NORD

COMPUTER SYSTEMS

DIGITRONICS 2540
TAPE READER

Maintenance
and Service

A/S NORSK DATA-ELEKTRONIKK
Økernveien 145, Oslo 5

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INTRODUCTION

The following documentation is a short description of operation, maintenance and troubleshooting on the Digitronics 2540.

GENERAL DESCRIPTION

The tape reader consists of following main parts: Tape transport mechanism, readhead, power supply, electronic unit with pulse shaping circuits and driver circuits for pinch roller and brake.

Tape transport mechanism

The tape motion is provided by a capstan mounted either directly on the shaft of the motor (Direct drive) or on a separate assembly (Indirect drive). When the pinch roller solenoid is energized, the pinch roller forces the tape agains the rotating capstan and tape transport is achived. In non operating position, the spacing between the punch roller and the capstan should be .007 (0,2 mm), enough for free clearance of the tape.

The tape is stopped and held in position by a brake operated by a solenoid.

External control logic must provide inverse action of pinch roller and brake.

Readhead

The light emitted by the exiter lamp is focused by a bus into the readhead. The readhead consists of 9 photo-voltaic cells corresponding to the holes in the tape. As the tape moves across the readhead, the photovoltaic cell will receive light, every time a hole is passing. The cell will generate a voltage wich in turn is applied to a preamplifier.

Power supply

The power supply generates + 28V DC for brake and pinch roller solenoids, and + and - 5V for control circuits and IC-logic. The + 5V is stabilized by Q1 and CR 5 while + 28V and - 5V are none-stabilized. The lamp voltage uses + 28V as source stabilized by Q7 and Q8.

Electronic unit

The electronic unit contains control and driver circuits for pinch roller and brake, Q1 through Q6. In addition, the pulses from the preamplifiers are shaped in schmitt triggers IC-1 through IC-5 before they are send out on the lines in plug J1.

TEST SUPPLY

For OFF-LINE test a special test supply is made. (Se drawing). Running from the plug J1, the data channels are terminated by the recommanded line R/C-filter. For marginal testing purpose, the lines are loaded with a resistor corresponding to the maximum fan out for the IC-circuits. Notice that sprocket is loaded with 390Ω, instead of 1,2K since the driver circuit for sprocket has higher fan out.

The tape drive is controlled by two switches, S1 and S2. In position OFF/CLEAR S2 resets the FLIP FLOP and provide proper levels for brake and pinch roller to remain de-energized, thus permiting the tape to be loaded. In position ST BY the brake is energized. In position RUN the brake is deenergized, the pinch roller is energized, and the tape is running forward.

The switch S1 tests the stopping performance on the reader. In order to operate S1, S2 must be in ST BY position. Puching S1 will set the FLIP FLOP and cause the tape to run forward. When S1 is let back in the NC position the output from the first NAND gate gous high and when CH8 comes HIGH this results in a low signal on the D-input on the FLIP FLOP. The leading edge on the sproched corresponding to ch.8 will reset the FLIP FLOP and the stopping distance can be directly observed on the readhead.

The test supply has outputs for sprocket and all data channals to allow osilloscop measurements.

MAINTENANCE

The recommended maintenance is described in table 5-1 in the reader manual. This schedule however is baced on 40 hours operation time a week. By the readers used in the NORD computer family one must estimate that the maximum operation time never exeeds 10 hours a week with 5 hours as a most possible average. This does not mean that the time in the table can be multiplied directly by 8. To assure trouble free operation it is very important that the daily cleaning schedule is followed. Dust is collected even if the reader is not in operation and even a small amount of dust on lamp, lens or readhead will

affect the light and disturb the channaul aligument. Use a soft bruch to wipe the dust from the lamp, pinch roller, capstan and brake, and a Q-tip dipped in alcohol to clean the lens and the readhead. Do not use other solvent as alcohol because the lens is made from plastic material.

The lamp position is a very important adjustment. Be careful during the clearing prosedure so that the lamp position is not disturbed as this will affect the channal output alignment directly.

Because of the relatively short operation time, the monthly check can be done semi-annually and the semi-annually check can be done once a year.

An easy calculation shows that it will take our readers in the order of ten years to become qualified for component replacement after the schedule in table 5-2. Without taking emergency breakdown of parts into account, the only regulary replacement that should be done is the lamp every second year. Replacement of lamp requires new alignment and control of the channal outputs.

INCOMING CONTROL AND SERVICE CHECK

For this purpose the 2540 TEST SHEET has been made. The test sheet contains a check list for all important data and adjustments, and is intended to be used when the reader is received from Digitronics, when it is at ND for service and when service is carried out in the field. The check list will help us to assure that the reader is in perfect condition after a service.

The different points in the check list will in the following be described in detail.

1. MECHANICAL INSPECTION AND ADJUSTMENTS

1.1 Pinch roller gap and paralellism

a) Pinch roller made from plastic should be replaced by the new type made from aluminium. Control that the centerline of the pinch roller falls directly under the centerline of the capstan. Fig. 1.1. Adjustment is possible after loosing the two screws holding the pinch roller plate.

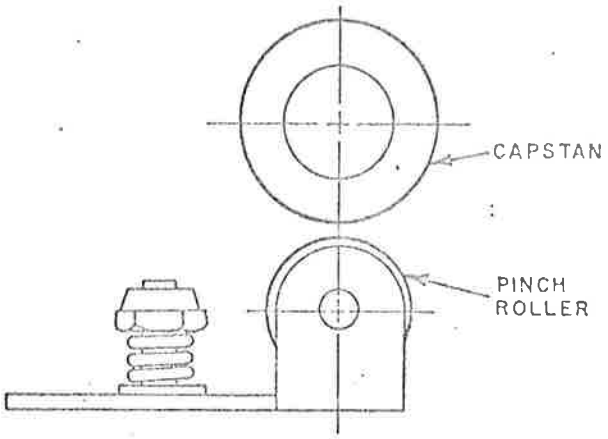


Fig. 1.1 Pinch Roller/Capstan Centerline Adjustment

b) Control that the pinch roller centerline and the capstan centerline are parallel in the hozisontal plane. (Look from above.) Adjustment is possible after loosing the same screws as mentioned in point a.

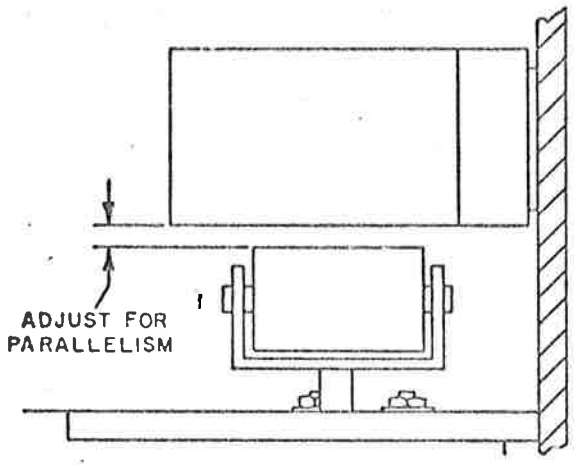


Fig. 1.2 Pinch Roller and Capstan Parallelism

c) Control that the pinch roller centerline and the capstan centerline are parallel in the vertical plane. Fig. 1.2. Adjustment being made after loosing the two screws item 15. Fig. 1.4.

d) With the pinch roller magnet deenergized, adjust the gap between the pinch roller and the capstan to .007" or 0,2 mm. After loosing the Allan Wrench screws holding the pinch roller assembly, (Allan Wrench 9/64" or 3,5 mm) the assembly can be moved up and down. In some cases, specially on units with indirect drive the pinch roller assembly can not be moved far enough upwards to give the right measurement. In this case loosen the three screws holding the capstan and try to move the bracket downwards. Make sure the belt tension is right after this adjustment is done.

1.2. Capstan and pinch roller eccentricity

There is no easy method to measure this requirement. But running the reader with pinch roller energized and without tape, it is relativily easy to observe if eccentricity is present.

1.3. Tape tracking

Load the rader with a tape loop. Run the rape and make sure it runs smooth along the head block bracket and the tape guide on the brake assembly. The tape tracking is adjusted by loosing the two screws holding the flat-spring for the pinch roller plate and carefully turn the plate in the horizontal plane as the tape is running.

1.4. Capstan wear

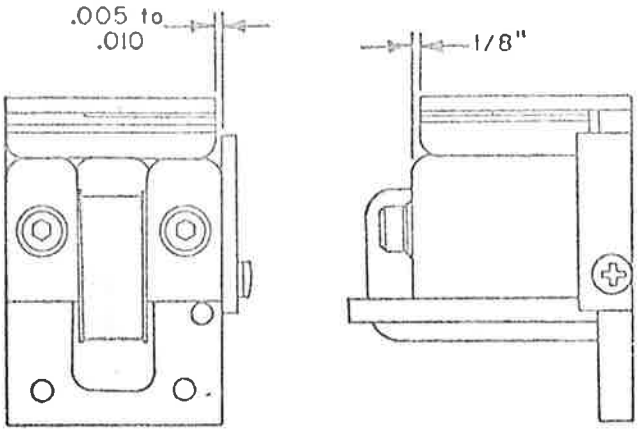
Replace the capstan if the surface is rudget and obviously worn.

1.5. Brake gap

Switch the test supply between ST BY and OFF position without tape in the reader. Control if the armature is loos when the switch is in OFF position. If not truth, this is due to remanent magnetism in the brake magnet. To assure that the brake armature will loose after the magnet has been energized, two punch marks are placed on the down surface on the armature. If the punch marks are to low, the armature will stick to the magnet after the magnet is deenergized. In this case, make the punch marks bigger.

The normal clearance between armature and magnet with coil deenergized is the armature front edge touching on the punch marks while the back edge has 0,2 - 0,3 mm clearance.

If the whole brake assembly has been loos, it should be set up according to fig. 1.3.

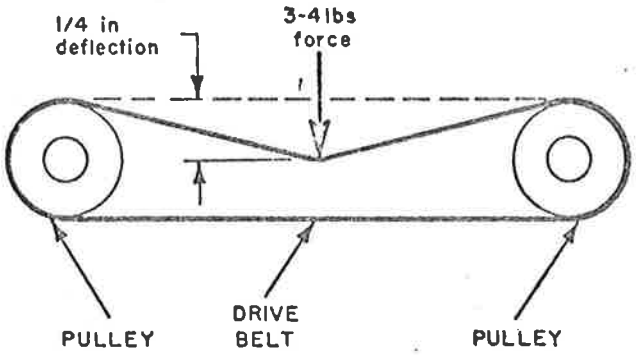


a. front view b. right side view

Fig. 1.3 Brake Armature Positioning

1.6. Belt tension

The belt should be adjusted to deflect 5 mm when a force of 1,5k. is applied perpendicular at the midt point of the span. Adjustment is done by loosing the three motor screws and moving the motor.



Drive Belt Tension Adjustment

1.7. Motor to PC clearance

After belt tension is adjusted, control that the motor to PC clearance is OK.

1.8. Lamp high and alignment

The lamp should be adjusted according to fig. 1.4. This is only a pre-adjustment. Control that the nut on the socket is tightened and that the lamp socket not is to wide. The lamp must have only one stable position.

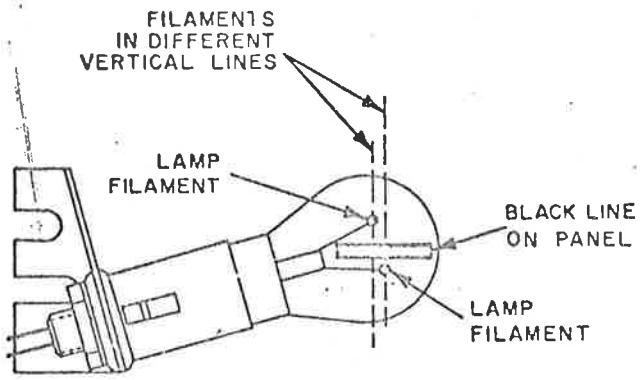


Fig. 1.4 Exciter Lamp Vertical Positioning

1.9. Loosen screws

Control that all screws are securely tightened.

1.10. Cleaning

Clean the reader as described under MAINTENANCE. Also blow the dust from PC-boards and other electroics. Do not forget the inside of the covers

1.11. Other visual condition

Control the reader for any possible transporation damage, dent in covers, break in PC-boards i.e. Also control that the plug connectors on the PC-terminals and all other connections are OK.

2. POWER

2.1 Power Requirement

This is intended to be used by incoming test to assure that the unit is delivered with the right power requirement. The data are found on the label inside the front plate.

2.2. + 5V DC

The voltage is measured directly on the power supply.

2.3. - 5V DC

The voltage is measured directly on the power supply.

2.4. 28V DC

The voltage is measured on the power supply.

2.5. Lamp voltage

The lamp voltage is measured on the PC-connector P3 pin L1 and L2.

3. SPEED

3.1. Speed on E402 (Direct drive).

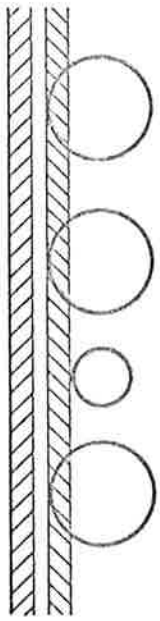
Run a tape loop with all channels punched. If the speed is right, the time, T, for a full output cycle should be 3.0 ms. (333 ch/sec)

3.2 Speed on E606 (Indirect drive)

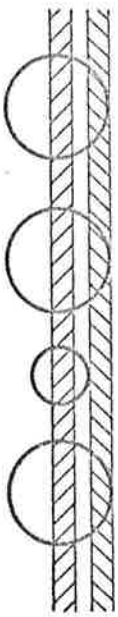
Run a tape loop with all channels punched. If the speed is right, the time, T, for a full output cycle should be 3,4 ms. (300 ch/sec).

4. STOP ON CHARACTER

Put the test supply switch S2 in ST BY - position. Load a tape loop with all holes punched 1-2 cm apart. Puch the stop test button, run the tape a few seconds and drop the button back again. Observe the light beam on the read head. The right side of the beam should not ecceed the right side of the holes. If it gons to far, the brake gap may be to big, or the pinch roller gap may be to narrow. Other error possibilities are to weak brake magnet or errors in drive circuit for pinch roller or brake.



STOP COMMAND IS GIVEN



TAPE HAS STOPPED

5. PARTS REPLACED

List all replaced parts.

6. DATA AND SPROCKET CHANNALS

With the lamp alignment according to 1.8 and the resistor R1 in the middle position (16-18V), the preadjustments are done.

Adjust the lamp in the horizontal plane until the splitted light beam strikes exactly in the middle of the read head.

Load the reader with a tape loop with all channels punched. This tape should be precontrolled in a master guide to assure, that the punching meets the specifications.

Switch the test supply to run, and observe the channel outputs on an oscilloscope. The requirements are following: (See fig. 6.1.)

Duty cycle: 60% - 80%
Sprocket : 35% - 45%

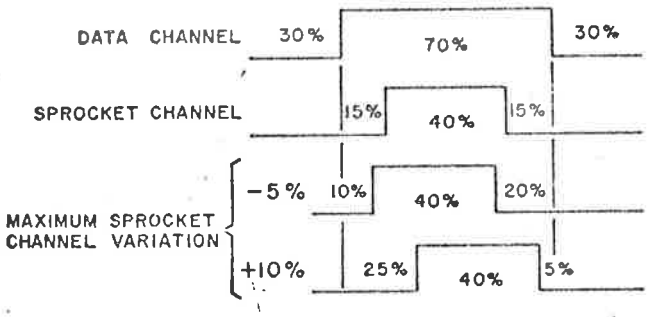


Fig. 6.1 Relative Coincidence of Sprocket and Data Channel Outputs

This specifications set up by the manufacturer are fairly rough, and leave very little play to temperature drift and differens in tape punching. Experience has shown that using a few minutes more in set up time it is relatively easy to obtain:

Channel outputs:	65% - 75%
Sprocket:	35% - 42%
Differens in leading edge of channels:	5%

This adjustment will increase the relayability a great deal.

The adjustment mechanism is position of lamp and lamp voltage.

During adjustment normally following problems arise:

1. All channels have to narrow ON-Cycle

Adjustment: Increase the lamp voltage by R1.

2. All channels have to wide ON-Sycle:

Adjustment: Decrease the lamp voltage by R1.

3. The ON-Cycle time is increasing in succeding order across the tape:

Adjustment: Bend the lamp in the horizontal plane against the side where the most narrow ON-Cycle appeares.

4. The leeding edge of the channels differ in time from ch 1 in succeding order across the tape.

Adjustment:

a) The tape tracking is not right.
b) The read head is not square.
c) The lens is not in line with the read head.
d) The punching is not square.
(Easy to control by running the tape up-side down).

5. One channel in impossible to get within specification while the other are OK.

Adjustment:

a) Make sure the surface of the read head is clean and without groows. Also make sure the lens is clean.

b) Measure the output from the photovoltaic cells and the preamplifiers. If great differens in amplitude is found, replace read head assembly.

Use ch 1 as reference, and plot the diagram on the test sheet. A typical example is shown in fig. 6.2.

Let the reader stay on for ap. 1 hour, run the tape again and compare to the diagram.

After all adjustments are made, seal all screws with proper laquer, and bring the test sheet to the service department.

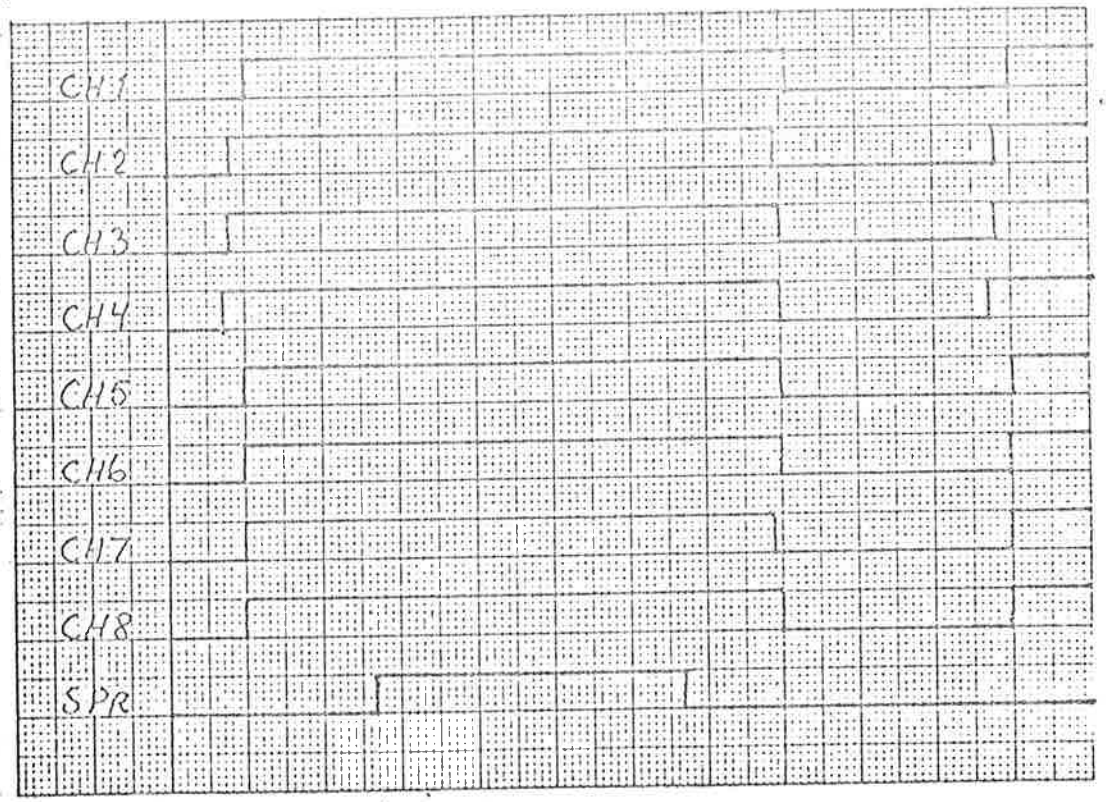


Fig. 6.2

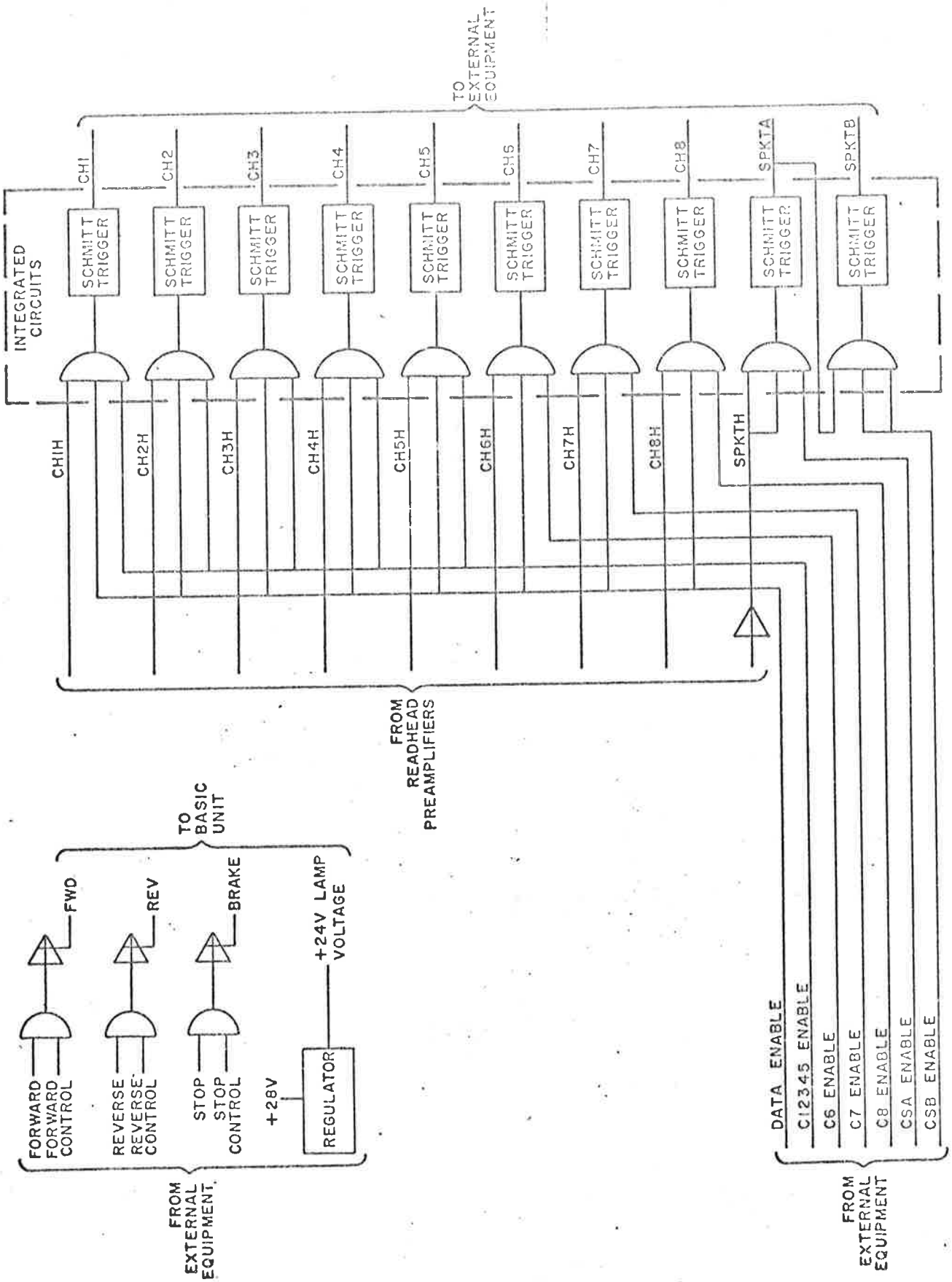


Figure 4-2. Electronics Unit, Logic Diagram

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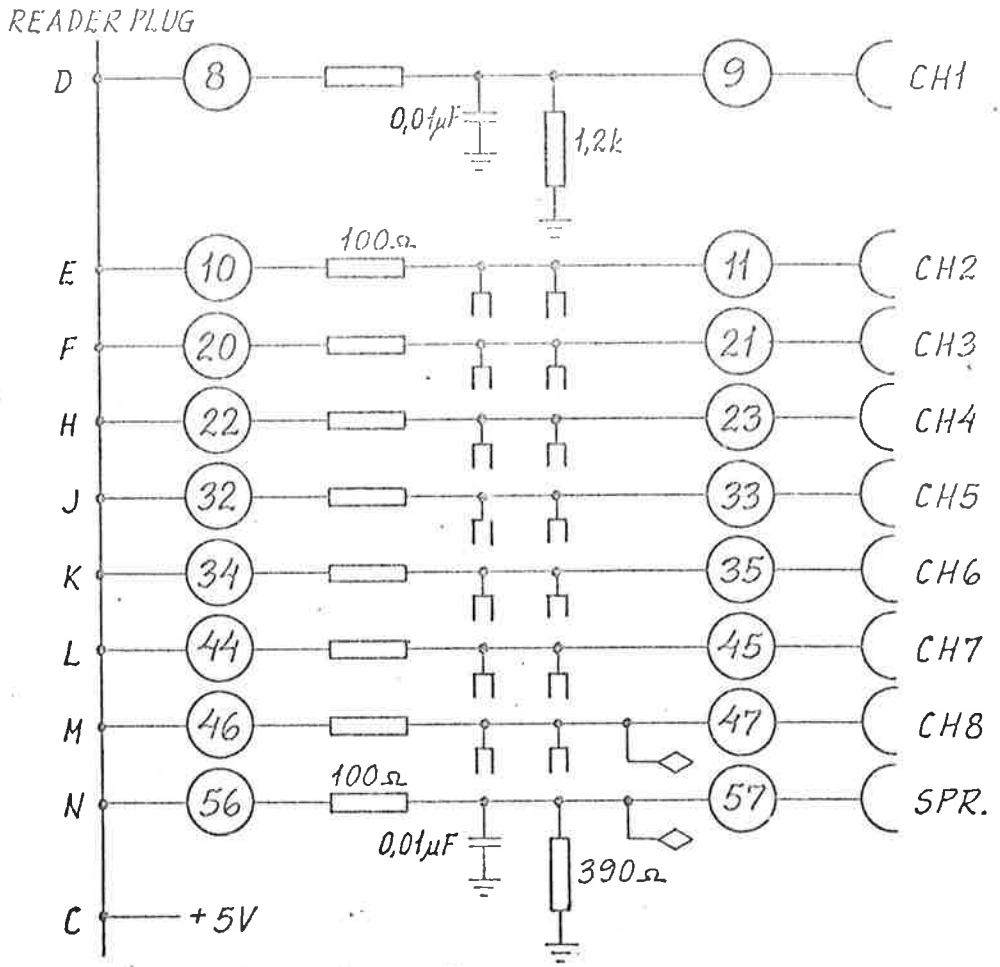

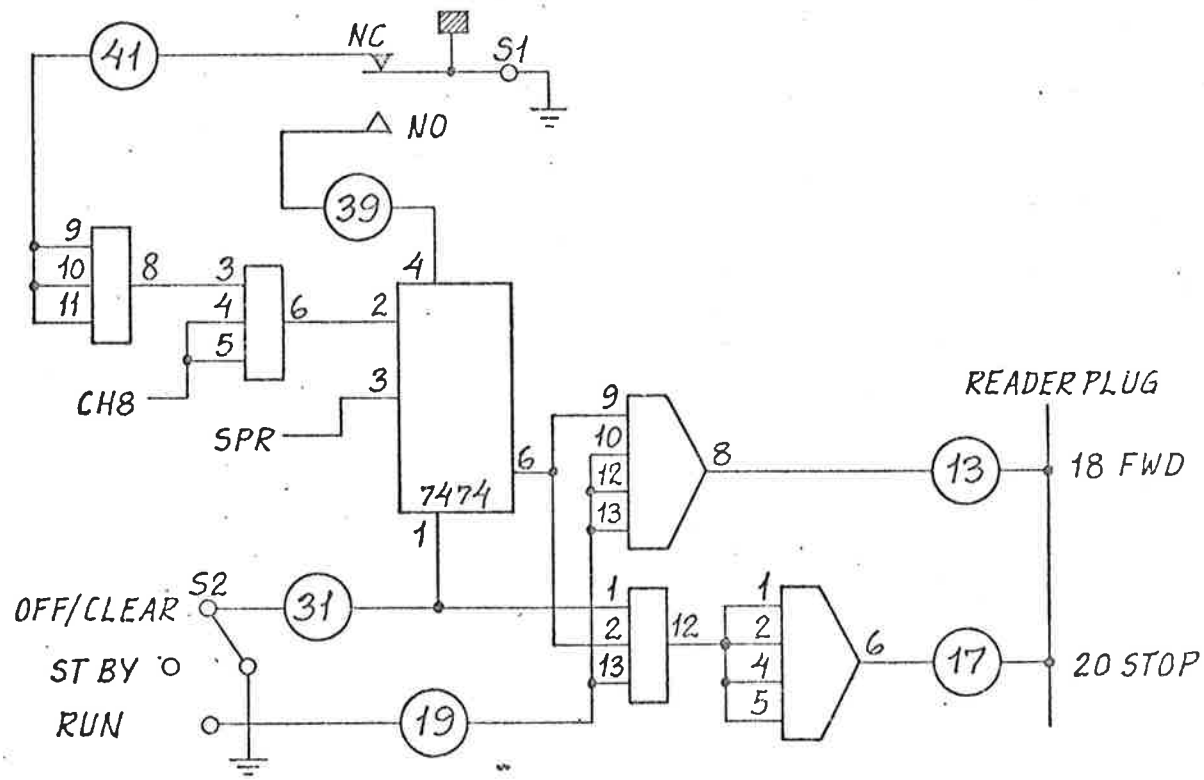

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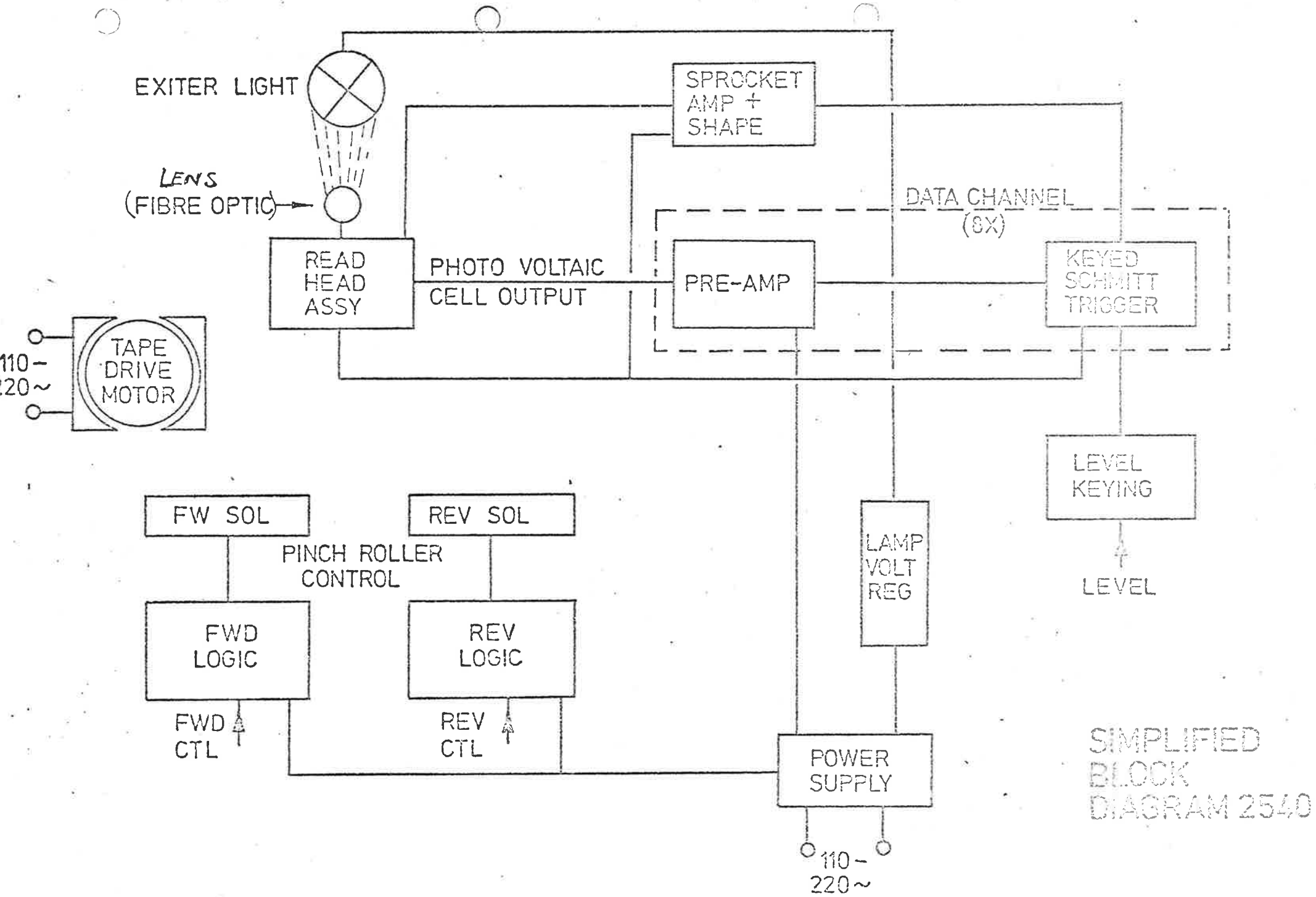
APPROVED BY		Replaced by	Date
DATE 5.2.71			



SIMPLIFIED
BLOCK
DIAGRAM 2540

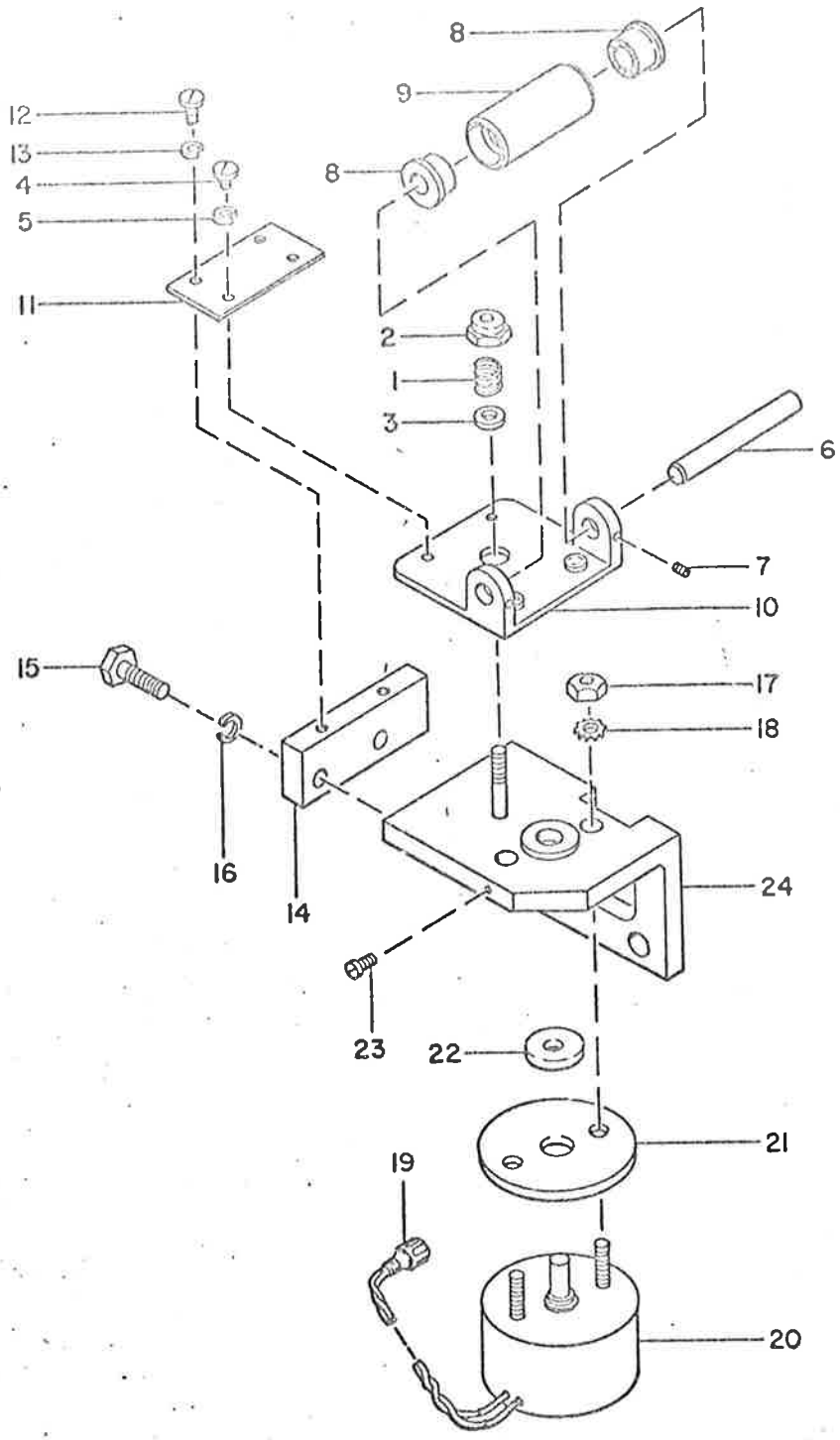


Figure 6-2. Pinch Roller Assembly

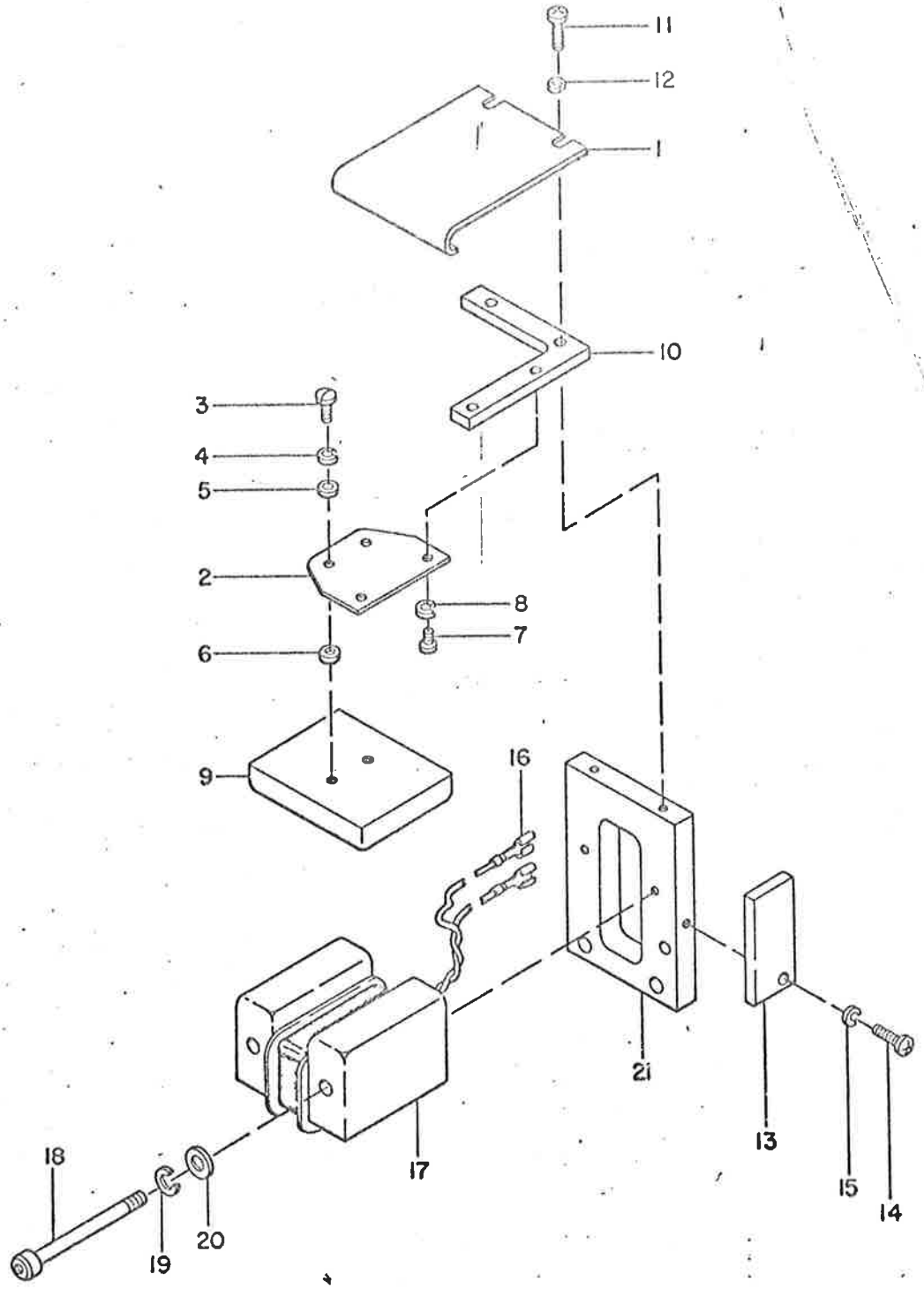
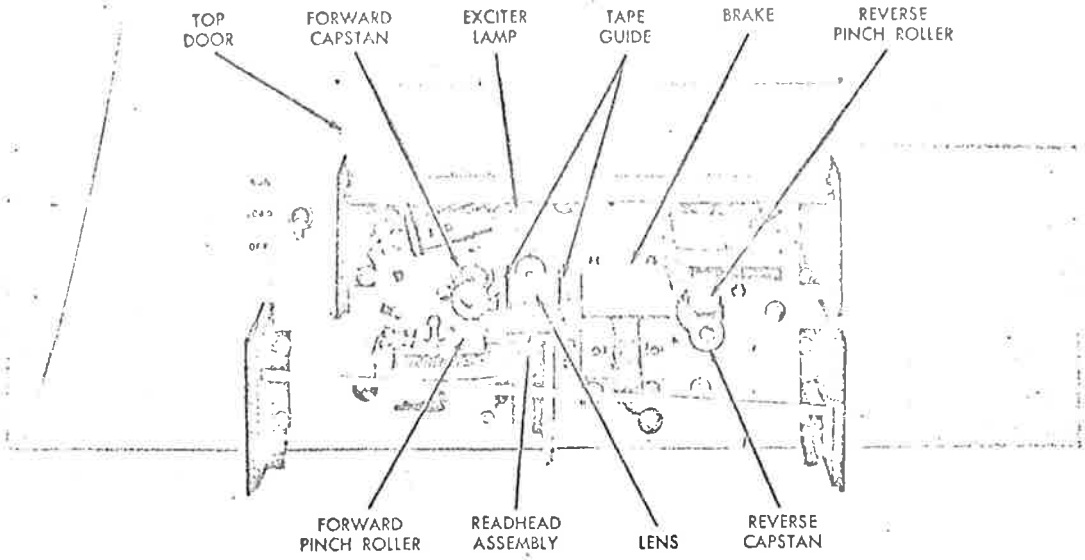
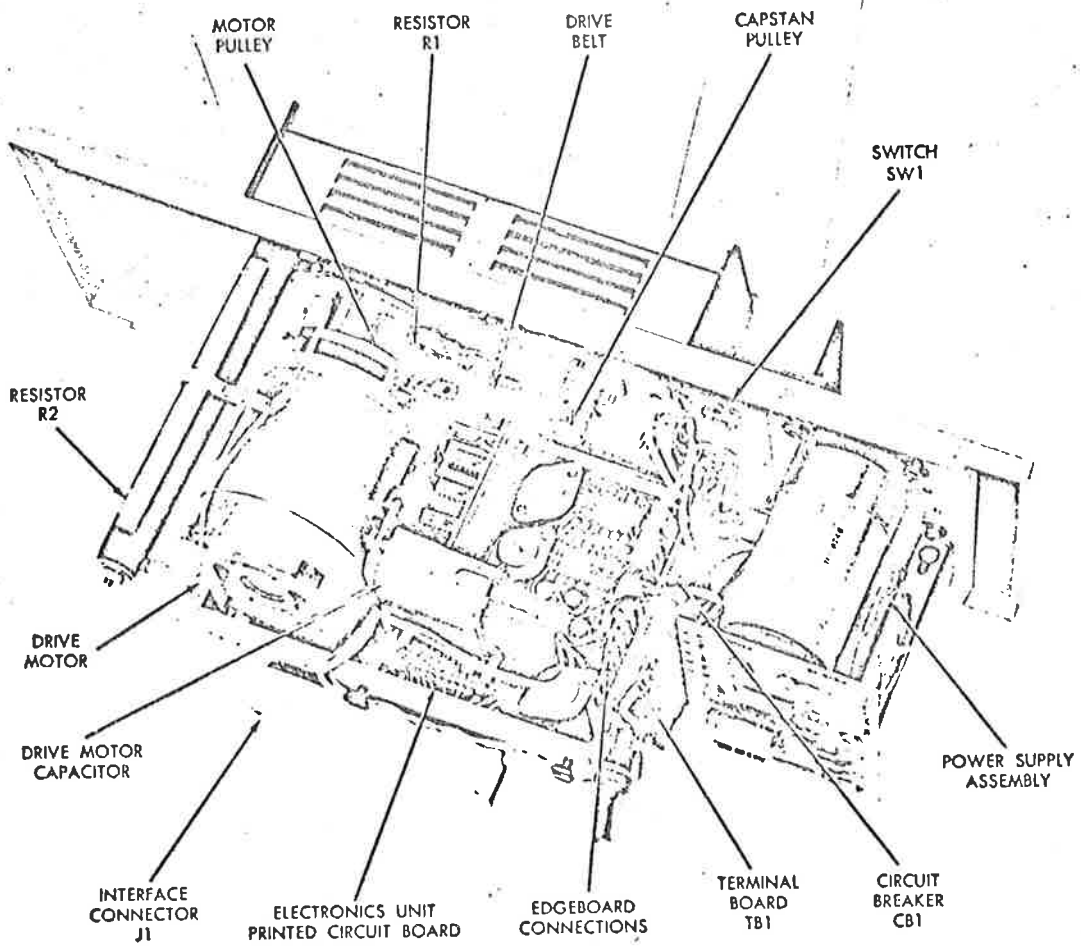


Figure 6-3. Brake Assembly



FRONT VIEW



REAR VIEW

Figure 5-1. Component Locations

Table 5-1. Periodic Inspection Schedule

DAILY	
Readhead, Lens and Lamp	Clean as required. (Refer to Paragraph 5.2.4.)
Pinch Roller	
Capstan	
Brake	
MONTHLY	
Pinch Roller Assembly	Check adjustments. (Refer to Paragraph 5.5.3.)
Drive Belt	Check for wear and slippage.
Brake	Check brake assembly adjustment. (Refer to Paragraph 5.5.4.)
SEMI-ANNUALLY	
All moving parts	Check for wear.
Operating Voltages	Check for proper levels. (Refer to Section II, Paragraph 2.5.1.)
Exciter Lamp	Check exciter lamp adjustment. (Refer to Paragraph 5.5.1.)

Table 5-2. Component Replacement Schedule
(Refer to Paragraph 5.4)

ITEM	REPLACE AFTER	APPROXIMATE REPLACEMENT TIME
Drive Belt	20,000 hrs.	3 min.
Exciter Lamp Bulb	2,000 hrs.	20 min.
Capstan Bearing (indirect drive capstan only)	20,000 hrs. or 500 million start/stop operations	18 min.
Capstan(s)	8,000 hrs. or 500 million start/stop operations	5 min.
Pinch Roller Bearings	20,000 hrs. or 500 million start/stop operations	15 min.
Pinch Roller Solenoid(s)	10,000 hrs. or 500 million start/stop operations	20 min.
Motor	30,000 hrs.	25 min.
Brake Assembly	10,000 hrs.	12 min.

2540 TEST SHEET

ND S.nr..... DIGITRONICS S.nr.....

Date: ..... Tested by: .....

1 MECHANICAL INSPECTION AND ADJUSTMENTS

1.1	PINCH ROLLER GAP AND PARALELLISM	.....
1.2	CAPSTAN AND PINCH ROLLER ECCENTRICITY	.....
1.3	TAPE TRACKING	.....
1.4	CAPSTAN WEAR	.....
1.5	BRAKE GAP	.....
1.6	BELT TENSION	.....
1.7	MOTOR TO PC CLEARANCE	.....
1.8	LAMP HEIGH AND ALIGNMENT	.....
1.9	LOOSEN SCREWS	.....
1.10	CLEANING	.....
1.11	OTHER VISUAL CONDITION	.....

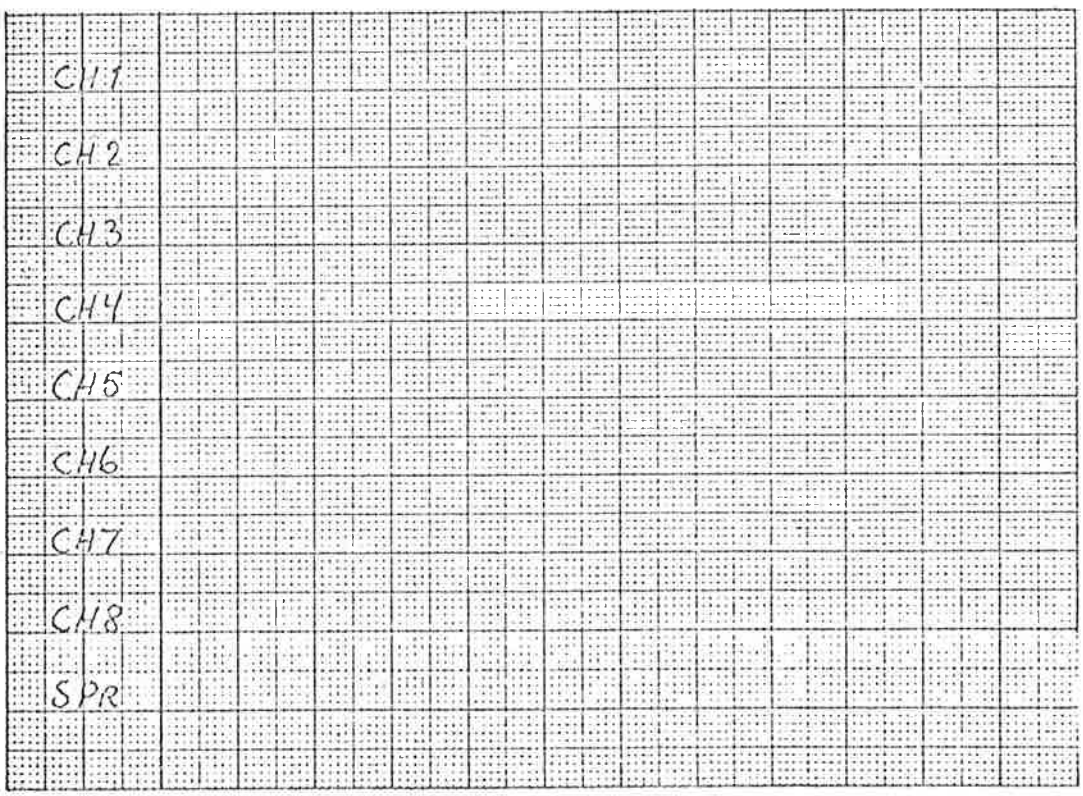
2 POWER

2.1	POWER REQUIREMENT 230V AC ..... 50 Hz	.....
2.2	+5V DC (+4.3V TO 5.5V)	.....
2.3	28V DC (24V TO 31V)	.....
2.4	-5V DC (-4.0V TO -5.5V)	.....
2.5	LAMP VOLTAGE (16V TO 18V)	.....

3 SPEED

3.1	TYPE E402 DIRECT DRIVE (T=3.0 ms)	.....
3.2	TYPE E606 INDIRECT DRIVE (T=3.4 ms)	.....

4	STOP ON CHARACTER	.....
5	PARTS REPLACED	.....
	.....	.....
6	DATA AND SPROCKET CHANNELS	.....



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