut A with caution.
- remove the locating washer B.
- replace the brake shoe C. Note that it fits only in one position because the slot is placed unsymmetrically.
- mount the locating washer.
- mount the nut and tighten carefully.
- remove the holding tool.
- check and adjust according to 5.1.8.

### 5.1.8 Motor Brake Check

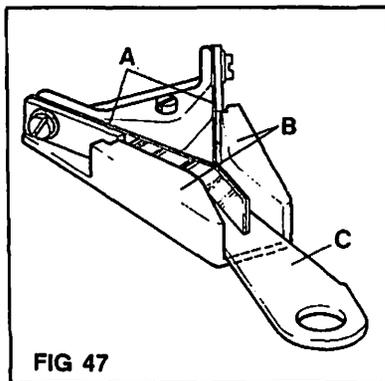
- check that the springs A do not touch the brake housing at the points B when the brake shoe is turned.
- check that the springs A do not make contact with the dust washer inside the brake shoe.

**Adjustment:** Insert a special feeler gauge C. Loosen the retaining screws that hold the brake springs and adjust the springs.

Tighten the retaining screws and remove the feeler gauge.

Repeat from the beginning of 5.1.8.

If the brake housing has been removed from the motor mount, or the brake shoe has been replaced, the brake housing must be positioned correctly relative to the electrical zero position of the motor shaft.



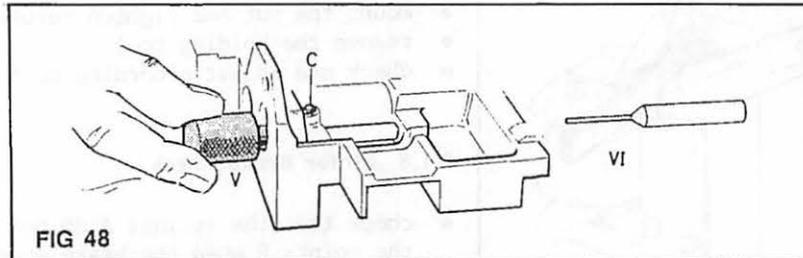
Connect approx. 1A from a DC source to the motor winding L10 and fasten the brake at the position obtained by the brake shoe.

### 5.1.9 Capstan Check & Replacement

With the punch/feed unit removed:

- remove the stepper motor and the cover A. See 5.1.5.
  - check that the capstan rotates easily.
- Action:** Replace the capstan.

When replacing the capstan:



- loosen the screw C.
- carefully push out the capstan using the mandrel VI.
- press in the new capstan by hand as much as possible.
- press in the capstan to its correct position using the mandrel V.
- tighten the lock screw C.
- check that the capstan rotates easily.

### 5.1.10 Stepper Motor/Capstan Transmission Check

With the punch/feed unit removed:

- remove the motor brake, see 5.1.7 & 5.1.8.
- lift the pinch roller away from the capstan by pressing the lever F in FIG 50.
- check that the transmission does not bind when the motor shaft is turned.

**Adjustment:** Remove the motor and turn the motor shaft  $120^\circ$  or  $240^\circ$ .

If it still binds - replace the capstan.

Check that there are no binds or mold marks at D (6 grooves). If binding still remains after that the capstan is replaced, the motor mount has to be replaced.

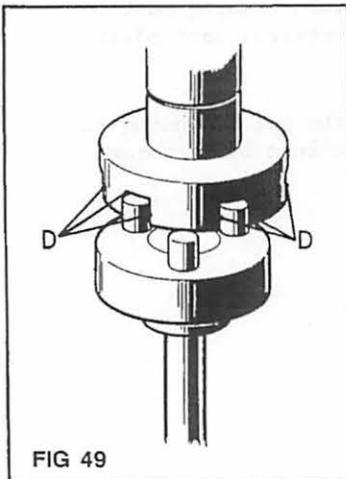


FIG 49

### 5.1.11 Pinch Roller Check

- unhook the spring D.
- check that the pinch roller presses against the capstan with a force of  $5,9 \pm 0,5N$  as shown in FIG 50.  
**Action:** Replace the springs B.
- remove the cover C.
- check that the pinch roller rotates easily.  
**Action:** Replace the pinch roller.

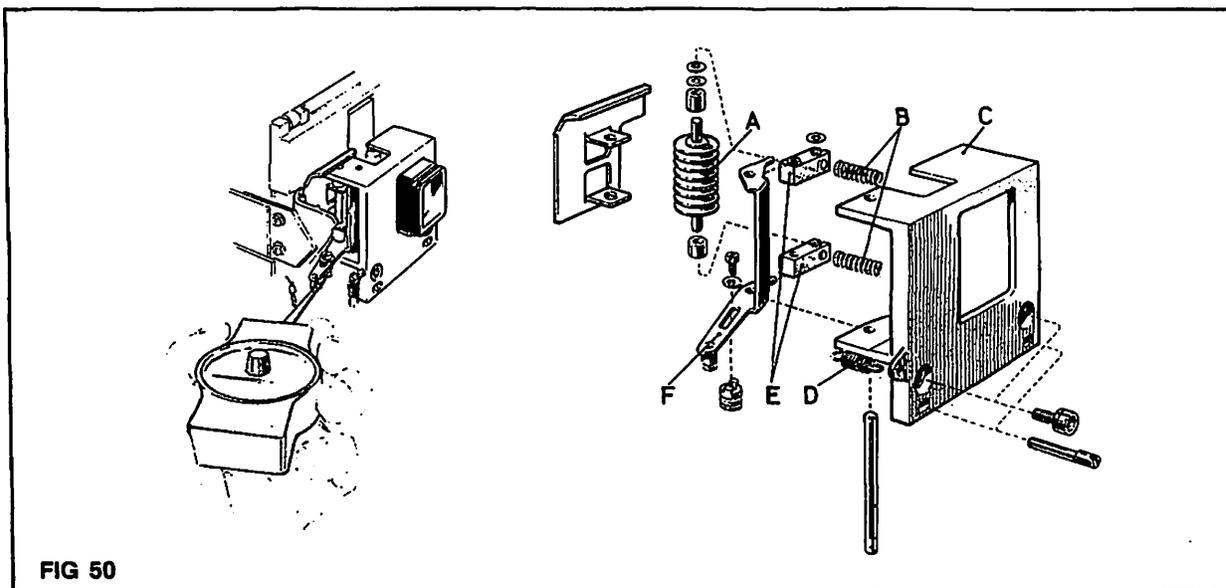
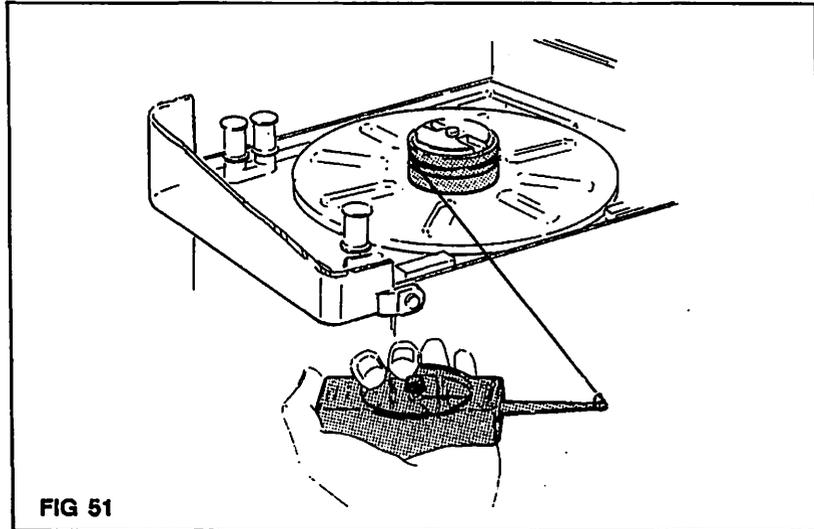


FIG 50

- check that there are no defects on the periphery of the pinch roller.  
**Action:** Replace the pinch roller.
- check that the pinch roller flanges do not run in any of the tracks on the tape.  
**Adjustment:** Insert washers between the arms E and the lever F.

### 5.1.12 Supply Flange Braking Force Check

- loosen the surge takeup arm from the retainer magnet.



- check the braking force on the supply flange as shown in the figure. It should be  $3,9 \pm 1,5N$ .

The braking force is too low.

**Action:** Replace the flange braking shoe.

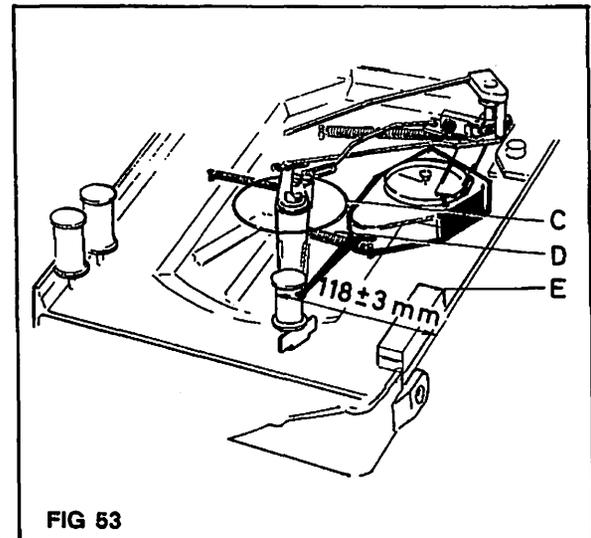
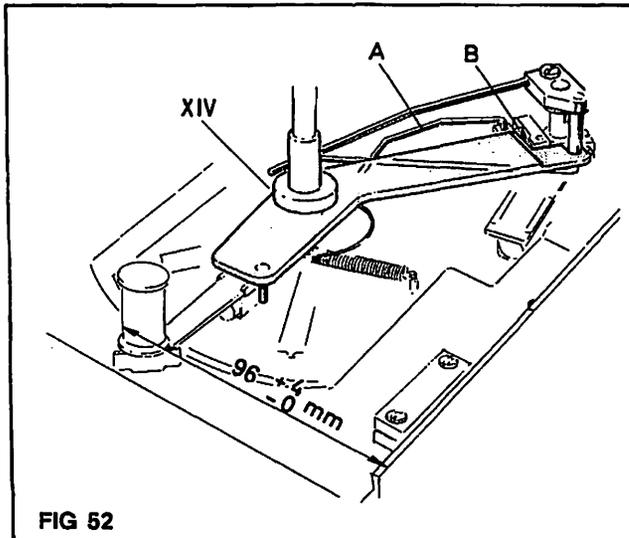
The braking force is too high.

**Action:** 1 Adjust the flange braking shoe.

2 Check and adjust the surge takeup arm torque.

Replacement and adjustment of the flange braking shoe: FIG 52.

- remove the supply flange.



- replace the flange braking shoe.
- secure the surge takeup arm by using the holder XIV.
- adjust the length of the link A so that the flange brake shoe just touches the edge of the tool.

When the flange brake shoe is adjusted correctly the surge takeup arm should be  $96 +4/-0$ mm from the left sidewall.

Surge takeup arm torque check: FIG 53

- measure the dynamical surge takeup arm torque at a point  $118 \pm 3$ mm from the left sidewall. It should be  $0,78 - 0,98$ N.

Readings should be done when the arm is moved to the left.

**Adjustment:** Clean the surge takeup arm shaft and/or replace the spring D.

### 5.1.13 Sensor Arm Check

- remove the supply flange, see FIG 54.

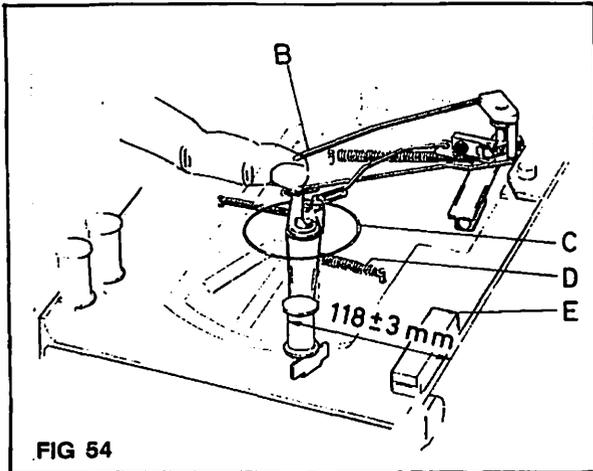


FIG 54

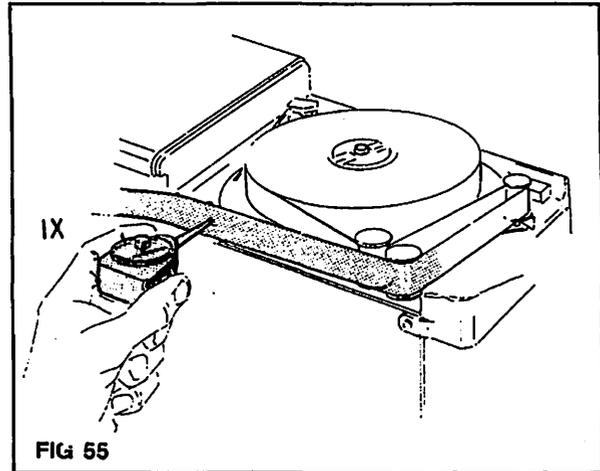


FIG 55

- loosen the surge takeup arm from the retainer magnet.
- check that the sensor arm B does not bind. It should easily be moved to both end positions.

After moving the surge takeup arm to the retainer magnet position, let it return while checking that the sensor arm is moving toward the centre of the flange shaft.

**Adjustment:** Clean the surge takeup arm shaft and/or replace the spring D.

### 5.1.14 Unwinding Force Check

- load a full roll of tape.
- loosen the surge takeup arm from the retainer magnet.
- check that the force needed for unwinding the tape does not exceed 0,49N (see FIG 55).

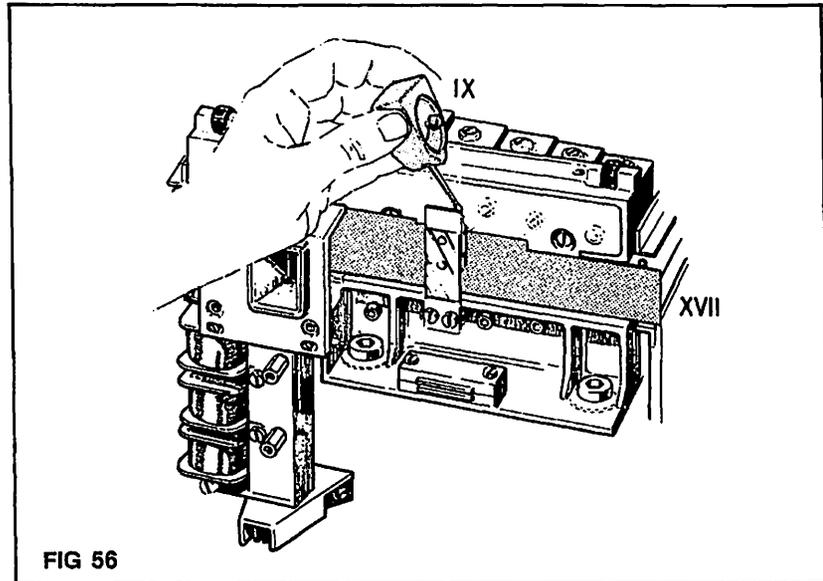
**Adjustment:** Remove the supply flange.

- clean both the shaft and the hole.
- straighten the supply flange or replace it.
- clean the guide roller shaft and their holes.

**NOTE:** This check is important to assure correct interrow spacing.

### 5.1.15 Spring Mounted Tape Guide Check And Adjustment

- check that the spring mounted tape guide has a max. force of 0,25N on the tape.

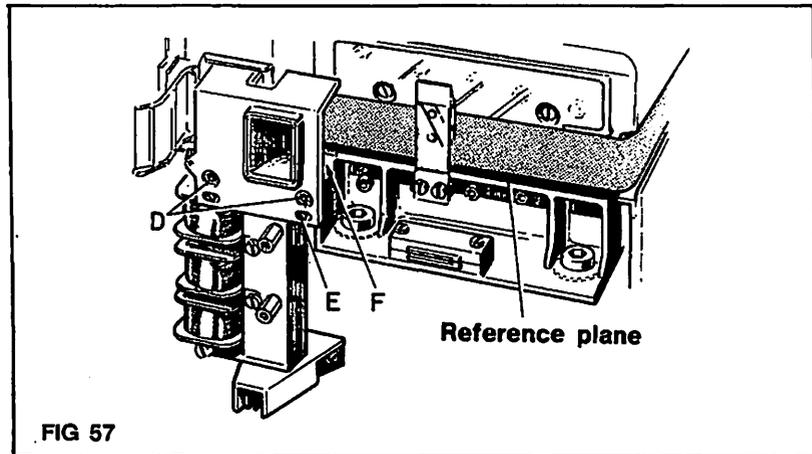


**Adjustment:** Remove the spring mounted tape guide and straighten it.

Use the tool XVII for adjusting the vertical position of the spring mounted tape guide.

### 5.1.16 Tape Feed Check

With the front cover tilted down and the punch loaded with tape, run the tape by first setting the punch OFF LINE by depressing **OFFL** **5** and then depressing **FEED** **7**.



- check that the tape is fed along the ref. planes of the punch/feed unit.

**NOTE:** The keyboard cover should be mounted and the tape guide should be properly adjusted.

**Adjustment:** Loosen the lock screw F. Loosen the retainer screws D slightly. While feeding tape, as said above, turn the eccentric screw E slowly until the tape moves away from the ref. planes.

Turn the eccentric screw E back until the tape is fed along the ref. planes. Lock the eccentric screw E with F. Tighten the retainer screws D.

### 5.1.17 Stepper Motor Pulling Force Check

- remove the keyboard cover (2 screws)
- remove the knife from the keyboard console 2 x (screw + nut)

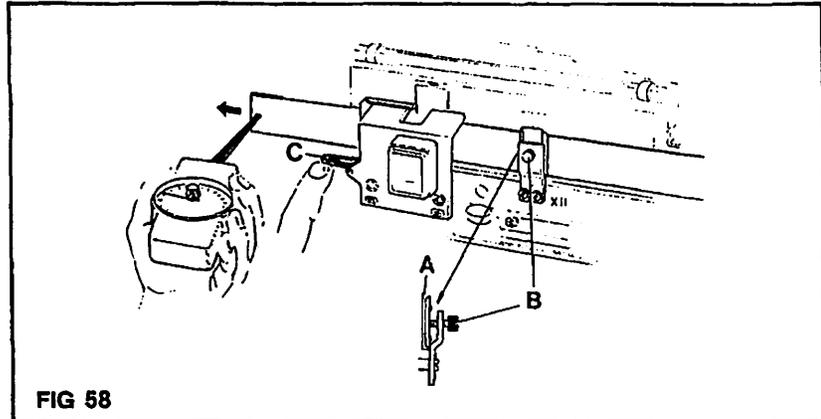
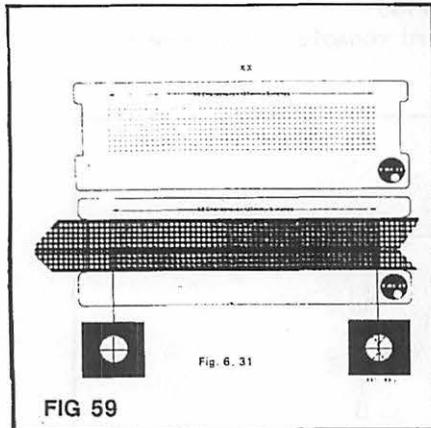


FIG 58

- replace the spring mounted tape guide with the special tool XII.
  - load with paper tape and let the tape run in space A of the special tool XII.
  - with the punch in OFF LINE, feed the tape and increase the friction on the tape by turning the screw B.
  - stop the tape feed when the friction becomes so high that the stepper motor is unable to feed the tape without missing a step occasionally.
  - cut off the tape and fold the end of it and make a hole for a dial type spring tension gauge.
  - move the surge takeup arm to the retainer magnet thus releasing the pinch roller.
  - move the spring tension gauge in the tape feed direction with its tip in the hole of the tape.
  - read the spring tension gauge when the pulling force just exceeds the friction of the tool XII (and other added by the punch unit). The reading should be min. 1,96N.
- Action:** Check the stepper motor, see 5.1.6, and replace the stepper motor if necessarily. The pulling force can also be adjusted, to some extent, by mounting straight, or pre-stressed, brake springs.
- replace the spring mounted tape guide, see 5.1.15.
  - replace the knife to the keyboard console.
  - mount the keyboard cover.

## 5.1.18 Interrow Spacing Check



With the punch unit in OFF LINE use the key 

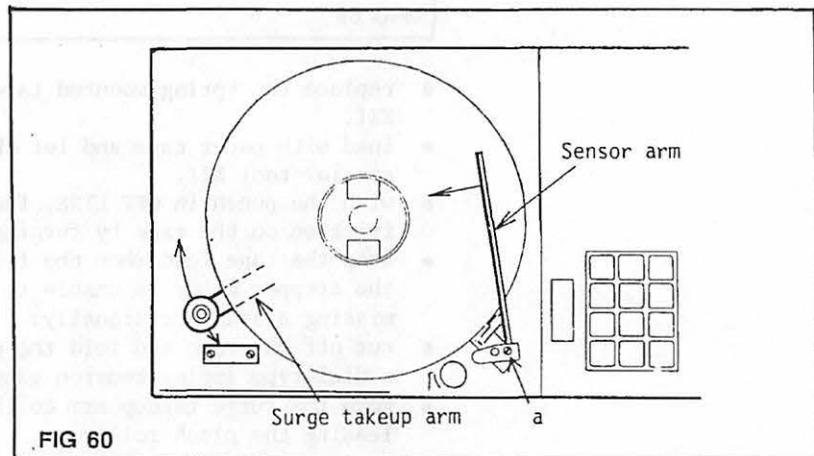
CODE
8

 to punch out a length of tape.

- position the punched tape on the template so that the centre of a feed hole coincides with the leftmost vertical line on the template and one of the horizontal track lines.
- check that the centre of the feed track holes - from the leftmost to the rightmost vertical line - are directly above the track line.
- check that one vertical line is visible in every feed hole.

The interrow spacing is indicated by the rightmost vertical line. The max. permissible deviation is  $\pm 0,5\%$ .

## 5.1.19 End Of Tape/Tape Low Function Check &amp; Adjustment



## Tape low:

- move the sensor arm towards the centre of the supply flange.
- check that the operator display shows  $\overline{1} \square$  just before the sensor arm reaches the hub of the supply flange.  
**Adjustment:** the actuation point can be adjusted to between 1 000 and 10 000 rows before end of tape by loosening the screw "a" and moving the sensor arm to the wanted position and then fastening the screw again.

## Tape jam (off/light):

- check with the punch running that the punch stops and that is  $\square \square \square$  blinking in the display when the surge takeup arm is moved to its end positions.

## 5.2 Punch Periodic Service

interval	measure
50-reel service (done by customer)	<ul style="list-style-type: none"> <li>● dust removal, punching control</li> </ul>
500-reel service*	<ul style="list-style-type: none"> <li>● lubricate the punch head (5.1.5)</li> <li>● check wear on the supply flange brake (5.1.12)</li> <li>● check wear on the hub rubber ring</li> <li>● check wear on the spring attachment on the punch solenoids</li> <li>● check wear on the brake shoe of the stepper motor (5.1.8)</li> <li>● check wear on the punch pin drivers (5.1.3)</li> <li>● check bearings on the supply flange</li> <li>● check bearings on the surge takeup arm (5.1.12)</li> <li>● check bearings on the tape low sensor arm (5.1.19)</li> <li>● check bearings on the guide rollers</li> <li>● check bearings on the pinch roller (5.1.11)</li> <li>● check bearings on the motor shaft (5.1.6)</li> <li>● check bearings on the capstan (5.1.9)</li> <li>● check bearings on the punch solenoids (5.1.2)</li> <li>● make the checks in 5.4</li> </ul>
1000-reel service	<ul style="list-style-type: none"> <li>● 500-reel service, when applicable</li> <li>● replace the punch die and the punch pins (5.1.5)</li> <li>● replace the punch solenoids (5.1.2)</li> <li>● replace the stepper motor mount (5.1.6)</li> </ul>
2000-reel service	<ul style="list-style-type: none"> <li>● 1000-reel service</li> <li>● remove, clean and check movable parts</li> <li>● remove, clean and check shafts</li> <li>● remove, clean and check bearing sleeves</li> <li>● check and if necessary replace: <ul style="list-style-type: none"> <li>.capstan (5.1.9)</li> <li>.pinch roller (5.1.11)</li> <li>.supply flange</li> <li>.supply flange brake (5.1.12)</li> <li>.springs</li> </ul> </li> </ul>

\* with respect to certain operating conditions such as:

- irregular duty cycles with very long stop periods
- characteristics of the used tape.

A lubrication of the tape punch head as in 5.1.5 is recommended every 500-reel service.

### 5.3 Punch Fault Tracing

fault	possible cause
Faulty interrow spacing	Incorrect pulling force 5.1.17
	Transmission motor shaft/ capstan binding 5.1.10
	Motor and brake binding 5.1.6,8
	Unwinding mechanism 5.1.14
	Pinch roller binding 5.1.11
	Flange on pinch roller run in code hole tracks on tape 5.1.11
	Brake shoe worn 5.1.8
Skipped track (no mark on tape)	Faulty printed circuit board 4.2,3
	Broken punch pin driver 5.1.3
	Faulty punch solenoid 5.1.2,4
	Punch solenoid loose on unit chassis 5.1.2,4
	Punch solenoid coil loose in solenoid frame 5.1.2,4
Fuzzy holes	Worn or damaged punch pins 5.1.5
Sporadically skipped track (mark on tape)	Incorrect punch pin vertical adjustment 5.1.4
	Improperly adjusted punch solenoid 5.1.2,4
	Play in punch pin driver 5.1.3
	Punch pins binding 5.1.5
	Chads jammed in die
	Faulty printed circuit board 4.2,3
Faulty tape feed indication	Supply reel core not secured or faulty core latch
	Supply flange brake improperly adjusted or worn 5.1.12
Faulty tape feed indication (tape too tight)	Supply flange binding
	Surge takeup arm binding 5.1.12
	Supply flange warped
	Sticky tape

### 5.4 Tape Reader 4031

#### 5.4.1 Mechanical Checks & Adjustments

- 1: Check that the sprocket wheel inner peripheri coincides with the main housing.

Adjust by moving the main housing.

- 2: Check that the sprocket wheel is placed in the centre of the slot in the main housing, see FIG 62.

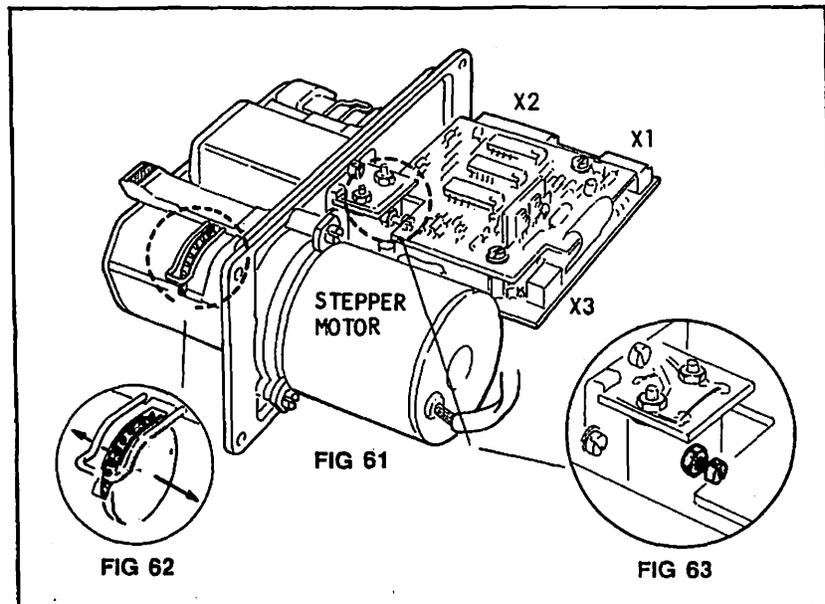
Adjust by moving the sprocket wheel.

3: Check that the tape slot between lamp housing and main housing is 0,3 - 0,4mm.

Adjust by moving lamp housing up or down.

4: If the stop screw for circuit board positioning has been moved for some reason, proceed as follows to obtain the best possible position for the PWB:

- connect a high impedance instrument on the collector of the phototransistor for FH.
- move the PWB in and out until the position with the lowest possible voltage is found.
- lock the stop screw and tighten the screws to hold the PWB in this position, see FIG 63.



5: When the lamp is replaced it must be positioned with the filament vertical.

The lamp is focused by moving it sideways. When the lamp is correctly focused a light spot can be observed in the centre of the light guide when viewed from the front.

#### 5.4.2 Electrical Checks & Adjustment

- 1: If the lamp to the photo transistor array is replaced, check with a double folded test paper inserted in the read head that the voltage across the photo transistor is more than 3V (3,5V for FH).

Adjust if necessary by replacing the collector resistor for the photo transistor in question (R12, R16 - 24).

Also check that the voltage without paper is less than 0,22V.

**NOTE:** When measuring voltages across the photo transistors the emitter must be used as reference point. R15 is a suitable point for the GND connector.

- 2: To adjust the tape position relative to the read head, connect an oscilloscope to R21 or C16 (see the circuit diagram).

Load the reader with a tape punched in all channels and operate the reader at LOW SPEED MODE.

Observe the pulses during operation.

Turn the motor in one direction (after loosening the screws, see FIG 64) until the pulses start being bad. Make a mark on the motor.

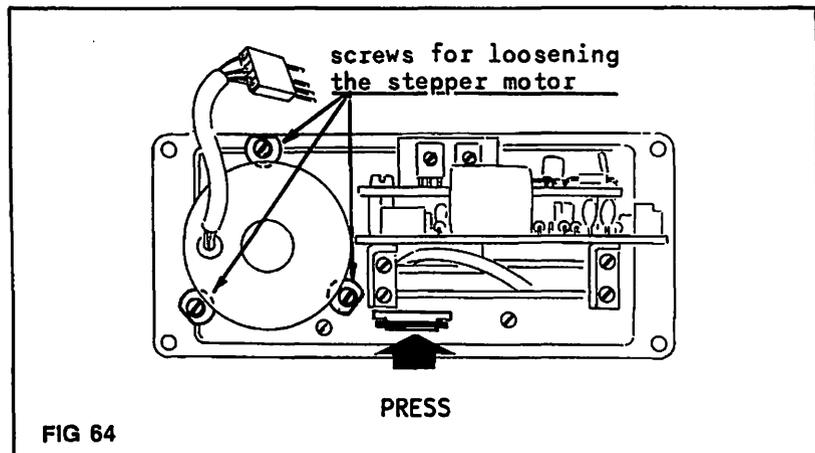


FIG 64

Turn the motor in the opposite direction until the pulses again start to be bad. Make another mark and let the motor have a position halfway between the two marks from the pencil.

- 3: The current used on the +24V line should be 360 +/-20mA.

Adjust by replacing R38. The greater value on R38, the lower current.

### 5.4.3 Control Panel Disassembly

To enable adjustment of the sprocket wheel according to 5.4.1 the control panel must be removed.

Press the plastic tongue and pull out the panel, see FIG 64.

When putting back the panel it is also necessary to press the plastic tongue.

Use a hex-key wrench 1,5mm to the sprocket wheel.

### 5.4.4 Light House Lid Disassembly

To pull out the lid, simply use a knife or something similar to separate the house from the lid.

Note the position of the light guide.

The lid is just snapped in.

## 5.5 Tests

There are built-in tests in this unit that are addressed from the keyboard.

Among them are tests of the memories, the punch, the reader etc.

Explanations how to do these tests and their results are found in the Technical Description (Facit no. 1103 89 38-00) chapter 8 "TEST MODE".

Also the keyboard functions, the parameter setting and conversions are found in the same publication, chapter 4 - 7.