IBM Customer Engineering

Reference Manual

223-6967-4

IBM 7330 Magnetic Tape Unit

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Safety and Operating Precautions

Safety

Personal safety cannot be overemphasized. Make it an everyday practice to follow safety precautions at all times. Become familiar with the safety practices outlined in IBM Form 124-0002, a pocket size card issued to all customer engineers.

Observe the following rules:

1. Use a fuse puller when changing fuses.
2. Turn power off before removing and replacing parts.
3. Wait at least five minutes after power has been turned off before attempting to work on the filter capacitors. (Capacitors should discharge fully in this time.) Also, use a shorting bar across output terminals.
4. After servicing the tape unit, check that all safety covers are replaced.
5. Care must be taken to prevent any IBM tape cleaner, P/N 517960, from coming in contact with the skin, as a toxic effect may result.

Operating Precautions

To prevent damage to the tape, never press the reset key or open the tape unit door during normal high-speed rewind.

If either must be done in an emergency, press the reel release key and manually wind at least 200 feet of tape back onto the machine reel. Close the door and resume high-speed rewind. This precaution must be observed on all tape units that do not have Engineering Change EC 251021 installed. This engineering change is available.

A tape unit used off-line but receiving power from a computer system must not be turned on or off while the computer is operating; otherwise, computer errors may result.

Power should never be brought up on a tape unit unless EC 251009 is installed or a line terminator P/N 556801 is installed on that particular tape unit or at the end of the string of tape units. If the terminator is left out, all tape units will go into high-speed rewind and can result in damage to many relay points.

The nature of the unloading procedure provides that the high-speed rewind arm will be in the up position after removing tape from the machine. Operators should be advised that the arm should always be left up when the machine is unloaded.

If the arm should be in the down position for some reason when power is turned off, the main input fuses may blow when power is turned on.

Readjustment of the left reel brake is necessary for use with 8½ inch diameter reels of tape (1200 feet) unless EC 251021 is installed in the tape unit.

The 208 VAC power cables should not be removed or connected with system power on. Pins should be checked for straightness so as not to be inserted into the wrong receptacles, for serious damage can occur.

MINOR REVISION (August 1964)

This manual, Form 223-6967-4, obsoletes Forms 223-6967-3 and CES S23-5017. Minor changes that have occurred since the previous printing of either publication have been incorporated into this revision. These changes provide additional or clarified steps to adjustment procedures; alternate adjustment procedures previously contained in 7330 Service Aids have also been included. In addition, certain figures have been altered to agree with the text, or to correct erroneous terminal labels. Suggestions from the field have also been incorporated into this manual.

Revised items are indicated by asterisks in the Table of Contents and in the Figure List, and by revision bars along side those items changed in text. Revised illustrations are denoted by the symbol • to the left of the caption.

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*Revised or added since previous printing.

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Tape Transport Cleaning

CLEANING FREQUENCY

The tape transport should be thoroughly cleaned after every 16 power-on hours. The read-write head surface should also be cleaned after every 48 or more consecutive hours of power-off.

CLEANING PROCEDURE

Care must be taken to prevent any IBM tape cleaner, P/N 517960, from coming in contact with the skin, as a toxic effect may result.

Prevent any tape cleaner from getting on the bearings and bushings because it will leach oil from them.

Unload tape from drive and keep rewind arm in the unloaded position. At no time should the interlock switch be bypassed.

For efficient cleaning, tools are available in a complete tape transport cleaning kit (P/N 352465). The kit can be ordered from Mechanicsburg, Parts and Supplies, Code 01.

1. Remove dust from reel and transport area with a lintless cloth.
2. Clean stop capstan by sliding a dry lintless pad (P/N 352468) between stop capstan and idler; use buffing action. Do not use tape cleaning fluid.
3. Brush oxide dust from head rollers and tape guides with a small dry brush (P/N 556945). It may be necessary to lightly dampen brush with tape cleaner (P/N 517960) to remove sticking oxide on guides. Remove loosened oxide with cotton applicator.

   CAUTION
   Clean with care so as not to damage spring-loaded tape guides.

4. Loosen all residue in tape columns. A round wood toothpick or broken applicator can be used to get into the corners. Do not, under any circumstances, use any metal instrument to clean columns.
5. Clean all residue from the columns and glass doors with a clean felt pad (P/N 352605) dampened with water. Repeat with clean felt pad dampened with tape cleaner (P/N 517960).
6. Clean the sealing edges of columns.
7. Remove residue left by the tape cleaner from columns and glass with a clean dry lintless cloth.
8. Clean head, H shield, and erase head with a clean cotton applicator slightly dampened with tape cleaner P/N 517960).
9. Clean tape column guide roller with a cotton applicator slightly dampened with tape cleaner.
10. Clean circumference of drive capstan, drive capstan idler, and stop capstan idler with a cotton applicator slightly dampened with tape cleaner. Capstan must be de-energized during the cleaning operation. Do not allow tape cleaner to get on stop capstan.
11. Occasionally, fibers will become detached from applicators and clothes during cleaning. Make certain that all of these are removed.
12. When cleaning the tape cleaner blade, use a clean dry brush and stroke toward the left side of the machine. Use light pressure to avoid damage to the cleaner blade.

Tape Transport Adjustment Procedure

Complete adjustment of the tape transport unit is done in the following sequence.

1. Make the preliminary tracking adjustments.
2. Make the moving coil adjustments.
3. Make the rewind arm and associated adjustments.
4. Make the tape tracking adjustments.
5. Make the rocker arm final adjustments.
6. Recheck the moving coil adjustments.
7. Recheck the erase head adjustment, but do not make the final H-shield adjustment.
8. Make the start-stop adjustments.
9. Adjust the preamplifiers.
10. Adjust read and write skew.
11. Make the inner head shield adjustment.

PRELIMINARY TRACKING ADJUSTMENTS

1. With the rewind arm down, loosen the nut on the stop capstan shaft (Figure 24) and rotate the shaft (Figure 27) until a maximum clearance is obtained between the stop capstan and the stop idler (Figure 1, adjustment 1).
2. With the rewind arm down, slightly loosen the locking screw of the GO idler. Turn the eccentric nut so that the front of the idler is at the highest point above the rocker arm frame. The spot mark is in the down position (Figure 1, adjustment 2).
3. Do the same for the stop idler eccentric (Figure 1, adjustment 3) as for the GO idler eccentric.

   CAUTION
   Do not loosen the locking screws excessively so as to prevent a retaining nut from becoming disengaged from a detenting slot (Figure 1). Do not

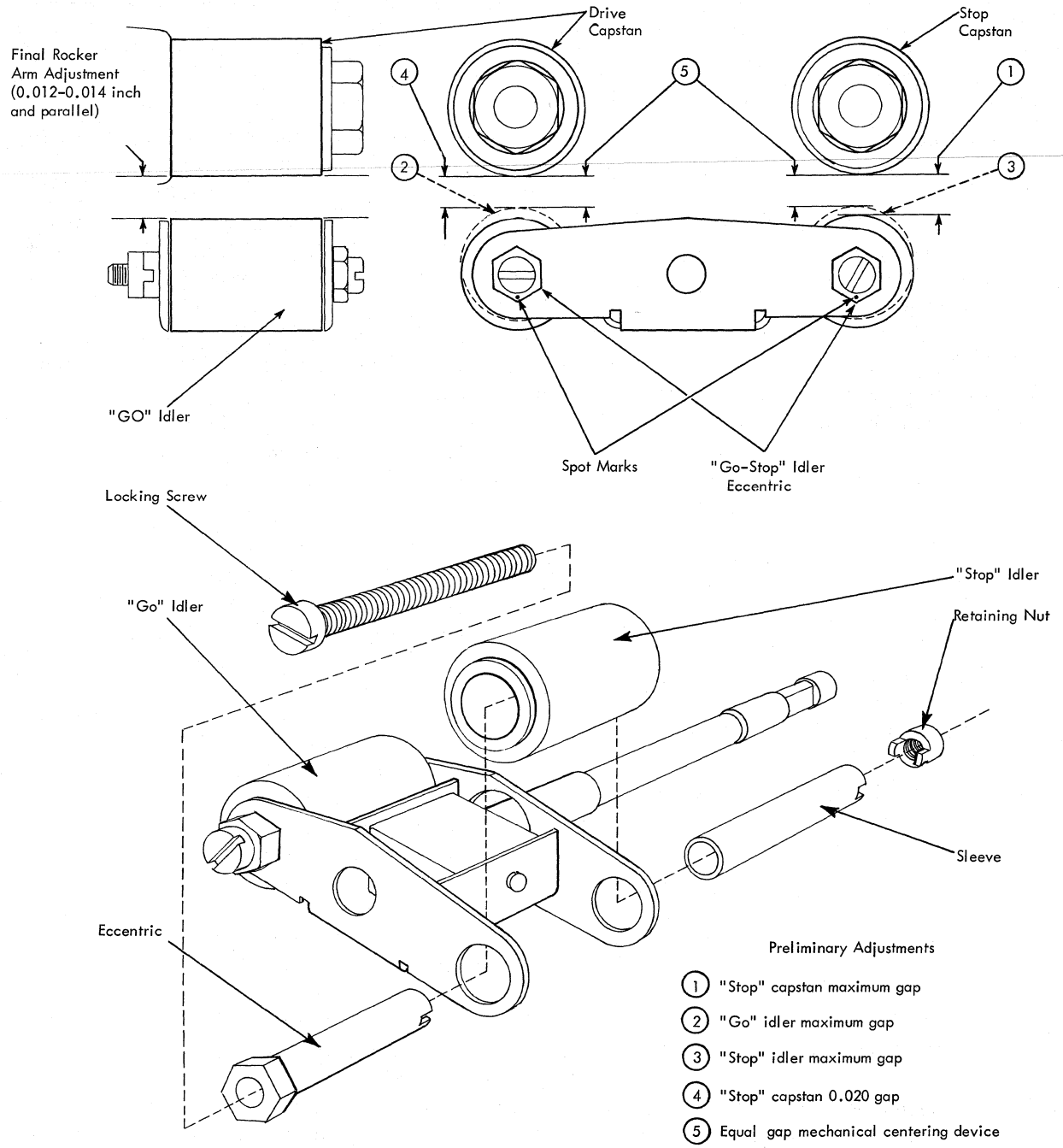


Figure 1. Rocker Arm Assembly

tighten locking screws excessively so as to prevent stripping the fine threads.

4. With the rewind arm down, rotate the stop capstan eccentric shaft (Figure 27) clockwise while facing the rear of the transport to obtain 0.020 inch between the co capstan and the co idler (Figure 1, adjustment 4).

5. With the rewind arm raised, loosen the two locking screws of the mechanical centering device (Figures 4, 29). Shift the centering device to provide equal distance between the co capstan and its idler and the stop capstan and its idler (Figure 1, adjustment 5).

TAPE TRACKING ADJUSTMENTS

The preliminary tracking adjustments must be made prior to these adjustments.

1. Turn on power, load tape, and initiate tape movement from either the CE panel on the control unit or the tape tester.

2. With tape moving forward, slightly loosen the locking screw and adjust the GO idler so that tape passes through the transport flat without signs of buckling or flutter. Tape should run flat from column to column, particularly between the two capstans, between the right rewind arm and the drive capstan, and at both tape guides (Figure 8).

Adjust for above by turning the GO idler hex nut eccentric counterclockwise until buckling occurs. Rotate the eccentric clockwise until tape runs flat. Continue clockwise rotation until tape starts to buckle again. Position the GO idler hex nut eccentric midway between the two extremes of buckling and tighten the locking screw.

CAUTION

The locking screw has very fine threads. Do not tighten excessively.

3. Initiate a low-speed rewind and observe for buckling as indicated in Figure 8. If tape runs flat, no further adjustment is required. If the tape does not run flat, readjust as indicated in step 2 for the forward direction. Some slight buckling is allowed in the backward motion. Obtain the best possible flatness in the backward direction while maintaining perfect forward flatness.

4. Press the start, reset, low-speed rewind, and reset keys in sequence. Now tape should be checked for even tracking between the front and back of the vacuum columns.

If tape continually rubs against either the front or back of the right vacuum column where tape enters and leaves, a slight readjustment of the GO idler may be necessary.

If tape continually rubs against either the front or the back of the left vacuum column or shifts from side to side, loosen the two mounting screws at the front of the left rewind arm idler bracket (Figure 8) and position the idler to obtain minimum front-to-rear shifting of tape. Tighten screws and observe tape again in the forward-reverse motion. A flashlight and dental mirror are useful to observe tape motion.

NOTE: Forward tracking is most important.

There may be some slight side shift immediately following a reversal of tape, but the tape should immediately assume the same path in the forward direction. This is necessary, for a shifting tape path will cause skew problems.

NOTE: Rocker arm final adjustments must now be made.

If proper tape tracking cannot be obtained by means of the adjustment procedure:

a. Check the rewind arm idlers for excessive end play. Idler end play should be barely perceptible.
b. Check for a spring-type washer on the left rewind arm shaft. The washer is located between the left rewind arm upper spur gear and the shaft bushing behind the main casting. If washer is present, remove. When reassembling components, the upper spur gear should be positioned on the shaft so that the left rewind arm assembly is to have no end play, but also should not bind when the solenoid raises the arm.
c. Check defective or binding rocker arm assembly.
d. Check the drive or stop capstan for an elliptical shape or a bent shaft.
e. Check for dirty tape transport.
f. Check for installation of rocker arm spring being in backwards.
g. Tape cleaner blade bent or crooked.
h. Erase head touching tape.

STOP-START ADJUSTMENTS

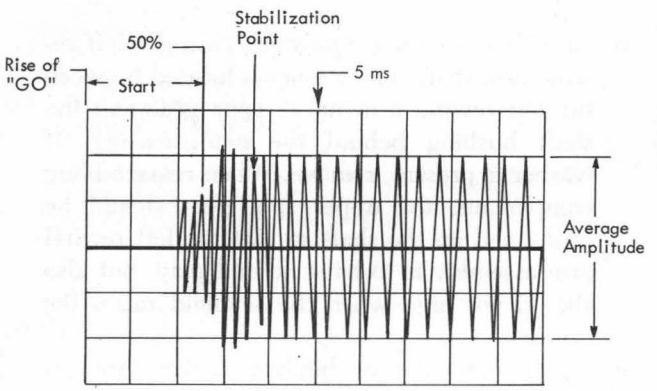
If the rocker arm adjustments are correct, the start-stop timings should be within the specified limits.

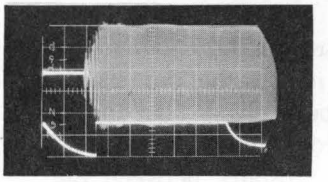
1. Use the tape tester as follows for checking start-stop time.
   a. Load tape unit with tape written continuously in track 8.
   b. Connect oscilloscope probe to READ hub on tape tester and set read scan selector switch to 8.
   c. Connect oscilloscope sync lead to GO SYNC hub and sync on external minus. This emits a constant multivibrator signal even when the GO switch is off.
   d. Set read-write toggle switch to READ.
   e. Place motion switch to START-STOP position.

2. For forward start time, sync oscilloscope on rise of GO and adjust time base for 1 ms/cm. The start envelope should be similar to Figure 2. Start time should be within limits specified in the start-stop parameter table.

If the start envelope does not meet the requirements specified, adjust the timing of the variable single-shot located at 6C06 with a potentiometer located on the SMS circuit card. Figure 2 includes actual oscilloscope photographs of correct and incorrect start envelopes.

3. For forward stop time, sync on fall of GO and adjust oscilloscope to give a stop envelope similar to Figure 2. Stop timing limits are shown in the table; however, the stop envelope is not critical and irregularities in its shape do not necessarily indicate faulty operation. Figure 2 shows actual oscilloscope photo-





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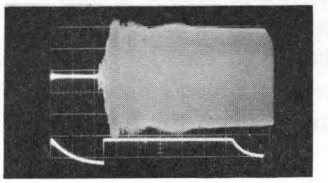
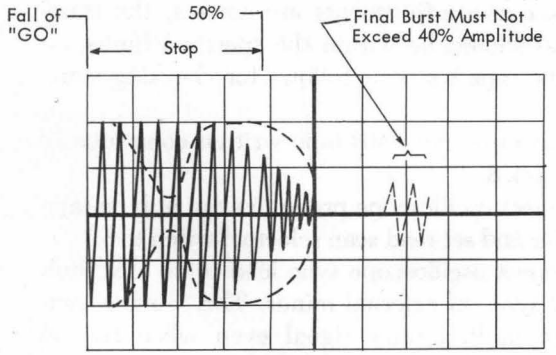


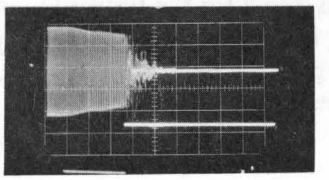
Bad

Note: This start envelope is unsatisfactory because of dip in waveform beyond 5.0 ms. If start envelope cannot be corrected by adjusting the "GO A" single-shot, look for binds or defective rocker arm.

START ENVELOPE



Note: Stop envelope may be irregular as shown by dotted outline.



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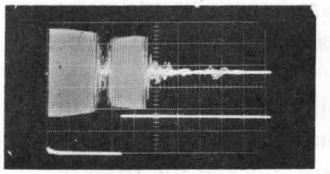


Good

STOP ENVELOPE

Figure 2. Forward-Backward Envelopes

graphs of variations in the stop envelope that still permit proper operation.

Instead of the ideal stop envelope shown in Figure 2, the envelope may have an irregular shape indicated by the dotted outline. Stop time should be measured to the last 50 percent point before tape motion stops. A final burst may occur as shown by the dotted portion of the figure. If the amplitude of this burst is not greater than 40 percent of the total amplitude, the burst will not affect the operation of the tape unit.

4. For backward start-stop time, operate tape unit in backward start-stop status and check that envelopes are within the limits shown in the table.

5. For check of stabilization point, refer to the following table.

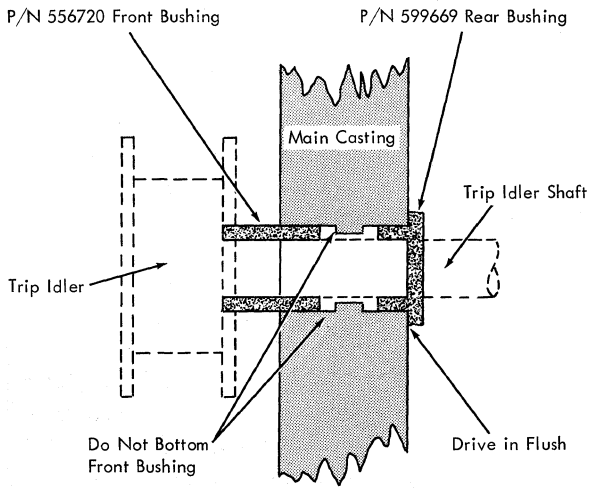
NOTE: The backward-start-stop characteristics are of secondary importance. If difficulties arise in attaining correct start-stop envelopes, check the following:

a. Loose moving coil mounting screws and loose set screws in the linkages.
b. Dirty vacuum columns causing tape drag.
c. Left rewind arm set too low (less than 0.020 inch clearance), causing tape to drag.
d. Bind in GO nylon idler of the rocker arm assembly.

e. Worn rocker arm assembly pivots.
f. Loose set screws in the rocker arm assembly at either end of shaft.
g. Binds in the moving coil linkage.
h. Moving coil not positioned properly.
i. Nut loose on main driven pulley.
j. Check for a defective GO A driver. It can cause a slow start time (3 ms) and a long stop time (6 to 7 ms).
k. Partially shorting or grounded GO and stop coils. The GO portion of the moving coil should have a resistance of 42 ohms; the stop portion, 14 ohms. An open stop coil winding can cause a long stop time (9 ms). A stop coil is only used on machines below S/N 16203.
l. If it becomes necessary to replace the rocker arm shaft bushings due to excessive wear, the following precautions should be observed.

The front and rear bushings should be replaced at the same time. This is necessary because there is the possibility of damaging either or both old bushings during removal. The bushings can be removed by use of a ¼-20 tap, driving lightly on threaded end of tap.

The rear bushing is installed first, as it is driven in until its shoulder contacts the casting. (See sketch.) The front bushing is then driven in *only* far enough to allow the rocker arm idlers to contact their respective stop and go capstans centrally. The rocker arm should be trial fitted as the front bushing is being installed. If the front bushing is driven in too far, the rocker arm frame will contact the main casting, making adjustment of the rocker arm impossible.



STOP-START PARAMETER LIMITS

PARAMETER	LIMITS AND POINTS OF MEASUREMENT
Forward Start	Measured from rise of GO to point where displayed waveform attains 50% of average peak-to-peak amplitude; should be 2.5 ±0.4 ms.
Forward Stop	Measured from fall of GO to point where displayed waveform diminishes to 50% of average peak-to-peak amplitude; should be 4.0 ±1.0 ms.
Backward Start	Measured from rise of GO to point where displayed waveform attains 50% of average peak-to-peak amplitude; should be 2.5 ±0.4 ms.
Backward Stop	Measured from fall of GO to point where displayed waveform diminishes to 50% of average peak-to-peak amplitude; should be 4.0 ±1.0 ms.
Stabilization Point	Measured from rise of GO to point where peak-to-peak amplitude of displayed waveform attains 100 ±5% of average peak-to-peak amplitude; should occur not later than 5 ms after rise of GO.

ON-LINE SCOPE CHECK

To insure good tracking adjustments, the following procedure should be followed. This is to be done on-line.

1. Write a series of long records (500-1000 characters each) with a minimum "go down" time of 20 ms between records.
2. Rewind tape.
3. Sync scope on the eight-bit track; display the C and 1 track simultaneously.
4. Observe the scope while reading tape in a continuous forward motion.
5. Observe scope while reading tape after a backspace operation.
6. Any pronounced variance or shift of an entire group of bits in either channel with respect to the other channel indicates a bad tracking adjustment.

Single-Shot Timings

SERVICE CHECK

Single-shot timings are shown in the following table. Adjust all single-shots as close as possible to the nominal values shown; however, the single-shots have a ±2 per cent tolerance, and the high and low limits are given for convenience. Do not change the adjustment of a single-shot if the tape unit is operating properly even though the timing differs from the value shown.

		OUTPUT PULSE DURATION		
SINGLE-SHOT	SYSTEMS	MIN	NOMINAL	MAX
Rew Fwd to Bkwd	73.20.01	196 ms	200 ms	204 ms
Rew Fwd to Bkwd*	73.20.05	196 ms	200 ms	204 ms
Go A	73.20.05	Adjust for proper start envelope (about 2 ms)		
Go B	73.20.05	5.88 ms	6 ms	6.12 ms
LP Delay**	73.20.10	88.2 ms	90 ms	91.8 ms
LP Pick	73.20.10	62.72 ms	64 ms	65.28 ms
Stop**	73.20.10	3.43 ms	3.5 ms	3.57 ms
Capstan Bkwd-Fwd	73.20.15	44.1 ms	45 ms	45.9 ms
Echo†	73.30.01.2	8.82 μs	9 μs	9.19 μs

*Replaced with R-C network on machines above S/N 16202 (Systems 73.50.10.0).
**Eliminated on machines above S/N 16202.
†Eliminated on machines above S/N 14882.

ADJUSTMENT

The timing of a single-shot is adjusted with a potentiometer on its SMS card.

Timing duration is checked on an oscilloscope connected to the single-shot output terminal as determined from Systems diagrams.

Read-Write Head Assembly (Figure 24)

SERVICE CHECK

Inspect head surface for pits, scratches, and uneven wear. Uneven or worn surfaces provide poor tape contact and cause low signal strength resulting in read-write errors. Check tape guides for free movement of the rollers.

Clean the head and tape guides with cotton-tipped sticks and IBM tape cleaner. Also clean underside of the erase head and the inner head shield.

CAUTION

Do not use excessive cleaning fluid as it will leach oil from the permanently lubricated tape guide bearings. Do not allow cleaning fluid to come in contact with magnetic tape, as it may attack the oxide binder material. Head cleaning should be performed by the customer only after he has been given adequate instructions.

INNER HEAD SHIELD ADJUSTMENT (FIGURE 5)

The purpose of the inner head shield (Figure 24) is to prevent write gap flux from reaching the read head. When current is reversed in any of the write head coils, the maximum feed-through measured at the output of the read preamplifiers must not exceed 0.40v peak-to-peak. Make the following adjustments, assuming that the read preamplifiers are adjusted to give an ouput of 8.8v peak-to-peak when reading while writing tape at high density, as outlined under Read Preamplifier Adjustment.

1. For an initial adjustment, move H-shield to a position shown in Figure 5. The middle of the H-shield should be ⅛ to 1/16 inch to the left of the read-write head laminations.
2. Mount a reel of tape and put tape unit in load status. Remove the capstan motor plug to prevent tape movement, thereby preventing reading bits from tape.
3. Initiate a write operation from the control unit or from the field tape tester and use the oscilloscope to measure the write circuit feed-through at the output of the read preamplifiers. Make certain that writing takes place in phase in all tracks and measure output of all read amplifiers. When operating from a field tape tester, reset tester occasionally to ensure that writing takes place in phase.
4. Should the feed-through be more than 0.40v peak-to-peak on any track, loosen the head shield mounting block screws and reposition the shield, using as little spring pressure as possible, to reduce feed-through to 0.40v or less.

NOTE: If difficulty arises in attaining this adjustment:

a. The R/W head assembly may have to be demagnetized with a magnetic degausser (P/N 451064).
b. Check for small washers under the H-shield mounting plate. Replace with larger washers or replace the H-shield mounting plate.

5. Recheck feed-through on all other preamplifier outputs to verify that they are still within tolerance.
6. Replace capstan plug when finished.

READ SKEW ADJUSTMENT (MECHANICAL)

The step-by-step procedure for adjusting read head skew follows. For more information on read skew see Read Skew in the General Information section of this manual. Before proceeding with the adjustment of mechanical skew, make the following checks to insure that a double tape path does not exist. This check may result in the readjustment of the left rewind idler, which is very critical and contributes to tape tracking and skew problems.

1. Mount a tape and write all bits.
2. Rewind Tape.
3. Sync oscilloscope on the output of the read preamplifier for the 8-bit track and initiate a read operation.
4. Observe the output of the 1-bit and the C-bit preamplifiers. Invert one of the signals and observe the shifting of the two tracks relative to each other. The 1- and C-bit tracks may not be aligned; at this time we are only concerned with the relative shifting of the outer tracks.
5. Hold the start key pressed and press and release the reset key repeatedly to start and stop tape. The 1- and C-bit tracks should not shift more than one to two microseconds in relation to one another.
6. If shifting is excessive, the left rewind arm is out of adjustment.
7. To adjust:
   a. Loosen the two screws holding the rewind pulley plate to the rewind arm.
   b. Manually position the idler to achieve minimum shifting of the 1- and C-bit tracks.
   c. When tightening the holding screws, the lower screw must be tightened first.
   d. Observe the 1- and C-track signals while starting and stopping tape motion; recheck to insure that a minimum amount of shifting exists.

Proceed with mechanical read skew adjustment.

Read head skew is adjusted by a spring-loaded screw positioned to the right of the head assembly (Figure 24). Before checking or adjusting the read head skew,

clean the head carefully and be sure the read preamplifiers and tape tracking adjustments are correct.

1. Mount master tape P/N 461096, and load tape unit.

2. Sync oscilloscope on output of eight-bit track read preamplifier and initiate a read operation from the tape control unit or tape unit field tester.

3. Observe oscilloscope and adjust head positioning screw until peaks of track 1 and C pulses occur at the same time.

NOTE: Set oscilloscope triggering to negative external, 2 μs/cm, and .5 v/cm, and observe negative-going read pulses while making the skew adjustment. This precaution is necessary because the master skew tape, P/N 461096, is generated and checked to negative pulses.

A skew adjusting screw in either of two sizes is used in production of the 7330 tape unit. One size requires a ⅛ inch hex wrench, P/N 116574. The other size screw requires a 9/64 inch hex wrench, P/N 451553.

4. Check remaining tracks and record time displacement of all tracks (leading or lagging). The maximum skew (most leading to most lagging track) should not exceed 3.0μs. When recording skew, use + for leading and − for lagging.

NOTE: If skew is more than 3 μs, check tracking adjustments.

WRITE SKEW ADJUSTMENT (ELECTRICAL)

The following text provides two procedures for adjusting write skew on the 7330 Magnetic Tape Unit; a simplified alternate procedure is given first, followed by the previously published detailed procedure.

For detailed information and the explanation of the write skew adjustment steps see "Write Skew" in the "General Information" section.

Write skew is determined by measuring skew at the output of the read preamplifiers while writing all bits in all tracks. This skew is actually the combined read-write skew. To find the write skew, subtract the read skew measured previously from the read-write skew. Write head skew is corrected by adding increments of delay to the write sample pulse of the various tracks, as needed.

Simplified Procedure:

1. Mount master skew tape and adjust mechanical skew; sync minus external on 8-bit.

2. Check and record read skew in each track.

3. Mount write tape; sync minus external on 8-bit; write all bits.

4. Adjust the write skew delay taps to give the same delay (to the nearest tap) as recorded when reading the master skew tape.

5. To check the write skew settings, write a continuous record of all bits; rewind, read back and compare to master skew tap readings.

Detailed Procedure:

The detailed procedure for determining and correcting write skew is as follows:

1. Remove the reel of master tape used previously, and mount a reel of regular tape. Load tape unit.

2. Set taps on delay line for zero delay in all seven channels.

3. Sync oscilloscope on track 8.

4. Initiate a write operation from the control unit, and write all bits in all tracks.

5. Check and record skew at the output of the read preamplifier for each track. This is the combined read-write head skew. When recording skew use + for leading and − for lagging.

6. Subtract read skew, recorded previously, from read-write skew. This is an algebraic subtraction. The result is write skew, and the time displacement between the most leading and lagging track should not exceed 6μs.

7. Make most lagging track a zero reference by adding the amount equal to this skew but opposite in sign to all tracks.

8. Adjust delay line tape for tracks, as required, to bring read-write skew as close to the recorded read skew as possible.

	TIME (IN MICROSECONDS)						
TRACK	C	B	A	8	4	2	1
Read-Write Skew (Recorded while writing bits in all tracks)	+2	0	+1	0	−1	−1	0
Read Skew (Recorded during read skew adjustment)	+1	0	+2	0	−1	−1	+1
Actual Write Skew	+1	0	−1	0	0	0	−1
			Most lagging tracks				
Add	+1	+1	+1	+1	+1	+1	+1
Delay to be added to correct write skew	2	1	0	1	1	1	0

NOTE: Each increment of delay equals 1.25 microseconds. Select tap that will come closest to the computed delay.

TAPE GUIDE ADJUSTMENT

The tape guides, which are part of the head assembly, are factory-adjusted and do not require field adjustment.

CAUTION

Never remove tape guides from the head assembly, as proper alignment with the head will be lost. If a tape guide becomes worn or defective, replace the entire head assembly.

REMOVAL OF HEAD AND TAPE GUIDE ASSEMBLY

1. Remove the head cover by removing the rewind arm handle and the cover mounting screws.

2. Remove the head shield mounting block from the head assembly.

3. Remove the two cable connectors from the head assembly.

4. Remove the head and tape guide assembly mounting screws.

5. Remove the photocell mounting bracket from the guide stand-off.

6. Pull head assembly forward and remove ground wire from rear of head.

7. Lift the head and guide assembly out of the transport.

8. To replace the head assembly, reverse the removal procedure. Allow the head assembly to assume the lowest position on the casting that the mounting screws will permit.

9. After the head is replaced check tracking, preamplifier level, and skew.

Read Preamplifier

Preamplifier gain is adjusted by a potentiometer on the amplifier card. Before checking or adjusting the preamplifiers, clean the read-write head thoroughly.

PREAMPLIFIER SERVICE CHECK

Adjust the preamplifiers to provide an output of 8.8v peak-to-peak while writing all bits at high density. A properly operating preamplifier should be capable of producing a minimum of 10v peak-to-peak when operated at maximum gain. When checking or adjusting the preamplifiers, use standard signal level tape P/N 461108. If a standard signal level tape is not available, use an average customer tape and set preamplifiers for 8.4v peak-to-peak.

ADJUSTMENT

NOTE: Preamps should be checked any time tracking adjustments are changed. Final adjustments to preamps must be made on line using a calibrated scope probe. Make certain all bit tracks are the same amplitude. A difference in signal amplitude between tracks aggravates skew conditions.

1. Set density switch on tape unit to high density position.

2. Initiate a write operation from the control unit and write all bits in all tracks.

3. Observe output of preamplifier on oscilloscope while turning preamplifier gain control to maximum. With maximum gain, preamplifier output must be 10v or more, peak-to-peak.

4. Adjust preamplifier gain control to provide an output of 8.8v peak-to-peak.

5. Perform steps 3 and 4 on all seven read preamplifiers.

6. Make final preamplifier adjustments on line using a calibrated scope probe.

Moving Coil and Linkage Assembly (Figures 4, 27)

SERVICE CHECK

1. Lubricate the moving coil linkage and pivots as required using IBM 6 oil sparingly.

2. With the rewind arm raised:
   a. Check the moving coil linkage for a 90 degree relationship as shown in Figure 4.
   b. Check that the moving coil is half way between its limits when the linkages are at 90 degrees.

3. With the rewind arm lowered:
   a. Check to see that the moving coil bobbin does not hit the top of the magnet in the down (stop) position. Check by looking through the holes in the bobbin (Figure 4).
   b. Check to see that the side of the bobbin does not touch the side of the casing in the up (GO) position (Figure 4).
   c. Check for free movement of the linkage by pushing the moving coil in the up (GO) position and releasing it. It must fall back to the down (stop) position freely.

NOTE: For machines which incorporate the magnetic stop slug (Figure 28), 3C is done with the stop slug removed.

4. Check GO and stop coils for 42 ohms and 14 ohms, respectively. For the machines with the stop slug, there is only a GO coil. This should read between 41.4 and 56.4 ohms.

ADJUSTMENTS

1. The 90 degree relationship between the linkages at the midpoint of the moving coil travel limits is adjusted by a combination of horizontal and vertical positioning of the moving coil assembly with the rewind arm raised.

To obtain vertical positioning, slightly loosen the three screws that hold the moving coil assembly on its mounting plate (Figure 24). Some machines have the bracket without elongated holes for vertical positioning. Attain the best possible adjustment.

To obtain horizontal positioning, slightly loosen the two screws that hold the moving coil mounting plate on the tape transport casting.

2. Lower the rewind arm and determine that the moving coil does not bottom on the pole piece in the down (stop) position by looking through the holes in the moving coil bobbin. Check that the bobbin does not strike the side of the pole piece in the upward (go) position. Also check for free movement of the linkage by pushing the moving coil into a go position and releasing it; it should fall back to a stop position freely. If the linkage is not free, check for binds. It may be necessary to reshim the moving coil assembly. (See

following procedure for removal of the moving coil assembly.)

NOTE: If the machine has a magnetic stop slug, it must be removed to attain free movement of the linkage. Loosen screw holding moving coil to linkage and slide out slug.

REMOVAL AND REPLACEMENT

1. Unload tape and turn power off.
2. Remove capstan main drive belt from the motor pulley.
3. Remove the plastic cover from the moving coil assembly.
4. Disconnect the moving coil leads from the edge connector.
5. Remove the spring clip from the stud on the trip lever (Figures 4, 27).
6. Loosen the two screws that hold the moving coil mounting plate to the main casting.
7. Remove the shims located between the mounting plate and the main casting.
8. Ease the link from the stud on the trip lever and slide the moving coil assembly down and out.
9. Replace in reverse order checking for:
   a. The 90 degree relationship of the linkages as shown in Figure 4. Refer to adjustment 1.
   b. Free movement of the linkages when the mounting plate screws are tight and the spring clip is in place on the stud. Refer to adjustment 2.
10. Recheck entire tape transport adjustments. Refer to tape transport adjustment procedure.

Rocker Arm Assembly (Figure 1)

SERVICE CHECK

1. Inspect the two nylon idlers in the rocker arm assembly for oxide build-up, worn or uneven surfaces, and freedom of rotation. Clean idlers with approved IBM cleaner and a lint-free cloth.

   CAUTION
   Do not use excessive cleaner, for it will leach oil from the inside bushings.

2. Lubricate inside bushings of stop and go idlers using IBM 6 oil sparingly. Do not allow oil to get on to the surface of the idlers.
3. Observe tape moving through the transport for signs of buckling (Figure 8). If tape does not lie flat, adjust as outlined under "Tape Tracking Adjustments."

ADJUSTMENTS

After tape tracking adjustments, make the following adjustments:

1. With power off, disconnect capstan drive motor plug. Turn power on and thread tape under the rocker arm assembly. (This is done to have tape in column so the go coil may be energized in stop and go conditions while adjustments are made.) Lower the rewind arm; the clearance between the drive capstan and go idler should be parallel. If not, adjust the stop idler eccentric to obtain this parallelism (Figure 1).
2. Loosen the nut holding the stop capstan (Figure 24), and rotate the stop capstan eccentric shaft clockwise (facing the rear of the tape transport, Figure 27) until the gap between the drive capstan and the go idler is 0.012 inch (free to light drag) and 0.014 inch (snug, Figure 1).
3. Raise the rewind arm, turn power off, and replace capstan motor plug.

With the rewind arm lowered, insert a 0.007 inch feeler gage between the drive capstan and its idler. Insert a 0.007 inch feeler gage between the stop capstan and its idler (an IBM card may be used). Raise the rewind arm cautiously and check the moving coil for a change of position. If the position changes, loosen the mechanical centering device locking screws (Figures 4 and 29) and reposition the centering device which results in no movement of the moving coil while the arm is being raised.

REMOVAL

Remove the rocker arm assembly as follows:

1. From the rear of the tape transport, loosen the two setscrews that hold the trip lever on the rocker arm shaft. (The side setscrew must be loosened until at least two threads are visible, Figure 27.)

The rocker arm shaft has a flat surface near the end to provide a seat for the side setscrew.

2. Remove the rocker arm assembly from the front of the tape transport by pulling forward. Note the position of the flat surface near the end of the shaft so that the rocker arm can be replaced in the same position.

REPLACEMENT

1. Install a rocker arm assembly from the front of the tape transport.
2. From the rear of the tape transport, push the trip lever on the rocker arm shaft so that there is no noticeable end play in the shaft.

Be careful to align the flat surface of the shaft with the side setscrew in the trip lever collar. Tighten the setscrew on the flat surface first.

3. Check the rocker arm for binds and perform the complete tracking and start-stop adjustments.

Capstan Drive Assembly (Figure 3)

SERVICE CHECK

1. Inspect the drive belt for wear. Clean with approved cleaner.

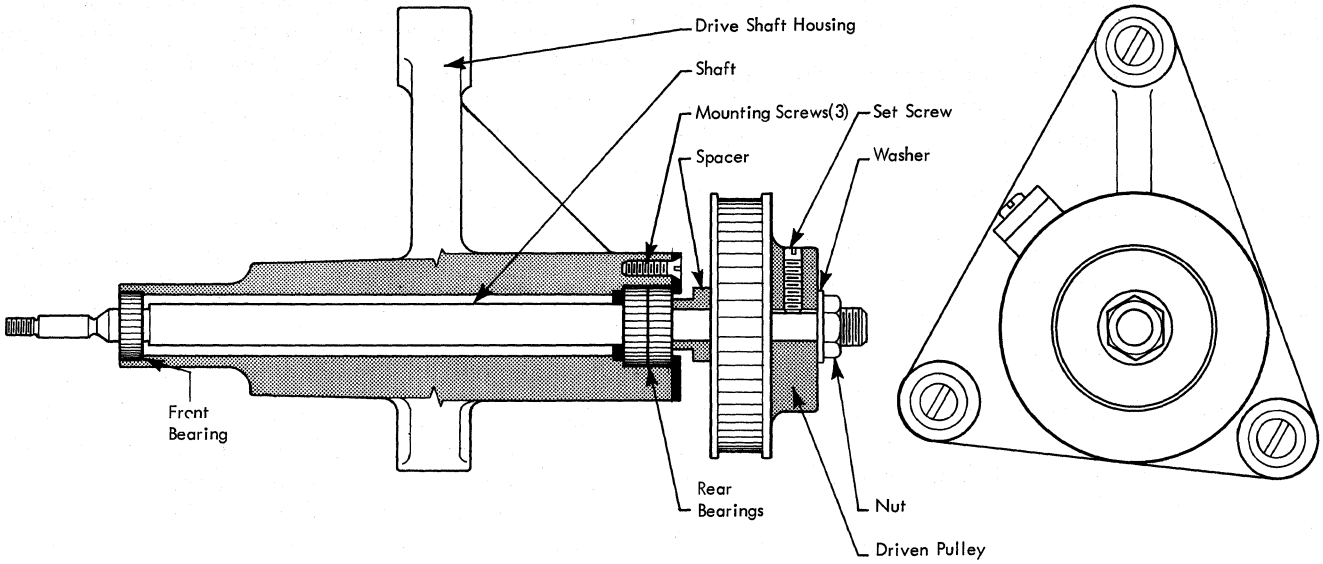


Figure 3. Capstan Drive Assembly

2. Check tension on capstan assembly drive belt. It must not be too tight, for binds can occur between the timing belt and its pulleys.

3. Inspect drive capstan for oxide build-up and wear. Clean with cotton applicator slightly dampened with tape cleaner.

4. Do not lubricate bearings of the capstan shaft, for they are permanently lubricated.

5. Check drive shaft for binds.

ADJUSTMENT

The capstan motor drive belt tension is the only field adjustment to be made on the capstan drive assembly.

1. Loosen capstan motor mounting screws.

2. Move motor to provide belt tension that will permit .25 inch of belt deflection when 0.5 pound (227 grams) of force is applied midway between the pulleys.

3. Tighten motor mounting screws.

4. Close tape transport gate and recheck belt tension. If belt is not correct with gate closed, repeat steps 1, 2 and 3.

REMOVAL AND REPLACEMENT

1. Remove drive belt.

2. Remove drive capstan from front of tape transport.

3. Remove three assembly mounting screws.

4. Remove assembly from rear of unit.

5. Replace in reverse order.

If the capstan drive shaft bearings develop trouble, they may be replaced as follows (Figure 3):

1. Remove drive capstan from front of tape transport.

2. Remove drive assembly from the tape transport.

3. Remove nut and washer.

4. Loosen two set screws.

5. Remove driven pulley and spacer from shaft.

6. Remove three counter sunk screws and bearing retainer ring.

7. Slide out entire capstan drive shaft.

8. Replace bearings. The two rear bearings are replaced as a pair. Assemble rear bearings with unshielded sides together. The front bearing cannot be removed, for it is cemented in.

9. Assemble and mount in reverse order.

NOTE: When replacing driven pulley, partially tighten two set screws; then securely tighten nut, and finally, completely tighten two set screws.

Left and Right Rewind Arm Assembly (Figure 24)

SERVICE CHECK

1. Inspect the left and right rewind arm idlers for binds and nicks (Figure 24).

2. Check both rewind arms for proper adjustment as specified under "Adjustment."

3. Clean rewind arm idlers with a clean cloth and approved cleaner. Do not use excessive cleaning fluid, as it will leach oil from the permanently lubricated bearings.

4. Check action of dashpot (Figures 4, 29) to insure that it provides sufficient cushioning when the rewind arm is lowered. Make check by first lowering rewind arm slowly; no dashpot action should be felt. Lower the rewind arm again with somewhat greater speed. At this time the dashpot should produce some resistance to the movement of the rewind arm. Full dashpot action should provide gentle contact of the head shield against the read-write head when the rewind arm is lowered vigorously.

CAUTION

Check the dashpot carefully. If the dashpot is not operating properly, the head may be damaged by lowering the rewind arm too vigorously.

5. Check for a 0.003 to 0.005 inch clearance between the right side of the erase head and the tape when the rewind arm is lowered.

6. Check for a shoulder type screw in the upper mounting of the dashpot bracket. For efficient operation, a shoulder type screw should be used.

ADJUSTMENTS

Check rewind adjustments with power off.

The left rewind arm is adjusted by two limit-stop screws accessible from the rear of the tape transport (Figures 4, 29). The right rewind arm is adjusted by moving the right rewind arm idler mounting bracket (Figure 6).

Be sure that the upper and lower positions of the rewind arms are controlled by the limit screws and not by the dashpot, arm-raising solenoid, or the erase head mounting bracket.

NOTE: Whenever the rewind arms are adjusted, the inner-head shield, erase head, photocell, and the rewind arm switch adjustments must be rechecked.

The rewind arm adjustments are:

1. With the left rewind arm raised and tape taut, there should be a minimum of 0.100 inch clearance between the rewind arm mounting bracket and the front flange of the left column upper idler. There should also be a clear tape path through the right tape guide area (Figure 7). It is permissible to have the upper side of tape touching the drive capstan. Make adjustment with the upper limit stop screw (Figures 4, 29).

2. With tape removed and the rewind arm in the down position, there should be a 0.030 to 0.060 inch clearance between the lower surface of the left rewind arm idler (not the flange) and the lower inside surface of the left vacuum column (Figure 7). This clearance is obtained by adjusting the lower limit stop screw.

NOTE: If machine has a rewind arm down stop eccentric as shown in Figure 6, the clearance is not attained by the lower limit stop screw. To attain the clearance, loosen pivot locking screw, rotate eccentric for clearance, and tighten screw.

3. With the rewind arm in the down position and no tape loaded, there should be a 0.020 to 0.045 inch clearance between the right rewind arm idler bracket and the upper right edge of the right tape guide block (Figure 7). This clearance is obtained by loosening the idler bracket mounting screws and shifting the idler mounting bracket. Tighten screws and check adjustment.

NOTE: If the right rewind arm idler bracket adjustment is made following the replacement of the arm, it may not be possible to obtain the required clearance. In this case, it will be necessary to loosen the set screws in the lower spur gear (Figures 4, 29) and rotate the right rewind arm until the bracket touches the right tape guide. Tighten the spur gear set screws and readjust the right idler bracket as outlined in step 3.

If tape is observed to be rubbing the front or rear of the left vacuum column, loosen the two mounting screws at the front of the rewind arm idler bracket and with tape moving forward, allow the idler to position itself. Retighten the two screws and check tape position by starting, stopping, and reversing tape motion to insure that the tape does not have more than one position during forward motion.

Load and observe the tape as it passes through the rewind idler to see that it is not riding on either flange. If the tape is riding either flange, remove or add shims as necessary to correct the condition. The shims are between the idler bracket and the rewind arm casting.

ARM DOWN SWITCH ADJUSTMENT (FIGURES 4, 29)

The rewind arm switch contacts should transfer when the rewind arm is within 1/16 inch of its lowered position. To adjust the switch, loosen two screws on the switch mounting plate. Position the switch, as required, and tighten the mounting screws.

ERASE HEAD ADJUSTMENT (FIGURE 5)

1. Remove the inner head shield (Figures 5 and 24).

2. Slightly loosen the screws that secure the erase head to its mounting bracket.

3. With power on, tape loaded, and the rewind arm down, adjust the erase head to obtain 0.003 to 0.005 inch gap between the tape and the right side of the erase head. The head should be parallel across the width of the tape. The distance between the left side of the erase head and the tape should be greater than 0.005 inch. Obtain adjustment by shifting bracket and head. Tighten screws and check adjustments.

4. If the machine has a new type erase head (as shown in Figures 5 and 22), the adjustment is done in the following way, keeping the same clearances.

   a. Loosen set screws and tighten center screw enough for a snug fit.
   b. For vertical adjustment, rotate bracket around pivot. For horizontal adjustment, slide bracket up or down.
   c. If further adjustment is necessary, move bracket up or down with upper set screws by loosening one before tightening another.

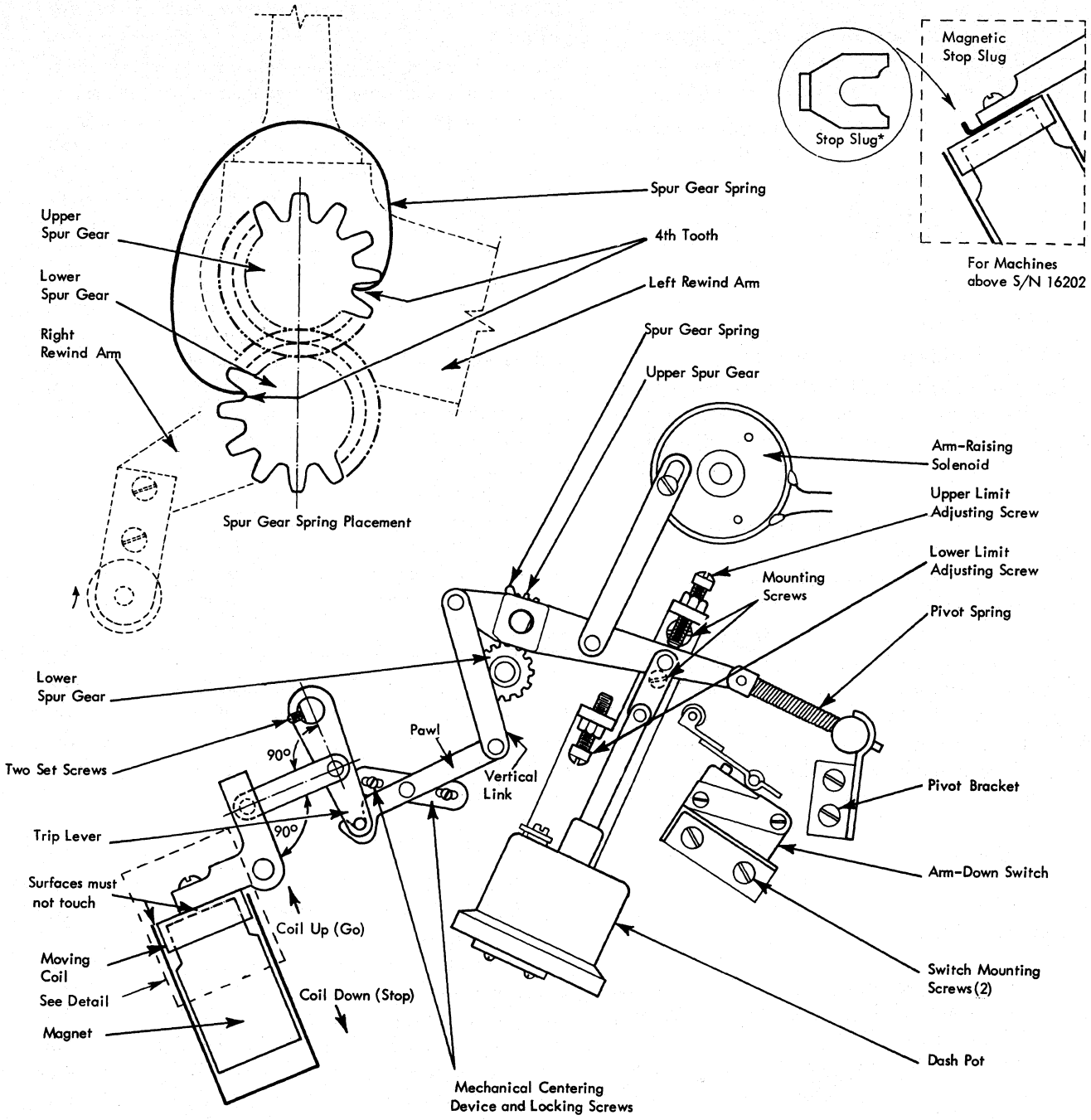


Figure 4. Moving Coil and Rewind Arm Linkages

d. When proper signal is obtained, balance set screws and tighten the central pivot screw securely.

NOTE: Make certain the erase head does not interfere with the left tape guide assembly.

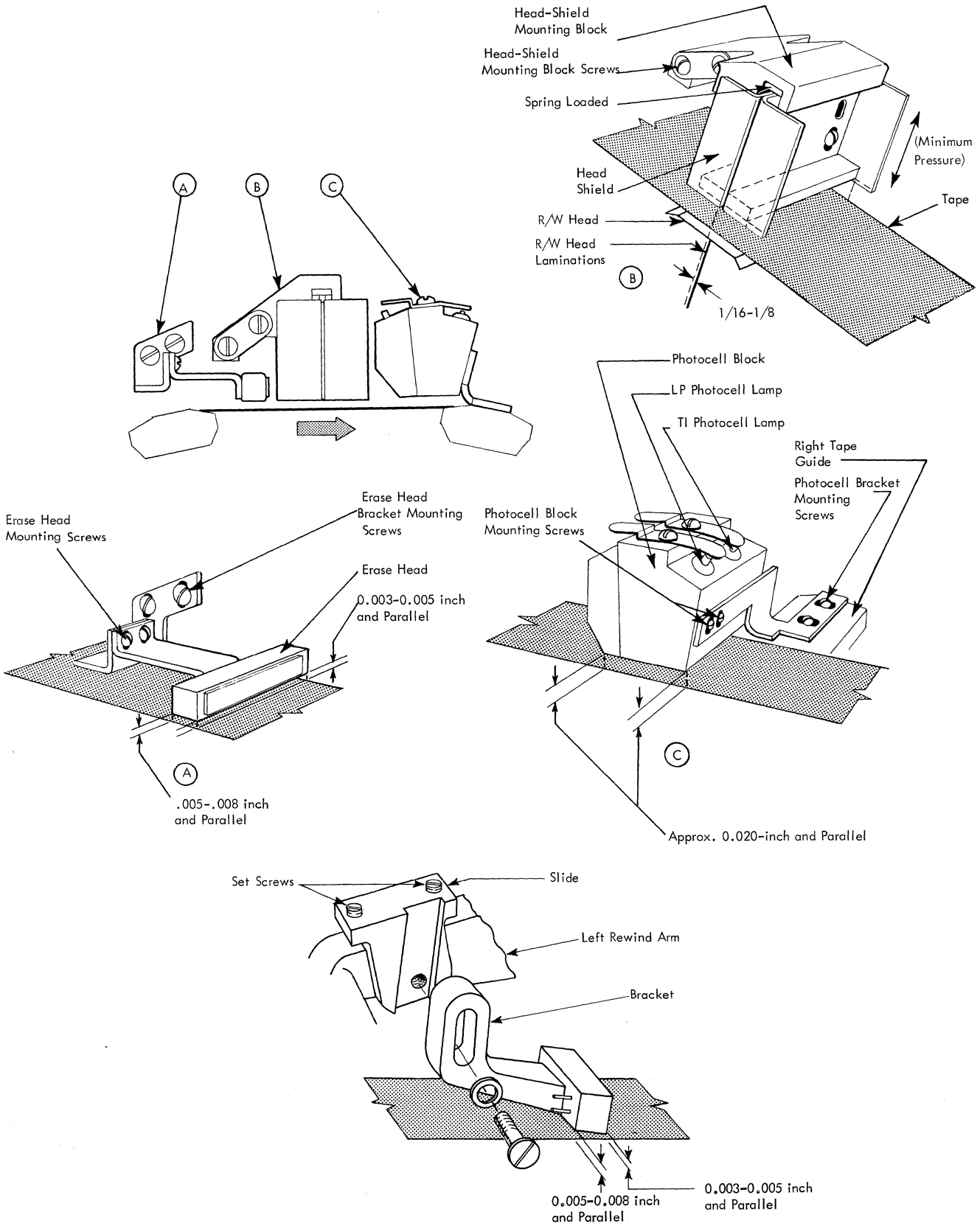
5. Check the erase head adjustment in the following manner:

a. Write a section of tape with all bits in all tracks.

b. Rewind tape to load point.

c. Disconnect the write head by removing the cable paddle from panel location 6D26.

d. Again operate tape in write status and check signal level at read preamplifier output for each track. Signal level must not exceed 0.6 volt peak-to-peak, or be less than 0.2 volt peak-to-peak; if less than 0.2 volt, be certain that erase



• Figure 5. Erase Head, Head Shield, and Photocell Adjustments

head does not touch tape. If it does, readjust the erase head and recheck.

6. Replace the inner head shield and adjust as outlined under "Read-Write Head Assembly."

ERASE HEAD POLARITY TEST

Whenever an erase head is replaced, the following test should be made to determine if tape is being erased to the proper polarity.

1. Starting from load point, write about 15 feet of tape with all zeros in all tracks.

2. Rewind tape to load point and write a record of about 80 characters.

3. Unload tape and check record with the dry bit viewer P/N 461180. If erase head polarity is incorrect, there will be seven bits written on tape about $1\frac{1}{16}$ inch beyond the last character of the record. With proper erase head polarity, there will be no bits or only slightly noticeable bits written beyond the record.

Results can be verified by reversing the erase head polarity and repeating the test.

DASHPOT ADJUSTMENT

Dashpot action is governed by two metering holes, one at each end of the cylinder. Each hole is covered by an adjustable tab. Adjust the lower tab to expose approximately half of the hole. Adjust the upper tab to expose a barely perceptible opening. Readjust slightly to obtain desired action as outlined under "Service Check."

REMOVAL AND REPLACEMENT, LEFT REWIND ARM

Remove the following:

1. Screws in the rewind arm handle, head cover, head shield block, and erase head mounting bracket.
2. Inner head shield mounting block from the arm.
3. Photocell assembly block.
4. Erase head mounting bracket from rewind arm.
5. Pivot spring block and spring from the pivot bracket in the rear of the transport casting (Figure 4).
6. Spur gear spring (Figure 4).
7. Locking pin from the rewind arm lever hub in the rear of the tape transport, and loosen the setscrews in the upper spur gear.
8. Rewind arm by pulling forward.

Replace the left rewind arm by reversing the removal procedure.

REMOVAL AND REPLACEMENT, RIGHT REWIND ARM

Remove the following:

1. Rewind arm handle and head cover.
2. Read-write head cable connectors.
3. Inner head shield mounting block from the arm, and lift the rewind arm to the upper position.
4. Head assembly by removing the three mounting screws.
5. Right rewind arm by loosening the setscrews in the lower spur gear in the rear of the tape transport and pulling arm forward. Replace the right rewind arm by reversing the removal procedure.

SPUR GEAR SPRING REPLACEMENT (FIGURE 4)

With the rewind arms down the spur gear spring should be located to the left of the gears (Figure 4). One end is placed between the fourth and fifth tooth of the upper gear, counting clockwise from the vertical center line at the top of the gear.

The other end of the spring is placed between the fourth and fifth tooth of the lower gear, counting clockwise from the vertical center line at the bottom of the gear.

Check position of spring as follows: Without tape in the transport, lower the rewind arms. Slightly depress the right rewind arm. If spring is properly adjusted, the arm will move downward slightly and then return to its original position when released.

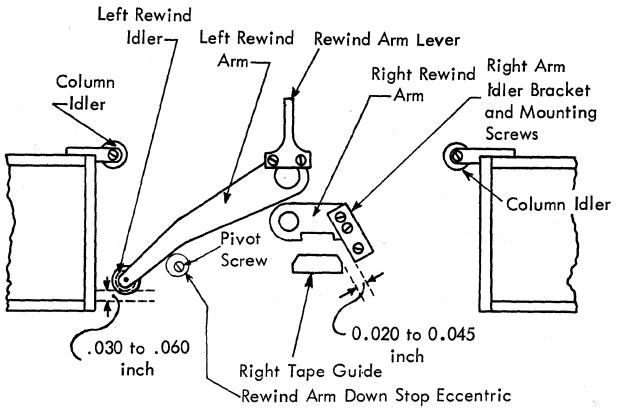


Figure 6. Rewind Arm Adjustments

Rewind Arm Solenoid (Figure 29)

SERVICE CHECK

1. Check the solenoid and its mounting bracket for loose screws.

2. Check solenoid for freedom from binds and for proper operation by pressing the high-speed rewind key while tape is in loaded status. The left rewind arm lever should raise fully against the upper stop limit screw.

ADJUSTMENT

The rewind arm solenoid is factory-adjusted and should not require field adjustment unless replaced.

The solenoid must be positioned on its mounting bracket so that, when energized, it will lift the rewind arm beyond dead center. When the rewind arm is down and the solenoid is de-energized, there should be a slight clearance between the solenoid operating stud and the upper end of the slot in the operating link. This clearance allows for the rewind arm lower limit stop adjustment.

Adjust the solenoid as follows:

1. Remove clip at lower end of solenoid operating link and remove link from stud.
2. Remove one of the solenoid mounting bracket screws and loosen the remaining screw.
3. Swing the bracket around until the solenoid mounting screws on the rear of the bracket can be reached.
4. Loosen the solenoid mounting screws slightly, allowing the solenoid to be rotated on its bracket.
5. Swing solenoid into position and temporarily place lower end of operating arm over stud. Rotate solenoid until operating stud touches top of slotted hole in arm; then rotate counterclockwise to provide slight clearance (about 0.016 inch).
6. Tighten solenoid holding screws and replace screw in mounting bracket.
7. Place operating arm on stud and replace clip. Check for proper operation.

Reel Drive System (Figure 25)

The drive system for each reel consists of a reel hub and shaft, electromagnetic brake, drive motor, and belt. Figure 9 shows the tape reel motor and brake circuits with a chart showing which relays are picked for a particular operation.

SERVICE CHECK

1. Inspect the reel drive components for loose or worn parts.
2. Drive belts should not be tight, for binds can occur with the timing belts and their pulleys. Proper tension is checked by pressing on the belt midway between the driving and driven pulleys. A pressure of 0.5 pound (227 grams) should deflect the belt a maximum distance of 0.5 inch.
3. Inspect reel hub and rubber latch ring for wear and dirt. Clean with approved cleaning fluid.
4. Clearance between the reel brake armature and the brake magnet should be at a minimum as shown in Figure 10. Brake armature must not rub against brake magnet at any point around armature.
5. Lubricate reel knob threaded section lightly with IBM 24 grease. The reel shafts and drive motors have sealed bearings and do not require further lubrication.

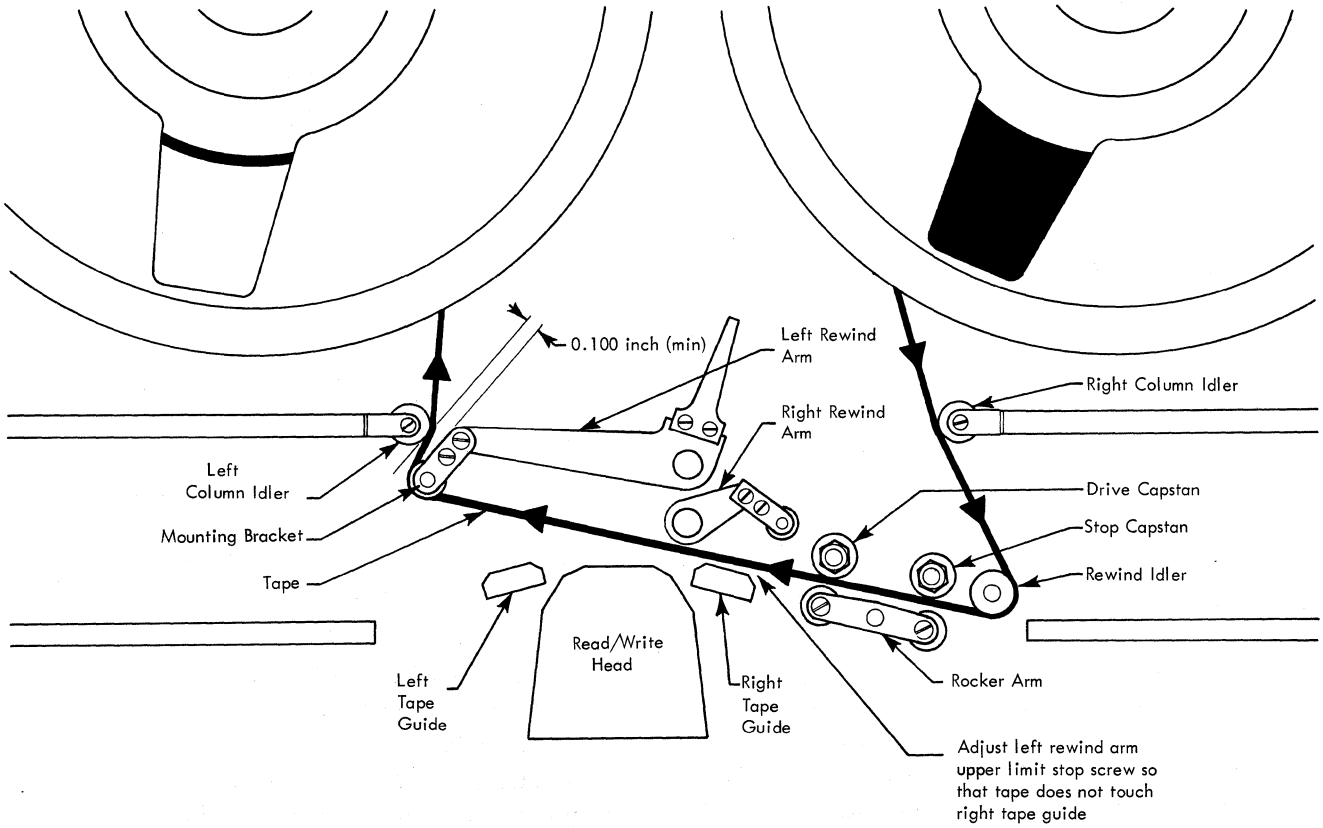


Figure 7. Tape Path for High-Speed Rewind

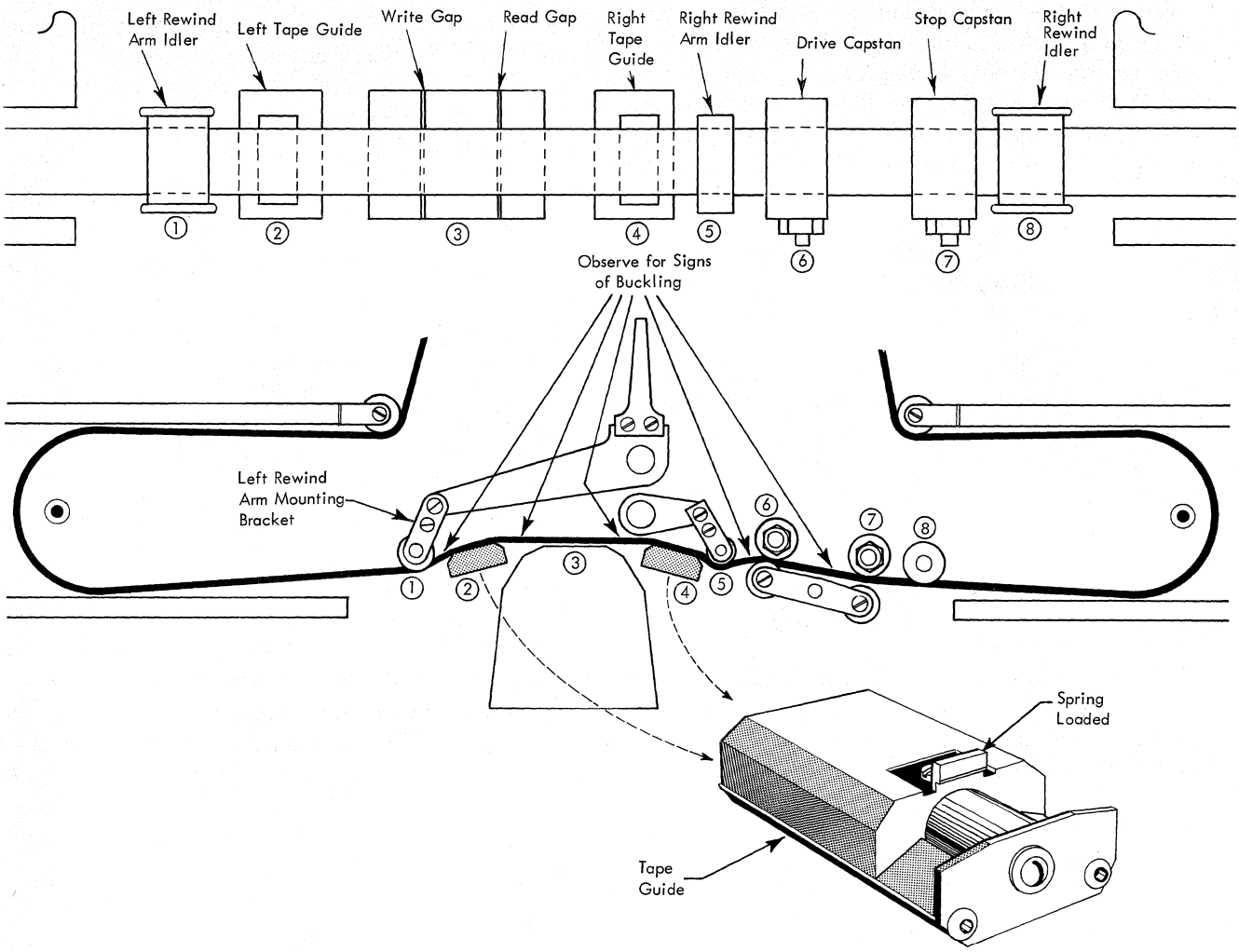


Figure 8. Tape Path for Low-Speed Rewind and Read-Write Operation

6. Periodically check the two nuts on the reel driven pulley shaft for tightness.

ADJUSTMENT, BELT TENSION

1. Loosen reel drive motor mounting screws and shift motor to obtain proper belt tension. (Motor mounting has slotted holes.)

2. Tighten motor mounting screws and recheck belt tension with the tape transport gate closed.

ADJUSTMENT, ARMATURE CLEARANCE (FIGURE 10)

Reel brake armature clearance should be adjusted when a brake becomes overly noisy (audible clacking). Clearance between the armature and the fixed part of the brake will increase with wear and will vary at different points around the brake due to uneven wear. The brake is adjusted by removing shims until the armature is as close to the fixed part of the brake as possible without touching at any point around the circumference.

Adjust the brake as follows:

1. Remove the reel drive belt.

2. Remove two nuts and two washers from reel shaft and remove reel pulley.

3. Remove the brake cover held in place by four screws.

CAUTION

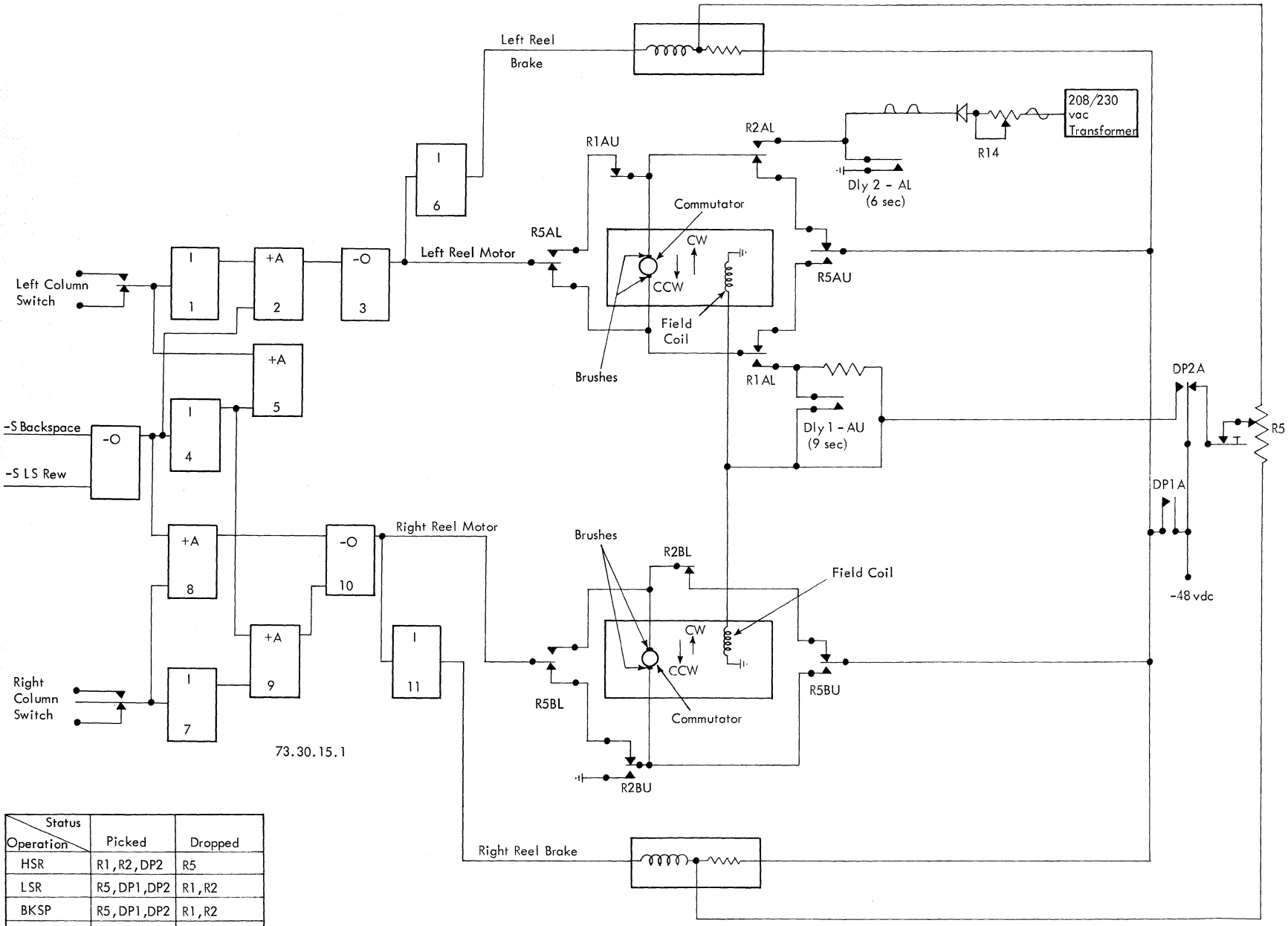
There may be magnetic particles inside cover. Do not allow these particles to spill into the tape unit. Clean the brake assembly to remove all metal particles before reassembly.

4. Remove spacer.

5. Remove key holding hub on the shaft, and slide armature and hub off of the shaft.

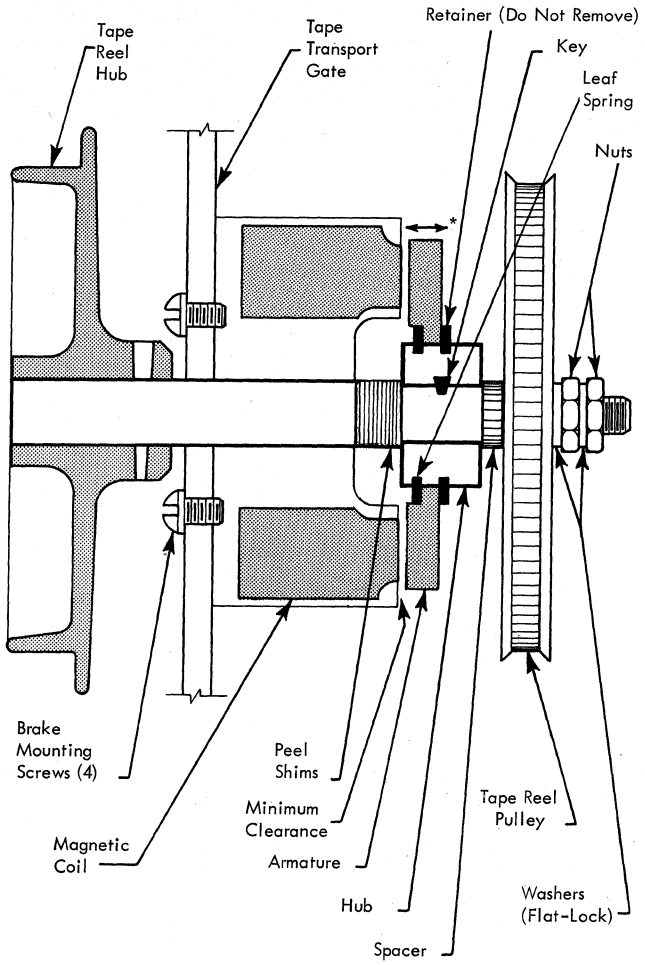
6. Remove shim.

7. Replace armature and hub, spacer, pulley, washers, and nuts to check whether armature touches fixed part at any point around its circumference. Hand



Operation \ Status	Picked	Dropped
HSR	R1, R2, DP2	R5
LSR	R5, DP1, DP2	R1, R2
BKSP	R5, DP1, DP2	R1, R2
R-W	DP1, DP2	R5

Figure 9. Tape Reel Motor and Brake Circuit



* Left and right movement

Figure 10. Tape Reel Brakes

pressure on the hub is not sufficient to check this portion of the adjustment.

8. Repeat steps 5 through 7 until armature rubs on fixed part of brake. Add the minimum amount of shims that will permit the armature to turn without touching the fixed part of the brake.

Early models of the 7330 tape unit employ a peel type shim in the magnetic brake. The peel shim looks like a single large shim but is actually made of very thin leaves pressed together. Leaves can be peeled off this shim by using a pocket knife.

When leaves are removed from a peel shim, they cannot be reused; instead use one or more of the following shims:

0.002 inch, P/N 383913
0.003 inch, P/N 383914
0.020 inch, P/N 383915

Later models of the 7330 tape unit employ the type shims listed above and these can be removed and replaced as required.

BRAKE REMOVAL AND REPLACEMENT

1. Remove reel hub from brake shaft at front of tape transport.
2. Disconnect brake leads.
3. Remove brake mounting screws from front of tape transport. Slide assembly from rear of unit.
4. Replace in reverse order.

High-Speed Rewind

Service Check

1. Condition the machine to rewind a full reel of tape at high speed. The slack tape in the columns should be taken up at slow speed for six seconds and at an intermediate speed for an additional three seconds. Then the drive should go into high-speed rewind. About 2.2 minutes are required to transfer a full reel. At the end of high-speed rewind, partial brake should be applied to the left reel and partial brake to the right reel. Adjust the reel brakes so that, when the reels stop, tape is not hanging in a loop between the reels. The reels should not stop with tape stretched excessively tight between the reels. Check this condition by pressing the reel release key. The counterclockwise movement of the left reel should be only slightly noticeable. Reel movement greater than ⅛ inch at outer edge of reel indicates that R5 is maladjusted. Figure 6 shows the tape path for a high-speed rewind.
2. Check for installation of EC 251864 and 251022.
3. Check for mechanical drag on tape reel hubs and brakes. Pulleys and belts should be checked for alignment. These malfunctions may cause a slow intermediate speed. If speed is still not corrected, change timer 1, position 6 to 9 and/or change R13 from 25 to 15 ohms.

ADJUSTMENT

1. To adjust the slack take-up speed, load the machine with a full file reel and raise the load rewind arm leaving slack in the vacuum columns.
2. Press the high-speed rewind switch.
3. With timer 2 on the relay gate set for a six-second delay (Figures 32, 33), adjust the high-speed rewind potentiometer R14 (Figures 47, 48) to remove all slack tape from the columns during the six-second delay.
4. Adjust timer 1 on the relay gate for a nine-second delay before the motor takes up tape at its maximum speed (Figures 32, 33).

NOTE: Adjustments 3 and 4 are not done on machines with S/N 16203 and above (Figure 42).

5. Adjust potentiometer R5 (Figures 47, 48) to provide minimum tape slack when a high-speed rewind is ended. See Figure 9 for brake circuit.

Vacuum Columns

Service Check

1. Clean vacuum columns with a clean felt pad dampened with water. Repeat with a clean felt pad dampened with tape cleaner.

2. Inspect hinged column doors for chipped or cracked glass and improper fit that could cause vacuum leakage.

To test a vacuum column for leaks, attach one end of a piece of magnetic tape to the outside of the column with cellulose tape. Attach other end of tape to a gram gage and loop the tape in the column. Insert another short length of tape in opposite vacuum column, tape both ends to the column to simulate a column-loaded condition, and lower the rewind arm. With vacuum up, a minimum force of 150 grams should be read on the gram gage.

NOTE: Vacuum column leaks may cause intermittent errors.

3. Inspect column idlers (Figure 24) for freedom of movement and proper adjustment. Improper adjustment of a column idler can be noted by an oxide accumulation on the inner surface of the column or the glass door.

CAUTION
Do not remove a column idler unless absolutely necessary.

4. Remove tape oxide from column idlers by means of a cloth moistened slightly with cleaner. Do not use excessive cleaner as it will leach oil from the permanently lubricated bearings.

ADJUSTMENT

A vacuum column door may require adjustment when a new glass is installed or when sufficient vacuum cannot be obtained. To adjust a column door:

1. Loosen the screws that hold the door hinges to the underside of the column.

2. Position the door for a close fit at all points and tighten the hinge screws.

3. Test the door fit by inserting a 0.003 inch feeler gage between the edge of the column and the glass at various points of contact. With the door closed, there should be a drag on the gage at all points.

If a column idler is replaced, adjust it by trial until the tape tracks properly within the column.

Pressure-Sensitive Column Switches (Figures 11, 25)

Four pressure-sensitive switches are located on the rear of the tape transport next to the tape reel pulleys.

SERVICE CHECK

1. Inspect the pressure-sensitive switches for dirty, loose, or misaligned contacts.
2. Check diaphragm for cracks.

ADJUSTMENT

The vacuum switch push rod should have 0.016 inch clearance between the adjusting nuts and the transferring contact strap with no vacuum applied. Position the adjusting nuts, as required, to obtain this condition.

REMOVAL, VACUUM SWITCH

1. Turn off all power to tape unit.
2. Remove the reel pulley shield.
3. Snap off switch cover.
4. Remove wires and plastic tubing from switch.
5. Remove switch mounting screws.

NOTE: Some components of these switches can be replaced without removing the entire assembly.

Tape Cleaner Blade

Figure 12 shows the top and side view of the tape cleaner blade in the 7330. The mounting bracket is held to the left vacuum column by a set screw. The blade is held to the bracket by a locating pin and two screws.

CLEANING

Refer to step 12 under "Tape Transport Cleaning."

REMOVAL AND REPLACEMENT

1. To remove the blade, remove the two screws that hold the blade to the mounting block and lift out blade.
2. When replacing blade, make sure the blade is parallel to the mounting block.
3. After installing a new blade, start and stop tape. If tape shifts front to rear at the left vacuum column, adjust blade so that this does not occur.

CAUTION
Do not push on top of blade.

Motors

The motors used in the 7330 have permanently lubricated bearings. They require no further lubrication.

The vacuum motor is located in the vacuum blower case. The motor and blower are replaced as a single unit.

SERVICE CHECK

1. Check all motor shafts for binds by removing the drive belts and spinning each shaft by hand. They should coast to a smooth stop. Bent shafts can also be detected by turning shafts by hand through 360 de-

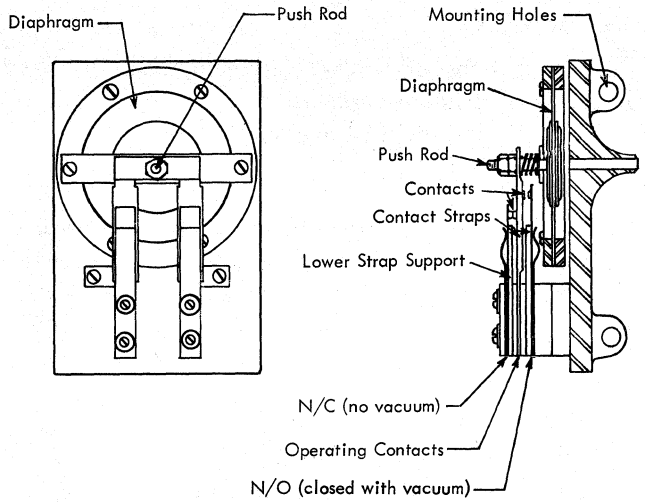


Figure 11. Vacuum Column Switch

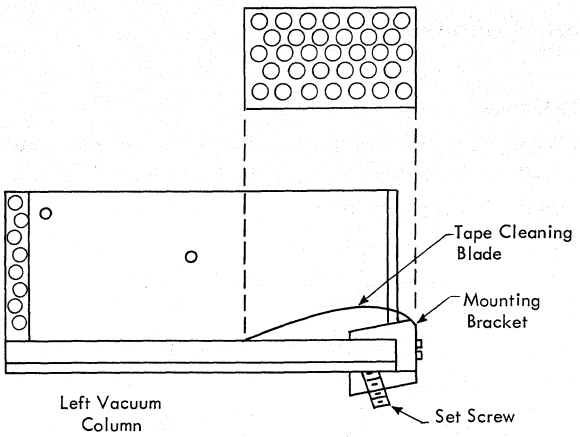


Figure 12. Tape Cleaner Blade

grees and feeling for sticking and dragging.

2. Check all pulleys for tightness on their shafts.

3. Inspect all drive belts for wear and tension. Drive belts should not be tight. The timing belts utilized in the 7330 tape unit tend to bind if too tight. They should be checked for adjustment as specified below.

ADJUSTMENTS

For adjustment of the tape reel belt tension and the capstan belt tension, refer to "Reel Drive System" under "Adjustment, Belt Tension" and "Capstan Drive Assembly, Adjustment."

For machines above s/N 16675, adjust vacuum motor input voltage for 187 VAC. This is done by varying R1 (Figure 48) with power off.

Photosensing

The load point and end-of-tape photocells and lamps are located in a block in the upper head assembly (Figure 24).

SERVICE CHECK

To check the load point photosensing, load the tape unit, making sure the load point reflective spot is well to the right of the head assembly. Press low-speed rewind key on tape unit. The tape should stop when the load point reflective spot is sensed, as it passes over the head assembly.

End-of-tape photosensing can be checked by operating the tape unit in write status until the end-of-tape reflective spot passes over the head assembly. When this occurs, the tape indicator lamp should turn on.

To aid in testing and servicing the photocell sensing circuits, place an end-of-tape reflective spot about two feet from the load point spot on tape. This will eliminate the time wasted in reaching the end-of-tape spot on a full reel of tape.

Check wiring of potentiometer R16. Wires on terminal A and the center tap may be reversed.

ADJUSTMENT

1. Adjust the variable resistor, R16, located in the relay gate 7, to obtain 5 ± 0.5 VDC across the series combination of the load point and tape indicate lamps (Figures 33, 34, 35, 42).

2. With the rewind arm raised and the tape taut (Figures 5, 7), the entire width of the photocell block should be approximately 0.020 inch from the tape. The block will be approximately parallel lengthwise with the tape.

PHOTOCELL REPLACEMENT

When a photocell is replaced in the block, align the cell so that its eye is parallel to the edge of tape.

Door Interlock Switch (Figure 25)

SERVICE CHECK

1. Check switch operation to see that contacts open when door is opened.

2. Close tape unit door and check to see that the switch actuating lever is resting on the flat, not the slope, of the actuating rod.

The adjustable stud at the end of the actuating rod should not extend so far that the actuating rod does not have overtravel when the door is closed.

ADJUSTMENT

1. Loosen locking nut on stud.

2. Turn stud to provide proper operation of the actuating rod and the switch as outlined above.

3. Tighten locking nut and recheck adjustments.

Door Latch (Figure 21)

SERVICE CHECK

Check door latch for sufficient tension to prevent door interlock pressure from forcing door open.

ADJUSTMENT

1. Adjust the latch stop so that roller strikes the stop when the door is closed.
2. Adjust latch roller tension so that it overcomes door interlock pressure when the roller is just over the high point of the latch stop detent. Avoid excessive tension on the latch roller.

NOTE: If tension is still too strong with a minimum adjustment, cut spring.

File Protect Mechanism (Figures 21, 25)

SERVICE CHECK

1. With tape unit power off, inspect the file protect plunger and relay armature for freedom of movement.
2. Clean and lubricate sparingly with IBM 6 oil.
3. Mount a reel containing a plastic ring insert, and with power off, check that the NFP1-A contacts have a minimum of 0.005 inch overtravel.
4. Turn on power and, with the NFP1 relay energized, check for a minimum clearance of 0.060 inch between the plunger and the plastic reel insert.

ADJUSTMENT

1. Loosen the relay mounting screws and position the relay to obtain proper adjustment.
2. Tighten mounting screws and recheck adjustments.

Air Filter

The air filter is located in the top of the tape unit directly behind the indicator panel (Figure 23).

SERVICE CHECK

Inspect the filter for dirt; replace if dirty.

REMOVAL

To remove the filter, swing the tape transport gate open and raise the indicator panel by rotating it outward and upward on its hinges. The filter is held in place by two clips. Loosen the two screws, turn the clips aside, and remove the filter.

Power Supplies (Figures 45, 46, 47, 48)

The 7330 tape unit utilizes 3-phase 208 or 230 VAC ± 10 per cent at the tape frame, at 60 cycles per second ± 0.5 cycles. On machines below S/N 16203, the input voltage is stepped down to 110 VAC for the blower, timer, and vacuum motors. On machines above S/N 16202, these motors operate on 208 or 230 VAC.

For a 7330 tape unit to be used with 230 VAC input, the wiring changes necessary are:

1. Move wire on TB-4 to TB-5 located on the ferroresonant transformer in the −48 VDC power supply (Figures 47, 48).
2. Move wire on 2 to 3 terminal of the isolation transformer (P/N 556643) in the −48 VDC power supply.

NOTE: This step is not done on machines with S/N 16203 and above. These machines do not contain this transformer.

3. For machines, serial numbers 13144 and below, having the old type ±6, ±12 VDC power supplies (P/N 556751), move wire on TB2-10 to TB2-9 (Figure 46). For machines above this serial number having the new ±6, ±12 VDC power supply (P/N 337520), no wiring change is necessary.
4. If the capstan motor has only a 208 VAC input (P/N 594233), replacement is necessary with a 230 VAC motor (P/N 383945).
5. For identification of 230 VAC power input, place decal 352604 to the plate holding the Burndy power plug (Figure 23).

±6, ±12 VDC POWER SUPPLY

The ±6, ±12 VDC power supply is used for the transistor logic on the SMS cards and is regulated in the tape unit. These supplies are adjustable and each potentiometer is identified with the supply it regulates. The supplies may have a tolerance of ±0.5 percent. Figure 46 shows the old type supply (P/N 556751). The supplies should be adjusted while the unit is in the write status. The voltages should be read between the back distribution panel and the ground plane. Figure 45 shows the new type supply (P/N 337520).

−48 VDC POWER SUPPLY

The −48 VDC power supply is used for relay operation, lights, and the tape reel motors. It is fixed and cannot be adjusted (Figures 47, 48).

SERVICE CHECK

Inspect the power supplies for loose terminals, broken wires, damaged cables, and leaking or defective filter capacitors. Measure the output voltages from the various supplies and check the operation of the circuit breakers.

CLEANING

Use a vacuum cleaner to remove dirt from the power supplies and surrounding areas.

DANGER

Make certain that the capacitors are completely discharged before cleaning the supplies.

Fuse Bail (Figure 13)

The fuse bail is operated by a pin which is ejected from a fuse when it blows. The pin touches the fuse bail and the actuator activates the microswitch, opening the N/C contacts. This de-energizes R101 which in turn holds down ready status of the machine.

SERVICE CHECK

1. Check that the microswitch is actuated with a blown fuse placed into a fuse holder.
2. Check to see if relay 101 is de-energized and if the ready light goes out when the actuator activates the microswitch.
3. Check to see if fuses 1, 2, 3, are MIC 10. EC 252010 provides for this value.

ADJUSTMENT

1. Loosen the locking nut.
2. With the fuse bail touching the screw, turn screw until there is a 0.015 inch clearance between the fuse bail actuator and the microswitch key.
3. Tighten nut and check adjustment.

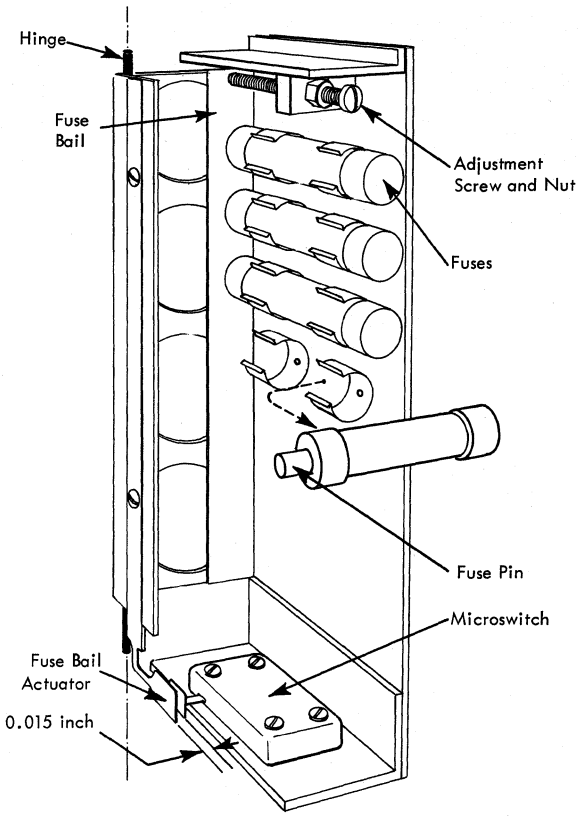


Figure 13. Fuse Bail

Physical Locations

This section consists entirely of photographs (Figures 14-48) of the 7330 Magnetic Tape Unit. In some cases close up views are given for greater detail. Each different aspect of various machines is shown with a photograph. The photographs are headed according to the respective serial numbers of the machines. Parts of the machine that have been changed are listed below:

Erase Head Bracket: There are two different types of erase head brackets. The original type is on machines with s/N below 16266, shown in Figure 24. The newer type is on machines with s/N 16266 and above, shown in Figure 22.

Transistor Power Supply: There are two different types of transistor power supplies. The original supply is on machines with s/N below 13144, shown in Figure 46. The newer supply is on machines with s/N 13144 and above, shown in Figure 45. The newer supply has been rearranged on machines with s/N 16203 and above, shown in Figure 31.

−48VDC Power Supply: The isolation transformer in the −48 VDC power supply has been eliminated and the supply rearranged. The original supply is on machines below s/N 16203, shown in Figure 47. The new type supply is on machines with s/N 16203 and above, shown in Figure 48.

Vacuum Blower: There are two types of vacuum blowers. The original type is on machines below s/N 16676, shown in Figure 25 and the newer type is on machines with s/N 16676 and above, shown in Figure 26.

Pressure Blowers: Two pressure blowers are used instead of one for the tape transport gate. The machines that use only one pressure blower are those below s/N 16203 and the machines with s/N 16203 and above use two pressure blowers, shown in Figure 31.

Magnetic Stop Slug: Some machines have a magnetic stop slug; others do not. The machines with s/N below 16203 do not have one (see Figure 27). The machines with s/N 16203 and above do have a magnetic stop slug, shown in Figure 28.

Timers: There are two types of timers. Adjustable timers and non-adjustable timers. The adjustable timers are on machines with s/N below 16203, shown in Figures 32 and 33. Non-adjustable timers are on machines with s/N 16203 and above, shown in Figure 42.

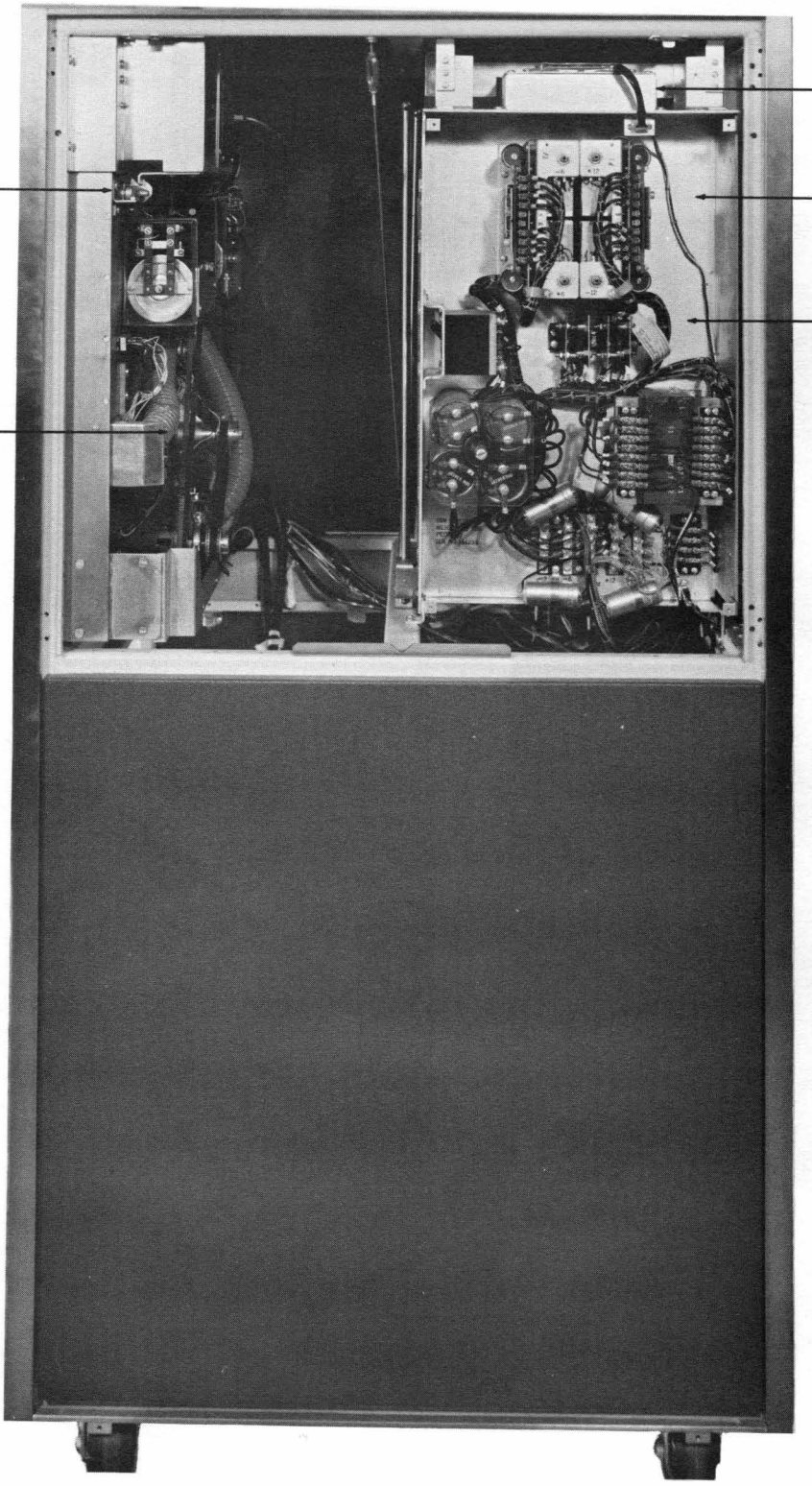
Cooling Fans: The fans used in the power supplies have been eliminated. Figures 45 and 47 show the supplies with the cooling fans. Figures 31 and 48 show the supplies without the cooling fans.

Component Locations: Engineering Change 252700 provides for the relocation of components within the 7330 Tape Unit. The change, incorporated in all machines beginning with s/N 18935 and above, includes the following:

1. The ±6v and ±12v transistor power supplies and 48 VDC power supply; these are mounted on one panel.
2. The relay gate; formerly housed in a vertically hinged gate, this is housed in a horizontal swinging gate. The SMS card gate is similarly housed.
3. The indicator panel; this is relocated on the tape transport gate.

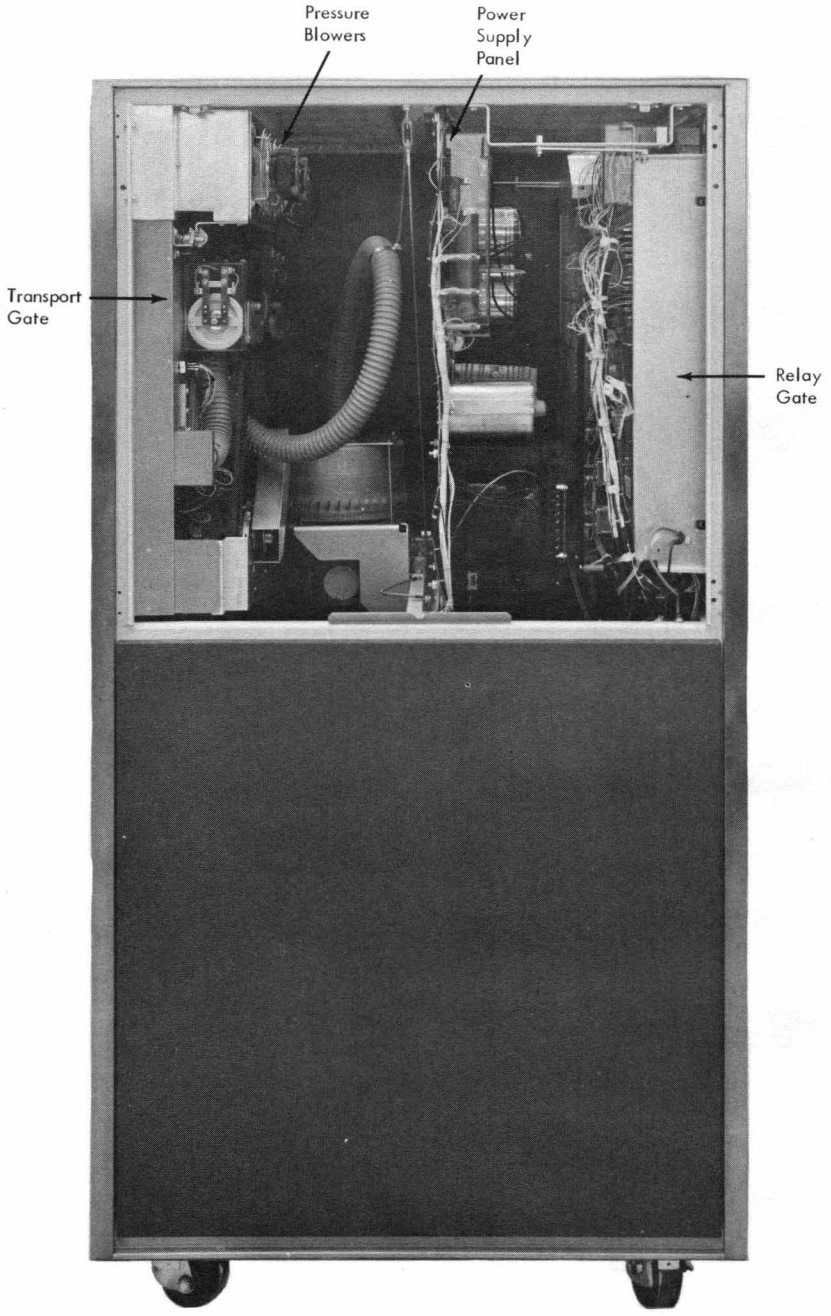
Machines Above S/N 18934

• Figure 14. Tape Unit – Front View



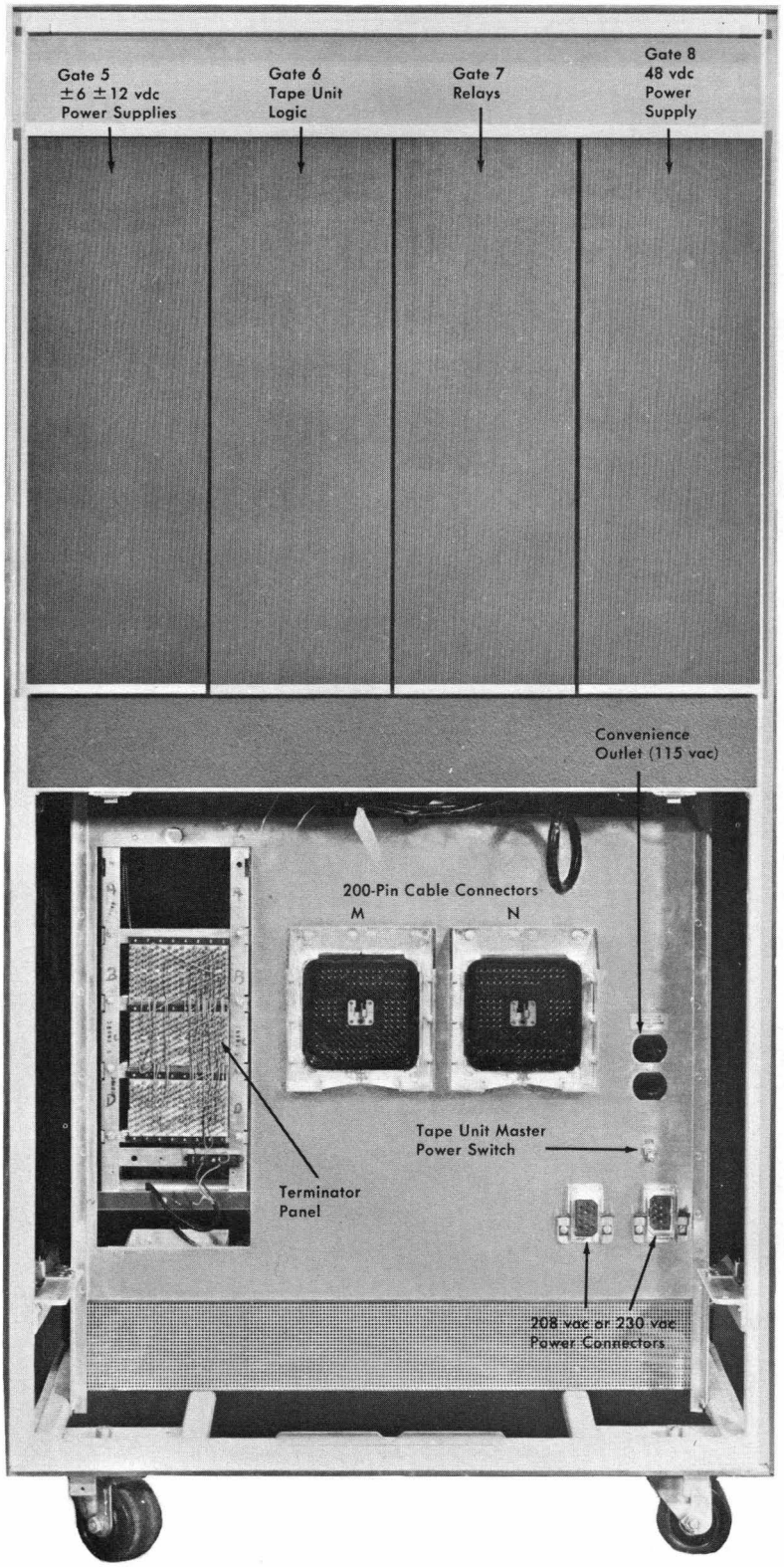
Machines with S/N 13144-16202

• Figure 15. Tape Unit – Right View



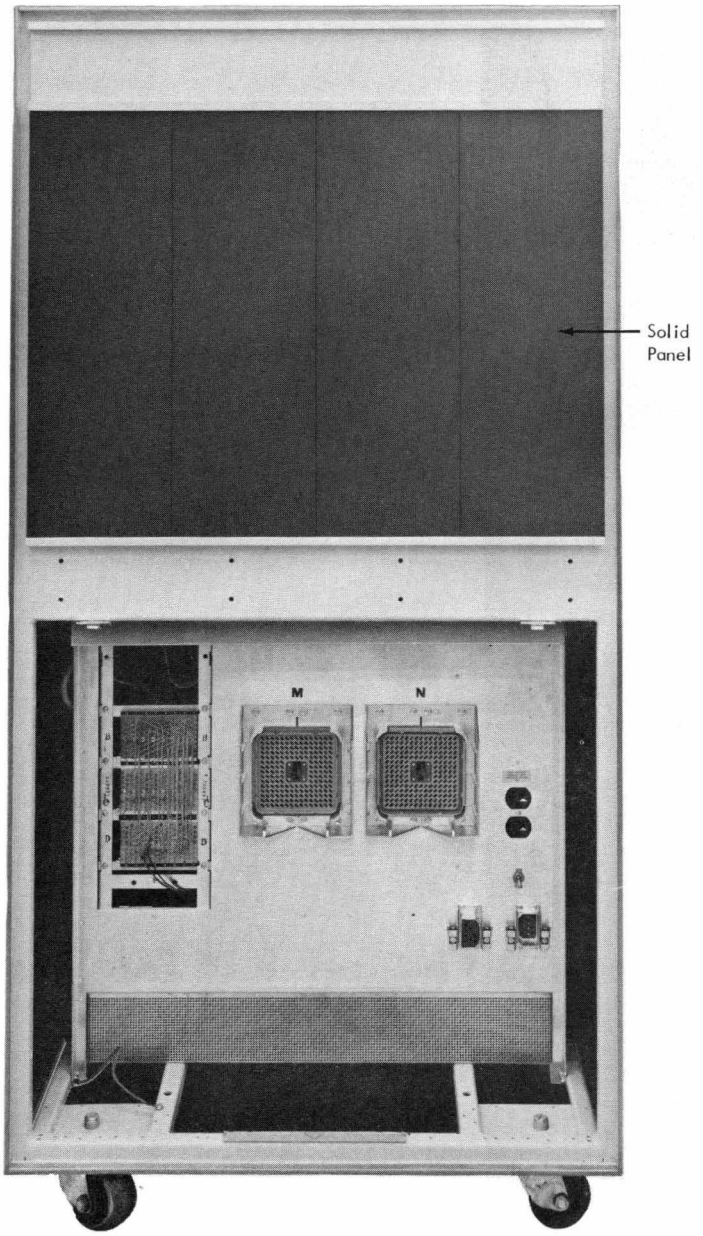
Machines Above S/N 18934

Figure 16. Tape Unit – Right View – EC 252700



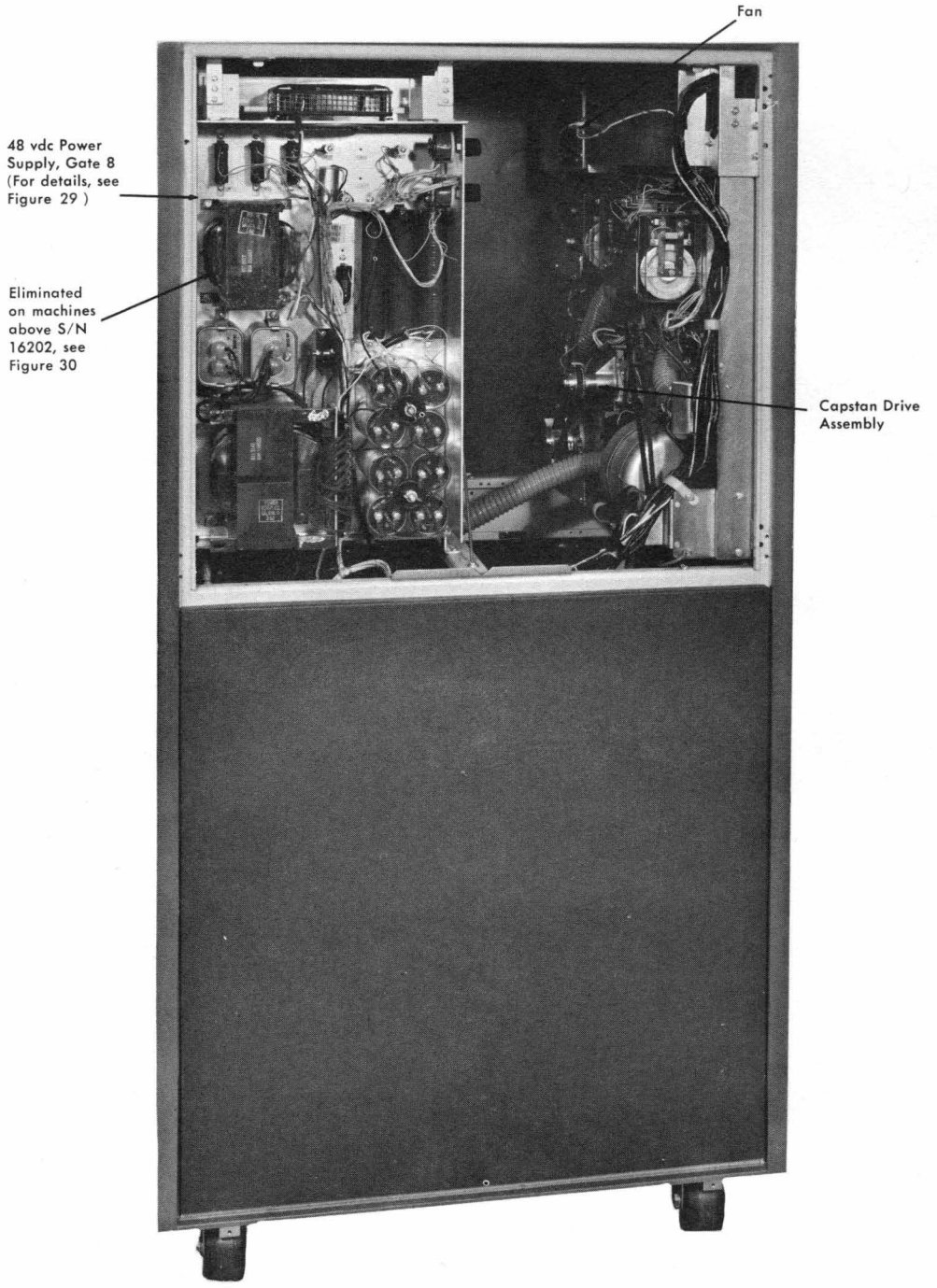
All Machines Up To S/N 18935

Figure 17. Tape Unit — Rear View



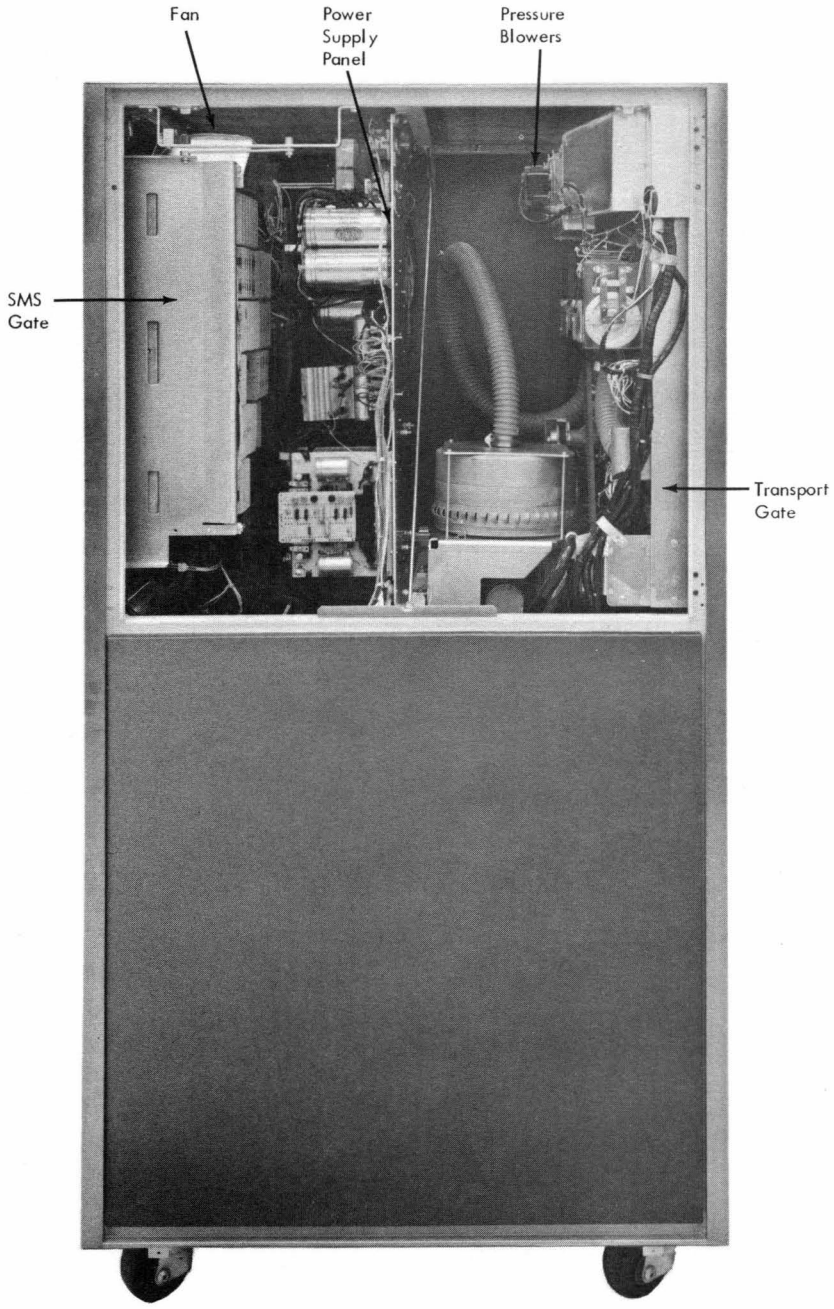
Machines Above S/N 18934

• Figure 18. Tape Unit – Rear View – EC 252700



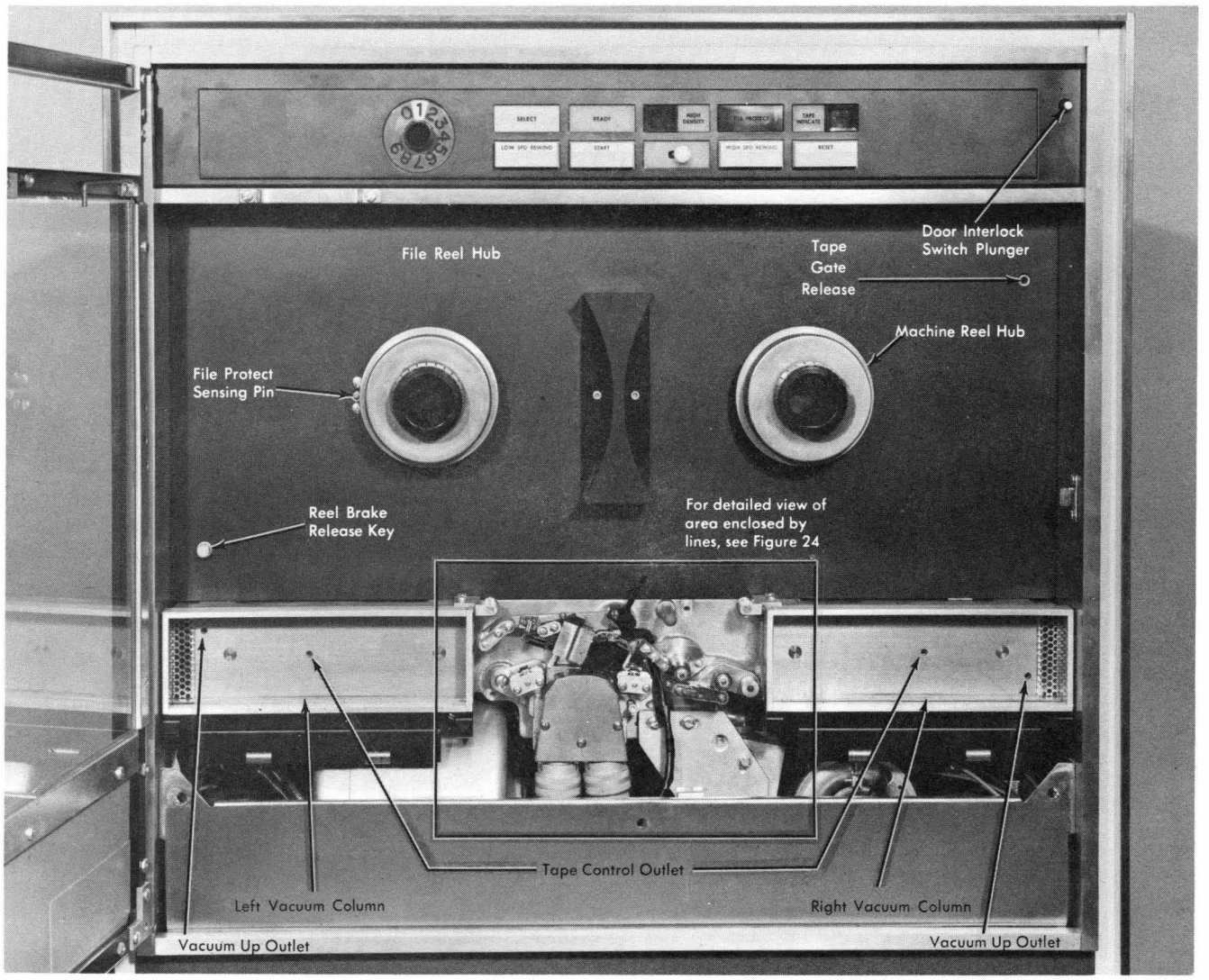
Machines Below S/N 16203

• Figure 19. Tape Unit – Left View



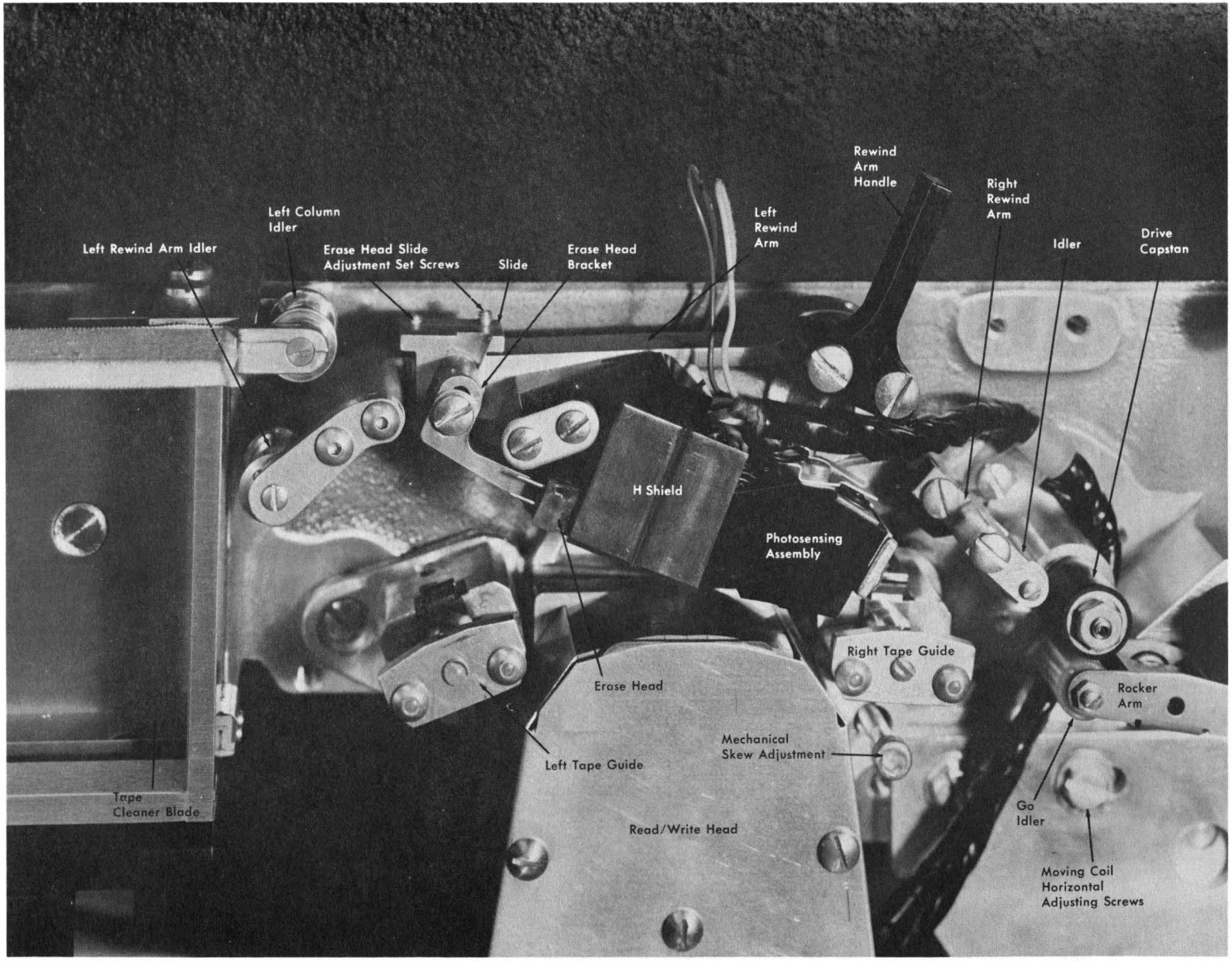
Machines Above S/N 18934

Figure 20. Tape Unit – Left View – EC 252700



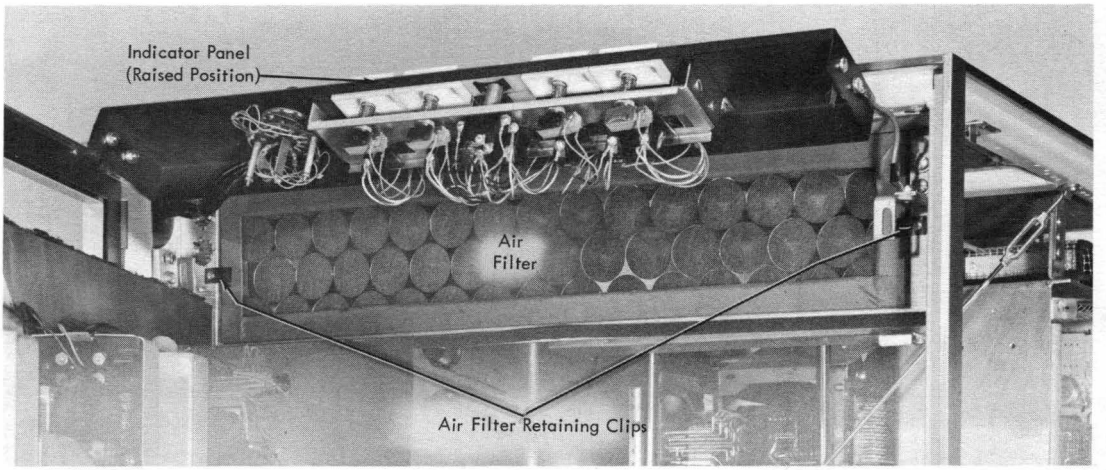
Machines Below S/N 16266

Figure 21. Tape Transport – Front View

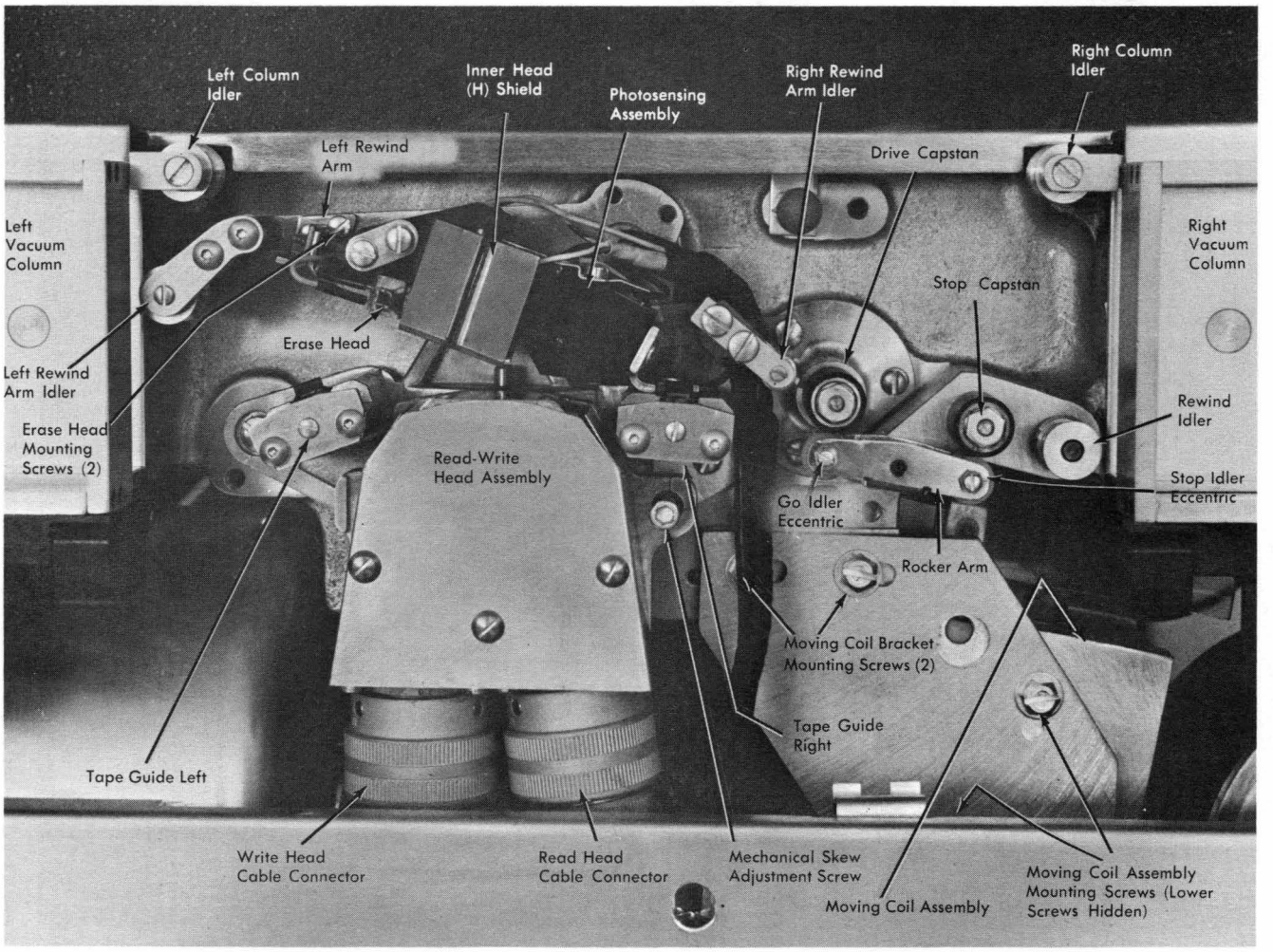


Machines Above S/N 16265

Figure 22. Erase Head Assembly

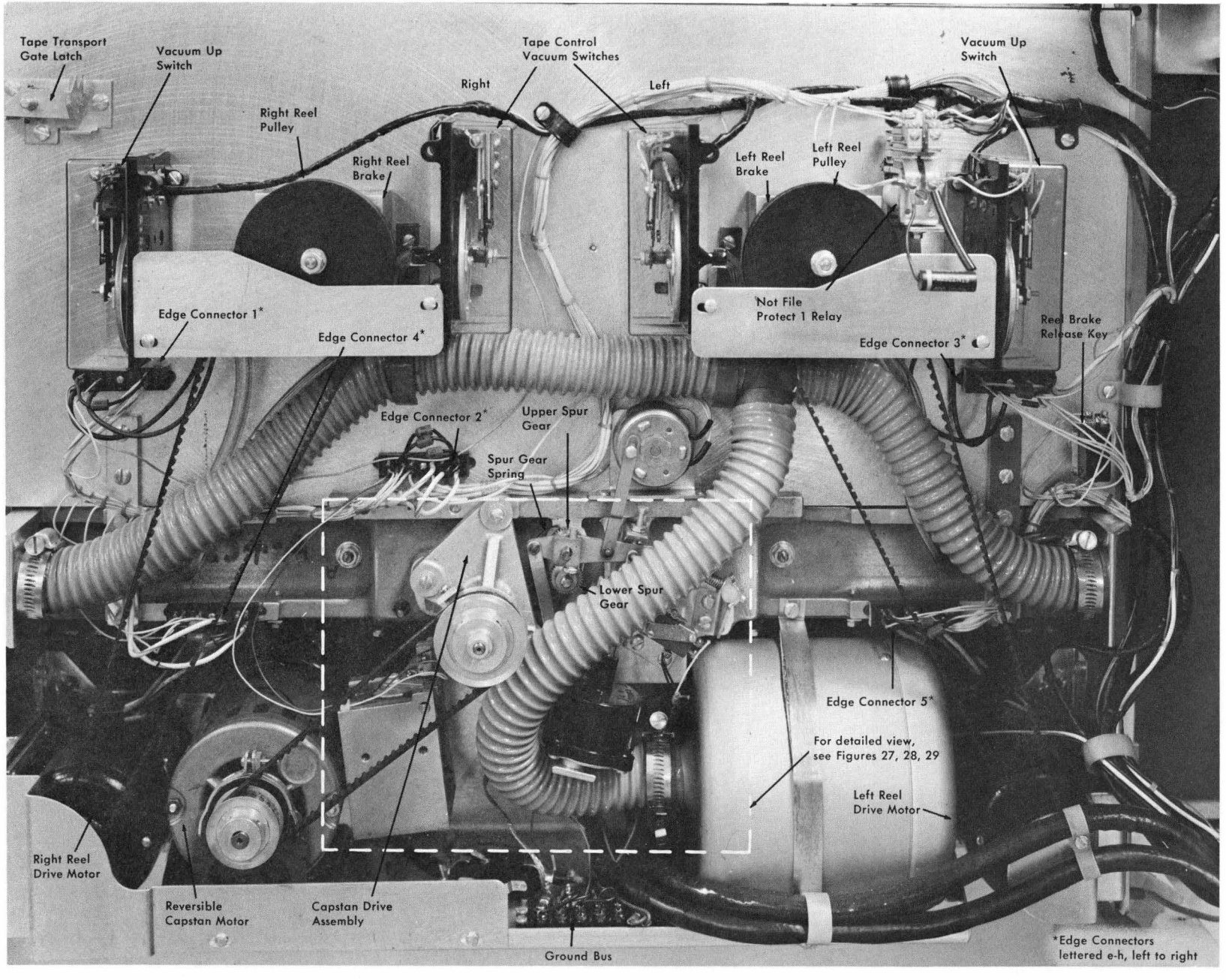


• Figure 23. Tape Unit — Upper Front View



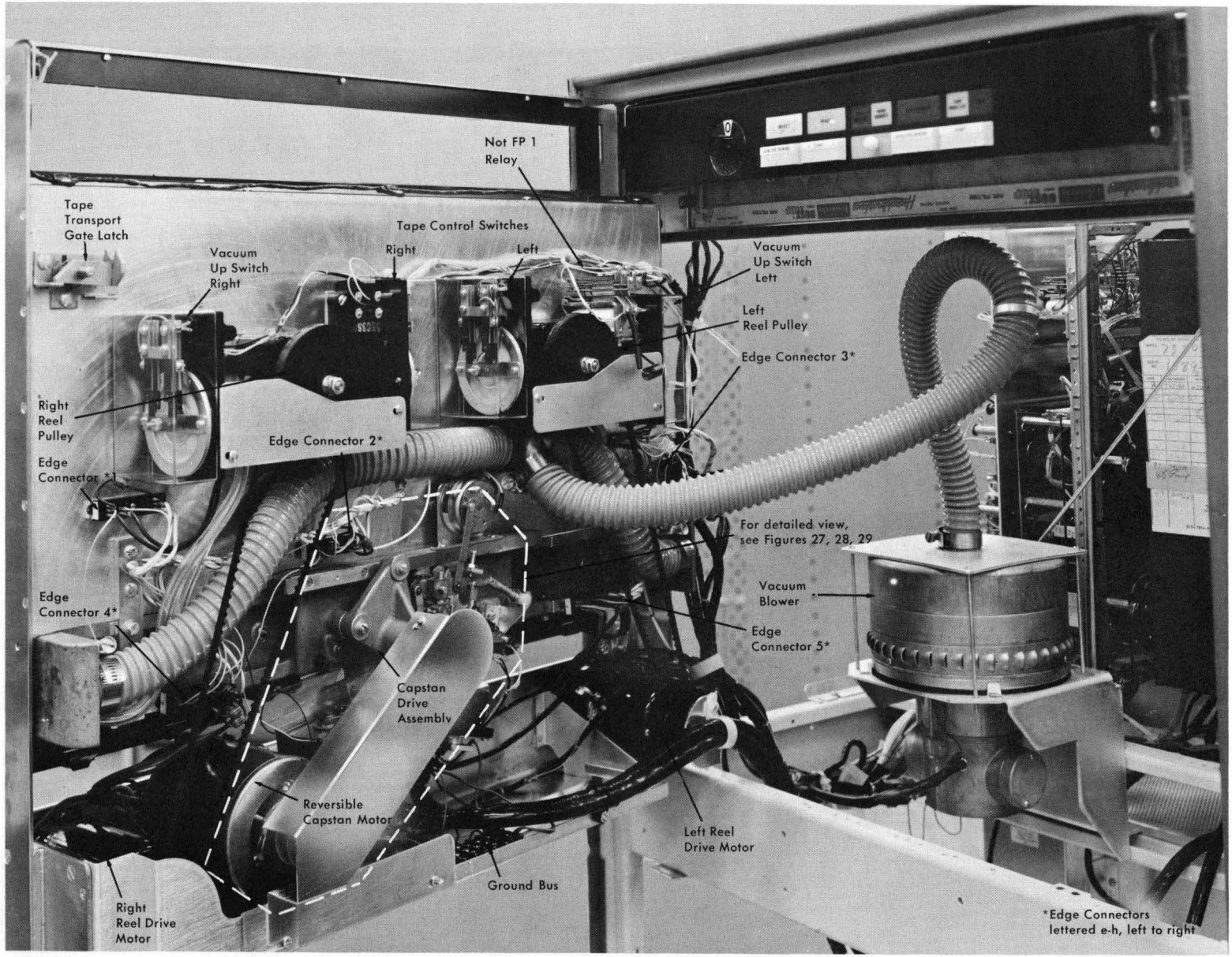
Machines Below S/N 1626(

• Figure 24. Tape Head Area — Arm Up



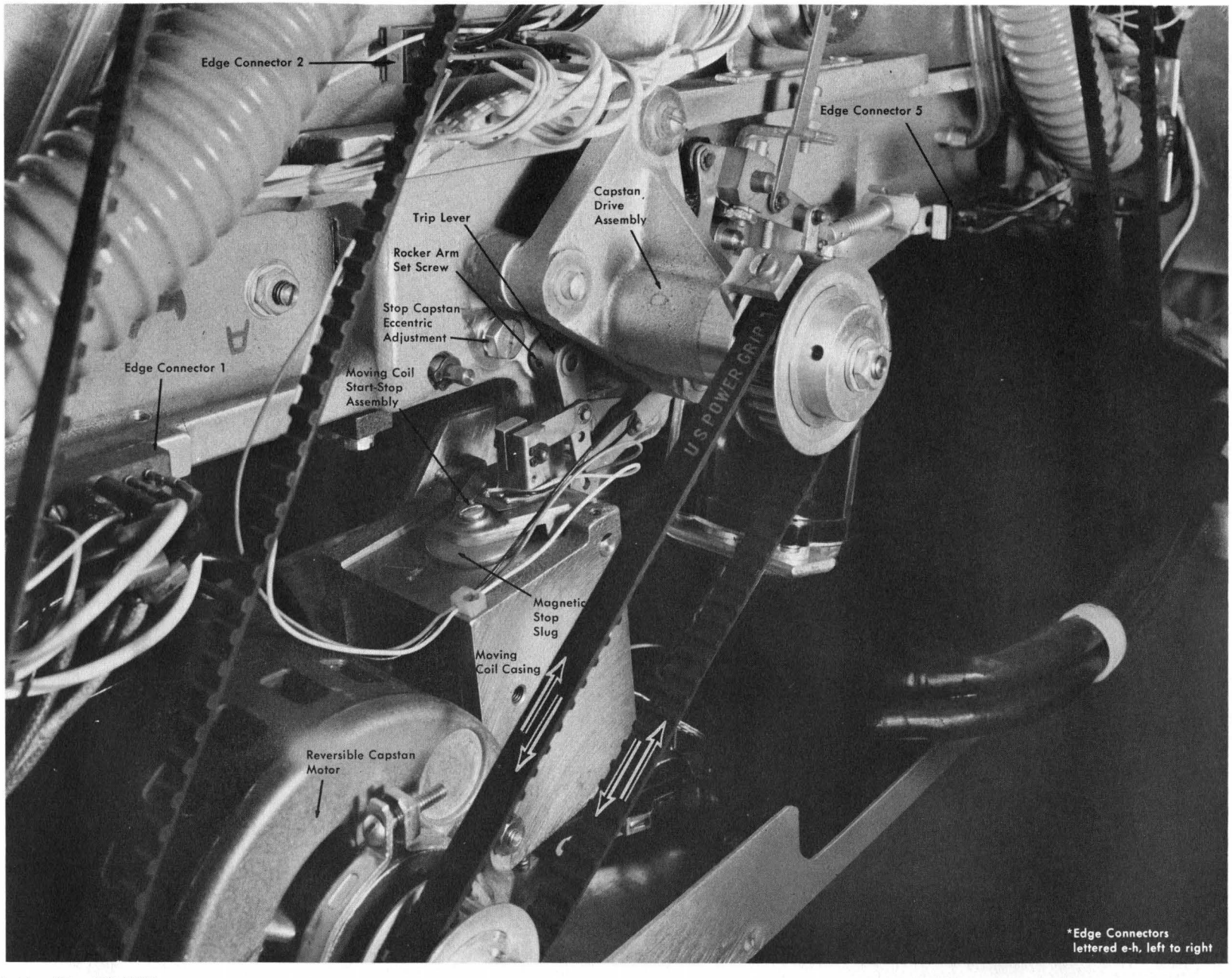
Machines Below S/N 16676

Figure 25. Tape Transport – Rear View



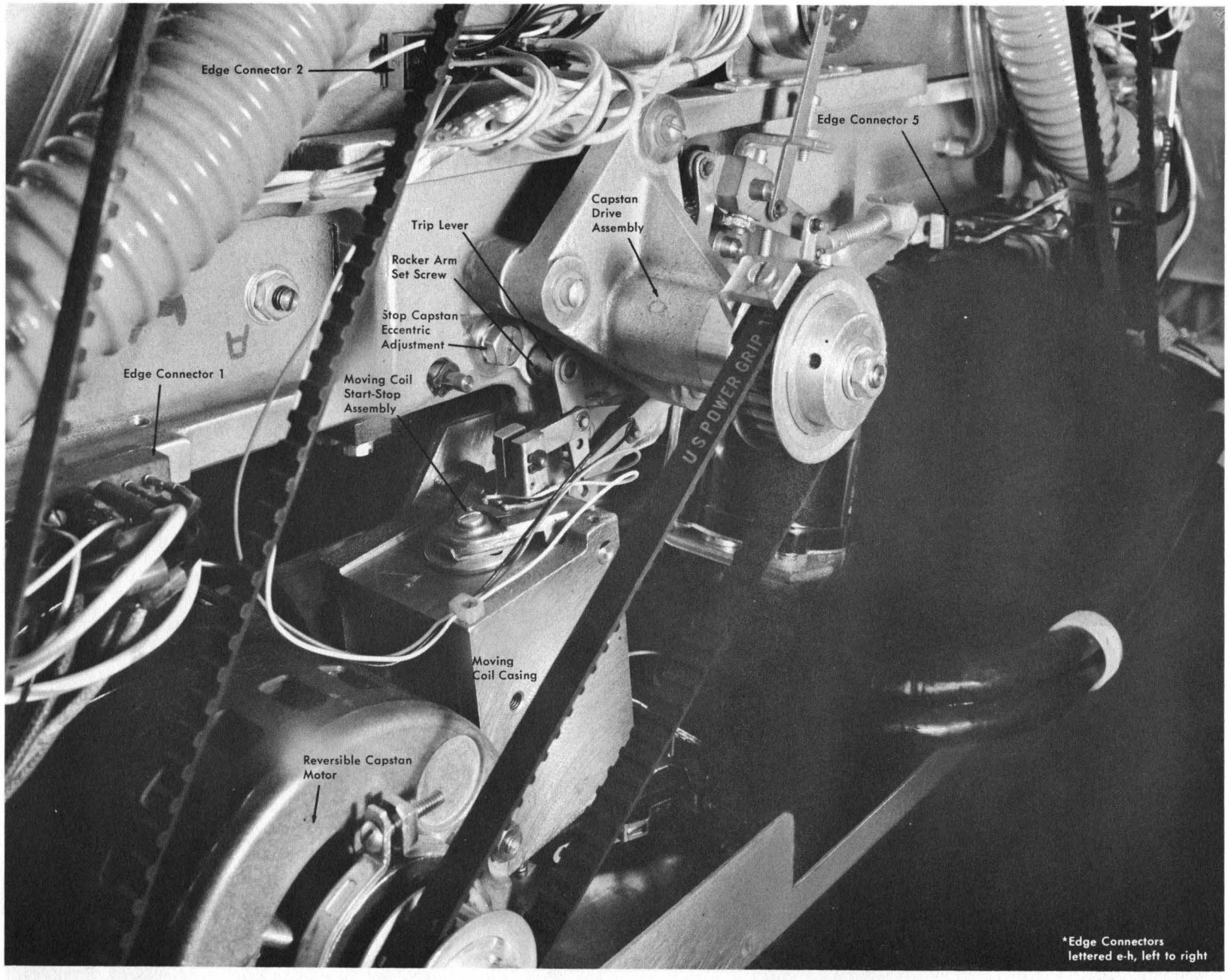
Machines Above S/N 16675

Figure 26. Vacuum Blower



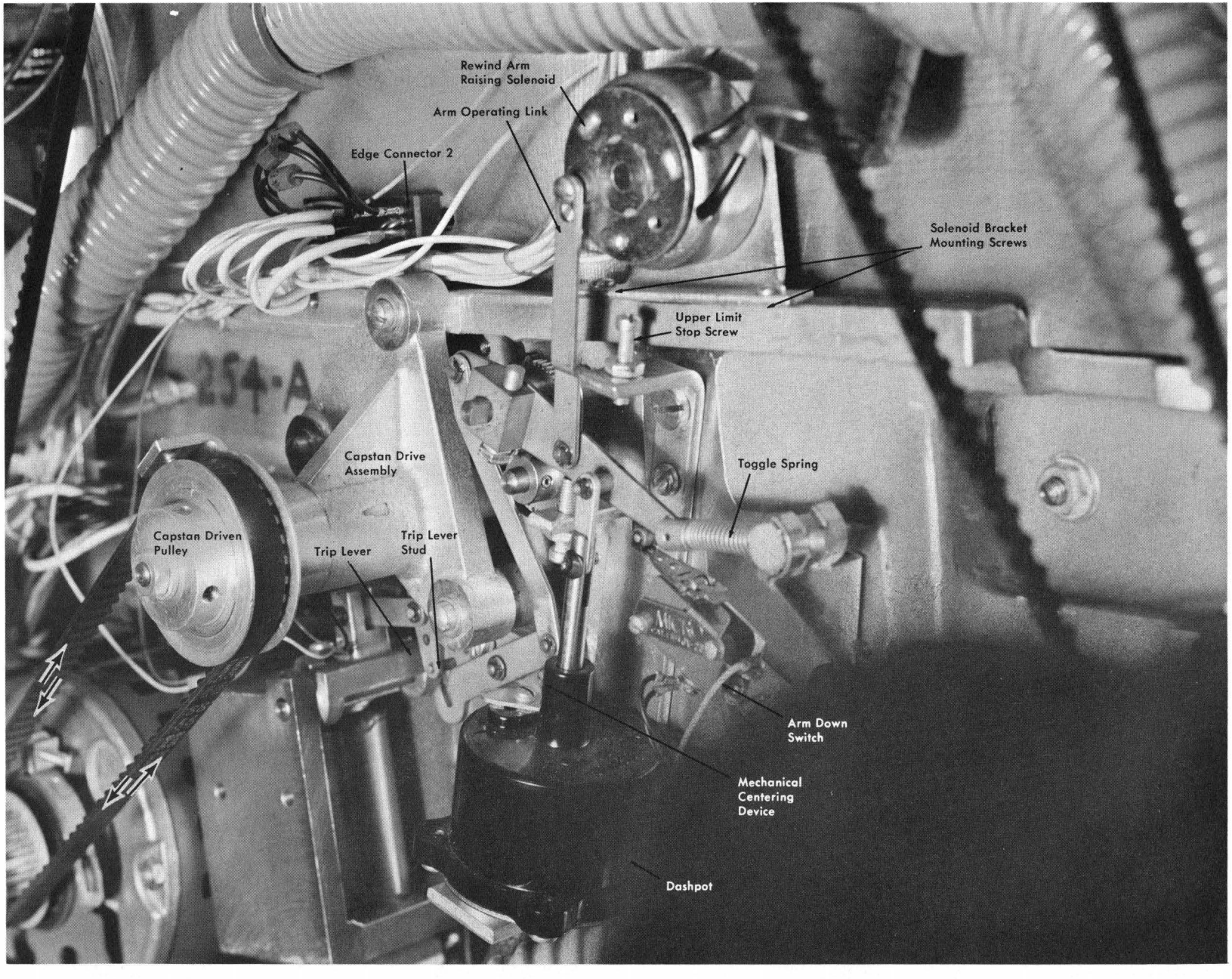
Machines Above S/N 16202

Figure 27. Moving Coil and Capstan Drive – Arm Down



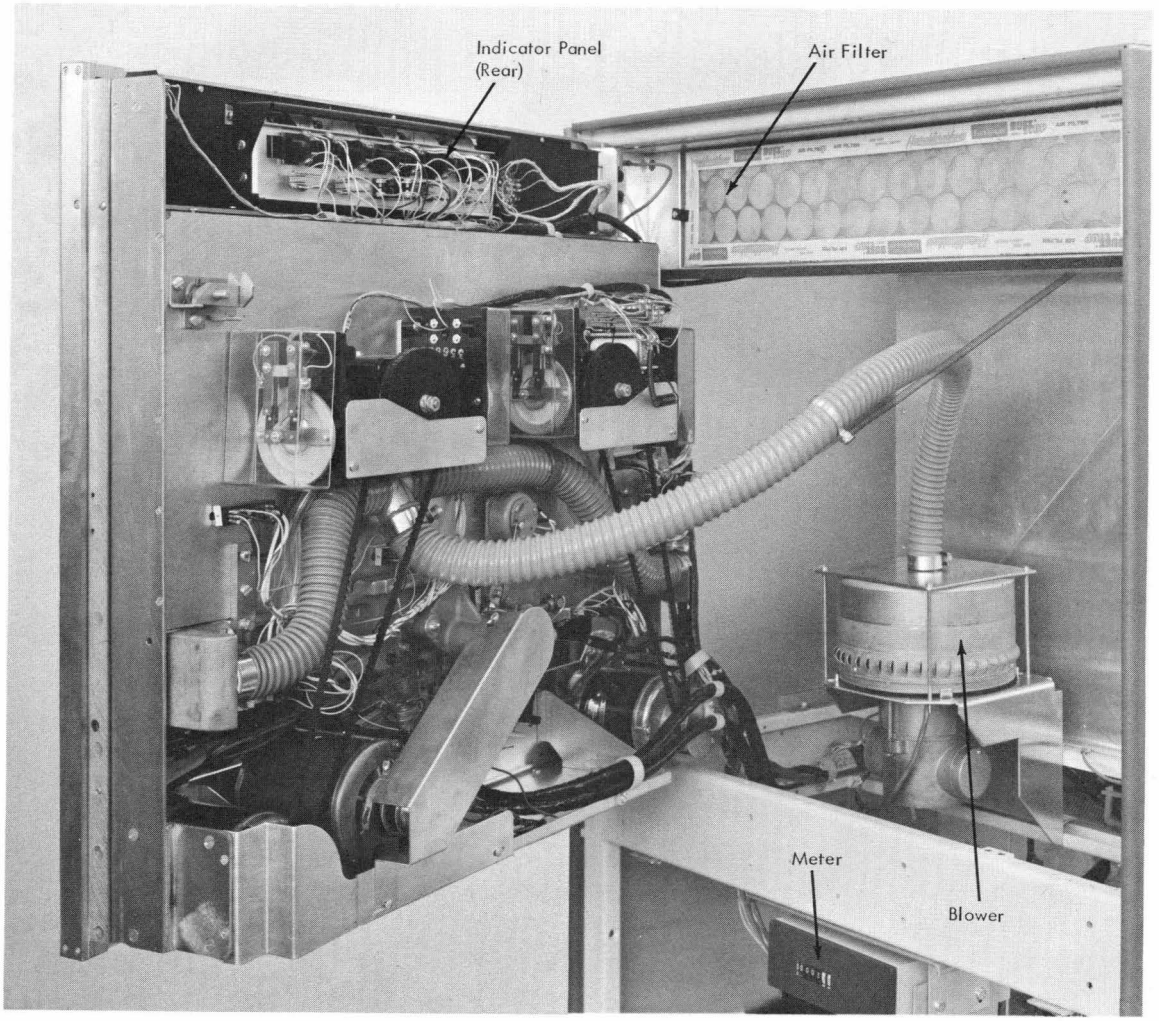
Machines Below S/N 16203

Figure 28. Moving Coil Stop Slug



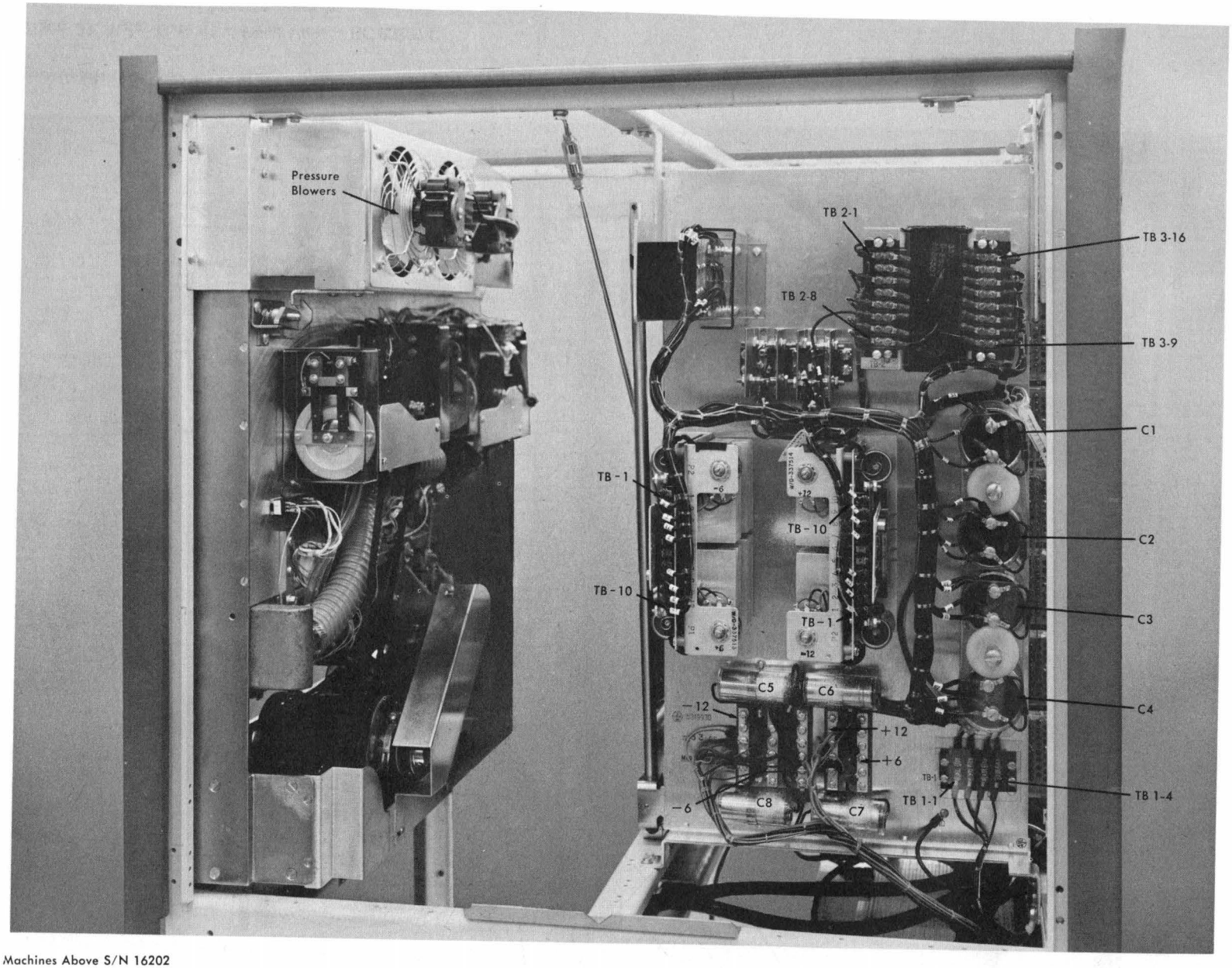
All Machines

Figure 29. Rewind Arm Linkage – Arm Down



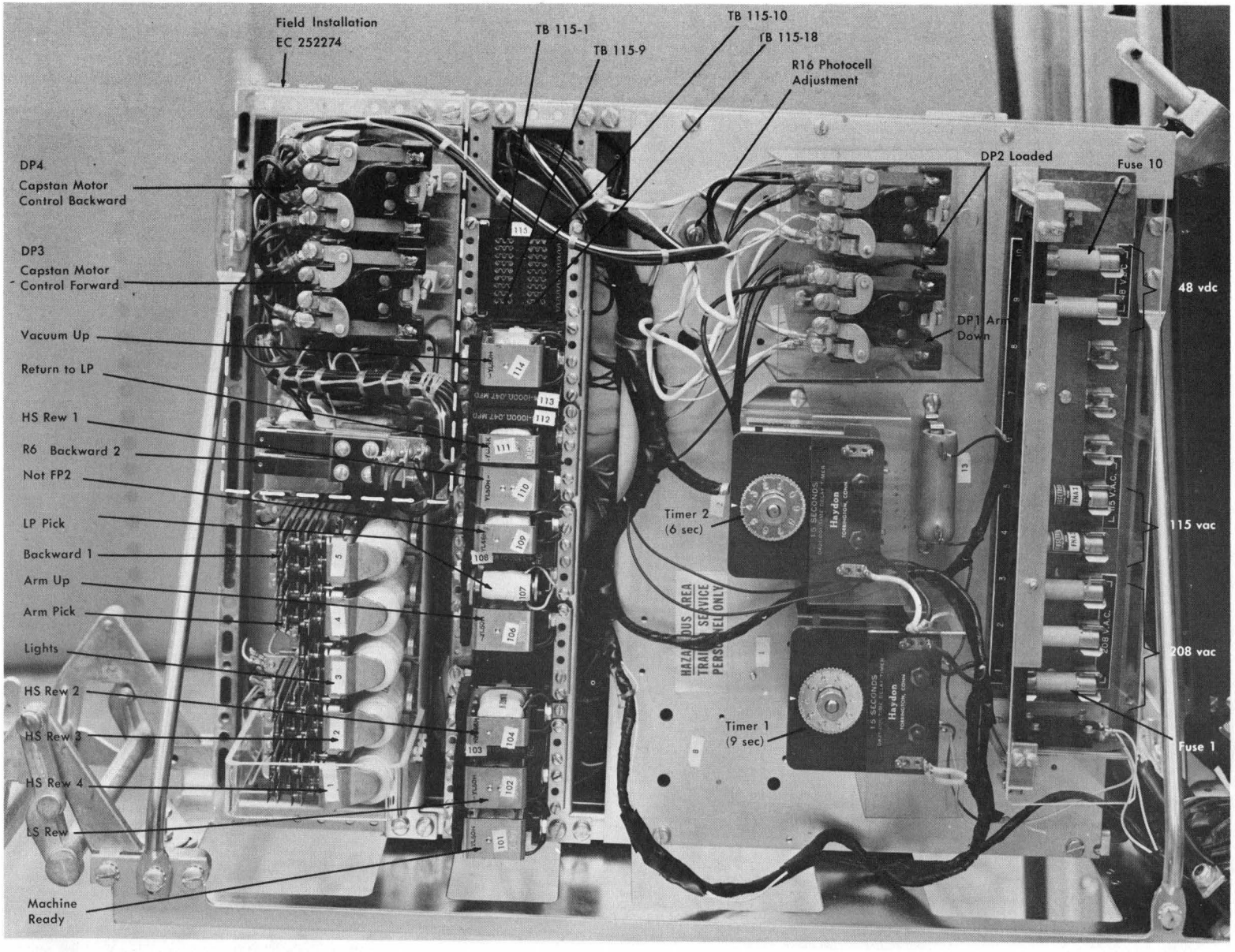
Machines Above S/N 18934

• Figure 30. Tape Transport Gate — Rear View



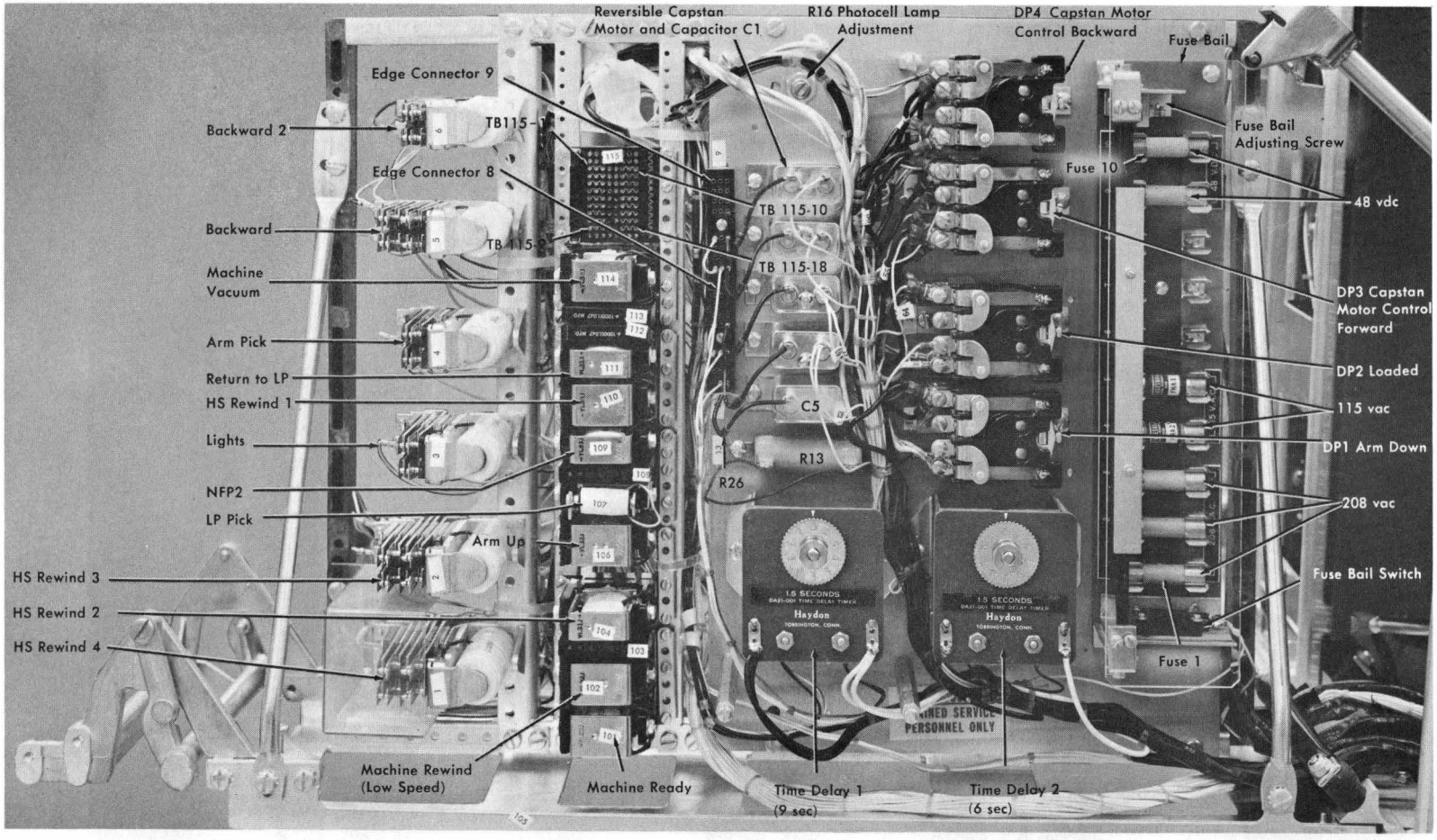
Machines Above S/N 16202

Figure 31. Tape Transport Pressure Blowers



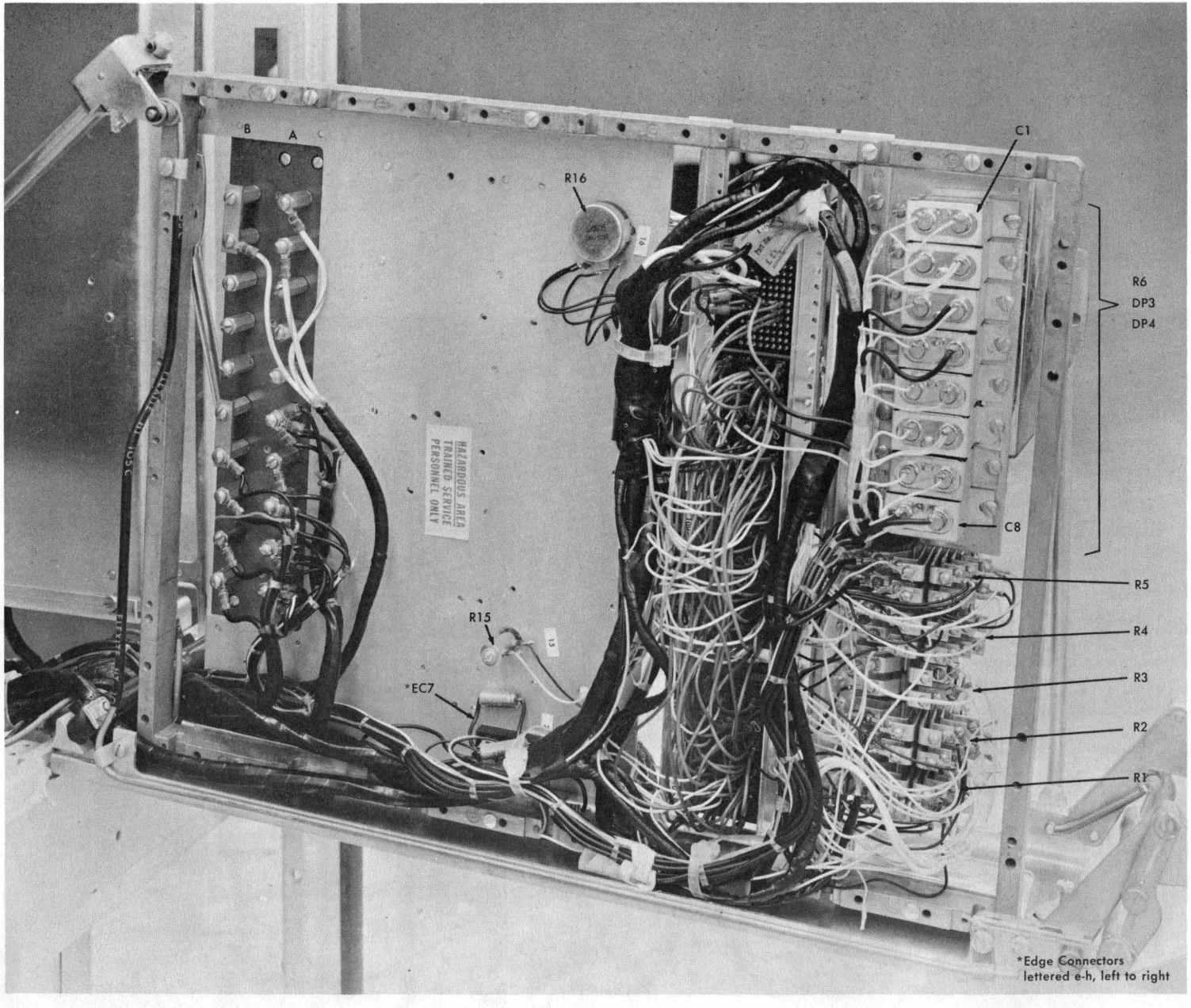
Machines Below S/N 14883 with EC 252274

Figure 32. Relay Gate A7 – Front View – EC 252274



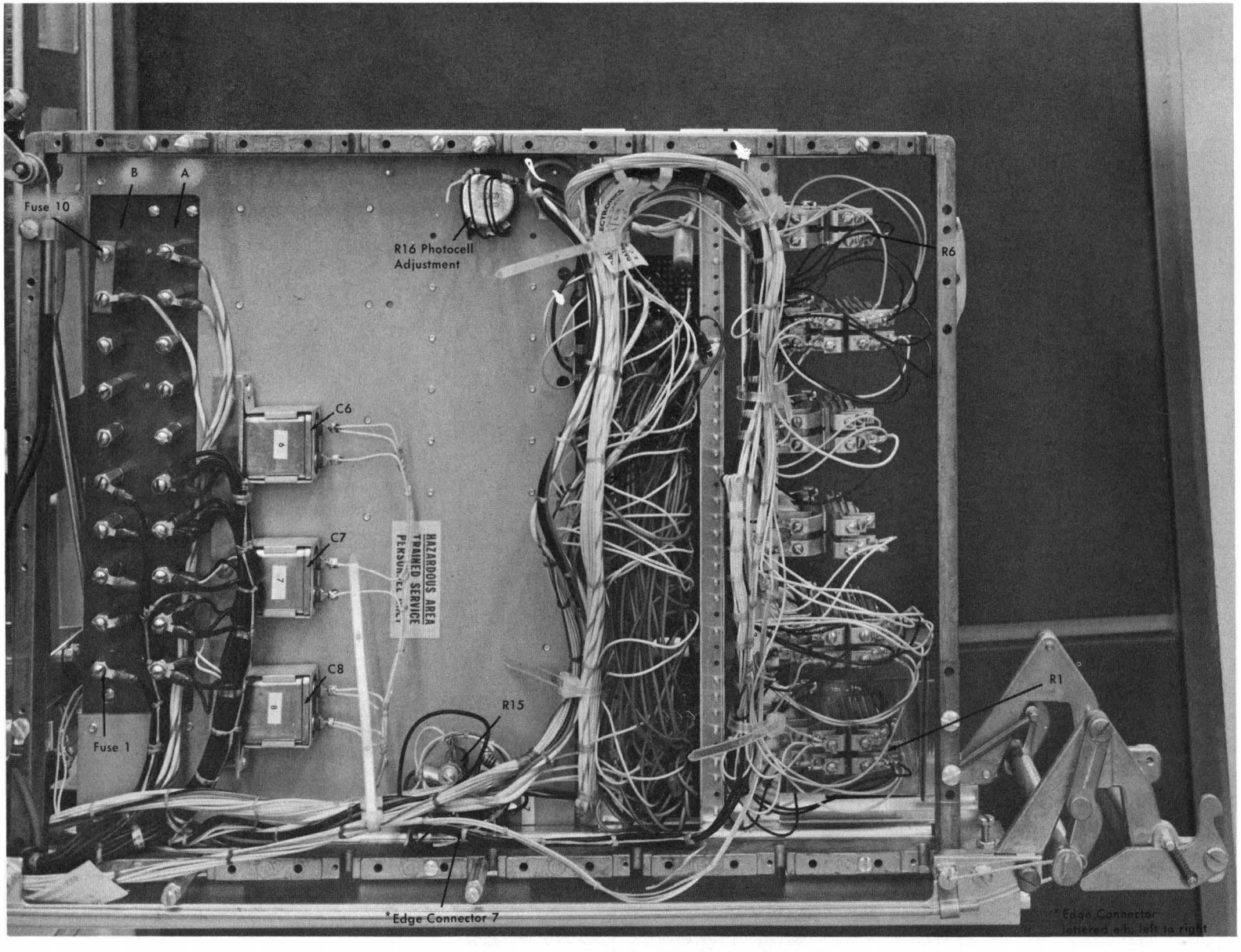
Machines with S/N 14883-16202

• Figure 33. Relay Gate A7 – Front View



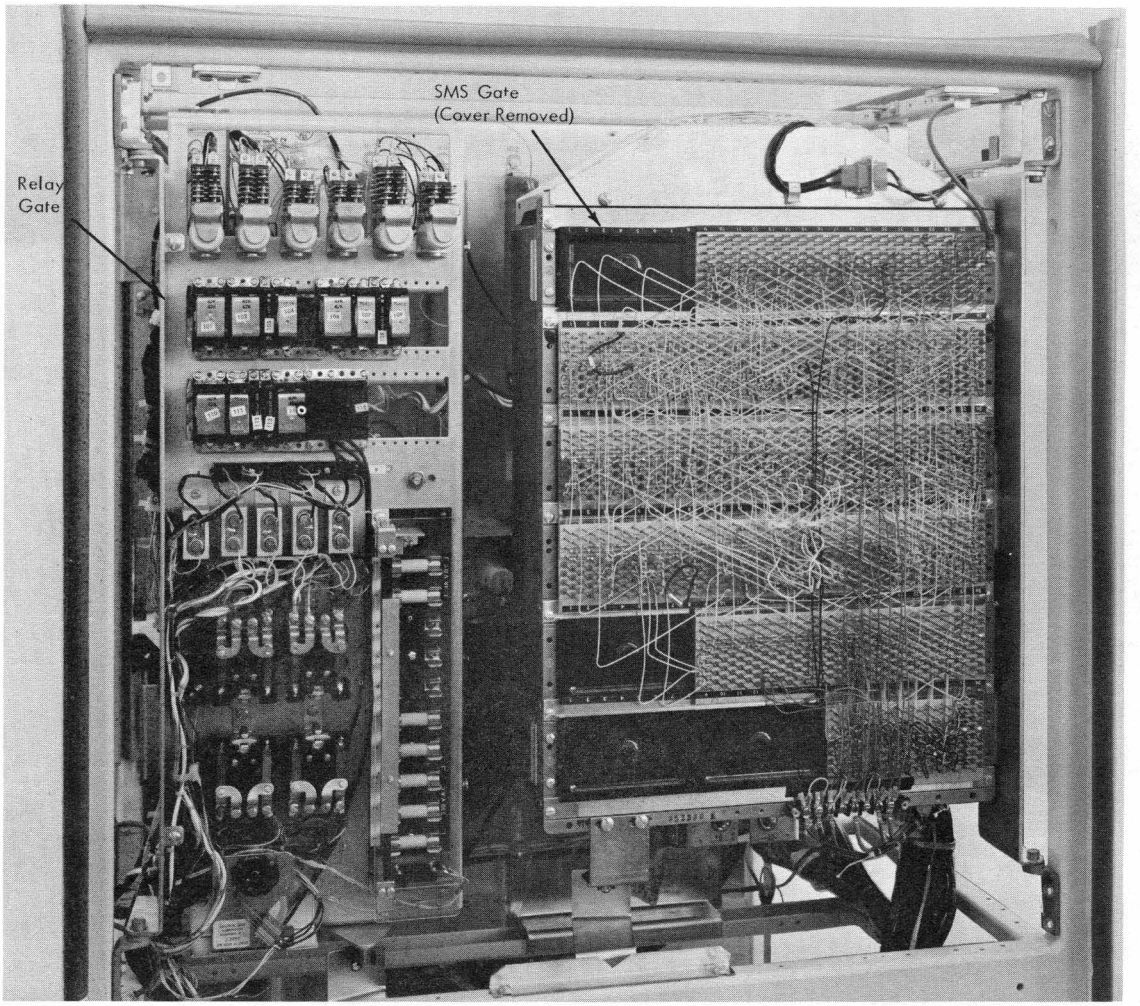
Machines Below S/N 14883 with EC 252274

• Figure 34. Relay Gate A7 – Rear View – EC 252274



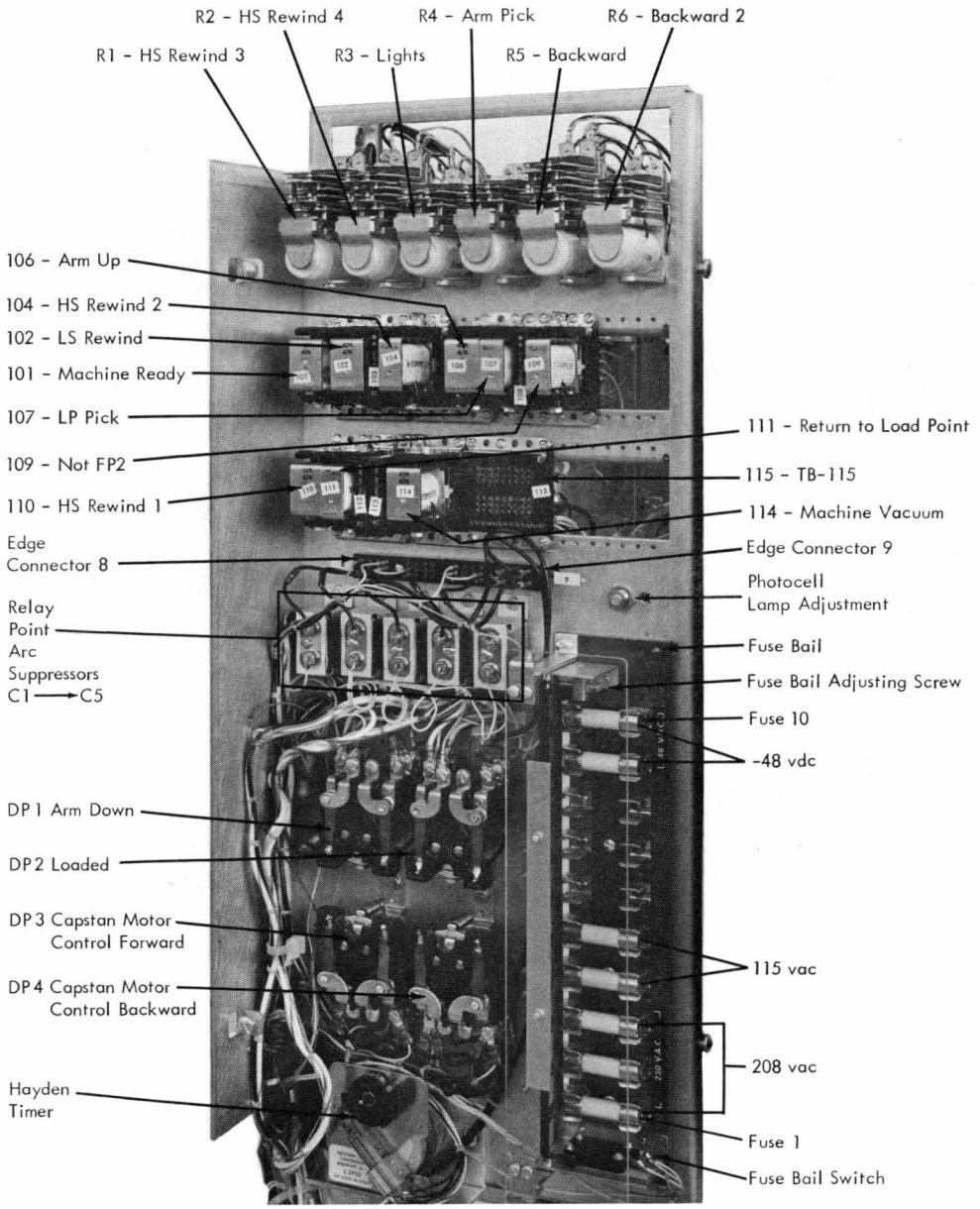
Machines Above S/N 14882 Up To S/N 18935

• Figure 35. Relay Gate A7 — Rear View



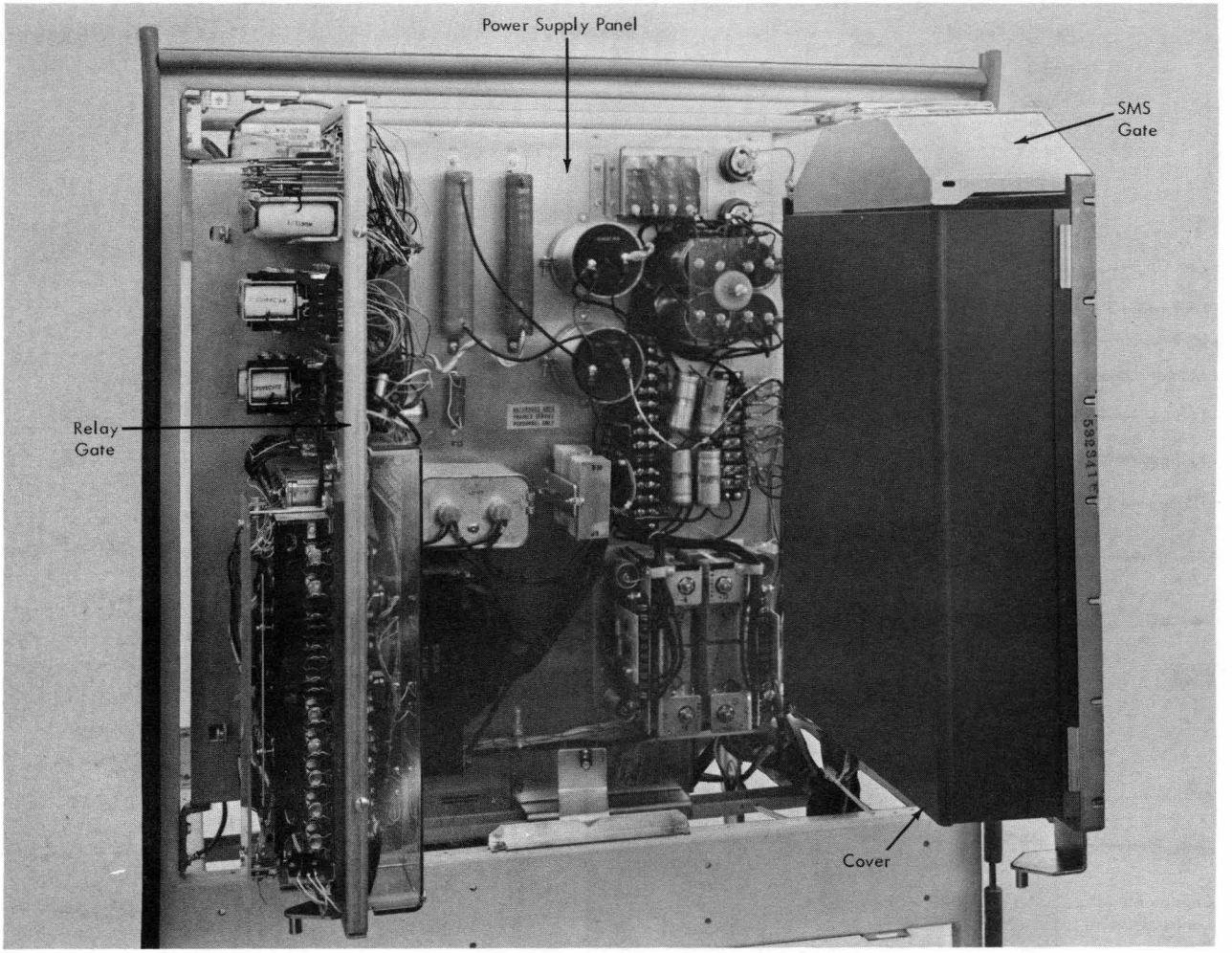
Machines Above S/N 18934

Figure 36. Relay Gate – SMS Gate – Closed Position



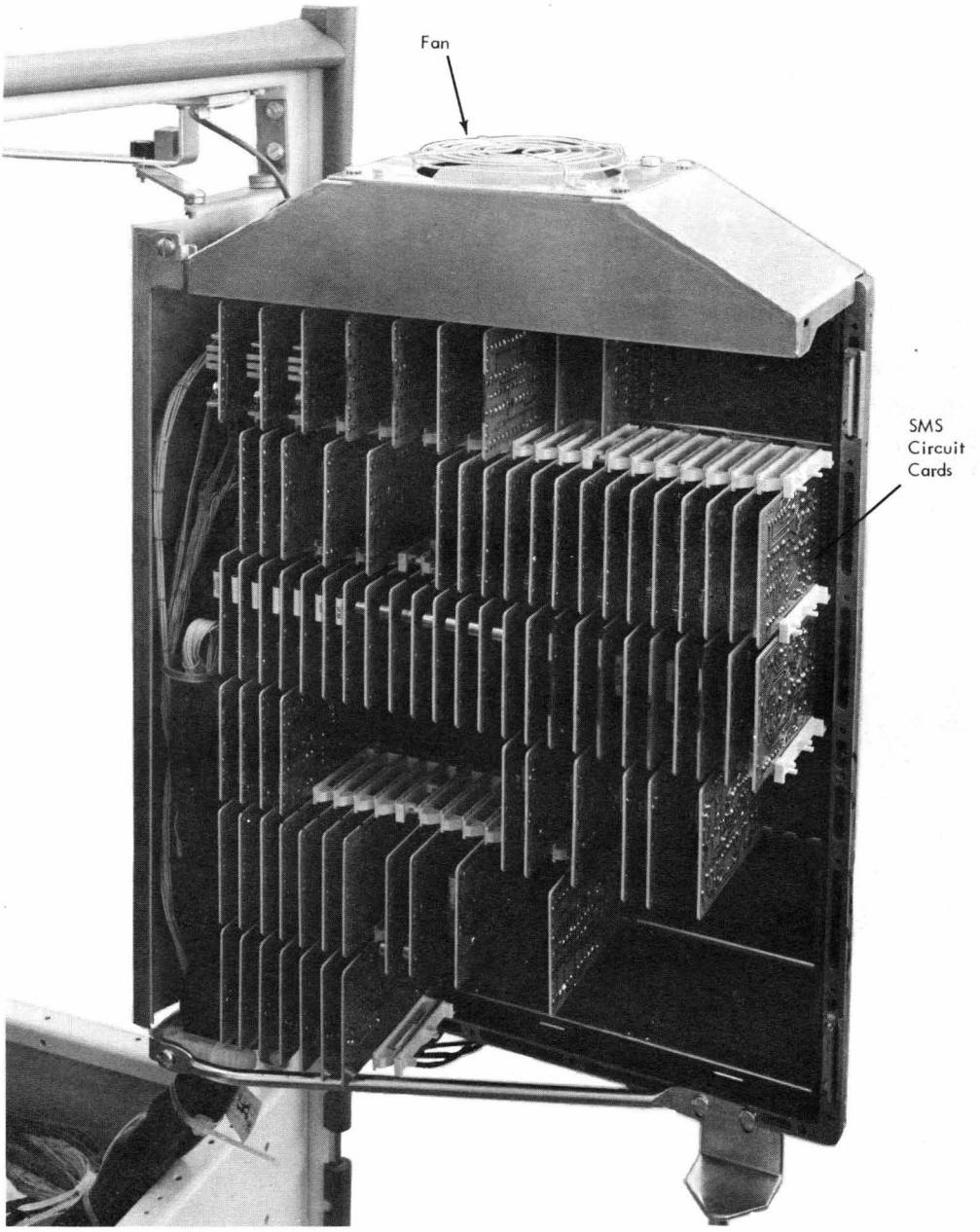
Machines Above S/N 18934

Figure 37. Relay Gate – Front View



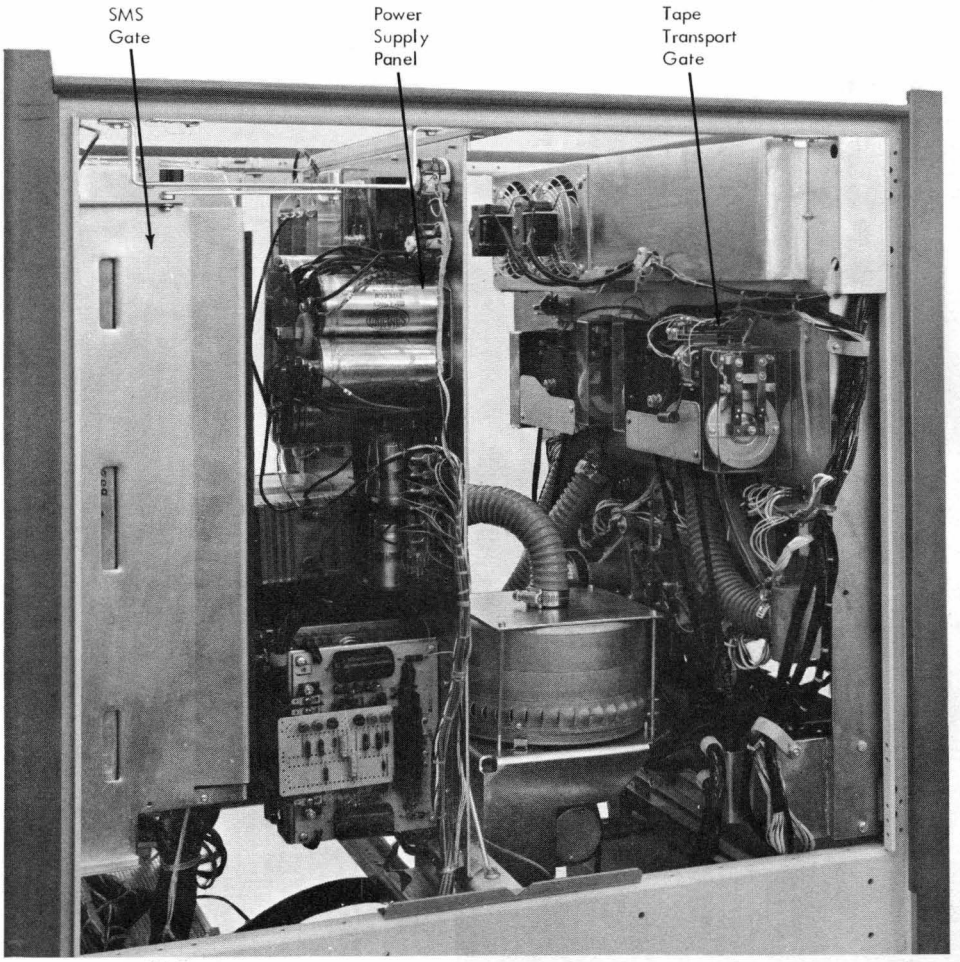
Machines Above S/N 18934

Figure 38. Relay Gate – SMS Gate – Opened Position



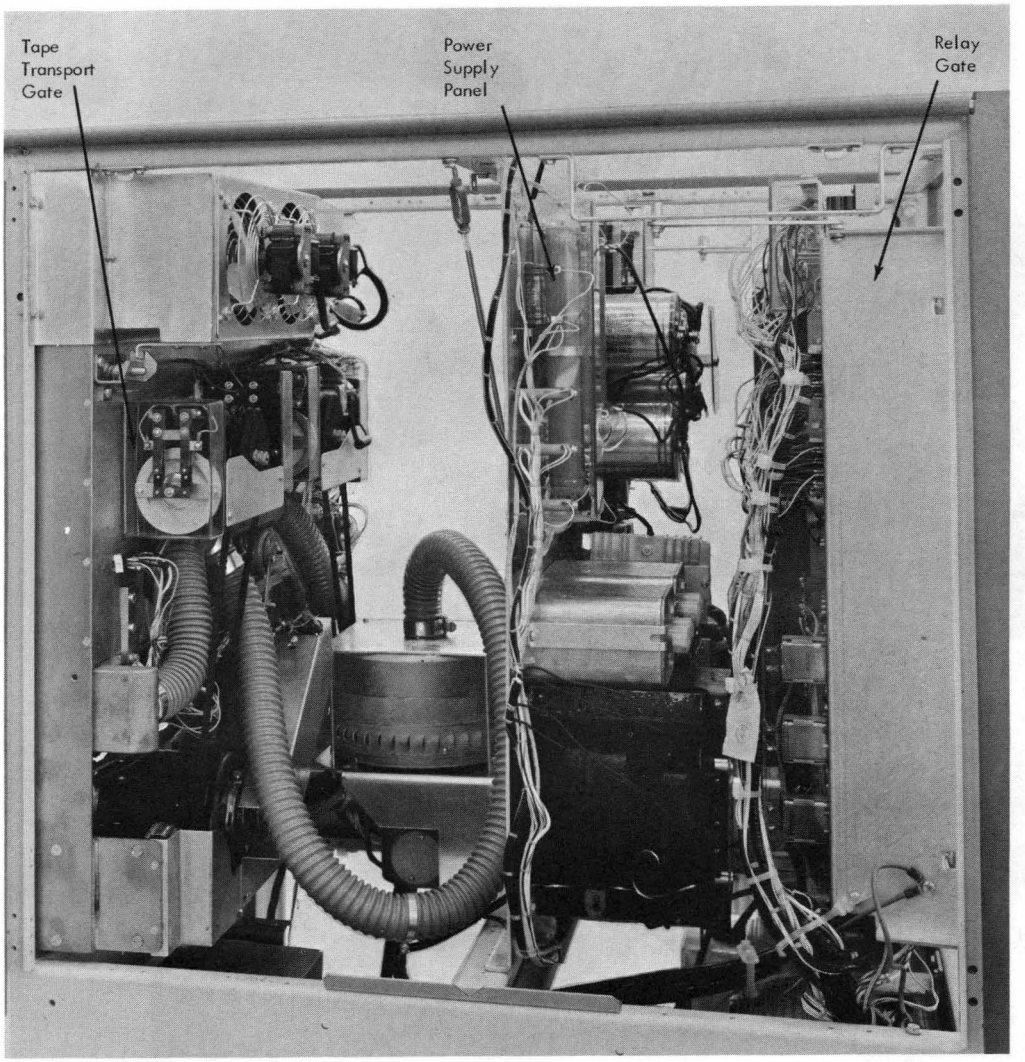
Machines Above S/N 18934

Figure 39. SMS Card Gate – Cover Removed



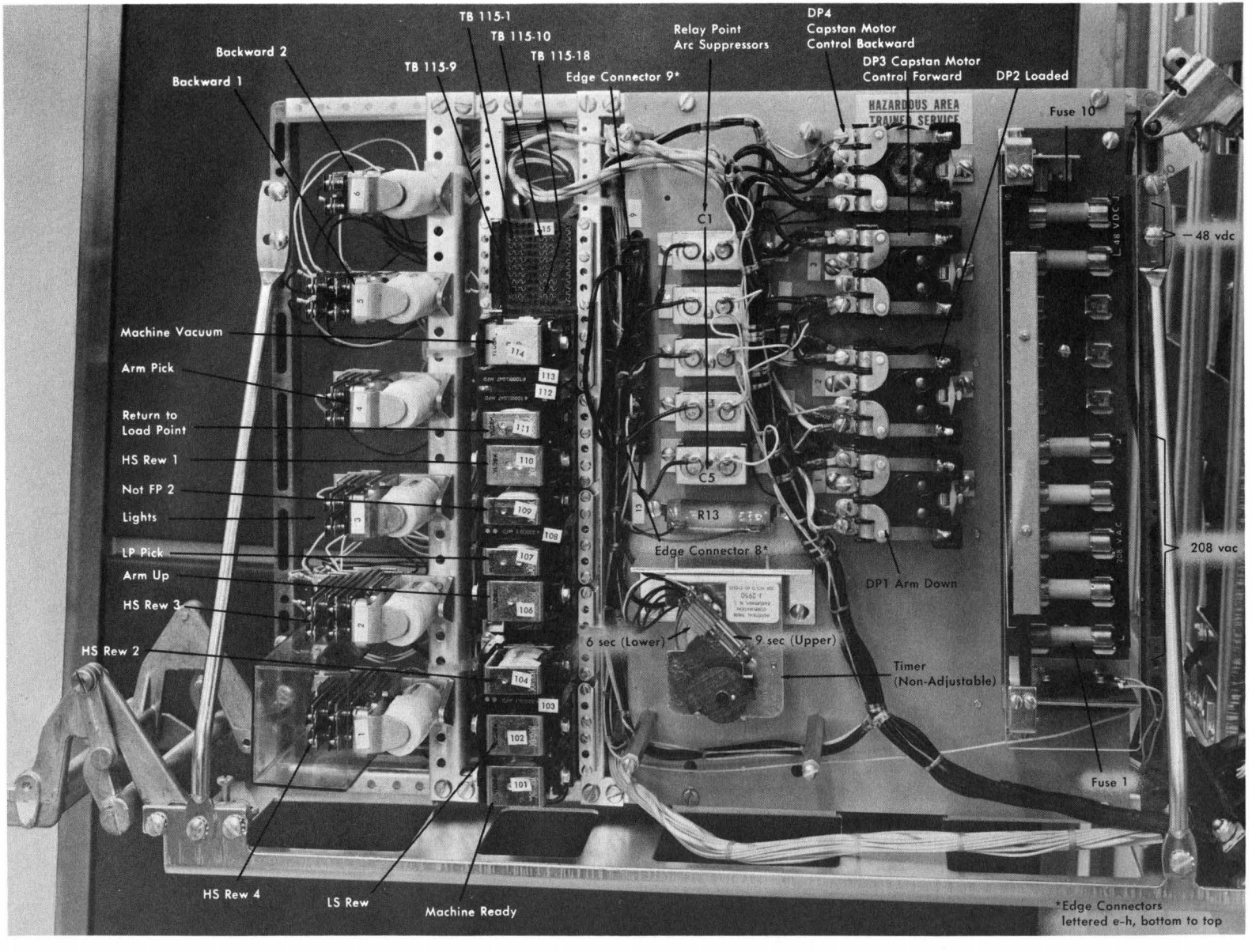
Machines Above S/N 18934

Figure 40. Tape Unit Layout – Left View



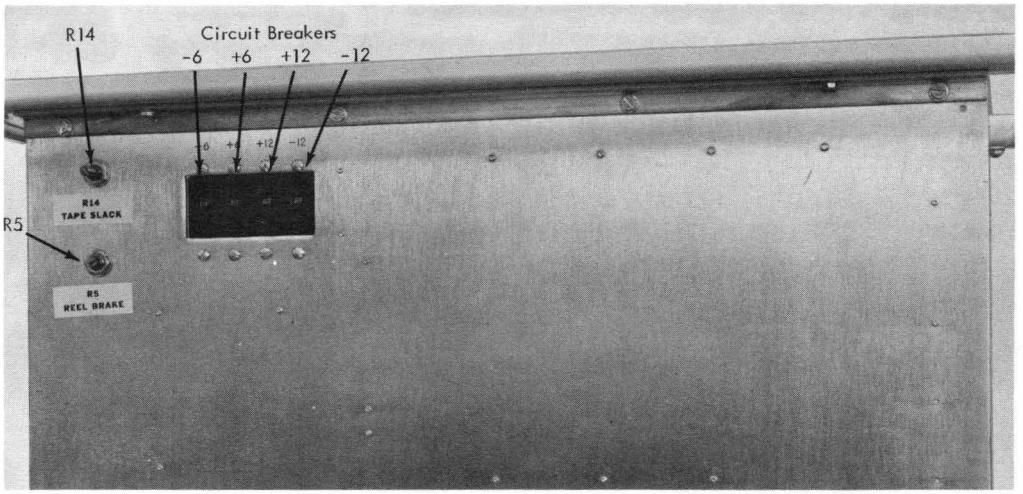
Machines Above S/N 18934

Figure 41. Tape Unit Layout — Right View



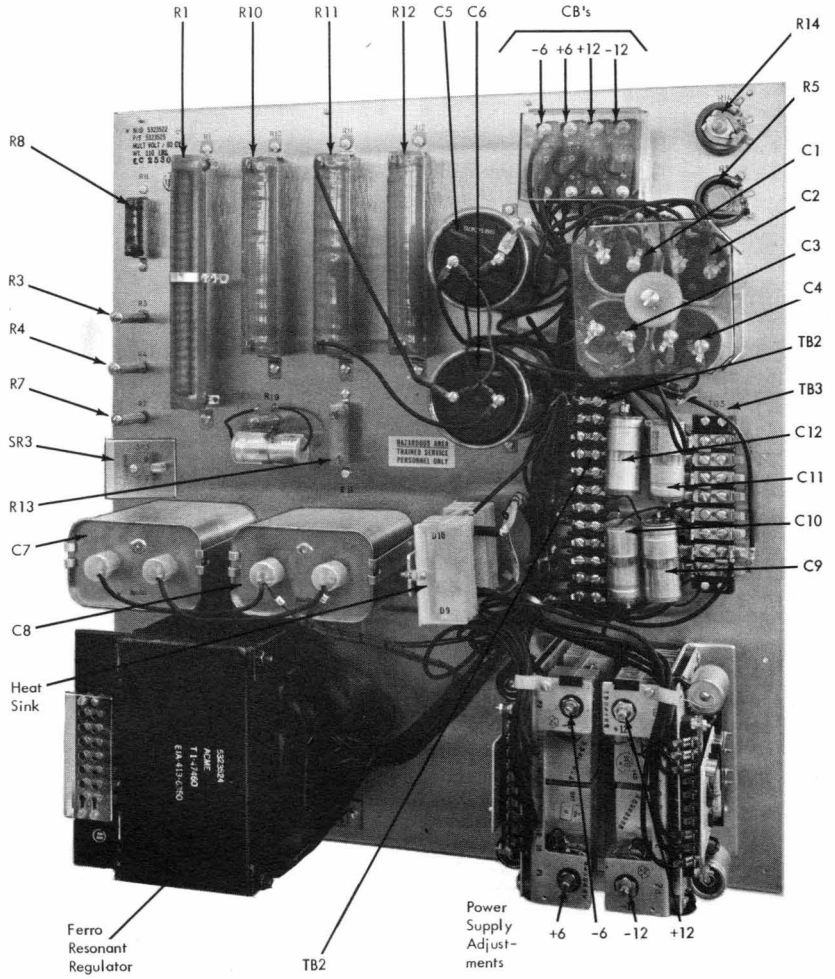
Machines Above S/N 16202 Up To S/N 18935

Figure 42. Non-Adjustable Timer



Machines Above S/N 18934

Figure 43. Power Supply Panel – Front View



Machines Above S/N 18934

Figure 44. Power Supply Panel – Rear View

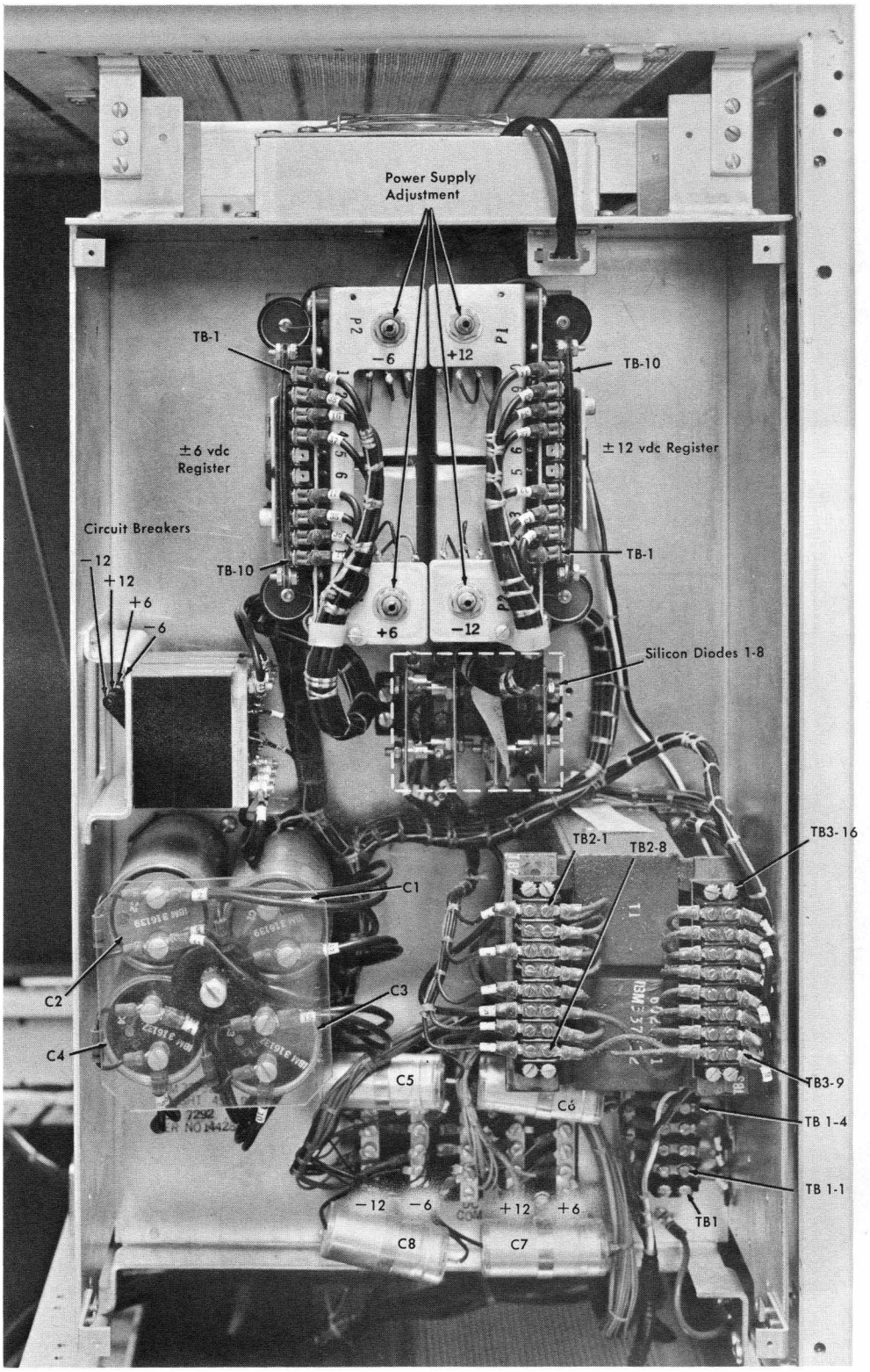
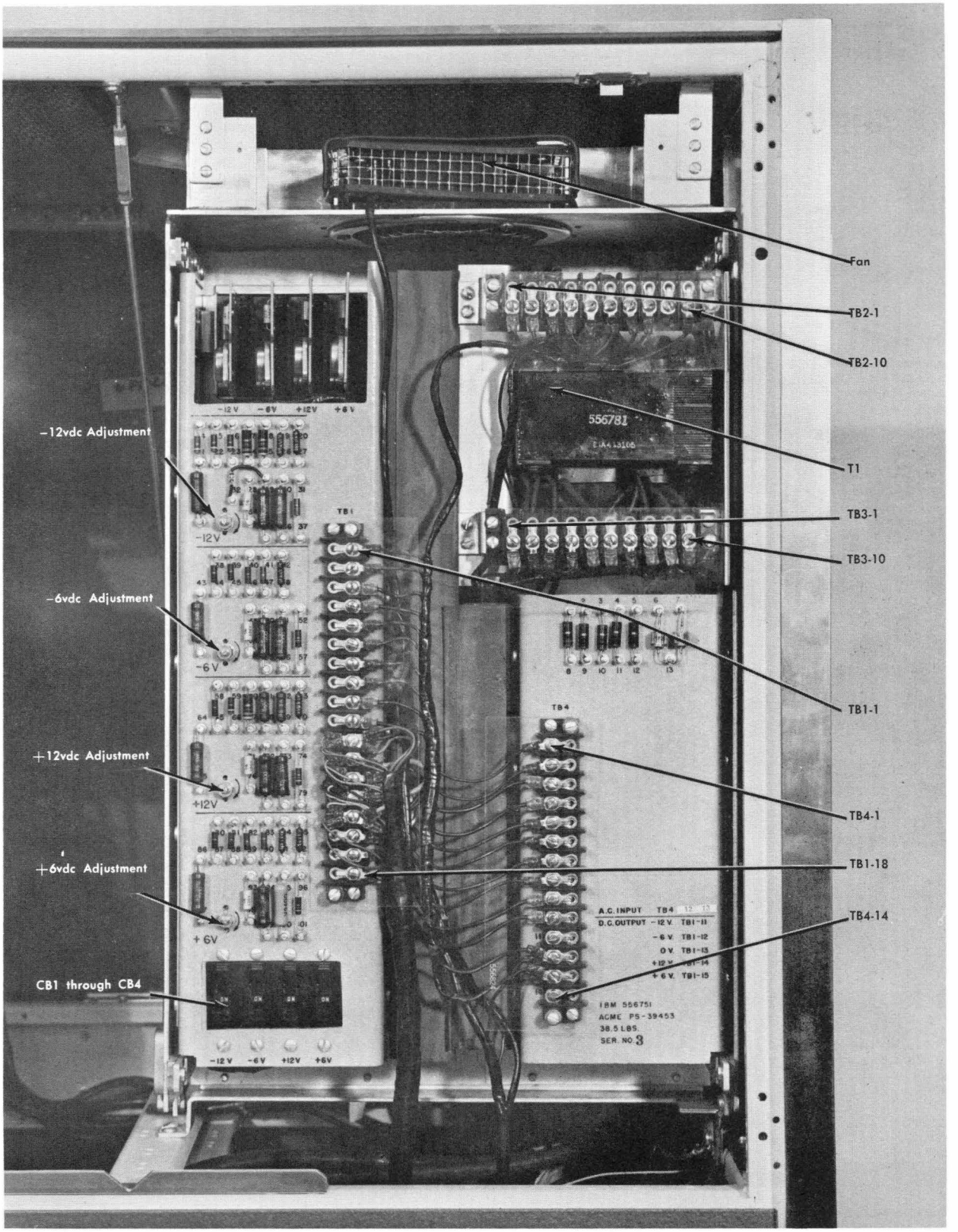
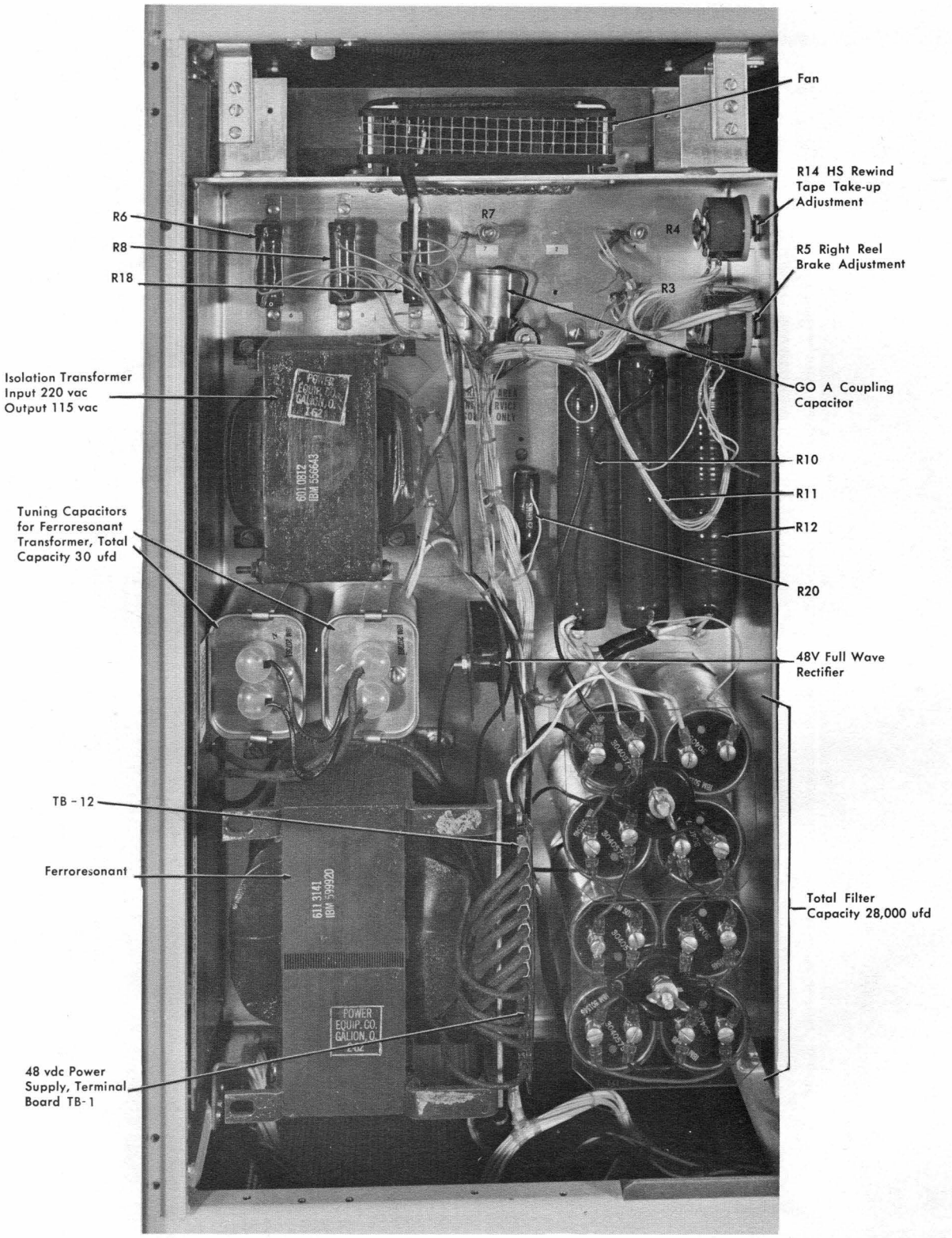


Figure 45. Transistor Power Supplies ±6, ±12, P/N 337520



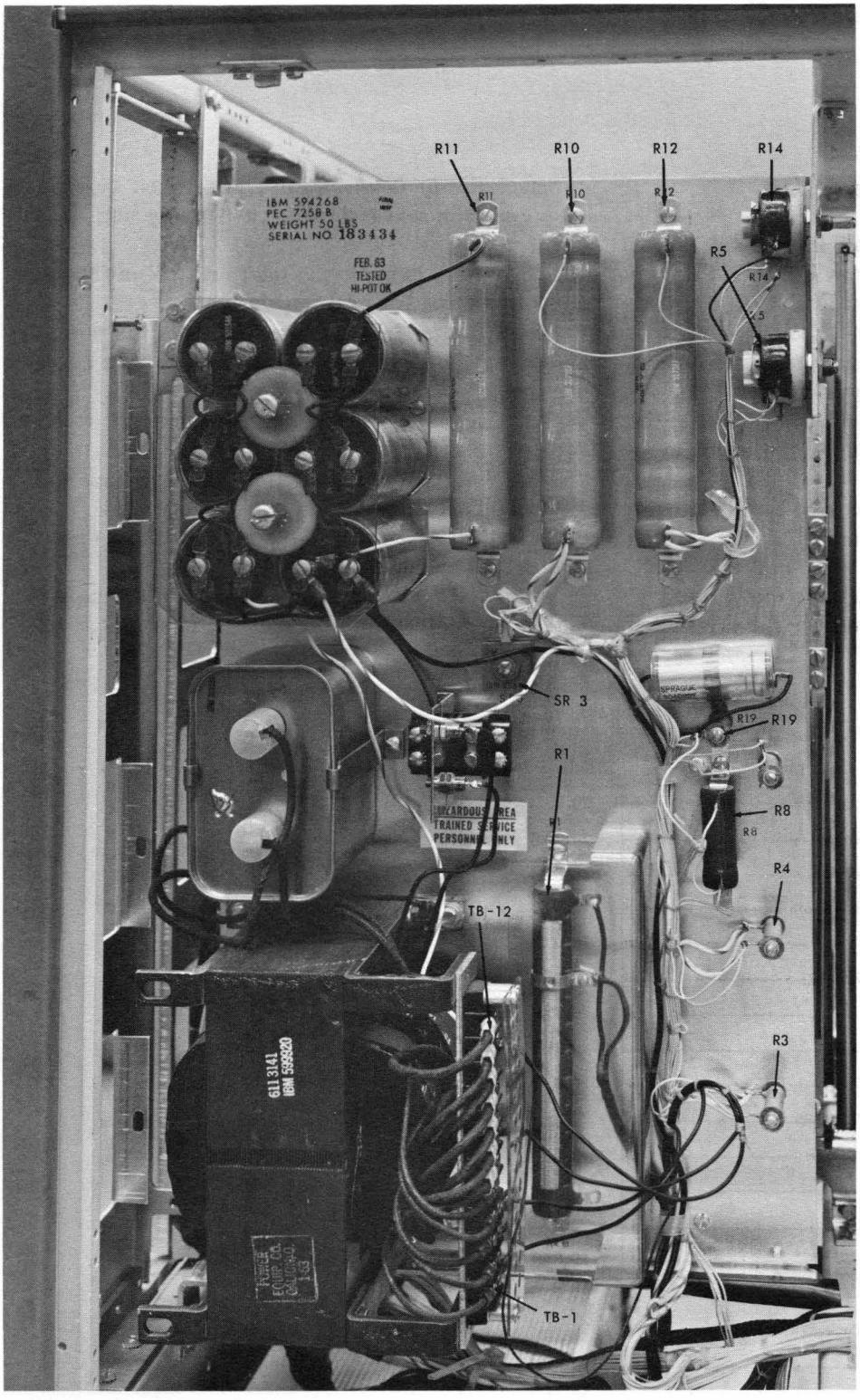
Machines Below S/N 13144

Figure 46. Transistor Power Supplies ±6, ±12, P/N 556751



Machines Below S/N 16203

Figure 47. Relay Power Supply −48 VDC – Isolation Transformer



Machines Above S/N 16202 Up To S/N 18935

Figure 48. Relay Power Supply −48 VDC

Lines Entering and Leaving Tape Unit

Figure 49 is a chart showing all lines between the tape unit and its control unit. Arrow heads on the lines indicate instructions sent to the tape unit or responses from the tape unit.

Select Tape Frame 0-9: There are ten lines, one of which is active according to the number of the selected tape unit. If the tape unit select switch is at the particular number desired, the tape unit sends a response back to the control unit.

Select Ready LO: The selected tape unit's response to a select signal if it is ready and the density switch is on low.

Select Ready HI: The selected tape unit's response to a select signal if it is ready and the density switch is on high.

Select Ready Load Point: The selected tape unit's response to a select signal if it is ready and at load point.

Set Read: A signal to the selected tape unit instructing it to prepare for a read operation.

Select Ready Read: A response from the tape unit informing the control unit that the tape unit is ready for a read operation.

Go: A signal to the tape unit instructing it to move tape.

Read Bits: Seven signals from the tape unit to the control unit containing data read from tape.

Set Write: A signal to the tape unit instructing it to prepare for a write operation.

Select Ready Write: A response from the tape unit informing the control unit that the tape unit is ready for a write operation.

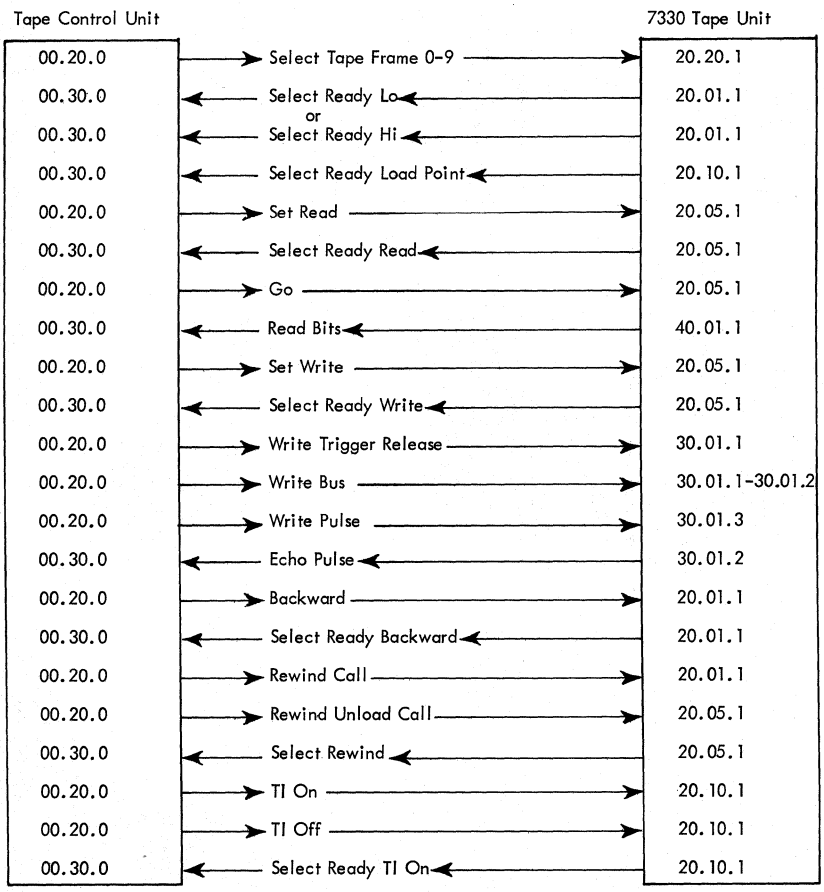


Figure 49. Lines Entering and Leaving Tape Unit

Write Bus: Seven signal lines from the control unit containing data to be written on tape.

Write Pulse: A control signal from the control unit to the tape unit which gates information to the write triggers so as to drive the write coils.

Echo Pulse: A response from the tape unit of the write pulse signal informing the control unit a character was written.

Write Trigger Release: A signal from the control unit resetting all write triggers when it goes negative, which results in writing the check character on tape.

Backward: A signal to the tape instructing it to prepare for a backspace operation.

Select Ready Backward: A response from the tape unit informing the control unit that the tape unit is ready for a backspace operation.

Rewind Call: A signal to the tape unit instructing it to prepare for a low-speed rewind operation.

Rewind Unload Call: A signal to the tape unit instructing it to prepare for a high-speed rewind operation.

Select Rewind: A response from a tape unit informing the control unit that the tape unit has started a rewind operation.

TI On: A signal from the control unit which turns on the tape indicate trigger.

TI Off: A signal from the control unit which turns off the tape indicate trigger.

Select Ready TI On: A response from a tape unit informing the control unit that the tape indicate trigger is on.

Block Diagrams

Selected portions of the 7330 tape units systems are presented in simplified form in Figures 49 through 55. The block diagrams follow standard automated logic conventions for position of lines entering and leaving blocks.

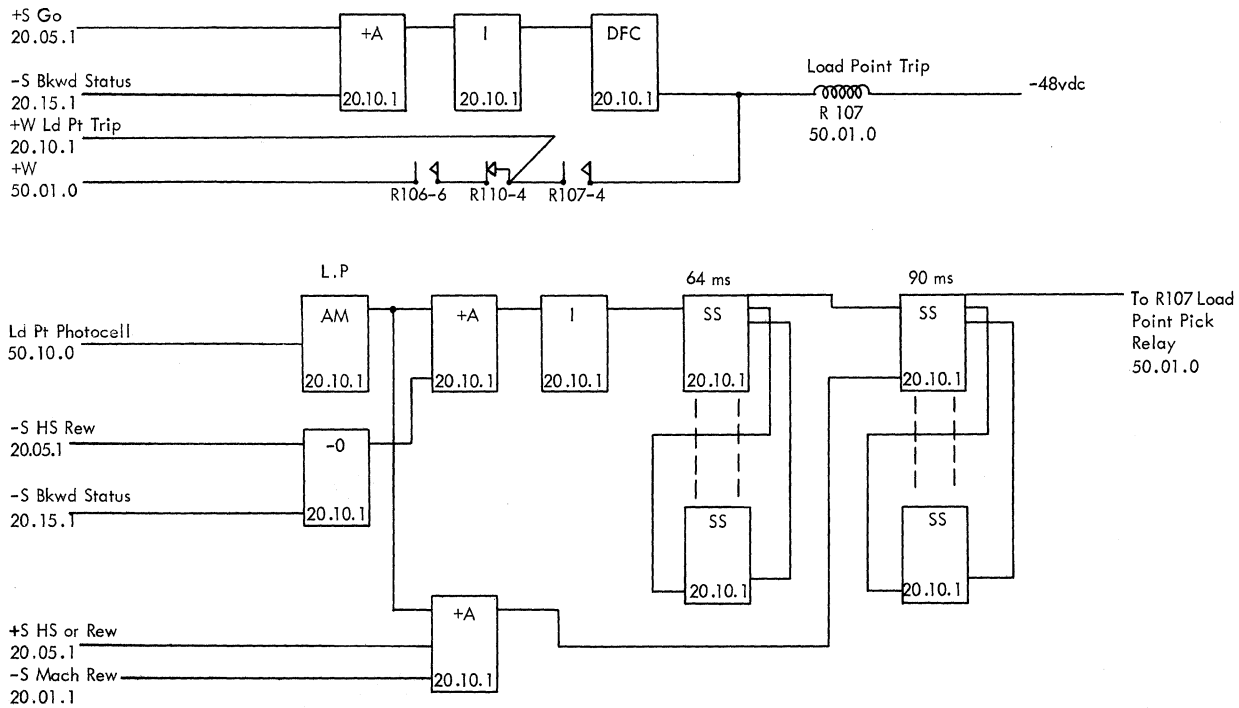


Figure 50. Load Point – 90 ms SS

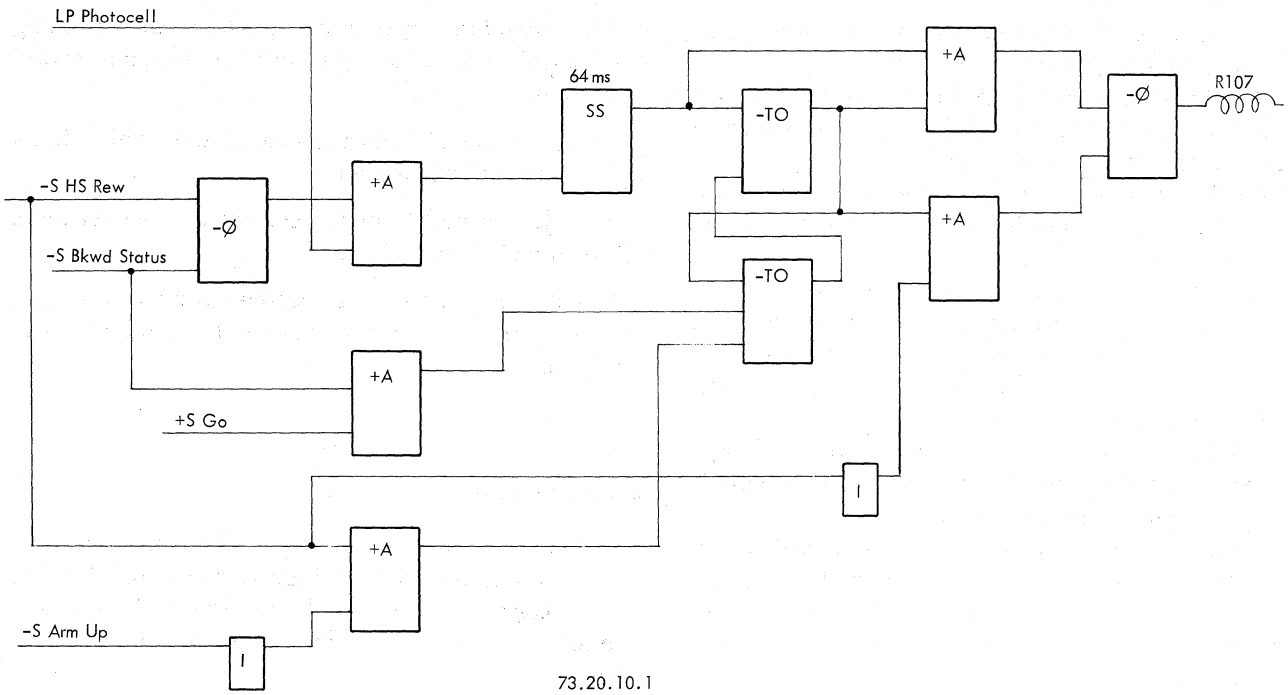


Figure 51. Load Point

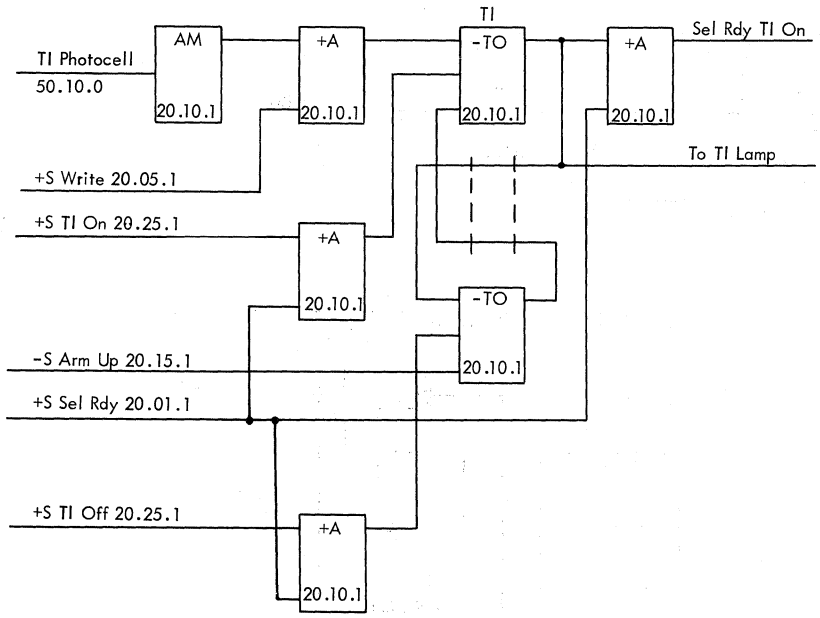


Figure 52. Tape Indicate

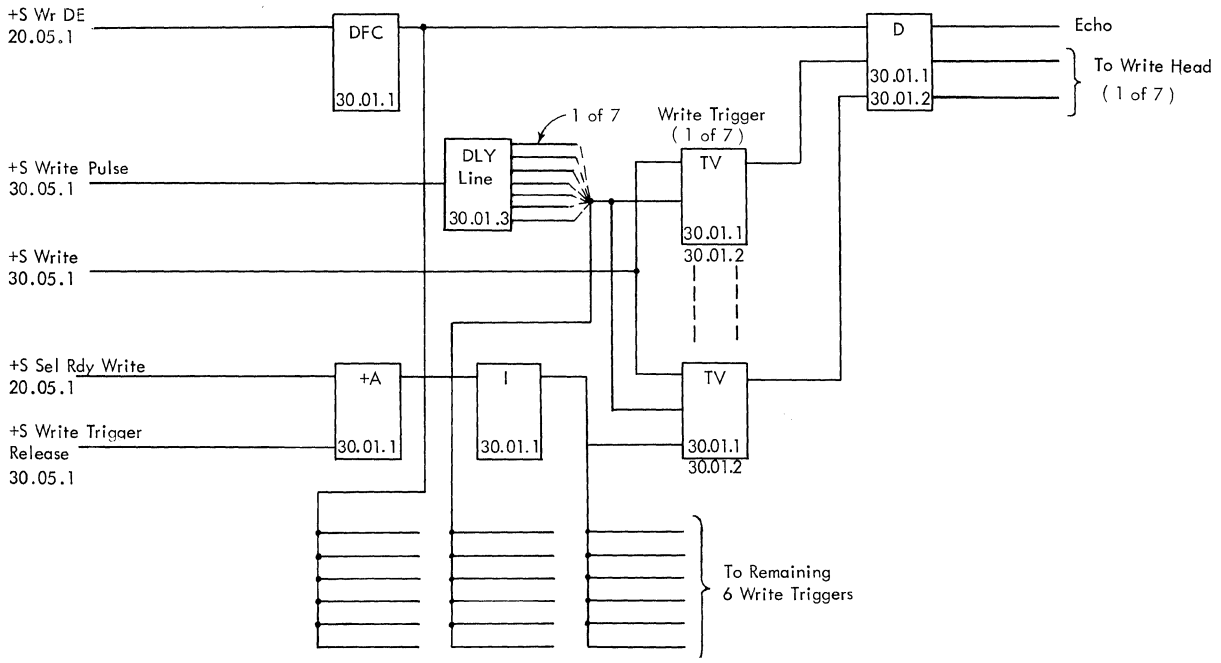


Figure 53. Write Circuit – One of Seven Tracks

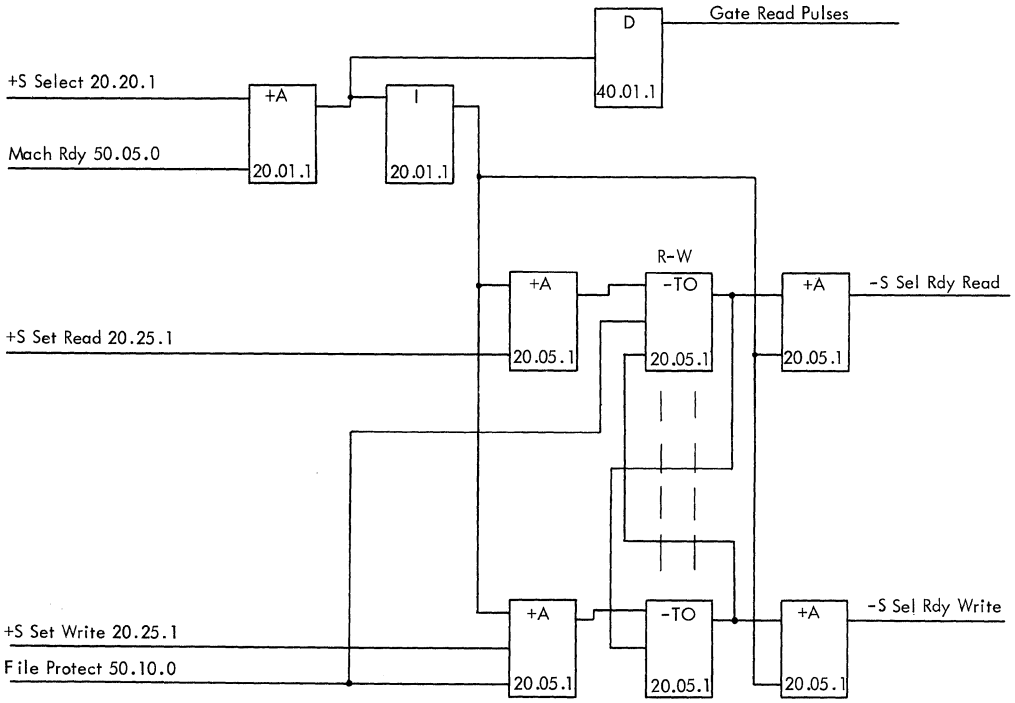


Figure 54. Read-Write Status

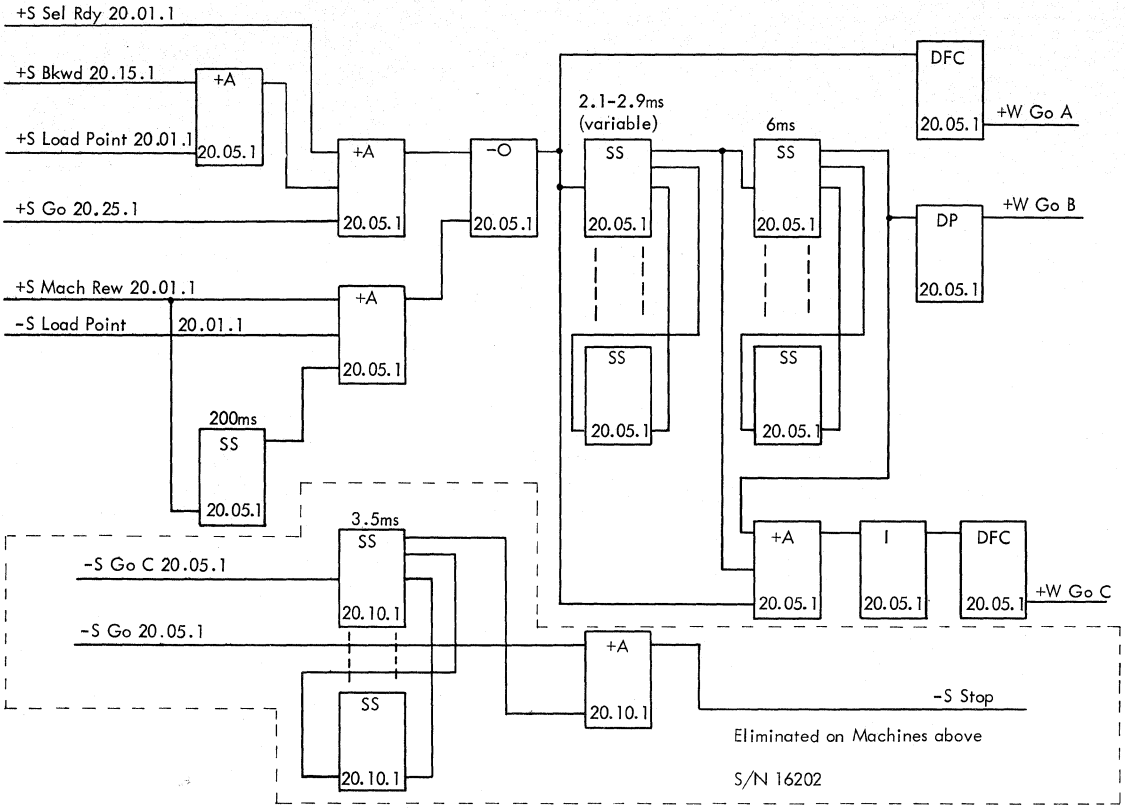
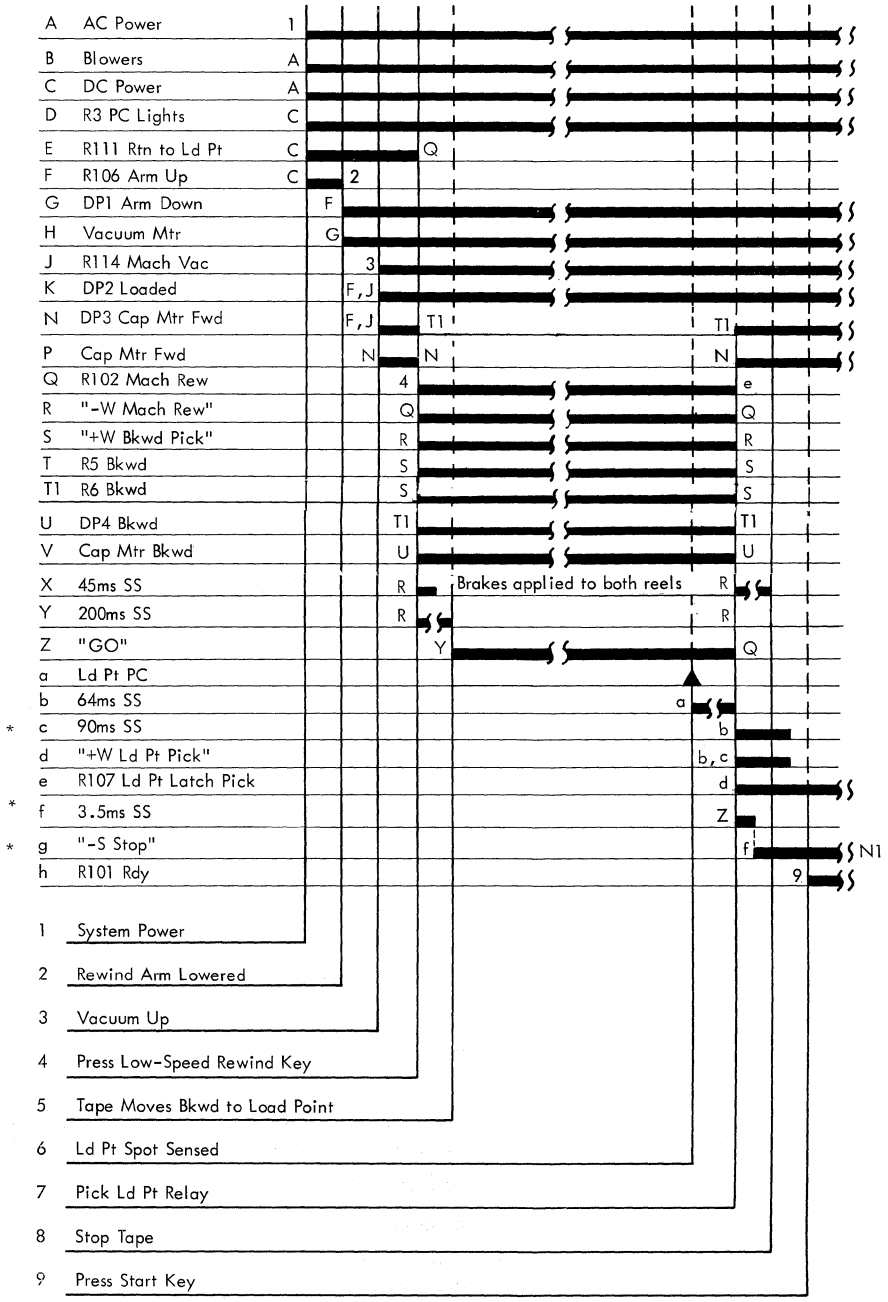


Figure 55. Go-Stop Control

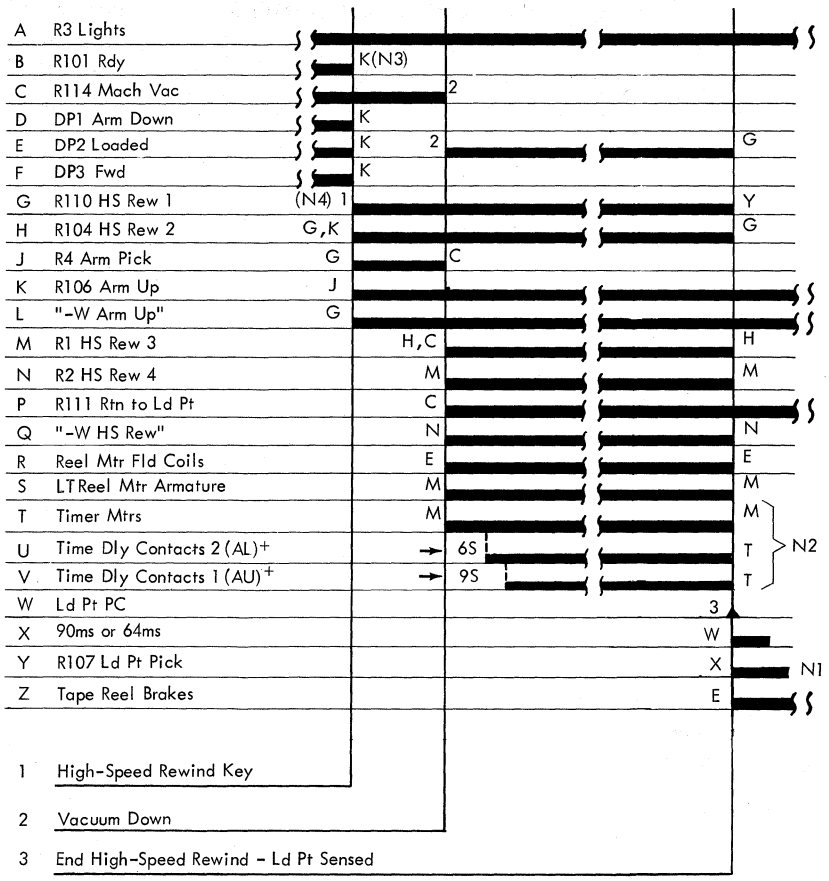
Sequence Charts

Figures 56 and 57 are charts explaining the sequence of events that occur during the various tape unit operations. The horizontal lines on the sequence charts indicate that a logic line or relay is active. Absence of a line indicates that the logic line or relay is inactive. Notes are made indicating different types of machines.



* Eliminated on machines above S/N 16202;
N1 latch tripped when GO is active.

Figure 56. Power On and Low-Speed Rewind



N1 De-energized when R110 is de-energized
N2 File reel moves slowly for 6 seconds to remove slack from tape. File reel is then driven at medium speed for an additional 3 seconds, after which time full power is applied to reel motor.
N3 Or Reset Key
N4 Or "+W HS Rew"
+AL, AU for machines above S/N 16202
*90ms on machines below S/N 16203
64ms on machines above S/N 16202

Figure 57. High-Speed Rewind

Purpose of Relay Points

A list of relays employed in the 7330 tape unit is provided. The function of each relay with its contact usage is also given.

Relay 1 HS Rewind 3 (73.50.04) is picked through R104 contacts during a high-speed rewind when vacuum goes down. R1 contacts are used to control the left tape reel motor.

R1AL N/C — Provides circuit for left tape reel motor operation when in the backward status (low-speed rewind or backspace).

R1AU N/C — Completes circuit for left tape reel motor operation from the logic circuits when in the backward status (low-speed rewind or backspace).

R1AL N/O — Provides circuit for left tape reel motor operation from timer motor relay contacts during a high-speed rewind.

R1BL N/O — Picks R2 on a high-speed rewind operation.

Relay 2 HS Rewind 4 (73.50.05) is picked on a high-speed rewind through R1 contacts. R2 contacts are used to control the left and right tape reel motors.

R2AL N/O — Completes circuit for left tape reel motor operation through the timer motor delay contacts during a high-speed rewind.

R2AL N/C — Provides circuit for left tape reel motor operation through logic circuits when in forward status.

R2BL N/C Opens circuit to the right tape reel motor during a high-speed rewind.

R2AU N/O Closes circuit to activate the "–W HS rewind."

R2BU N/C Opens circuit to the right tape reel motor during a high-speed rewind.

R2BU N/O Applies ground to one side of the right tape reel motor armature during a high-speed rewind.

Relay 3 Lights (73.50.01) is picked through the load point and tape indicate lamps. This relay is picked as long as power is on and neither lamp is burned out.

R3AL N/O Provides circuit to pick relays 101, 102, and 110.

Relay 4 Arm Pick (73.50.05) is picked at the beginning of a high-speed rewind when there is still a vacuum. It is used to raise the rewind arm.

R4AL N/O Closes circuit to energize the rewind arm solenoid.

Relay 5 Backward (73.50.05) is picked through logic circuits when the tape unit goes into the backward status (low-speed rewind or backspace). Its contacts control the direction of the tape reel motors.

R5AL N/O Completes circuit for left tape reel motor operation from the logic circuits when in the backward status.

R5AL N/C Provides circuit for left tape reel motor operation from the logic circuits when in forward status.

R5AU N/O Completes circuit for left tape reel motor operation when in the backward status.

R5AU N/C Provides circuit for left tape reel operation when in the forward status.

R5BL N/O Completes circuit for right reel motor operation from logic circuits when in the backward status.

R5BL N/C Provides circuit for right reel motor operation from logic circuits when in forward status.

R5BU N/O Completes circuit for right reel motor operation when in the backward status.

R5BU N/C Provides circuit for right reel motor operation for forward status.

Relay 6 Backward (73.50.05.0) controls the direction of the reversible capstan motor.

R6AL N/C Provides circuit to pick DP3 for tape forward.

R6AL N/O Closes circuit to pick DP4 for tape backward.

Relay 101 Machine Ready (73.50.01) is picked when the start key is pressed, provided certain other mechanical and electrical conditions are met.

R101-1 N/O Provides a holding circuit for R101 when the start key is released.

R101-2 N/C Opens the circuit to the machine rewind relay 102 through the low-speed rewind key when the machine is ready (R101 picked).

R101-3 N/O Provides circuit to pick the not file protect 2 relay 109 when the machine is ready.

R101-4 N/C Opens the circuit to the high-speed rewind relay 110 through the high-speed rewind key when the machine is ready.

R101-5 N/O Completes circuit to turn on the ready light.

R101-6 N/C Allows "+W machine ready" to become active when R101 is energized.

Relay 102 Machine Rewind (73.50.01) is picked by pressing the low-speed rewind key or by a programmed low-speed rewind operation.

R102-1 N/O Provides a hold circuit for R102 after the low-speed rewind key is released.

R102-2 N/C Opens to prevent picking the not-file protect relay 109 on a low-speed rewind operation so as not to write on tape.

R102-3 N/C Opens during a low-speed rewind to prevent the ready light being on.

R102-4 N/O Activates R-C network for load point delay. Used on machines above S/N 16202.

R102-4 N/C Closes to activate the "–W machine rewind."

R102-5 N/C Opens to prevent holding the return to load point relay 111 during the low-speed rewind.

R102-6 N/C Opens circuit to the high-speed rewind relay 110 through the high-speed rewind key.

Relay 104 HS Rewind 2 (73.50.01) is picked through R110 contacts after the rewind arm is up during a high-speed rewind operation.

R104-1 N/O Closes to complete circuit to pick R1.

R104-2 N/O Closes during the high-speed rewind to keep the NFP1 relay energized. This is done to keep the sensing pin from dragging on the plastic ring in the file reel.

Relay 106 Arm Up (73.50.01) is picked through the arm down microswitch. This switch is closed whenever the rewind arm is up.

R106-1 N/O Provides circuit to pick R111 through R110 contacts.

R106-1 N/C Provides a circuit to pick relay DP2 through R114 contacts during the low-speed rewind operation.

R106-2 N/C Prevents picking the machine ready relay 101 while the rewind arm is up.

R106-3 N/C Provides circuit to DP3 relay to operate the reversible capstan motor when the arm is down.

R106-4 N/O Completes circuit to activate "−W arm up."

R106-5 N/C Provides circuit to pick the relay DP1 when the arm is down.

R106-6 N/O Conditions circuit to latch trip the load point relay 107. For machines above S/N 16202, these contacts only provide a circuit to pick R104.

Relay 107 Load Point (73.50.01) is a latch-type relay that is picked from logic circuits when the load point reflective spot is sensed during a rewind operation. R107 is latch tripped when the tape moves away from the load point during a read-write operation. R107 is latch tripped immediately when picked on a high-speed rewind. On machines above S/N 16202, the relay is not a latch type relay.

R107-1 N/C Opens to de-energize R102 and end low-speed rewind.

R107-2 N/C Opens to de-energize R110 and end high-speed rewind.

R107-3 N/C Opens to permit "load point" to rise to +W level.

R107-4 N/O Closes when R107 is latch picked. Conditions circuit to R107 latch trip coil. These contacts are not used on machines above S/N 16202.

Relay 109, Not File Protect 2 (73.50.05) is picked when the file reel contains a plastic ring (NFP1 relay picked). The tape unit must also be in ready status. R109 must be energized in order to write on tape.

R109-1 N/O Closes to complete +12v circuit to center tap of write coils.

R109-2 N/O Used in parallel with R109-1 contacts for greater reliability.

R109-3 N/C Completes circuit to operate file protect indicator lamp when R109 is not picked.

R109-4 N/O Completes circuit to energize erase head during write operation.

Relay 110 HS Rewind 1 (73.50.01) is picked to start a high-speed rewind by pressing the key or by an automatic instruction from the control unit. The tape unit must not be in ready status, at load point, or in a low-speed rewind operation when the key is pressed.

R110-1 N/O Provides a holding circuit for relay 110 when the key is released.

R110-3 N/C Provides an alternate path to pick R111 when the arm is up.

R110-3 N/O Picks relay DP2 when there is no vacuum.

R110-4 N/C Completes circuit to latch trip relay 107 when relay 110 is de-energized after the load point spot is sensed during the high-speed rewind. These are not used on machines with S/N above 16202.

R110-4 N/O Allows relay 104 to energize if the arm is up and the high-speed rewind key has been pressed.

R110-5 N/O Completes circuit to pick relay 4 at the start of the high-speed rewind.

R110-6 N/O Provides a circuit for activating "−W arm up" during the high-speed rewind.

Relay 111 Return to LP (73.50.05) prevents the tape unit from going ready when picked after a high-speed rewind.

R111-1 N/C Prevents picking relay 101 when relay 111 is picked.

R111-2 N/C Provides circuit to pick the NFP1 relay.

R111-3 N/O Used for a holding circuit when relay 111 is picked.

Relay 114 Machine Vacuum (73.50.05) is picked whenever there is tape in both columns and the vacuum is up.

R114-1 N/O Provides circuit to pick relay 101 when vacuum is up.

R114-2 N/C Provides circuit to pick relay 111 when there is no vacuum.

R114-3 N/O Completes circuit to pick relay 4 when vacuum is up.

R114-3 N/C Provides circuit to pick relay 1 after vacuum drops at the beginning of a high-speed rewind.

R114-4 N/O Completes path for energizing relay DP2 when the arm is down and vacuum is up.

R114-4 N/C Provides path to pick relay DP2 when vacuum is not present.

R114-5 N/C Provides an alternate path for activating "−W arm up."

R114-6 N/O Allows relay DP3 or DP4 to be picked if the rewind arm is down and there is a vacuum.

Relay DP1 Arm Down (73.50.05) is picked whenever the rewind arm is down.

DP1-A N/O Closes the −48 VDC circuit to the left and right tape reel motor armatures and brakes, and arm solenoid during operations with the arm down.

DP1-B N/O Closes circuit to vacuum motor when the arm is down.

Relay DP2 Loaded (73.50.05) is picked when the tape unit is performing a rewind operation or when the unit is performing a normal R/W operation. Its contacts provide power to the capstan motor.

DP2-A N/O Completes −48 VDC circuit to the left and right tape reel motor field coils.

DP2-A N/C Provides −48 VDC to energize reel brakes when tape unit is in an unloaded status.

DP2-B N/O Completes first leg of 3-phase AC power to the reversible capstan motor.

Relay DP3 Capstan Motor Control Forward (73.50.01.0) is picked if the rewind arm is down, there is a vacuum and the tape unit is in forward status. Its contacts provide power to the reversible capstan motor.

DP3-A N/O Provides power to terminal 2 of the reversible capstan motor from fuse 2.

DP3-B N/O Provides power to terminal 3 of the reversible capstan motor from fuse 3.

Relay DP4 Capstan Motor Control Backward (73.50.01.0) is picked if the tape unit is in the backward status, the rewind arm is down, and there is a vacuum. Its contacts provide power to the reversible capstan motor.

DP4-A N/O Closes circuit to terminal 3 of the reversible capstan motor from fuse 2.

DP4-B N/O Closes circuit to terminal 2 of the reversible capstan motor from fuse 3.

Relay NFP1 (73.50.05) is picked whenever the plunger detects a plastic ring on the tape reel. It is also picked on a high-speed rewind.

NFP1 BLN/O Provides circuit to relay 109.

NFP1 ALN/O Provides holding circuit for the NFP1 relay when it is energized.

7330 Field Tester

General Operation

The 7330 Field Tester (P/N 461142, Figure 58, Systems Diagram 73.50.35.0) is used to check various functions of the 7330 Magnetic Tape Unit when the machine is in an off-line status. To use the tester, the machine must be on select position 0. The select indicator light will operate only on the 0 position. To use the tester with the machine in the off-line status:

1. Disconnect the computer interconnecting signal cables P/N 535099 from receptacles M and N; receptacle N may have a computer line terminator P/N 556801 or P/N 556930, which must be removed.
2. Disconnect the computer interconnecting power cables P/N 535098 from the power receptacles.
3. Connect the signal cable attached to the tape tester to receptacle M.
4. Plug a line terminator P/N 556801 into receptacle N.
5. Plug the power cable P/N 460663 from the wall socket to the power input receptacle.

When it is desired to write on tape using the tester, there are a number of switches used in conjunction with each other. The write switch must be on to produce the write pulses and the read-write switch must be in the WRITE position.

With the tester, the density of bits on tape is totally controlled by the density high-low switch. The density switch on the tape unit panel only controls the high-low density light.

If it is desired to scope the read buses using the tester, the scope probe must be placed into the read-direct hub and the rotary switch read scan rotated to the desired track to be read.

Start-stop times may be checked using the tester. The go sync hub, start-stop frequency potentiometer, and the start-stop, go, stop three-position toggle switches are used in conjunction with each other.

NOTE: The field tester does not recognize the end of tape.

All switches on the 7330 Field Tester are explained below.

Switches and Keys

TOGGLE SWITCHES (FIGURE 58)

Read-Write: This switch produces a set read or set write signal when the switch is set accordingly. These signals correspond to the set read and set write signals that originate from the tape control unit.

TI On-Off: This switch, when set accordingly, will produce "TI on" and "TI off." These signals will turn the tape indicate trigger on or off which in turn turns the TI light on or off.

Write On-Off: This switch, when on, allows the write pulses to be sent to the tape unit. It must be on for the density switch to be effective.

Fwd-Bkwd: This switch controls the direction of tape motion while reading or writing on tape.

Start-Stop, Go, Stop: This three-position switch controls tape motion. When the switch is in the STOP position, GO is held inactive and the moving coil is energized in stop status. When the switch is moved to the GO position, the tape unit is placed in GO status and tape moves at 36 inches per second. When the motion control switch is placed in the START-STOP position, the GO line is activated under control of a multivibrator that can be varied by means of the start-stop frequency control potentiometer.

Density Hi-Lo: This switch controls an oscillator frequency output. When the switch is in the HI position, the oscillator output is 20 KC ±20 percent. When in the LO position, the oscillator output is 7.6 KC ±20 percent. The signal resulting from the output of the oscillator is "write pulse." For this switch to be effective the write on-off switch must be on.

Bit Switches: There are seven 1 or 0 bit switches controlling the writing of a character on tape when set

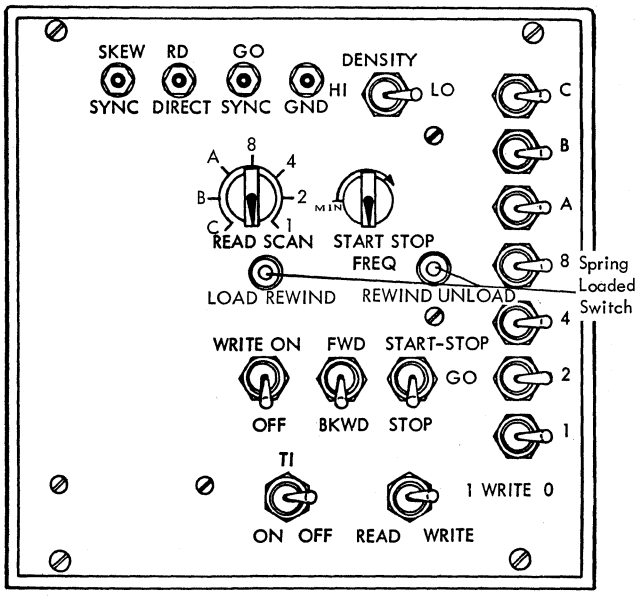


Figure 58. Field Tester for IBM 7330

accordingly. Each switch controls one track. When the switch is set to the 1 side, a −12 voltage level allows the switching of the write trigger. When the switch is on the 0 position, the write trigger will not be able to switch; thus a 0 is written on tape. The switches are connected to the "write bus" signal lines.

PUSHBUTTON SWITCHES

Load Rewind: If the tape unit is ready, this spring-loaded switch will initiate a low-speed rewind to load point. This switch performs the same function as "rewind call" line from the control unit.

Rewind Unload: If the tape unit is ready, this spring-loaded switch will initiate a high-speed rewind. This switch performs the same function as the "rewind unload" line from the control unit.

HUBS

Skew Sync: This hub is connected to the eight bit track as a sync pulse.

Rd Direct: This hub provides the output from the read line as determined by the position of the read scan rotary switch.

Go Sync: The output of this hub is used as a sync pulse when checking start-stop times from the tester. When using this hub, it is necessary to sync on external minus if this hub on the tester is used. This hub emits a constant multivibrator signal even when the GO switch is off. The hub is used in conjunction with the start-stop frequency potentiometer and the start-stop, GO STOP three-position toggle switch.

Grd: This hub may be used to ground the oscilloscope when checking the various functions of the tape unit.

VARIABLE CONTROLS

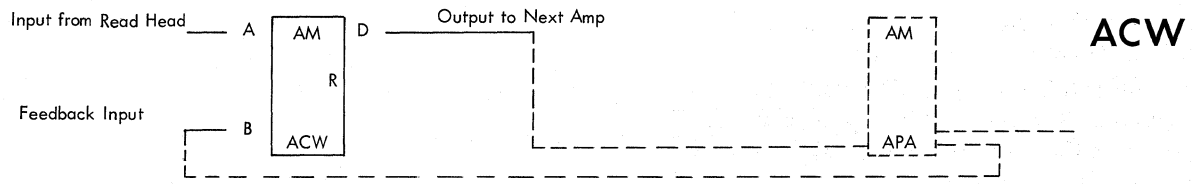
Read Scan: This seven-position rotary type switch allows the selection of the individual track (read bus) that is to be displayed on the oscilloscope.

Start-Stop Freq: During start-stop operation, this control permits the stop time to be varied from about 1 ms to 50 ms. The GO time is fixed at about 20 ms.

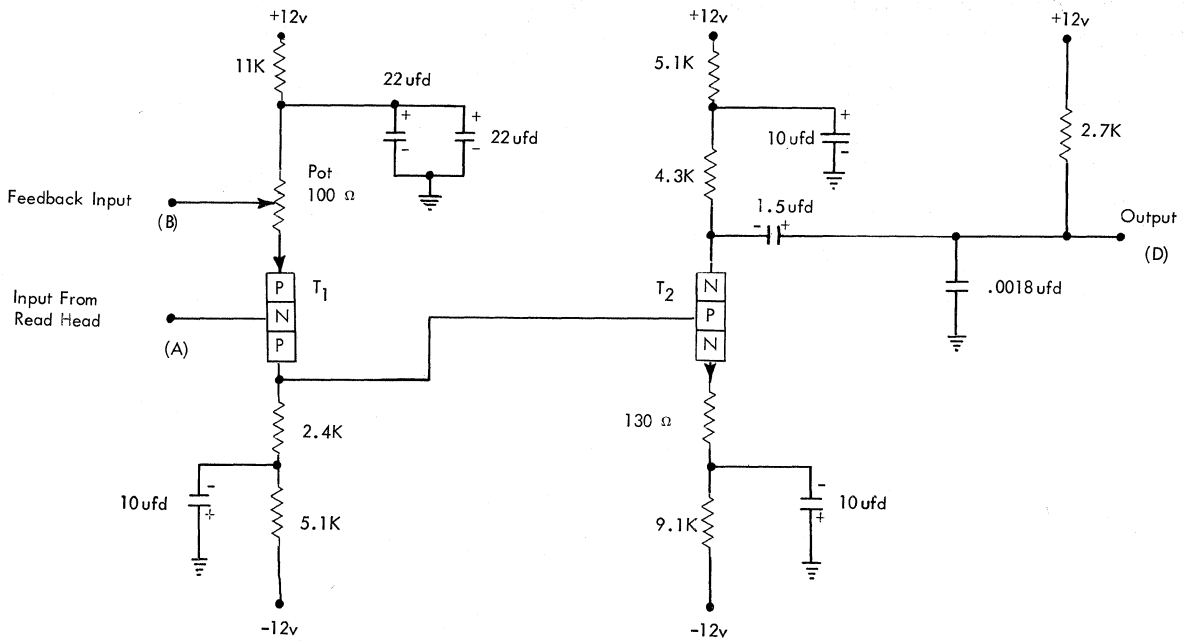
SMS Component Circuit Cards

This section contains data on SMS component circuit cards used in the 7330 tape unit. Only those cards having transistors are shown; capacitor cards and converter cards are omitted.

The logic block configuration, schematic diagram, and a brief circuit description are given for each card.



BLOCK CONFIGURATION



ACW
Magnetic Tape Preamplifier

The ACW card is used in the 7330 tape unit as the first stage amplifier for signals from the read head. The output from this card feeds the input of the second stage amplifier (APA card).

A feedback signal, fed from the APA card back to the ACW card and through a potentiometer, determines the overall signal gain of the system.

Circuit Description

The small signal produced by the read head is fed into the base of transistor T1 which is conducting. T1 will either increase or decrease its conduction, depending on the polarity of the input signal. The action of T1 produces an amplified signal across its 2.4K collector load resistor. The 11K resistor along with the parallel combination of two 22 MFD capacitors serves as a bias network. The 5.1K resistor in the collector circuit is also heavily bypassed and serves as a decoupling filter. A 100-ohm potentiometer in the emitter circuit controls the amount of inverse feedback and therefore determines the gain of the amplifier.

The output of transistor T1 feeds the base of transistor T2. The signal is further amplified and is capacity-coupled to output pin D. To trace a signal through the ACW amplifier, consider a negative shift at input pin A. T1 will conduct harder, producing a positive shift at the collector. This positive shift feeds the base of T2, causing T2 also to conduct harder. A negative shift is produced at the collector of T2 and is capacity-coupled to output pin D.

Magnetic Tape Preamplifier

The APA card is used in the 7330 tape unit as the second stage of the read preamplifier. The input to the APA card is the output of the ACW first stage preamplifier. In addition to the signal output at pin H, this circuit also provides a negative feedback signal to the first stage.

Circuit Description

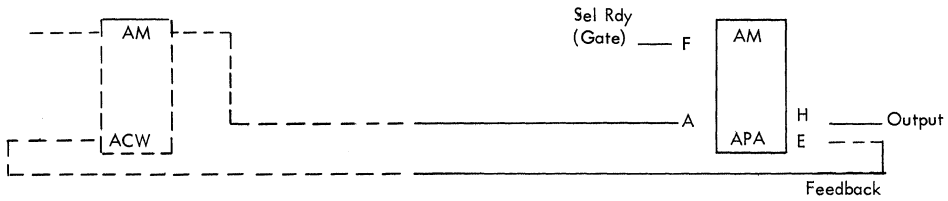
Transistors T1 and T2 are normally in conduction but change to heavier or lighter conduction when a signal is applied. Transistor T3 is simply an emitter-follower output with an externally connected emitter load resistor.

To trace the progress of a signal through the circuit, consider a negative shift applied to the base of transistor T1. This will cause T1 to conduct harder, producing a positive shift on its collector. The positive shift is capacity-coupled to the base of transistor T2, causing T2 to conduct less. This action causes a negative shift on the collector of T2, and this negative shift coupled to the base of transistor T3 produces a negative shift at output pin H.

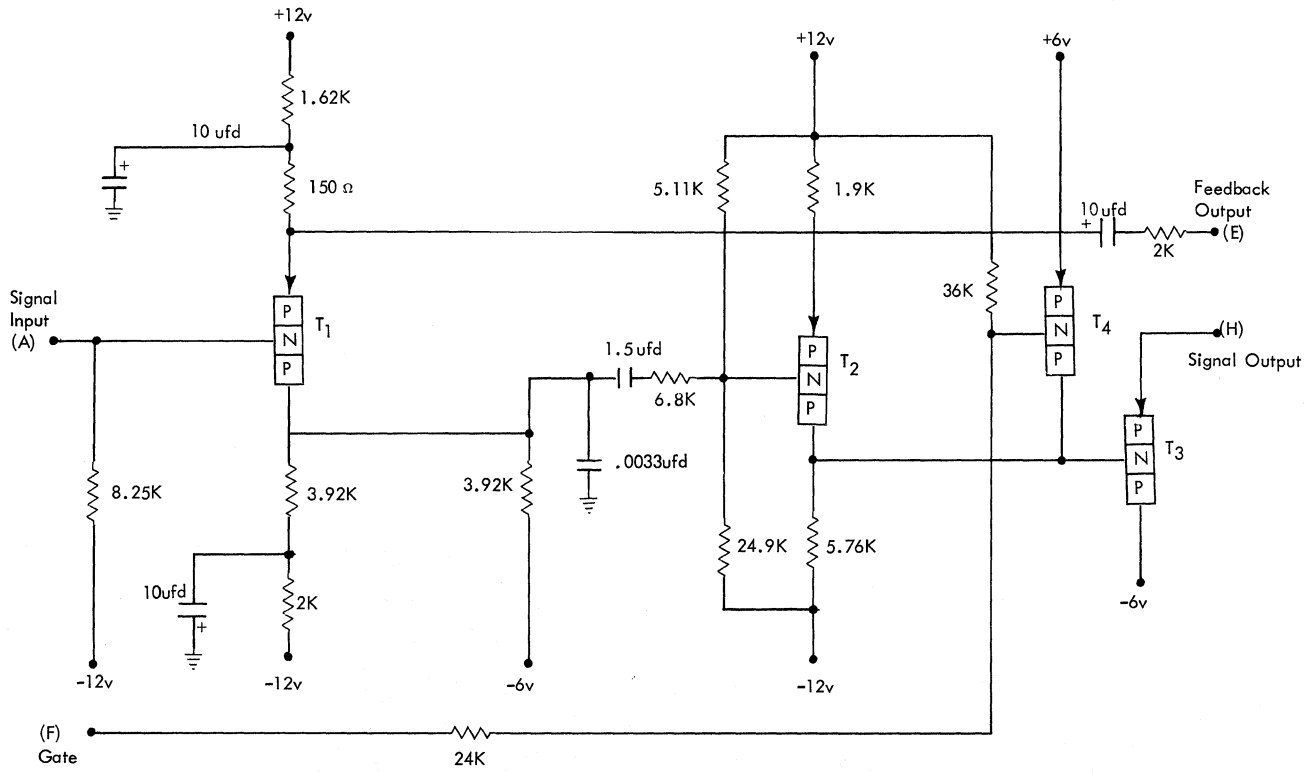
With transistor T1, a negative shift occurred on its emitter at the same time that the positive shift occurred on the collector. This negative shift is capacity-coupled to pin E and is connected back to the first stage amplifier to produce degenerative feedback.

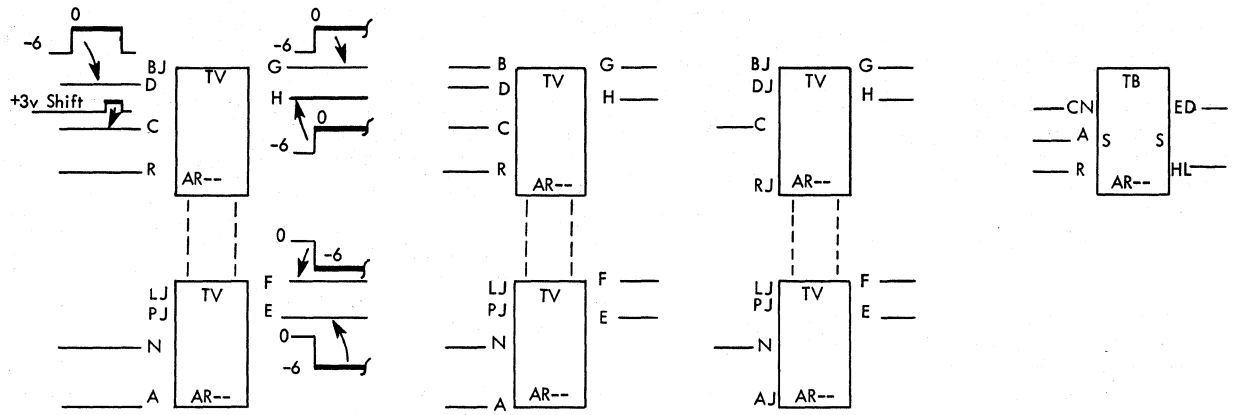
Transistor T4 serves as a gating switch. When a +T level (+6v) is applied to pin F, transistor T4 is cut off, allowing normal preamplifier operation. A −T level on pin F, however, causes T4 to conduct and clamp the collector of T2 at about +6v.

APA

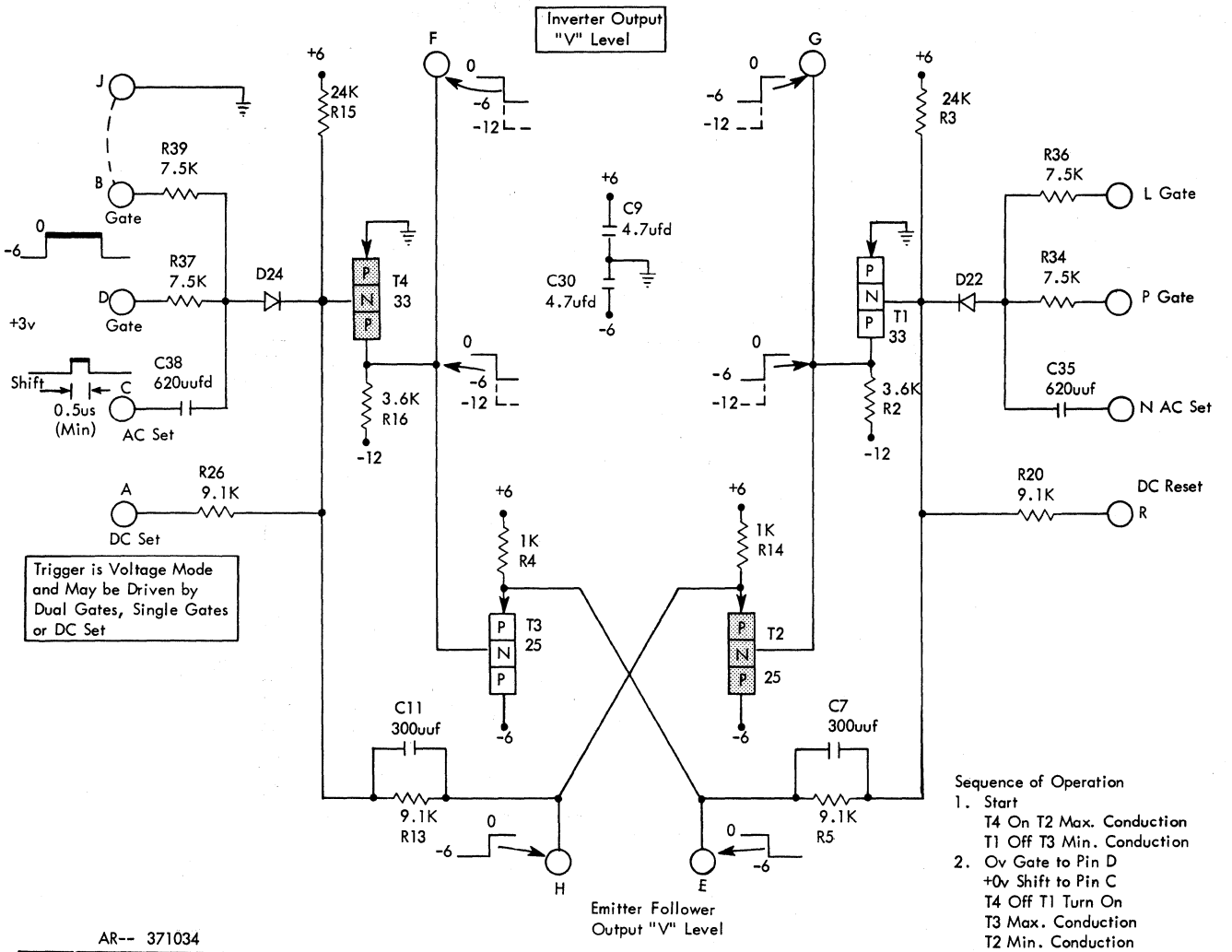


BLOCK CONFIGURATION





Possible Logic Block Configurations



Sequence of Operation

1. Start
   T4 On T2 Max. Conduction
   T1 Off T3 Min. Conduction
2. Ov Gate to Pin D
   +0v Shift to Pin C
   T4 Off T1 Turn On
   T3 Max. Conduction
   T2 Min. Conduction

AR-- 371034

Input Levels						Output Levels				Delays (Usec)				
AC Set		Gate		DC Set		Emitter Follower		Inverter			Trigger		Gate Condition Time	
Min	Max	Min	Max	Min	Max	Min	Max	Min	Max		Min	Max	Min	Max
2.6v / 3.8v		-0.2 / -5.56	+0.35 / -12.48	-0.2 / -5.56	0 / -12.48	-0.2 / -5.56	+0.35 / -6.24	-0.2 / -5.56	0 / -6.24	Turn On	.30	.80	3.0	7.5
										Turn Off	.14	.54	—	—

The AR - - card consists of a voltage mode trigger circuit designed for use in clock and ring circuits and as an isolated binary bit memory. The trigger circuit uses two inverters and two emitter followers and operates at a frequency near 150KC. The trigger may be connected to be operated by many input configurations. It may be operated as a binary input, a single gated AC input, a dual gated AC input, or a DC set input. Both in-phase and out-of-phase outputs are available from this card.

Binary Operation: The trigger may be connected for binary operation (gated or not gated) by connecting one of the gate resistors to the emitter follower output on the same side of the trigger. The other gate input may be then used as an external gate or tied to ground. The two AC inputs are connected together and driven from a sample pulse driver to form the binary operation.

AC Set Input: For gated input operation, the AC set pulse may be either a 3v or a 6v positive shift with a minimum rise rate of 2.6v in 0.9μs and a minimum up duration of 0.5μs. The following data show the input shifts and the time required to condition the gates (The gates have to be at about ground level for a 3v AC input shift to flip the trigger.).

AC Set Input	Gate 1	Gate 2	Gate Condition Time	Minimum Gate Level
3v	−12.48v	−12.48v	7.5μs	−0.5v
3v	−12.48v	GND	6.0μs	−0.5v
3v	−6.2v	−6.2v	6.0μs	−0.5v
3v	−6.2v	GND	4.5μs	−0.5v
6v	−12.48v	−12.48v	4.5μs	−2.0v
6v	−12.48v	GND	3.0μs	−2.0v
6v	−6.2v	−6.2v	3.0μs	−2.0v

DC Set Input: A signal of −5.56v (or more negative) applied to the DC set input triggers the circuit. The negative set signal may go as far negative as −12.48 volts. The down input pulse must be at least 3.0μs in duration.

Circuit Description

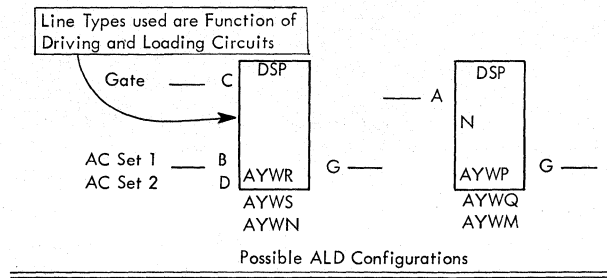
Assume a starting condition of T4 and T2 in full conduction, T3 at minimum conduction, and T1 off. With one gate (pin B) tied to ground (pin J) and the other gate (pin D) gated from −6v to 0v for 4.5μs before the AC input shift is applied, a positive going 3v pulse of 0.5μs is applied to the AC set input (pin C). The output of the gate at D24 causes the base of T4 to become more positive than the emitter (ground potential). T4 becomes reverse-biased off and its collector voltage tries to go to −12v. Because of the diode action between the collector and base of T3, the collector of T4 is allowed to go only to −6v (pin F). This negative −6v forward biases T3 into full conduction. The emitter of the emitter follower (T3) follows the base to −6v. The output of the emitter follower (pin E) is coupled to the base of T1 through the voltage divider R3 and R5, forward biasing T1. The conduction of T1 causes its collector (pin G) to rise from −6v to 0v. This T1 collector voltage rise to 0v is fed to the base of T2 and reduces the forward bias of T2. The reduced bias on the emitter follower (T2) reduces its conduction so that its emitter rises to 0v. The emitter output of T2 (0v) at pin H is coupled back to the base of T4 and holds reverse bias on T4, thus providing latch back to the circuit. If gating of pins L and P and an AC set pulse to pin N are applied, the trigger is flipped to its original state.

The turn-on and turn-off delays are a function of circuit loading.

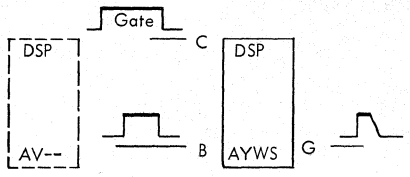
Application

This circuit is used mainly for ring and register applications. Various logic block configurations for the trigger circuit are possible; some of these configurations are shown.

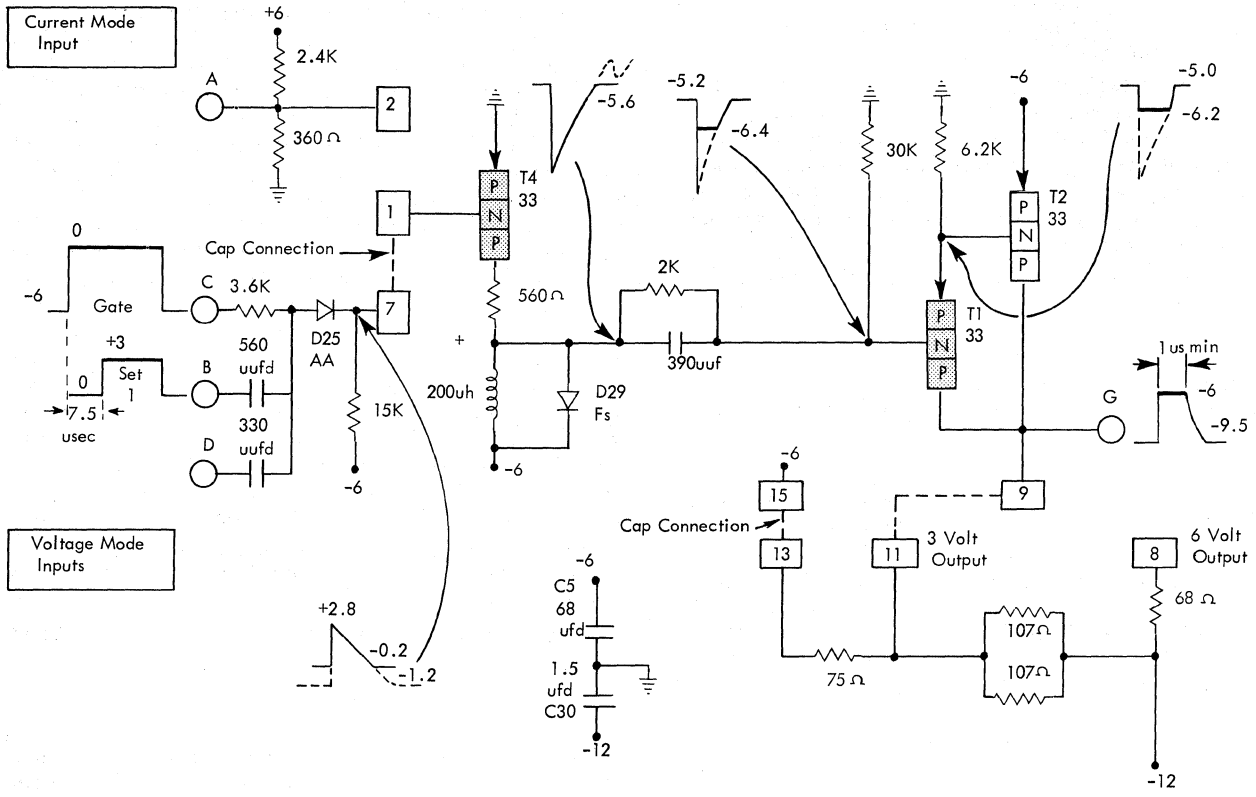
AYWM WN WP WQ WR WS



Possible ALD Configurations



Logic Application



Card Code	Part No.	Cap Connections Used	Coupling Input Used	Collector Loading	Input Waveforms				Max Rise Time	Repetition Rate(Max)	Output Waveforms
							Min	Max			At Pin G For:
AYWM	371426	1 to 2	CM	None	Voltage Mode Inputs	Gate Pin C	-0.2 / -5.56	0 / -12.48	—	—	3 Volt Output: Min -6.54 / -8.72; Max -6.06 / -9.64
AYWN	371425	1 to 7	VM	None							
AYWP	371044	1 to 2 9 to 8	CM	Yes(6v)		AC Set 1 Pin B	2.6v	3.4v	1.0us for 2.6v Shift	150KC	
AYWQ	371043	1 to 2 9 to 11 13 to 15	CM	Yes (3v)		AC Set 2 Pin D	5.56v	6.2v	1.4us for 5.6v Shift	200KC	6 Volt Output: Min -6.54 / -11.76; Max -6.06 / -12.48
AYWR	371042	1 to 7 9 to 8	VM	Yes (6v)							
AYWS	371041	1 to 7 9 to 11 13 to 15	VM	Yes (3v)	Current Mode Input	Pin A	+0.4 / -0.4	+1.2 / -2.5	1.0us for 0.5v Shift	200KC	Rise Time (Max) = 0.9us Pulse Duration = 1.0us (Nom)

Gated Sample Pulse Driver 2

This family of sample pulse drivers (DSP) is used to drive voltage mode triggers 1, 2 and 3. An output repetition frequency, independent of circuit loading, is obtained from each card in this group. Circuit operation is similar for all the cards and the different cap connections permit flexibility of application. These pulse generators are driven by either voltage mode or current mode circuits and have various collector loadings which produce either a 6v or a 3v output shift.

The circuits function as single-shot oscillators and provide about a 1μs output pulse regardless of the input signal duration. A gated, positive signal to the voltage mode inputs or a +N level at the current mode input starts the single-shot action.

Circuit Description

Cap connections on the schematic are those found on the AYWS card. The normal status of this circuit is: T4 conducting, T1 partially conducting, T2 cut off, and output pin G at −9.5v. There are two inputs, both conditioned by a single gate that must be up to 0v before either input can operate the circuit. The output expected is a 3v positive, 1μs pulse regardless of input duration in excess of 1μs.

With the input gate (pin C) at 0v for more than 7.5μs, a positive shift at input pin B cuts off T4. The attempt to reduce current through the 200μh inductance is resisted with a strong negative potential at the normally positive end of the coil. This negative spike passes through the 390$\mu\mu$f capacitor and drives T1 base negative. T1 emitter seeks to follow T1 base but is clamped by T2 emitter-base diode action. T1 base is, in turn, clamped by T1 emitter. T2 in full conduction brings output pin G up to −6v. This level is maintained while the 390$\mu\mu$f capacitor charges to −5.2v, through T1 emitter-base junction and T2 emitter-base junction. T2 is reverse-biased off when its base rises more positive than its emitter (−6.0v) and drops the output at pin G back to −9.5v.

The input signal must extend beyond the 1μs period to allow the circuit to time out. The 390$\mu\mu$f capacitor discharges through the 2K resistor.

Because of the large voltage developed by the collapsing field of the 200μh inductor, capacitors (C5, C30) are provided to short to ground any interference that might be introduced onto the −6v and −12v supply leads. The diode in parallel with the inductor prevents oscillation or ringing in the coil and speeds circuit recovery.

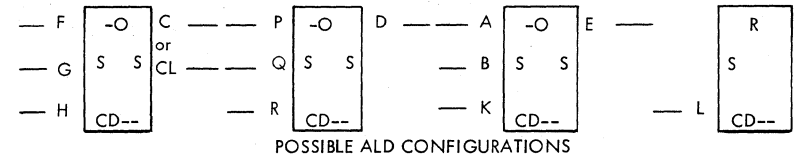
Other cap connections use the current mode input (pin A), which requires a current input; circuit operation is the same.

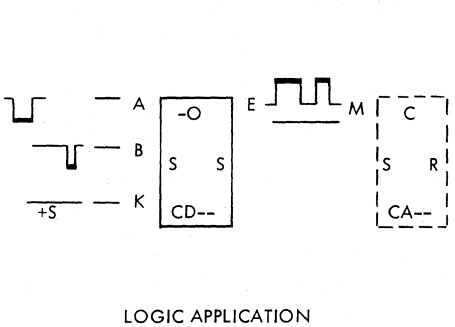
Application

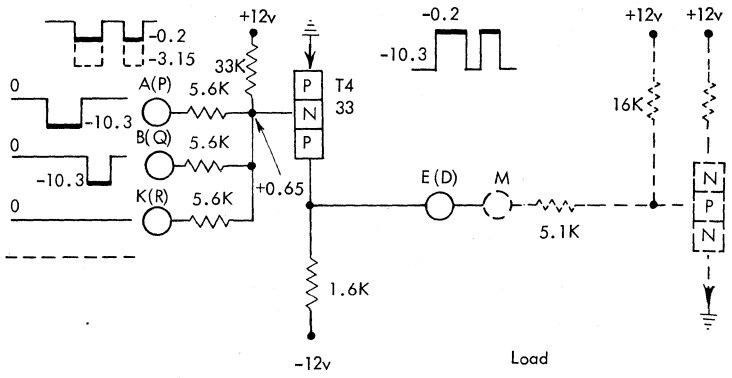
The internal collector loading and input coupling network used are noted in the chart for the card code and cap connections. External collector loading is required for the unloaded circuits. Input and output waveform data are also given in the chart.

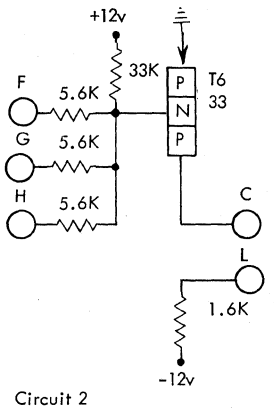
Gating: The gate input (pin C) is normally driven by CTDL, CTRL, or voltage mode trigger circuits that provide the required voltage levels. When the gate is used with the AC set 1 input, it must be conditioned 7.5μs before the set pulse is applied. When the gate is used with AC set 2 input, it must be conditioned 5.0μs before the set 2 pulse is applied.

Driving Capabilities: The 3v pulse from the DSP can drive 25 triggers (Voltage Mode Trigger 1 or 2) at a repetition rate of 150KC. The 6v pulse from the DSP can drive 25 type 3 triggers. A typical logic application is noted on the schematic.









CD--371029

Input Levels		Output Levels		Delays (usec)				
Min	Max	Min	Max	Measurement	Per		Block	Load
-0.2 to -5.56	+0.35 to -12.48	-0.2 to -5.56	+0.35 to -12.48	Gnd, Input, -5.25, -0.6, Gnd, 0.6, -5.56, T_{on}, T_{off}, Output	Turn On (T_{on})	Min	+0.26	-0.03
						Max	+0.84	-0.02
					Turn Off (T_{off})	Min	+0.6	+0.03
						Max	+2.8	+0.06

The CD - - card consists of 3 three-way PNP non-translating circuits used for repowering and level setting of CTRL signals. This circuit is sometimes called the NOR circuit. Each circuit on the card performs a basic logical function (+A, −O, I) and inverts the S input signal. The logical function is performed by the input resistor network and the invert function is accomplished by the common emitter transistor configuration. Collector loading for circuit 2 differs from that of circuits 1 and 3, and permits flexibility in driving external loads and for accomplishing the DOT functions. In the −OR logic application shown, a +S output is obtained whenever a −S level occurs at any of the input pins.

Circuit Description

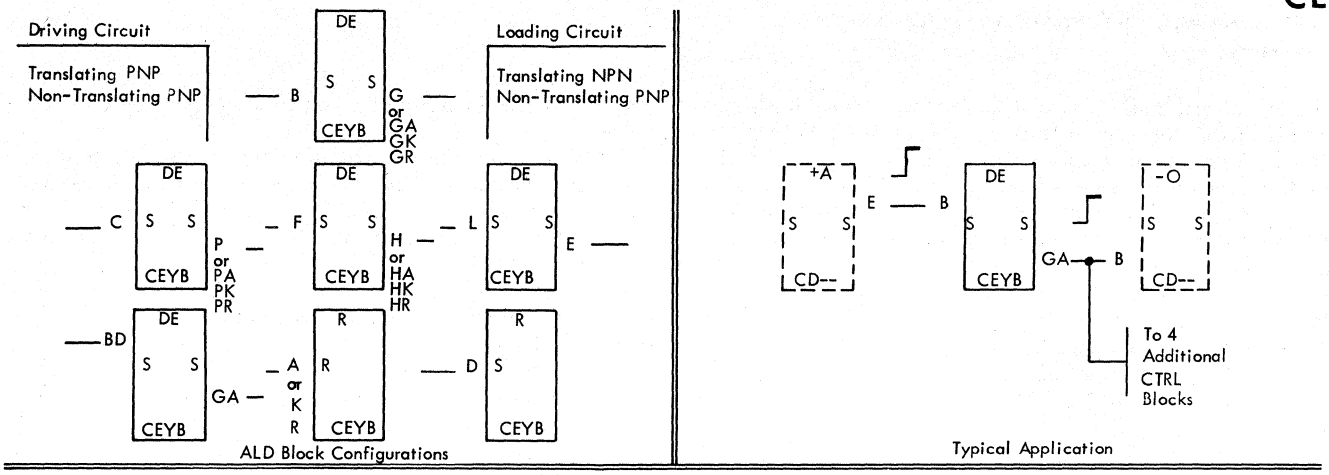
The base of T4 is biased by the voltage developed across the input divider network. The exact level of this bias depends on the number of inputs used and their level. Input levels may vary at their low levels (−S), but all will reach ground potential at the +S level. When +S levels exist at all the input pins, T4 base is at +0.65v. The transistor is reverse-biased off as its emitter is returned to ground. Current flow from the −12v supply through the 1.6K collector resistor to the load divider network gives a −10.3v off output.

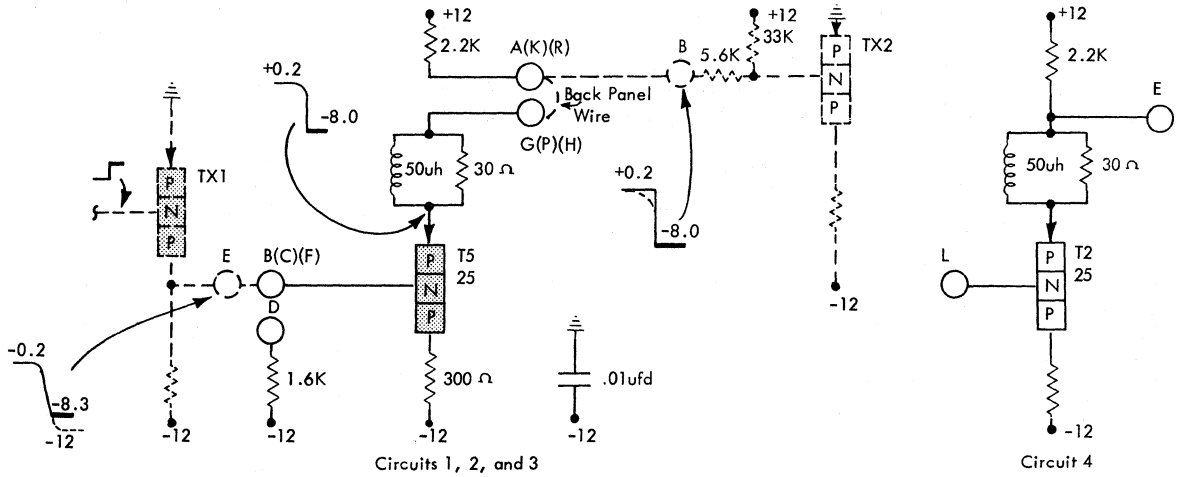
Dropping any input to the −S level causes T4 base to decrease toward −3.15v. T4 becomes forward-biased on and clamps the base at −0.2v. Saturation current flows through the transistor and quickly raises the output to the +S level (−0.2v).

Coincidence of more than one −S level at the input drives the transistor farther into saturation and increases the turn-off delay of the circuit. Circuit delays are summarized in the chart. The delays are measured from the time the input reaches the circuit switching threshold until the output reaches the switching threshold of the loading stage.

Application

Possible logical functions of these circuits are indicated in the Circuit Use chart. DOT'ing the collectors (sharing of a common collector load by similar outputs) does not perform another level of logic, but merely increases the number of inputs. These inverter circuits are also combined with other CTRL logic circuits to make up trigger and latch configurations. Possible driving and loading circuits are indicated with the ALD representation.





Card Code	Part Number	Input Voltage Levels		Maximum Output Current		Maximum Output Loading	Delay (usec)				Circuit Use
		Min	Max	Up Output	Down Output				CTRL-DE	Inv- DE	
CEYB	371032	-0.2 to -6.06	0 to -10.55	4.98ma	7.97ma	5 CTRL or 7 Inverter Circuits	Turn On	Min	+0.34	+0.3	DE +DEA -DEO
								Max	+1.55	+1.2	
							Turn Off	Min	+0.27	+0.65	
								Max	+2.3	+2.9	

The CEYB card consists of four one-way PNP emitter follower circuits. Each circuit serves as a non-translating current amplifier that drives additional logic or branching circuits. Emitter followers also serve as buffer devices to match impedances or provide isolation. A slight DC voltage shift results between the input and output voltage signals. Card and circuit design permit many variations in input and output loading connections of these emitter followers. A typical circuit application, input and output type loading, and some of the possible ALD block configurations are shown.

Circuit Description

Assume circuit 1 has the input and output loading indicated by the dash-line circuitry. With TX1 on, T5 base is at about −0.2v and T5 is in partial conduction. This current flows through the low resistance inductor into the 2.2K emitter follower resistor and input divider network of TX2 to the +12v supply. T5 base-emitter drop (0.2v to 0.4v) causes a slight voltage shift between the input and output signals. A +S output exists at pin A and reverse-biases TX2 off.

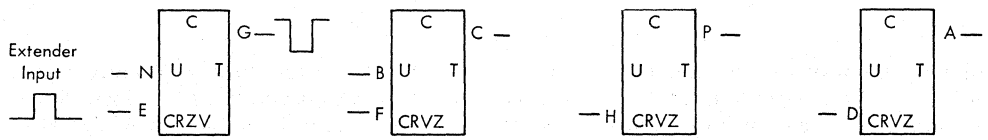
When TX1 turns off, its collector voltage drops toward −12v and increases the forward bias on T5. Current through T5 starts to increase but is momentarily resisted by the inductor. The voltage drop developed across the parallel LR network holds the output positive until the counter-EMF is overcome. Then, the output drops sharply to the −S level and the transistor is in full conduction. Additional current flow into the load network forward biases TX2 on.

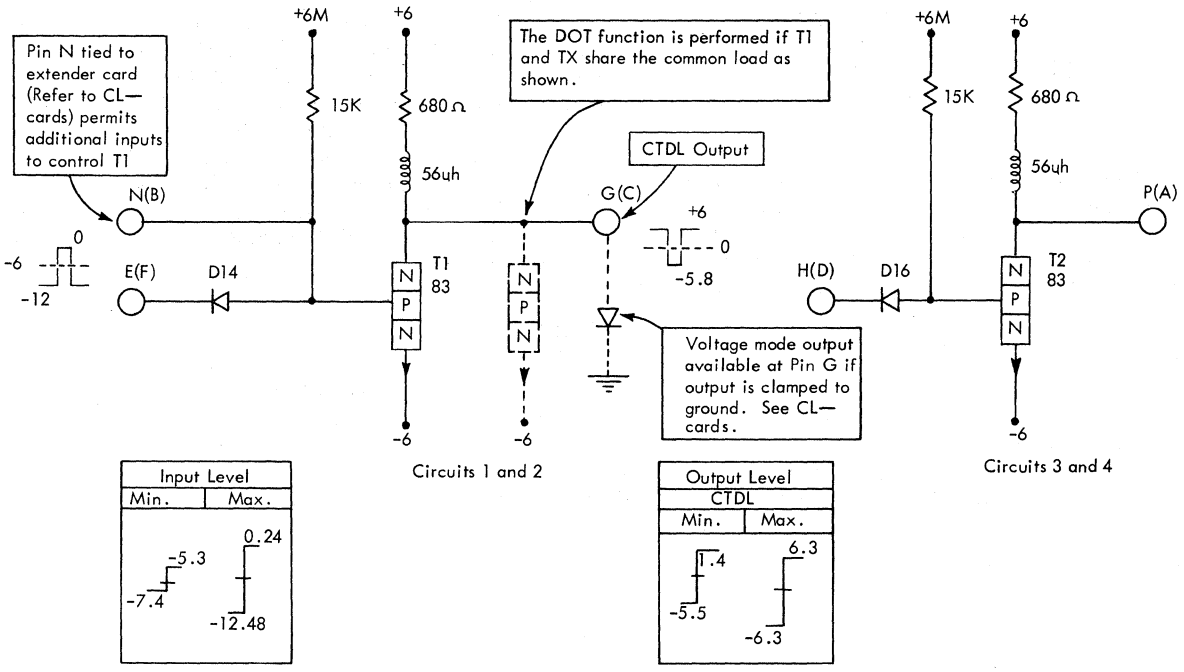
The circuit is returned to its original status by a +S level to T5. The rise to the former +S level is similarly resisted by the inductor and again a sharp shift results.

Because of the relatively low impedance offered by the emitter follower, the output level is little affected by the output loading (within limits). The 300 ohm collector resistor limits the power dissipation across T5. The 0.01μfd capacitor filters to ground any oscillation or ringing that might be introduced onto the −12v line by the coil. Because the emitter followers are normally driven by CTRL logic or inverter circuits, the delays given in the chart are the total delays encountered through the driving circuit and the emitter follower.

Application

The logical functions performed by these circuits are indicated in the Circuit Use chart. Back-panel wiring permits additional flexibility. For example, the DOT functions are accomplished by connecting similar output pins together to share a common emitter load. Wiring an input pin to pin D allows the DE to be driven from an unloaded logic circuit.





Card Code	Part No 37---	Extender Input Circuit	CM Output Circuit	Collector Loading Circuit 1	2	3	4	Delays	Per	Basic Block	Par'lel C'lector	CM Base	Diode Input	100 uufd	Circuit Use
														(usec)	
CRVZ	1274	1,2	No	Yes	Yes	Yes	Yes	Turn On	Min.	0.18	.00	.00	.00	.02	+C CO +TC +TCO -CA
CRZT	1275	1,2	No	Yes	Yes	No	No		Max.	0.52	.007	.02	.02	.05	
CRYG	1277	1,2	No	Yes	No	No	No	Turn Off	Min.	0.05	.004	.005	.000	.03	
CR--	1276	1,2	No	No	No	No	No		Max.	0.12	.01	.02	.005	.06	

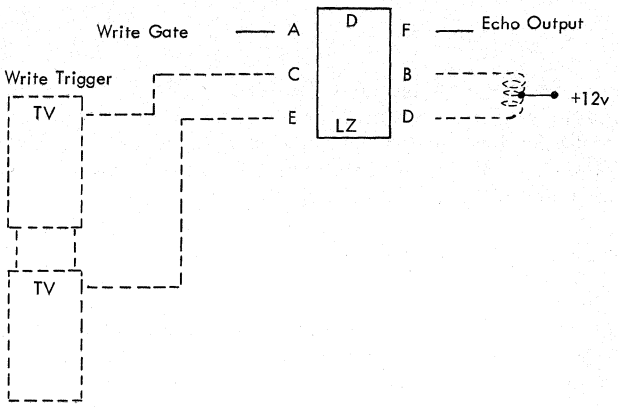
The CRZV card consists of four one-way NPN logic circuits. Each circuit on the card translates a U input to an out-of-phase T output. Internal collector loading for each circuit gives CTDL outputs at pins G, C, P and A. Extender pins N and B permit additional inputs to control circuits 1 and 2.

A +U level is required at pin E to forward-bias T1 on. With T1 on, the output at pin G is near −6v minus the slight voltage drop across the forward-biased transistor. When the input signal drops to −12v, T1 is turned off. The low forward impedance of the conducting diode rapidly removes the excessive minority carriers from the base region. This action minimizes the effect of operating the transistor in saturation and assures a fast response at the trailing edge of the output waveform. At this time, the transistor acts as a high impedance and the output at pin G increases to +6v (No Load).

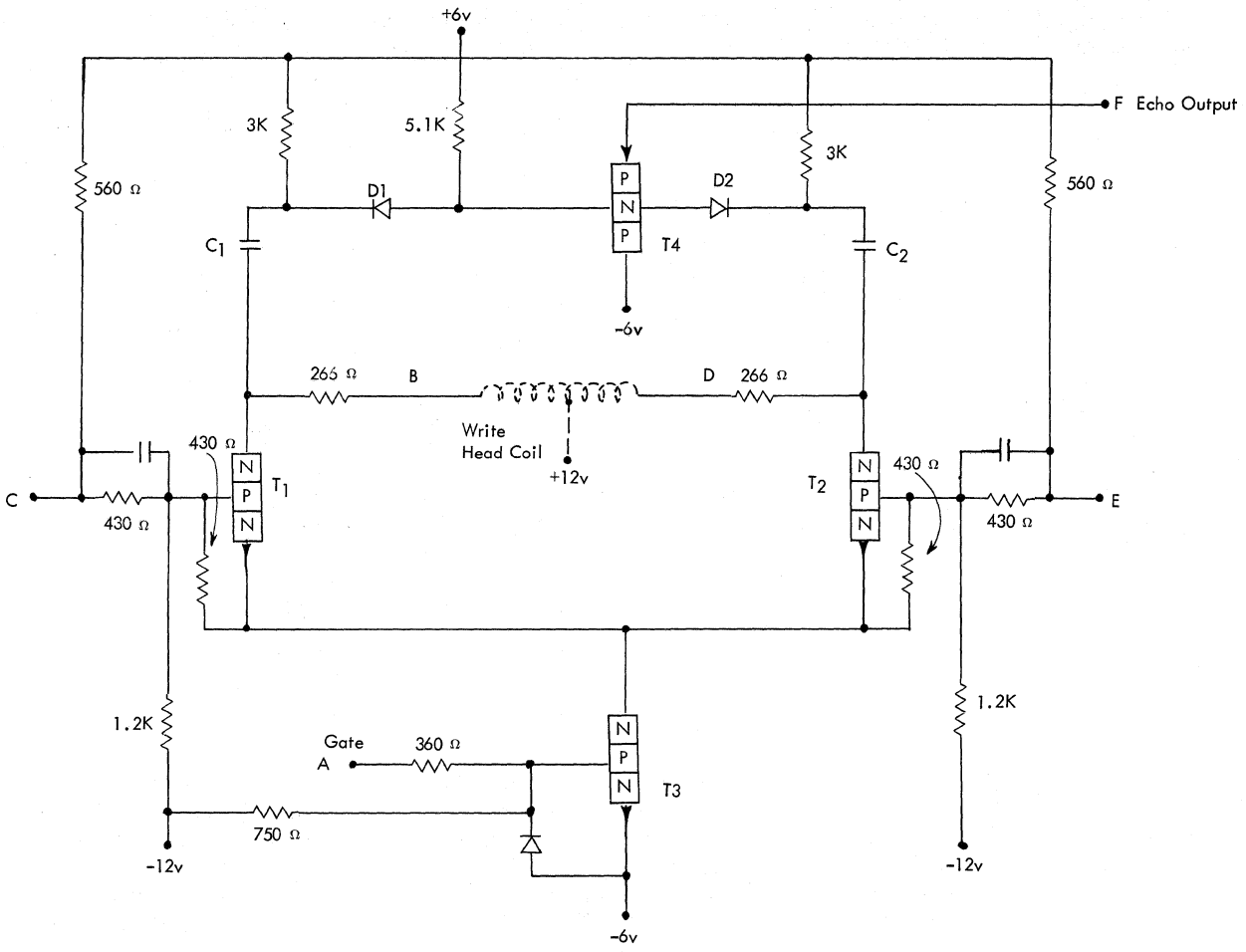
Because of the large input signals used, variations in the input loading conditions do not affect the transistor status. The transistor is either in saturation or at cut-off. Output voltage levels are dependent on loading conditions.

Application

The circuit loading is noted above for the different cap connections in this group of cards. External collector loading is required for the unloaded circuits. Logical functions performed by these circuits are indicated by the symbols listed in the chart labeled Circuit Use. The DOT function is accomplished by connecting similar output pins together to share a common collector load. CTDL and voltage-mode outputs are available from these circuits as noted on the schematic.



BLOCK CONFIGURATION AND TYPICAL APPLICATION



Input Voltage Levels (Terminals C and E)		Status Gate Voltage Levels (Terminal A)	
Min	Max	Min	Max
-.2v -5.76v	0v -6.54v	-.3v -11.52v	0v -12.48 v

Head Driver and Echo Pulse Amplifier, P/N 371674

This is a high-current driver used to switch current in a magnetic tape write coil. The circuit also incorporates an echo pulse amplifier that provides a pulse each time current is switched in the write coil.

The two inputs (terminals C and E) are fed from the outputs of a voltage mode trigger. An up level (ov) must also be applied to the gate input (terminal A) for the driver to function.

Circuit Description

The objective of this driver is to pass current through either half of the write coil. Current must therefore flow from −6v through transistor T3, through either transistor T1 or T2 and through half of the write coil to +12v. Since current must flow through T3, first consider the status of the write gate terminal A. A +S level on the gate terminal will forward bias T3, causing it to offer a very low resistance path for the current.

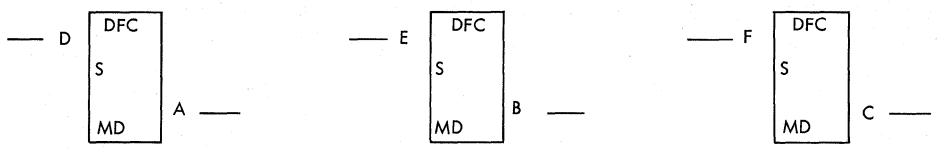
Next, consider the status of transistors T1 and T2. The base of T1 is connected to one output of a voltage mode trigger while the base of T2 connects to the other trigger output. The two output levels of the voltage mode trigger are ov (up level) and −6v (down level).

Consider the condition where ov is applied to terminal C and −6v to terminal E. With ov on terminal C, T1 conducts and therefore offers a low resistance path for the flow of current. At the same time, −6v on terminal E holds T2 cut off, preventing the flow of current. Under these conditions, current flow is through T3, T1, and the left half of the write coil.

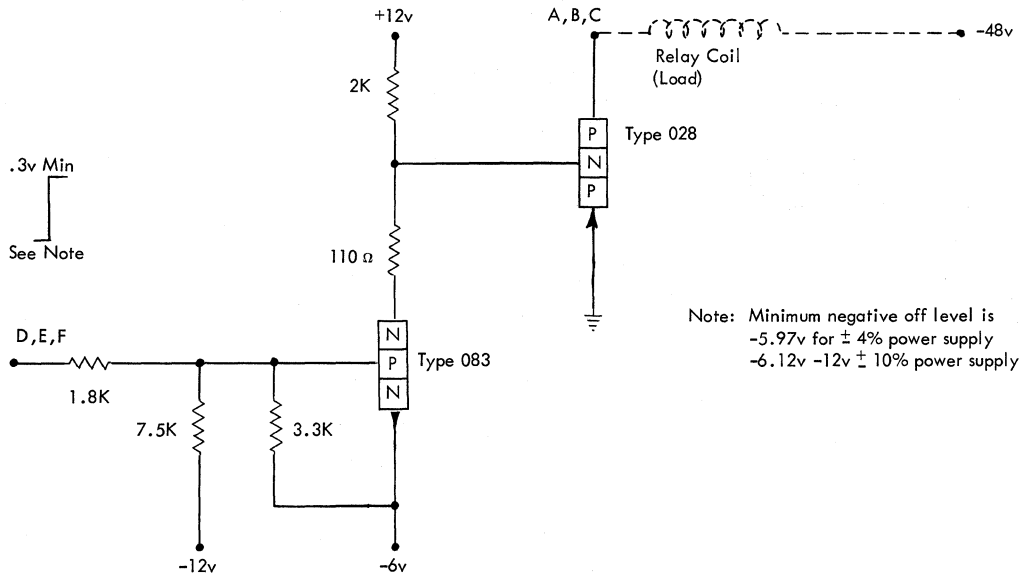
When the write trigger flips, the voltage levels on terminals C and E are transposed and T1 cuts off while T2 conducts. Current then flows through T2 and the right half of the coil.

The echo amplifier function of the driver is performed by transistor T4. The collector of T1 and the collector of T2 are capacity-coupled through negative facing diodes to the base of T4. Consider the condition where the write trigger flips so that T1 conducts and T2 cuts off. When T2 conducts, its collector drops from +12v to a somewhat negative level. The negative shift is coupled through capacitor C1 and reaches the base of T4, causing it to conduct momentarily. At this same instant, T2 cuts off and its collector rises to +12v. This positive shift, however, has no effect because diode D2 prevents its from reaching the base of T4.

When the write trigger flips again, the negative pulse will reach T4 through diode D2 while the positive shift will be blocked by diode D1. Therefore, each time current is switched in the write coil, an echo pulse is developed by T4. The echo pulse determines if the tape unit attempts to write correctly.



POSSIBLE ALD CONFIGURATIONS



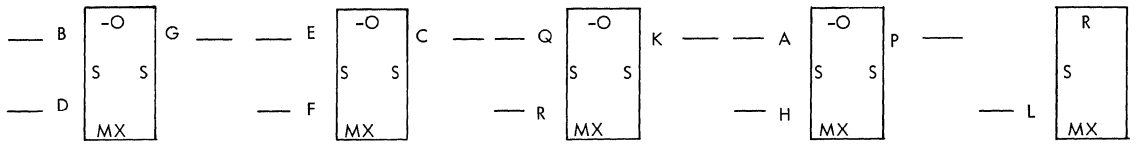
MD
Functional Coil Driver

This circuit is designed to operate with loads requiring a steady state current of 500 ma maximum. A +S level is required at the input to cause current flow in the load.

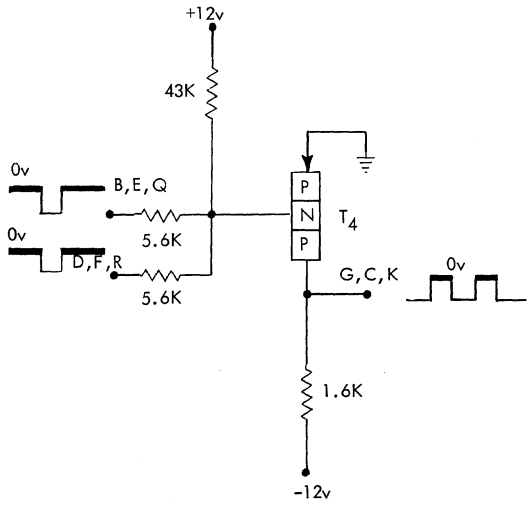
Circuit Description

With −S level at the input, the circuit is in the off status. The type 083 transistor is cut off and the positive level at the junction of the 2K and 110-ohm resistors also cuts off the type 028 transistor.

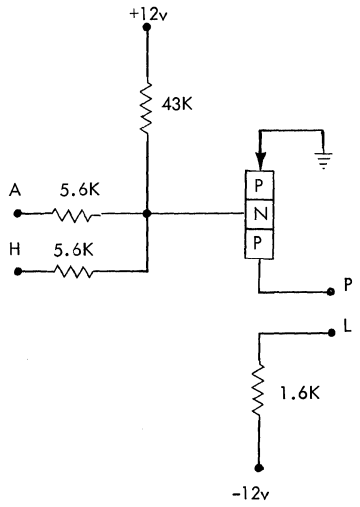
When the input rises to +S level, the 083 transistor conducts, applying a negative level to the base of the 028 transistor. The type 028 transistor conducts, allowing current to flow in the load.



POSSIBLE ALD CONFIGURATIONS



Circuits 1, 2, and 3



Circuit 4

MX-371661

Input Levels		Output Levels		Delays			(usec)	
Min	Max	Min	Max	Measurement	Per		Block	Load
-0.2 / -5.56 / -12.48	+0.35	-0.2 / -5.56	0v / -12.48	Gnd Input -5.25 -0.6 Gnd 10.6 -5.56 T_{on} Output T_{off}	Turn On (T_{on})	Min	+0.24	-0.02
						Max	+0.62	-0.01
					Turn Off (T_{off})	Min	+1.28	+0.04
						Max	+3.9	+0.1

MX
Two-Way PNP Nontranslating Circuits

The MX card consists of four 2-way PNP nontranslating circuits sometimes called NOR circuits. Each circuit on the card performs a basic logical function, (+A, −0, I) and inverts the S input signal. The logical function is performed by the input resistor network, and the invert function is accomplished by the common emitter-transistor configuration. Collector loading for circuit 4 differs from that of circuits 1, 2, and 3 and permits flexibility in driving external loads.

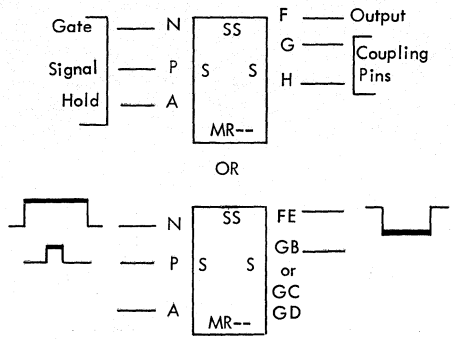
When the MX circuit is used in a −OR logical application, a +S output level is obtained whenever a −S level occurs at either input.

Circuit Description

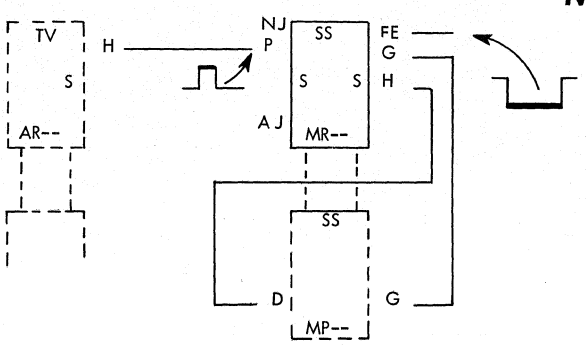
The base of transistor T4 is biased by the voltage developed across the input divider network. The exact level of the bias depends on the number of inputs used and their level.

When +S level exist on both inputs, transistor T4 is reverse biased off. Current flow from the −12v supply through the 1.6K collector-resistor to the external load gives an output level of about −10.3 volts depending on the value of the load resistance.

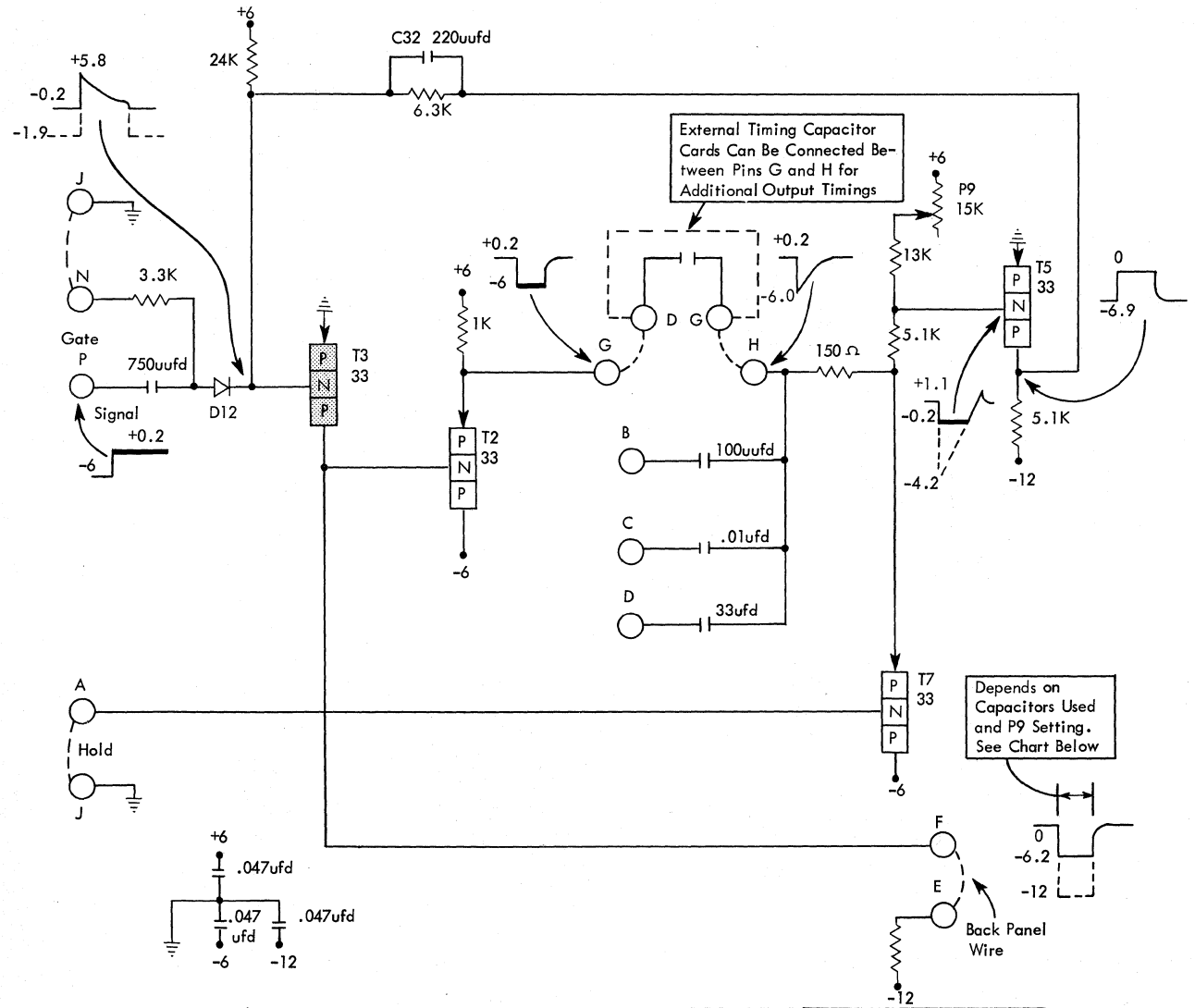
Dropping either input to a −S level causes T4 to conduct, raising the output level to +S.



ALD Configurations



Typical Application



Card Code	Part Number	Input Requirements			Output		Output Pulse Duration		
		Signal Input	Gate, Hold Inputs		Voltage Level		Connect Pin G to	(msec)	
			Min	Max	Min	Max		From	To
MR--	371623	0.8 Min usec; 5.6v Min; 1.0 usec; Max	-0.2	+0.2	-0.2	0	Pin C	.0457	.0812
			-5.56 Depends on Driving Circuit		-5.56	-6.54	Pin D	160.0	215.0
							Pin B	452.0	735.0
							Pin B and D	610.0	960.0

The MR - - card is a gated single-shot trigger circuit that produces output pulses of a fixed time duration. The circuit consists of four PNP transistors and three capacitors of different values used in the time-out network. By changing the back panel wiring to the various capacitors on the card, different output pulse durations are possible. A positive shift to a gated input starts the single-shot action and provides a negative output pulse of a fixed time duration. This output pulse duration does not depend on the input staying up. A −S level at the gate input prevents the positive shift from starting the single-shot action. Additional control of the circuit is possible with a special hold input. This input can be used to initially start or maintain the single-shot active output (−S) regardless of the other input levels. The output remains active for the selected pulse duration after the hold input is released.

A typical application of the single-shot using an external timing capacitor is shown. Both the gate and hold inputs are returned to ground.

Circuit Description

With the input gate (pin N) at +S and the input hold (pin A) at +S, the status of the circuit is: T3 fully conducting, T2 and T7 partially conducting, T5 cut off, and output pin F at the +S level. The positive shift at input pin P, through the input capacitor and the input diode, reverse biases T3. T3 cuts off and T2 base seeks −12v. Output pin F falls to a −S level and T2 reaches full conduction. The negative shift at T2 emitter, through the selected timing capacitor and 150 ohm resistor, appears on the emitter of T7. T7 cuts off. This negative voltage shift, developed across the resistor network of 150 ohm, 5.1K, 13K,and the 15K potentiometer also appears at the base of T5. T5 base seeks the −4.2v and forward-biases the transistor on.

The positive shift at T5 collector is coupled back to T3 base, maintaining T3 cut off. This action is instantaneous through the coupling bypass capacitor C32. The circuit remains in this status while the timing capacitor charges through the resistor network toward +6v. As soon as T5 base reaches ground, T5 cuts off and the coupling voltage to T3 base is lost. The input shift has long since dissipated to ground through the input gate pin N. Therefore, T3 resumes conduction and output pin F rises to its former +S level. T2 and T7 resume partial conduction and the timing capacitor discharges through T7. The circuit is back to normal.

If the hold input is used, pin A is not returned to ground. An active output level can be maintained by establishing pin A at a −S level. T7 is biased to full conduction, lowering T5 base below ground; T5 conducts, and through the coupling to T3 base, T3 is cut off; and T2 goes to full conduction. Causing T7 to conduct drives the entire circuit to the same status as an input signal does. When the hold input is released (pin A rises to +S), the timing capacitor must again charge through the resistor network toward +6v. The output at pin F will remain active until T5 is cut off by the rise in its base level, and T3 again conducts.

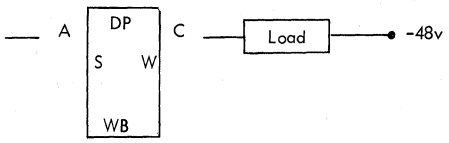
The repetition rate of this circuit is 1.3 times the selected output pulse duration,if 0.3 of the output pulse duration is used for recovery of the circuit. Turn-off delays are a function of the input rise time, and circuit loading. Delay values vary from 0.16μs to 0.8μs.

Application

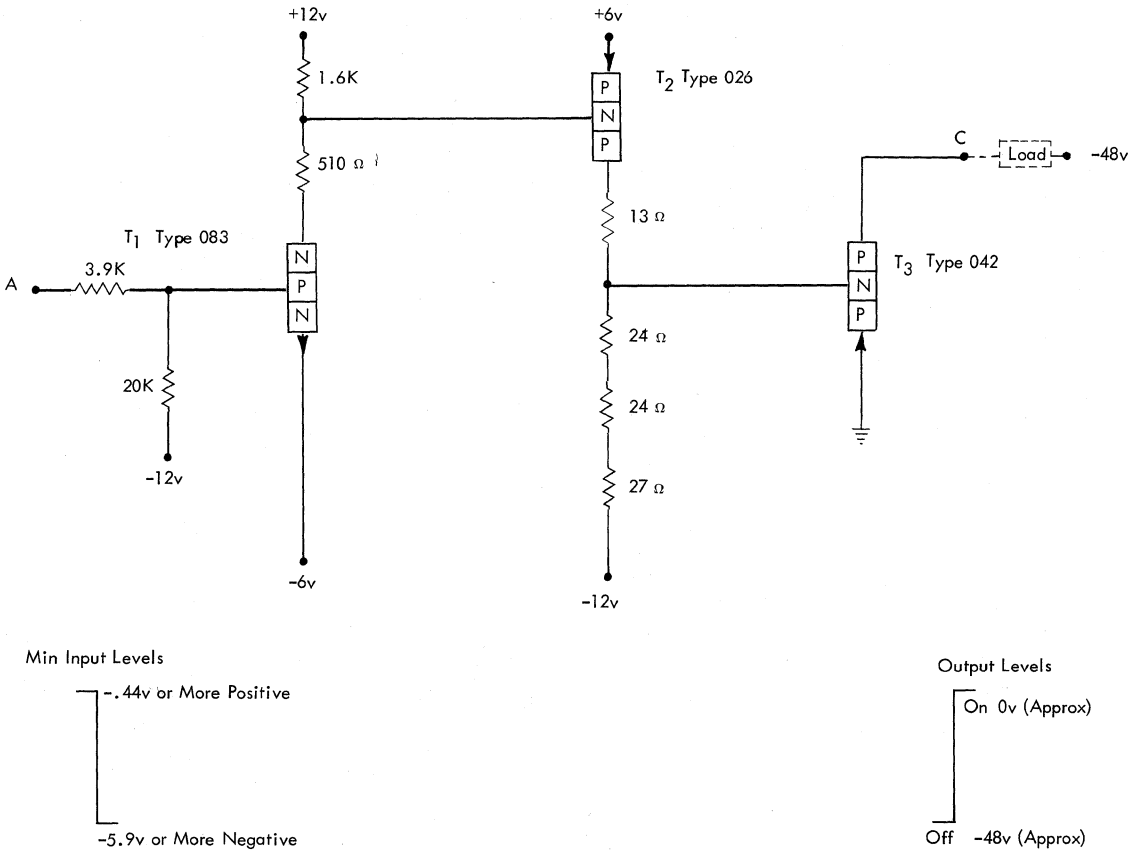
The pulse durations for the capacitor values on the single-shot card are summarized in the chart. An exact timing within the range noted is obtained by adjusting the 15K potentiometer. If additional timings are desired, external timing capacitor cards can be connected to the coupling pins. Refer to the MM - -, MN - -, and MP - - timing cards for other possible single shot timings.

Gate inputs are normally driven from CTRL logic circuits or from a voltage mode trigger. The gate input must be conditioned before the set input is applied. Levels and timings for the gated AC input operation are:

AC Set Input	Gate Level Before Conditioning	Gate Condition Time	Minimum Gate Level
6v	−12.48v	8.75μs	−0.5v
6v	−13.2v	8.90μs	−0.5v
6v	−6.24v	6.85μs	−0.5v
12v	−12.48v	5.00μs	−2.0v
12v	−13.2v	5.15μs	−2.0v



BLOCK CONFIGURATION AND TYPICAL APPLICATION



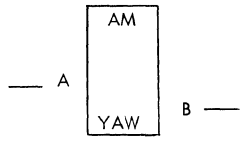
WB--
Relay Driver

The relay driver is a three-transistor nonlatch driver with a maximum steady-state current capability of 2.5 amperes. Although this circuit is primarily a relay driver, it can be used to drive other high current loads.

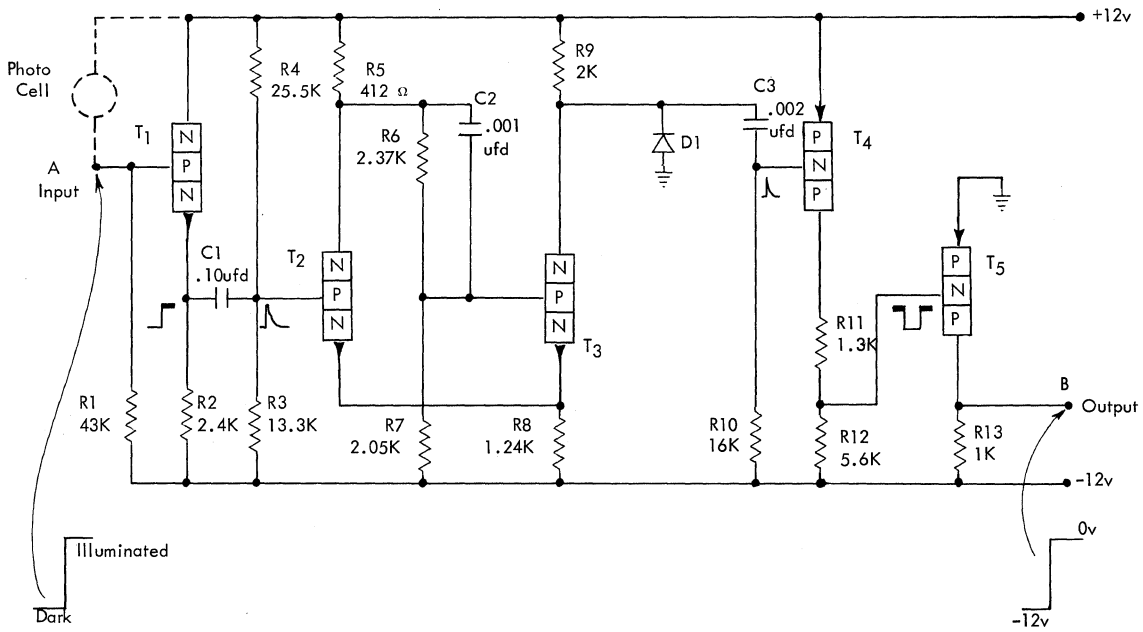
Circuit Description

When the driver is in its inactive condition, the input is at +S level and T1 and T2 are conducting, but T3 is cut off.

When the input drops to −S level, T1 cuts off, causing the junction of the 1.6K and 510-ohm resistor to rise toward +12v. This action reverse biases the emitter base junction of T2, cutting off conduction and allowing the junction of the 13-ohm and 24-ohm resistor to drop from a positive to a negative level. As this level drops slightly below ground (ov), the emitter base junction of T3 is forward biased, causing T3 to conduct. Current then flows from −48v through the load, through T3 to ground.



BLOCK DIAGRAM



YAW
Photo Cell Amplifier

The circuit is used with a photo cell, to sense an aluminum strip on magnetic tape. Light reflected from the aluminum strip produces a 10 ±3 μs positive pulse at the output of the amplifier.

Circuit Description

The photo cell connected between +12v and input terminal A, along with R1, forms a voltage divider. The junction of this divider connects to the base of transistor T1 which serves as an emitter follower. The output of T1 is capacity-coupled to the base of transistor T2. Transistors T2 and T3 form a Schmitt trigger that provides an output pulse of good rise time regardless of the input pulse rise time. Diode D1 connected between the collector of T3 and ground provides a clamped output. The input to T4 is a differentiated pulse having accurately controlled amplitude and rise time. The output of T4 is used to drive the output transistor T5.

In the static condition (photo cell dark), T1 conducts lightly. Transistor T2 is cut off and T3 is conducting. Transistor T4 is conducting and output transistor is cut off. With transistor T5 cut off, the output level at terminal B is −12 volts.

When light strikes the photo cell, its resistance decreases causing a rise in voltage at the base of T1. The positive output of T1 turns on transistor T2 and this action turns off T3 producing a positive pulse at the base of transistor T4. Transistor T4 cuts off, allowing the junction of R11 and R12 to go negative. The junction of R11 and R12 is connected to the base of transmitter T5, and when the base drops slightly below ground, T5 conducts heavily and output terminal B rises to +S level (ov). The output remains at an up level for about 10 μs determined by the time that T4 remains cut off. The cutoff duration of T4 is determined by the positive output of the Schmitt trigger and the time constant of C3 and R10.

Troubleshooting Hints

Read-Write Errors

EXCESSIVE READ ERRORS

1. A high cutoff current in the write head driver circuit can cause a low signal in one track.
2. A high cutoff current in the erase head driver can cause a low signal in all tracks.

READ ERRORS IN ONE TRACK

A noisy preamplifier can cause this trouble.

READ ERRORS IN ALL TRACKS

Large noise spikes on reel drive motor line can be caused by:

1. Clamping diode open.
2. Burned spots on the tape reel motor commutator.

INTERMITTENT READ ERRORS

The 7330 tape unit is sensitive to inter-record gaps that are less than $^{11}/_{16}$ inch. Intermittent read errors may occur as a result. Magnetic tapes generated on other tape units, to be read on the 7330, must have gaps no less than the minimum specification.

IR gap size for IBM 727, 729, and 7330 tape units is: 0.75 +0.125, −0.0625 inch.

EXCESSIVE READ-WRITE ERRORS

1. If the start envelope is unstable up to 8 MS, check the moving coil for topping in the GO position. If the stop envelope is unstable up to 8 MS, check the moving coil for topping in the GO position. If the stop envelope has variations, check the moving coil for bottoming in the stop position.
2. Check for loose write skew delay line taps.
3. A loose bonding on vacuum cannister, plug, or terminal board can cause a high frequency noise.

Tape Trouble

TAPE STICKING TO STOP CAPSTAN

The stop capstan should be replaced on machines with serial numbers below 11752. The old type capstans' manufacturing process has been changed to eliminate a possible tape stick problem. EC 251017 provides for this modification.

TAPE DAMAGE

The 7330 installations experiencing tape creasing near the front edge of tape should check the head cover stop assembly. If the rubber bumper P/N 328469 is missing from the stop assembly stud, the hinged cover may contact the edge of the tape. If the rubber bumper is loose, cement it to the stud.

TAPE BOTTOMING IN VACUUM COLUMNS

1. Tape bottoming in the columns may occur while tape is being fed into the column or when a computer high-speed rewind instruction is given. This problem has appeared only on the 7330 tape units with EC 249984 installed in them. EC 251022 has wiring changes which provide for a more reliable operation.
2. Tape bottoming can be caused by a failure of the 45 MS single-shot to fire. EC 252271 corrects this trouble.
3. Tape bottoming can be caused by the failure of the tape reel drive motors to rotate. Dirty contacts on relays 2 and 5 have caused this trouble. Thorough cleaning of the contacts has corrected this problem.

TAPE BUCKLES UNDER ERASE HEAD

The amount of current flowing in the erase head (P/N 556918) is slightly high. As a result, the head may slightly overhead and cause tape to "buckle" if one section of tape remains under the erase head for an extended period while the tape unit is in write status. This condition is most prevalent near the load point area of tape.

Erase head current is reduced by EC 249984, which is a mandatory field change. If trouble is experienced with this problem, the change may be installed in advance of the EC by replacing the erase head current limiting resistor R15.

R15 is now 20 ohms. Replace with a 50-ohm, 5-watt wire wound resistor, P/N 207319.

INCORRECT CREEP INDICATIONS

If these indications appear, check for:

1. An unclean tape transport.
2. Wrong stop time.
3. A misadjusted GO A single-shot.

Rewind

LOW-SPEED REWIND FAILURE

If the tape unit fails to do a low-speed rewind on a rewind instruction, check R102, readjust tension, or replace relay. EC 251009 provides for circuit changes giving a more positive pick pulse.

Relays

BURNING OF R111 LATCH RELAY

Some installations have been experiencing overheating of R111 (RTN LP); EC 251867 eliminates this trouble.

RELAY 5 ARCING

To reduce electrical noise caused by arcing of relay 5, the brake single-shot has been changed from 25 ms to 45 ms. EC 251022 provides for this wiring change.

Lights

SELECT LIGHT ON IN BLANK POSITION

EC 251022 provides wiring changes to keep the select light off when the select switch is in the blank position. This change prevents the select line from floating while the switch is in this position.

Terminators

1. Of the new production tape unit line terminators, some were released with a shoulder-type screw for the keeper plate mounting. This allowed the 200-position connector to shift, resulting in keeper plate breakage. Replace shoulder screw with a 6-32 countersunk screw P/N 438573.

2. If a 729 line terminator is used on a 7330 tape unit, machine malfunctions will occur. Each unit must make use of its own terminator. Mark each one accordingly.

Skew

Read Skew

Read skew is the condition where the bits of a character are read at slightly different times and has the effect of increasing the time required to read a complete character from tape. In order to read characters from tape accurately, all bits of each character must be read within a certain portion of the read cycle as determined by the control unit. Skew must therefore be held within limits that will permit all bits of a character to be read within the allotted time.

Read head skew in the 7330 tape unit is caused by slight misalignment of the read gaps during manufacture and by incorrect positioning of the head assembly with respect to the path of tape across the head.

Alignment of the read gaps is held to close tolerance during manufacture of the read head. Gap alignment therefore causes only a small amount of skew and this skew is not adjustable.

Read head skew is mainly determined by the position of the head with respect to the tape path.

To understand how the position of the read head affects skew, consider the read head in Figure 59.

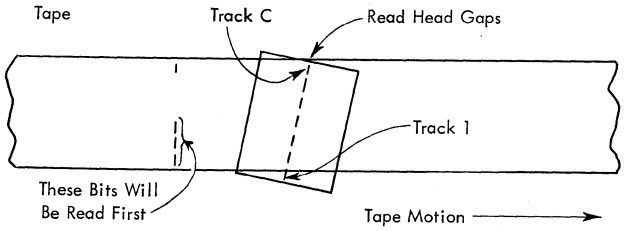


Figure 59. Misaligned Read Head

Note that the read gaps are not aligned at right angles to the edge of tape. As a character passes over the head the bits are read at different times as shown in Figure 60.

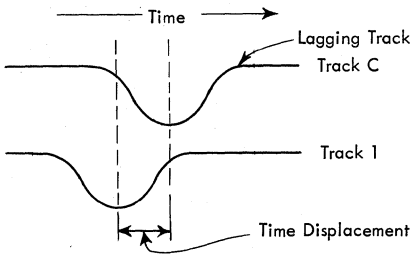


Figure 60. Output from Tracks C and 1 with Skew

The purpose of the read skew adjustment is to position the head as shown in Figure 61 so that the bits of a character are read as nearly as possible at the same time (Figure 62).

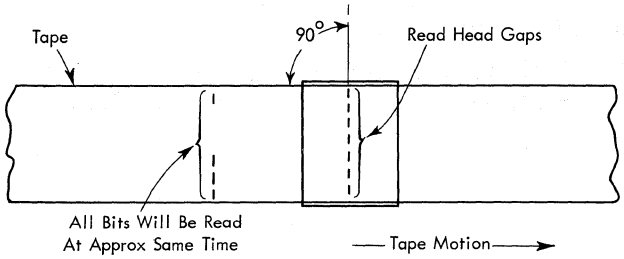


Figure 61. Properly Adjusted Read Head

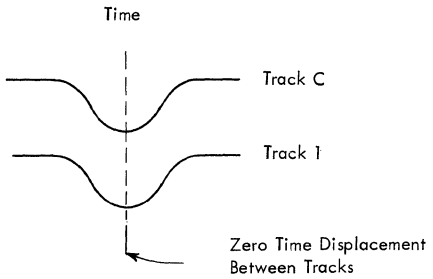


Figure 62. Output from Tracks C and 1 without Skew

The mechanical skew adjustment screw just to the right of the head in Figure 24 positions the head with respect to the tape. The purpose of this adjustment is to position the gaps for the two outer tracks so that they read bits from tape at the same time.

The actual adjustment consists of reading a master tape that is written with all bits in all tracks, while adjusting the head position so that bits are read by the outer tracks (C and 1 bit tracks), simultaneously, as determined by observing the bits on an oscilloscope. The master tape is used because it has all bits of each character written in a straight line across tape.

When the outer tracks are in proper alignment, the only remaining read head skew is that caused by the slight misalignment of the individual gaps.

The final step in the read skew adjustment procedure is to check and record the time displacement between each track. The time between the most lagging and most leading track must not exceed 3.0 microseconds. If it does, the read head is defective or one of the preamplifiers is improperly adjusted or defective.

The time displacement between tracks is recorded because the data are needed during the write skew adjustment.

Write Skew

When a character is written on tape without skew, its bits lie in a straight line at right angles to the edge of the tape. If a character is written with its bits in a staggered line, or in a line that is other than 90° with reference to the edge of tape, the character contains skew.

If characters are written with skew they will be read with skew regardless of how accurately the read head is adjusted. The tape unit must therefore be adjusted to write information on tape with a minimum of skew.

Write skew is produced by slight misalignment of the write head gaps, by improper position of the write head with respect to the path of tape over the head, and by writing bits at slightly different time intervals due to transistor circuit characteristics.

The write and read portions of the head are assembled in a single unit.

During the read skew adjustment, the read-write head was positioned for minimum read skew. This may not be the ideal position for minimum write skew. The position of the read-write head cannot be changed to adjust write skew, as this would also change the read skew adjustment.

A different method must therefore be employed for the write skew adjustment. Basically, the write skew adjustment in the 7330 tape unit consists of determining the most lagging track and then adding appropriate amounts of circuit delay to the remaining tracks so that bits for a character are written at just the right time to produce minimum write skew.

To understand how this system operates consider the example shown in Figure 63. Assume that before any write skew adjustment is made, bits are written on tape as shown. Also assume that there is no read head skew. As the bits pass over the read head, bits A and 1 are read first. One microsecond later bit 8 is read and after another microsecond interval bits C and 4 are read.

Bits B and 2 are the last to be read and this occurs 3 microseconds from the time the first bits were read.

In this example, tracks B and 2 are the most lagging tracks. If we make tracks B and 2 our standards we can say that the five other tracks are leading.

Now, consider tracks C and 4, which lead tracks B and 2 by 1 microsecond. If we delay the writing of the C and 4 bits until 1 microsecond after writing the B and 2 bits, tape will move just far enough to allow the C and 4 bits to be written exactly in line with the

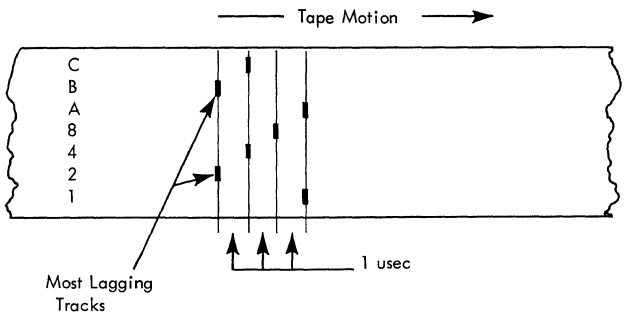


Figure 63. Write Skew

B and 2 bits as shown in Figure 64. Following this same procedure, 2 microseconds of delay will cause the 8 bit to be written in line with bits C, B, 4, and 2. Likewise, 3 microseconds of delay will bring the A and 1 bit tracks in line and characters will be written without skew.

Notice that we electrically delayed the writing of bits in a manner that compensated for the original write skew condition.

The delay referred to in this discussion is obtained from a lumped constant delay line placed in the write sample pulse circuit. Taps on the delay line allow the required amount of delay to be selected for each write track.

The write skew adjustment outlined in "Service Procedures" is slightly more detailed than the example just given.

Step 2 in the adjustment procedure removes all delay from the write tracks. This is done so that the actual write skew can be determined. Bits are then written in all tracks and are observed as they pass over the read head. Note in step 6 of the procedure that the recorded skew is actually a combination of write skew and read skew.

Remember that during the read skew adjustment some skew remained and this was recorded for future use.

The recorded read skew must now be subtracted from the combination skew observed and recorded in step 6. The remaining skew is the true write skew that must be corrected.

Step 7 of the procedure is needed because all skew is recorded in reference to track 8 which is used as the sync point for the oscilloscope. Therefore some tracks may be leading while others may lag in reference to track 8. At this time we must make the most lagging track or tracks the standard (zero skew) so that delay may be added to all other write tracks to bring them into proper alignment.

In the example of skew computations shown in the section on Service Procedures, notice that tracks A

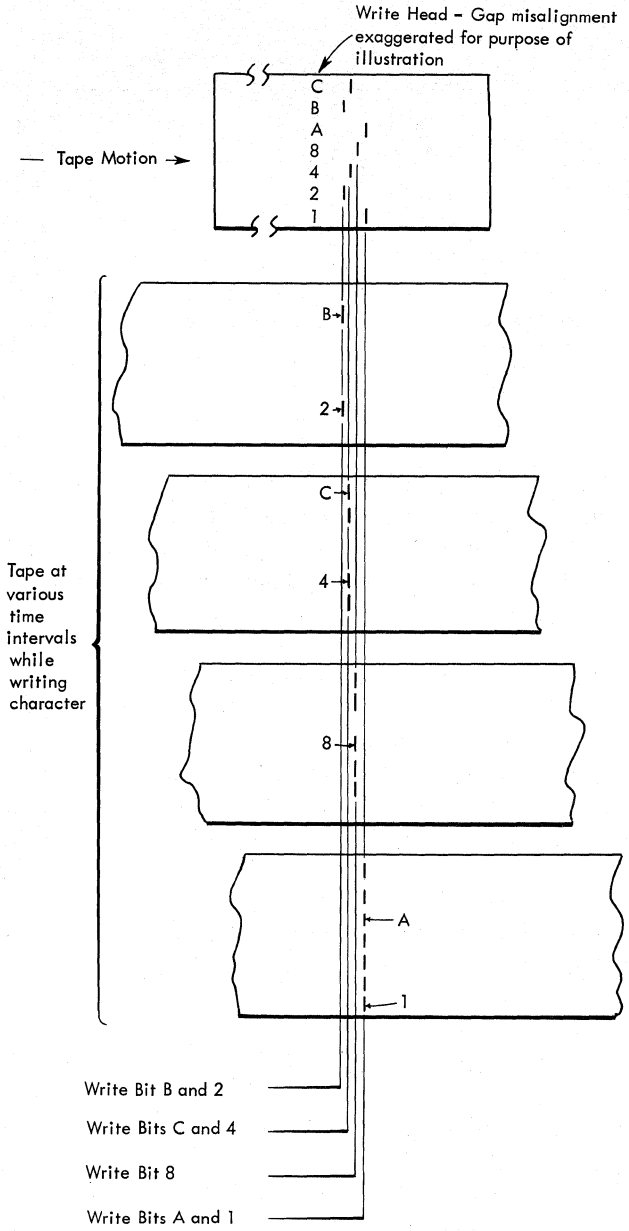


Figure 64. Write Skew Correction by Use of Delay

and 1 are the most lagging (−) tracks by one microsecond. To make these tracks have zero skew we must add the same amount of leading (+) skew to all tracks. The last line in the example shows the exact amount of delay that must be added to the tracks to reduce write skew to a minimum.

To add delay to the write sample pulse line for a particular track, move the line from the zero tap and place it on the tap that gives the delay closest to the required amount. Remember that each tap provides an additional delay of 1.25 microseconds. Because the delay can only be added in fixed steps, it will not be possible to remove all traces of write skew. It will be possible however to come well within the skew limits required for accurate reading of information from tape.

Manual Form Numbers and Recommended Test Equipment Part Numbers

7330 Tape Tester, P/N 461142: The tester does not require an extra cable because the cable is permanently attached.

7330 AC Power Cable, P/N 460663: This cable is necessary to power the tape unit off line when using the tape tester. It is also used with the 729 tape unit.

7330 Line Terminator, P/N 556801: A line terminating "shoe" is necessary in the tape unit for off line use with the tape tester.

Standard Signal Level Tape, P/N 461108: This test tape is also known as a Master Output Tape. It is specifically recommended by Engineering as necessary when setting 7330 tape unit preamplifiers. The tape is manufactured to very close signal output tolerances and will reduce possible level setting errors.

Master Skew Tape, P/N 461096: The skew master is necessary for setting mechanical and electrical skew. It is the same tape used for 729 tape units.

7330 CE Manual of Instruction, Form 223-6943-1.

7330 Parts Catalog, Form 123-0360-1.

7330 CE Installation Manual, contact Manager, Dept. 297, Poughkeepsie, N. Y.

Test equipment should be ordered from Mechanicsburg well before a new system is received. Catalogs and manuals are now available from IBM Endicott.

Copies of the reference manual and parts catalog are now included in the 1401 and 1410 installation package. However, there have been cases, especially on early systems, where they have been left out. It is recommended that at least one copy of each form number be ordered by every branch office as a precautionary measure.

Tape Loading Procedure

Use of the proper tape loading procedure is necessary to minimize tape damage, tape contamination, and insure correct seating of the rewind arm. Customer engineers should demonstrate this recommended procedure to customer operators.

1. Place file reel on machine with about 18 inches of tape hanging.
2. Open center cover and right column door.
3. Thread tape through tape transport (as indicated on inside of center cover).
4. Press reel release key.
5. Transfer load point to right of head area by turning machine reel clockwise (tape should not have slack).
6. Close the right column door.
7. With the reel release key pressed, lower the rewind arm.

8. Let the reel release key out for a few seconds.
9. After vacuum comes up, press the reel release key, turn left reel clockwise, and turn the right reel counterclockwise, loading the tape into columns. Let out reel release key.
10. Seat rewind arm.
11. Close center cover.
12. Close tape transport door.
13. Press low-speed rewind key.
14. Press start key.

Tape Care

Tape Handling

IBM magnetic tape is so durable that any limitation to successful use is almost always caused by physical damage, by the presence of cumulative wear products, or by contaminating foreign particles such as dust. Consequently, tape must be handled with care at all times to protect and extend its life. Also, maximum cleanliness must be preserved in and around tape units, tapes, reels, containers, and the general areas of use. Recommended conditions of temperature and relative humidity must be maintained.

Dust, dirt, or damage to the tape can reduce or prevent the necessary physical contact between the oxide surface of the tape and the read-write unit. Signal strength may be sharply reduced or information may be completely obliterated.

Because recorded information comes within 0.040 inch of the edge of the tape, tiny nicks and kinks caused by careless handling of tape or reel may seriously affect the quality of magnetic reading or recording. Damaged tapes are as ineffective as chipped or broken phonograph records.

As a result of the complete testing of each reel of magnetic tape throughout its length, no error-producing defects are present at the time of shipment to the customer. But after continued use, normal wear products may be generated and collect on the tape, foreign material may accumulate if proper handling procedures and precautions are not observed, or the tape may be inadvertently damaged.

Physical Conditions

Several characteristic physical conditions are sometimes found during the use of magnetic tape. With a proper understanding of these conditions, the customer can avoid complications which otherwise might arise.

IRREGULAR WINDING

Normally, tape winds on the reel with some of the edges slightly protruding. These irregularities usually result from high-speed rewinding, which causes air to be trapped between adjacent layers of tape. Another contributing factor may be static electricity.

In itself, slightly protruding edges do not interfere with the proper operation of tape. It does require, however, that proper care in handling tape be exercised by all operating personnel. The exposed tape edges can be badly damaged if they are squeezed through the reel openings or pinched in the edges of the reel.

WAVY EDGE

One condition that can give magnetic tape the appearance of having a wavy edge is curvature. If a short length of tape is spread flat on a clean surface, its edge will not be perfectly straight but will form a slight arc. The arc should not exceed ⅜ inch in 36 inches of tape. Otherwise, the tape tends to turn in the vacuum columns. A nominal curvature is present to some degree in almost all tapes. Although it may produce a slight flutter in the vacuum columns, a curvature less than ⅜ inch in 36 inches of tape does not interfere with proper operation.

Another condition that can cause magnetic tape to exhibit a waxy edge results from edge damage. If the tape reel is improperly mounted, the edge of the tape will receive undue wear and become burred. This burr causes one edge of the tape to be slightly thicker than the other. When wound on a reel, the edge of the tape with the burr will wind to a larger diameter than the undamaged edge. After a period of time, the center of tape will be permanently stretched. A tape in such condition will prove unpredictable and generally unsatisfactory. The read errors encountered are usually of the random, nonrepetitive type.

CUPPED TAPE

The outside layers of tape sometimes have a cupped appearance; that is, the oxide side of the tape may appear slightly concave.

Acetate tape may sometimes exhibit this condition when first removed from the plastic shipping bag. The cupping occurs when the relative humidity of the surrounding air is increased over a short period of time. (An increase in relative humidity can be the result of a sudden drop in air temperature as well as an actual increase of moisture content.) The acetate reacts to the humidity increase by expanding slightly, while the oxide coating does not. The cupped effect does not interfere with the proper operation of the tape and disappears after a few passes through the tape unit.

REEL WARPAGE

Reels must be properly supported when not in use. The plastic container provided has been designed so that a reel is fully supported. A reel that is supported in any other manner may become warped.

One common reason why a reel wobbles or appears to be warped during use is that the reel may not be seated properly on the hub. The same effect is produced if the file protect ring is not inserted completely and because the reel is, therefore, not fully seated. In either case, the reel behaves as if it is warped, and can produce damage to the edges of the tape.

Procedures and Precautions

The recommended conditions of temperature and relative humidity for operating IBM magnetic tape are as follows:

RECOMMENDED OPERATING CONDITIONS

The recommended operating conditions for both Mylar and H-D tape are relative humidity of 20 to 80 percent and a temperature of 50 to 90 degrees F.

For extended storage of Mylar at humidities greater than 80 percent, tape reels must be hermetically sealed within moisture-proof plastic bags. This prevents the formation of mold growth and fungus.

OPERATING PROCEDURES

Smoking should not be allowed in the machine room. Ashes can contaminate tape. Live ashes can produce permanent damage if they touch the surface of the tape.

Tapes that contain useful information must not be exposed to magnetic fields with an intensity greater than 50 oersteds.

During loading, the tape should be taken directly from the container and mounted in the tape unit. After unloading, the tape should immediately be replaced in its container.

Extreme care must be used while removing the file protect ring. Under no circumstances should the ring be removed while the tape is loaded in the columns.

When being loaded, the reels should be pushed near the hub firmly against the stop on the mounting hub to insure good alignment.

Special precautions should always be taken to make sure that the hub has been tightened during loading.

To wind the take-up reel to the load point, rotate the reel with the finger in the recessed finger hold on its surface. Rotating the reel with the finger in the cut-out will nick or curl the guiding edge of the tape.

While the tape is on the machine, the container should be closed and put in some location where it is not exposed to dust or dirt.

The tape unit should be allowed to complete the unload sequence before the door is opened.

The reels should be handled near the hub whenever possible. If difficulty is encountered while removing the reel, the bond between the reel and the hub can be broken by placing the palms of the hands along the edges of the reel and rotating it. The reel should never be rocked by grasping the outer edge. If a tape break occurs, the reel should be divided into two smaller reels. Splicing is not recommended. If it is necessary to make a temporary splice to recover information, special low-cold-flow splicing tape should be used.

Be careful when placing reflective strips on tapes. Trouble may result if the tape is soiled or damaged in the process.

GENERAL HANDLING PROCEDURES

Do not use the top of a tape unit as a working area. Placing material on top of the unit exposes it to heat and dust from the blowers. It may also interfere with cooling of the tape unit.

A reel card holder is provided for identifying tape reels. If adhesive stickers are used, make sure they do not leave a residue. Use stickers that can be easily applied and removed. Never alter labels with an eraser.

A loose end of tape should never be allowed to trail on the floor.

When necessary to clean tape, gently wipe the tape with a clean, lint-free cloth moistened with the proper tape transport cleaner. Extended exposure of tape to the solvent should be avoided; damage to the tape can result.

Periodically inspect the plastic tape reel containers for accumulated dust. Containers can be cleaned with a vacuum cleaner or by washing with a regular household detergent.

Pinching of the reels and any contact with the exposed edges of the tape should be carefully avoided.

Dropping a reel can easily damage both reel and tape and make their subsequent use unsatisfactory.

Reels of tape, whether in or out of a container, should never be thrown or carelessly handled.

STORAGE PROCEDURES

The tape must be supported at the hub and kept in its container to protect it from dust when not in use.

Tapes should be stored in some type of cabinet elevated from the floor and away from sources of paper or card dust. This should minimize the transfer of dust from the outside of the container to the reel during loading or unloading operations.

Before reels are stored, sponge rubber grommets should always be placed on the reels to prevent the free end of the tape from unwinding in the container.

If shipping of tape reels is necessary, the tape and reel should be packed in the plastic container provided for this use. The container should be hermetically

sealed in a plastic bag. Additional support should be obtained by packing in individual stiff cardboard shipping boxes.

Tape Developing

A kit is available which allows data written on H-D magnetic tape to be physically seen without damaging tape. The following procedure is recommended to make use of this kit.

1. Shake up the developer solution before using.
2. Support the tape to be viewed, oxide side up, against the bottom of the bit viewer with the white plastic card.
3. Wash the solution back and forth slowly by rocking the bit viewer from side to side; the recorded data will take shape.
4. Inter-record gaps can be checked by making a ¾ inch mark on the white plastic card.

Care should be taken to prevent physical damage to the tape being inspected.

If the iron filings in the solution become magnetized and the solution becomes thin, a small magnet or degausser will loosen the filings.

The bit viewer assembly should be ordered using code 01, Mechanicsburg. The part numbers are:

Bit Viewer Assembly	P/N 461180
Bit Viewer	P/N 461181
Bit Viewer Case	P/N 461182
White Plastic Card	P/N 461263

Engineering Changes

Mandatory engineering field changes are:

EC	PURPOSE
249779	Improve cover appearance
249992B	Replace rewind arm handle
249994	Door switch
249984	Reduce erase head current
250409	Correct voltage error
251009	Increase reliability of rewind instruction, and to have polarity compatibility
251021	Improve machine reliability
251022	Improve HS rewind slack take-up
251864	Improve HS rewind brake circuit
251867	Eliminate burning of R111 latch relay
251017	Replace stop capstan (only on machines with serial numbers below 11752)
252006	Prevent cable from holding contactor closed
252010	Fuse change
252274	Reversible capstan motor
252395	Tape reel brakes

Cables

The tape signal cable assembly, IBM P/N 535099, may have an aggregate length of 100 feet. This includes tape unit to tape unit and tape unit to tape control unit. Ten 7330 tape units may be attached to one IBM control unit channel (N or M). Cable length must be specified.

The tape unit power cable assembly, IBM P/N 535098, may have an aggregate length of 100 feet. This includes tape unit to tape unit, tape unit to tape control, and tape control to power source.

A tape unit signal terminating shoe P/N 556801 must be installed on the last tape unit. Signal and power connections are shown in Figure 65.

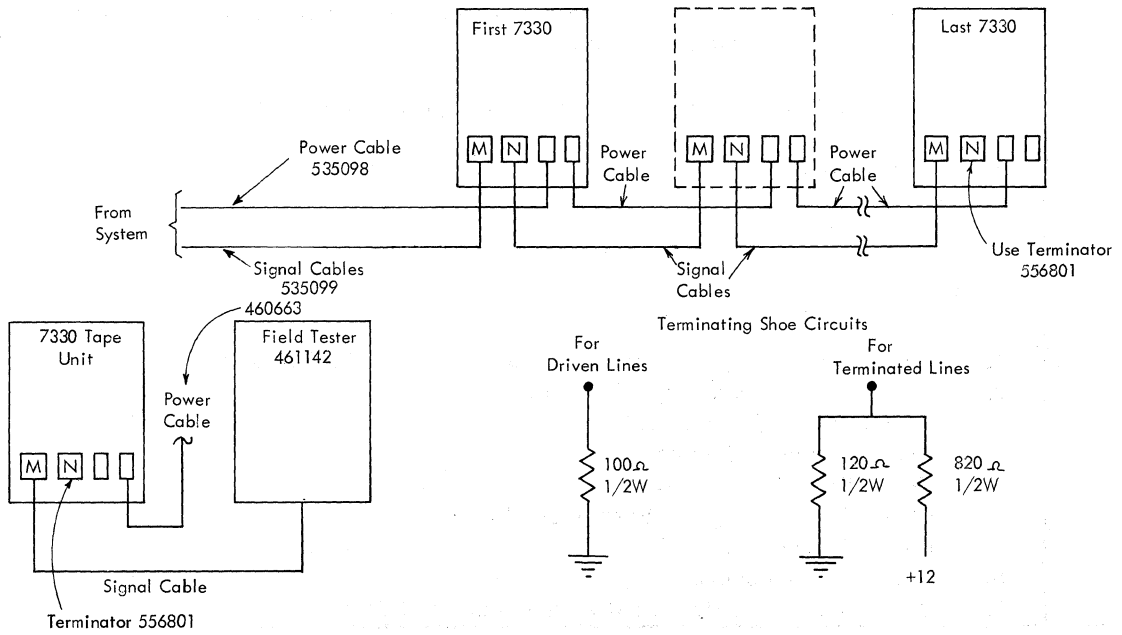


Figure 65. Tape Signal and Power Connections

Appendix. 7330 Preventive Maintenance Schedule

ROUTINE	FREQ.	DESCRIPTION - Refer to CE Reference Manual or specific Service Aid
1	6	The following PM Schedule is recommended for a one to two shift operation. The frequency should be adjusted as indicated by machine performance. The three basic PM steps performed on the 7330 tape drive are: clean, lubricate, and inspect. On Line Check 1. Run IRG Test 2. Check Rewind Operation 3. Check Tracking 4. General Inspection of Tape Transport for Worn or Binding Parts. 5. General Cleaning
2	18	Off Line PM Power Off 1. Reel Drive a. Clean Brake Assembly b. Check armature gap and wave washer tension - Service Aid #70 c. Check belts d. Lube reel knobs - IBM #24 e. Check roll pin for wear. 2. Capstan Drive a. Check belt b. Check for binds in motor and capstan shaft 3. Go Linkage a. Remove rocker arm - clean and lube bearings and pivots - IBM #6 b. Lube linkage - IBM #6 4. Inspect DP Relays for burned points and proper adjustment. 5. Check filter 6. General Cleaning Power On 1. Check power supplies - make voltage checks at SMS panels 2. Tracking and Start Stop adjustments 3. Check single shot timings. 4. Check Indicator Lamps 5. Check Read/Write Skew 6. Check feed through - adjust H-shield 7. Check Erase Head 8. Check Rewind operation 9. Check pre-amp gain - final adjustments on line

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COMMENT SHEET

IBM 7330 MAGNETIC TAPE UNIT

CUSTOMER ENGINEERING REFERENCE MANUAL, FORM 223-6967-4

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Since the computer industry continues to grow, more and more customer engineers and machine publications are required. You as a customer engineer are instrumental in attaining more useful manuals. The publications' department welcomes your valued suggestions and constructive criticism. Since this manual is designed specifically for you, we can incorporate your ideas into it if you answer one or more of the following questions.

1. Are the adjustments clear? Would you like to see more cross references between adjustments and figures?

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3. Is there a better understanding of skew since the explanation has been included in the "General Information" section?

4. Are there any areas lacking in clarity?

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COMMENTS

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NOTE: Suggestion giving specific solutions, and intended for award consideration, should be submitted through the IBM Suggestion Plan.

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