IBM Customer Engineering Reference Manual

729 II III IV Magnetic Tape Units

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MAJOR REVISION (February 1961)

This manual, Form 223-6868-2 obsoletes Form 223-6868-1 and all earlier editions. All major maintenance information has been revised and now includes subjects covered in Customer Engineering Memorandums through Number 110.

Each page on which changes appear has a dot (●) in the lower outside corner. (●) opposite a subsection heading indicates that the section has been revised. Individual paragraphs are not marked.

IBM 729-II, 729-III, 729-IV Magnetic Tape Units

Contents

1 Scheduled Maintenance

1.1 Approach to Scheduled Maintenance

The prime objective of any maintenance activity is to provide maximum machine availability to the customer. Every scheduled maintenance operation should assist in realizing this objective. Unless a scheduled maintenance operation cuts machine down time, it is unnecessary.

Do not adjust or disassemble a unit that is working properly, even if tolerances vary from specification.

1.1.1 Visual Inspection

Visual inspection is the first step in every scheduled maintenance operation. Always look for corrosion, dirt, wear, cracks, binds, burnt contacts, and loose connections and hardware. Alertness in noticing these items may save later machine down time.

1.2 Scheduled Maintenance Procedures

Specific items of scheduled maintenance are scheduled on punched cards processed in the local customer engineering office. Details of scheduled maintenance operations are listed in Section 1.3, "Scheduled Maintenance Routine Chart." During normal scheduled maintenance, perform only those operations listed on the chart for that scheduled maintenance period. Details on adjustments, service checks, and removal and replacement are found on the pages listed in the index column of the chart.

1.2.1 Electronic Circuits

Diagnostic programs, marginal checking, and pulse checking are the three basic tools used in scheduled maintenance of electronic circuits. All of these are effective in locating potential and intermittent troubles. These items are also excellent troubleshooting tools. When using them for scheduled maintenance, use them only as directed on the scheduled maintenance chart.

Do not adjust pulses unless the condition of the machine warrants it.

1.2.2 Mechanical Units

The three basic scheduled maintenance steps performed on every mechanical or electro-mechanical machine are clean, lubricate, and inspect. Remember, do not do more than recommended scheduled maintenance on equipment that is operating satisfactorily.

1.3 Scheduled Maintenance Routine Chart

Read section 1.1 through 1.2.2 before doing scheduled maintenance. Observe all safety practices.

SCHEDULED MAINTENANCE ROUTINE CHART

Code	Unit or Routine	Freq.	Operation	Observe	Page
5	Routine 5	1 or 2	Test tape timings with appropriate record gap diagnostic program.	Compare results with those of last test	7,8, 9
1	Routine 1		General inspection: Vacuum clean; clean prolay pulley shaft, vacuum columns. Replace air filters, if dirty. Lubricate the prolay pulley shaft, prolay forked arm pivot bushing, capstan shaft and motor bearing, vacuum column cover latches. CAUTION: Lubricate only the door latches in the vacuum columns. Lubricant in any other area can get on tape and contaminate it.	Tape cleaner; belts; relays for burned points, air gap, rise, and possible sluggish action; capstan motor for binds; clutch powder leaks; clutch slip rings and brushes	30 36 38 40 44
2	Routine 2	13	Power on. Photosensing lamps for 6v ± 2v, photocells for 40-70v shift	Tape break circuit operation. Tape indicator on-off by switch and auto cycle	29
3	Routine 3	13	Write Ones: Write current -12v (+.3, -1.0v); echo pulses, shape and levels; preamp gain nominal 8.5 to 8.8 volts.	High speed rewind	28,30
			Read Ones: Read coil 15-30mv at head, start stop-check at 10 ms to 100 ms or greater go down time.		
4	Routine 4	13	Power supply voltages	Levels and ripple	44

Safety

Personal safety cannot be over-emphasized. To insure your own safety, make it an everyday practice to follow all safety precautions at all times. Become familiar with and use the safety practices outlined in IBM Form 124-0002, a pocket-sized card issued to all customer engineers.

For the IBM 729 Magnetic Tape Units, observe all safety rules when working on or near high-voltage areas.

2.1 Approach to Trouble Diagnosis

Trouble diagnosis has many facets. Each problem must be approached individually. However, there are certain basic rules that help in locating troubles. Some of these rules are:

1. Gather as much information as possible from the customer.
2. Note all symptoms.
3. Know what diagnostic material (diagnostic programs, systems diagrams, troubleshooting charts, sequence charts, and written information) is available to assist in locating the trouble.
4. Learn to make the best use of information, symptoms, and diagnostic material.

This section of the manual contains specific diagnostic information that will reduce the time required to locate trouble. The section includes all available diagnostic programs used for the IBM 729 II, III, and IV Magnetic Tape Units, simplified logic diagrams for electronic circuitry, symptom charts showing cause and effect on troublesome operations, and sequence charts. Proper use of the information will cut the time needed to locate trouble. Troubleshooting and maintenance information of a general nature is located in Section 4, "Service Aids."

2.2 Diagnostic Programs

Diagnostic programs are an important tool in scheduled maintenance. They indicate whether or not the 729 is functioning properly and assist in locating a failure.

Described first are the diagnostic programs for the 729 III, now used only in the 705 III system. Part of the 729 III diagnostics are included in DIANA, which is an integrated group of diagnostics made to check the operation of the 705 III system.

For the 729 II and IV, different diagnostic tests must be written for each particular system in which they are used, such as the 7090 and 7070. Established tests for tape units in the 7090 and 7070 systems are explained here.

For more detailed information on any of the diagnostic programs, see the applicable complete description of the diagnostic available at each installation.

2.3 729 III Diagnostic Programs

2.3.1 5TU04B Tape Motion Test

This diagnostic is used with the IBM 767 Data Synchronizer to measure the inter-record gaps. (See Figure 2-1.) The test measures the length of time needed for an inter-record gap to pass over the read head. Time is measured under varying conditions:

1. Go line up continuously between two writes; no delay while writing.
2. Go line down for about 1.5 ms; minimum delay while writing.
3. Go line down for varying amounts of time (between 1.5 to 7.5 ms); variable delay while writing.
4. Go line down 11.5 ms before each write operation.

The average, minimum and range times to cross 324 groups of inter-record gaps are computed and the results typed out.

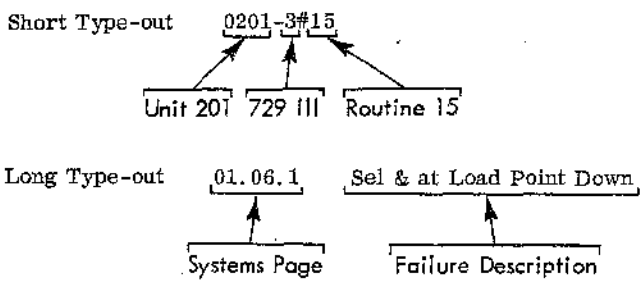
The next section of the test measures the inter-record gap while operating the drive with the GO line down for 400 ms prior to each write operation. The time to cross 50 groups of inter-record gaps is measured, and the average, minimum and range computed. The results are typed out. The delay may be varied from 12 ms up to 7200 ms.

2.3.2 5TUH0A, Tape Hung Condition

Diagnostic 5TUH0A is a complete individual memory load that measures line failures in the 729 III. All tape unit circuits controlled by the 767 are tested.

Manual circuits are not tested by 5TUH0A. If there is an error in the read or write circuits, another test must be used for diagnosis. If such an error occures during this test, the proper test to check for this error will be typed out.

The diagnostic is written with a group of routines. Each routine checks specific circuitry. The routine that is running when an error type-out occurs tells the probable area of failure.



EXAMPLE TYPE-OUT

The tape unit must be at load point every time this test is run. Certain errors will cause the machine to hang up prior to the error type-out. If this happens, press the machine stop and start until an error type-out occurs. Do not continue beyond an error indication, as each routine is written on the assumption that the previous routine was correct. Since the test takes only seven seconds, it is worthwhile to run the test several times to see if the same error shows up.

An intermittent error may cause a different routine to fail on each pass. Run the test many times and note which routines fail. The actual error will be in or before the first routine showing a failure.

2.3.3 5TUH1A, Tape Interchangeability Test

This test checks for read and write errors by generating a multi-record tape on a 729 III. This tape is checked on the same unit for write errors, then the tape is interchanged to any other 729 III to see if there are any read errors.

Diagnostic 5TUH1A gives the following information:

1. Good or bad tape.
2. Electrical and mechanical skew troubles.
3. Correctness of polarity of write heads.
4. Reliability of all tape units, through interchangeability.

Careful examination of the type-outs will show the cause of read and write errors.

2.3.4 5TUT2A, Gap, Skew, Long Record, and Creep Test

This diagnostic tests tape motion and skew under worst conditions. Type-outs for the gap test in this diagnostic show only that there is incorrect gap length or that tape gap is out of specifications. For more exact information, use diagnostic 5TU04B (Section *2.3.1*).

Diagnostic 5TUT2A is made up of a series of cupels which make specific tests:

T208 rewinds all tapes.
T209 is the write cupel for the gap test.
T212 is the read cupel for the gap test.
T220 and T225 are write cupels for the skew tests.
T221 and T226 are read cupels for the skew tests.
T233 is the write cupel for the long record test.
T234 is the read cupel for the long record test.
T240 is a write cupel for the skew tests.
T241 is a read cupel for the skew tests.
T251 is the cupel for the creep test.

2.3.5 5TUT1A, Erasing of Tape during Skip

Diagnostic 5TUT1A tests erasing of tape under high sensitivity after execution of the skip instruction. The test is made up of only one cupel. Three illegal halts in this cupel, that may be caused by incorrect backspacing, are:

Halt 11111. Program out of step; start to read forward. If this does not place the tape in step, restart the program.

Halt 4444. Program out of step; start to move tape backward one record. This halt may occur if tape fails to erase, because the BOR recognizes the unerased bits. Tape should come into step on repeated starts.

Halt 555. Program out of step; start to read forward. If this does not put the tape in step, restart the program.

2.4 729 II and IV Diagnostic Programs for 7090

2.4.1 9T51, Tape Frame Unit Test

This is the basic tape unit performance test. It checks tape motion forward and backward, and data flow. The test is made up of a series of routines that check the following specific areas of the machine:

1. Load tape key.
2. Instructions referring to channel
   Transfer on redundancy
   Transfer on end of file
   Beginning and end of tape test
   Transfer if channel is in operation
   Transfer if channel is not in operation
   Test for input-output check.
3. Correct use of reset load channel and load channel instructions in conjunction with the store channel instruction.
4. All configurations of the channel command indicators.
5. Writing and recognition of record gaps and end-of-file indications in forward and reverse motion.
6. Data flow in short and long records through fixed and random word patterns.
7. Simple go-no-go, write-backspace write test.
8. Test of any number of tape units singly on any number of channels, through eight.

2.4.2 9T53, Tape Multi-Channel Data Flow Test

The tape multi-channel data test checks concurrent write and read operations through as many as eight channels, using fixed and random word patterns in data flow. Up to eight units at a time, one per channel called, are tested. The test will repeat a program pass for each successive unit called on any one channel.

2.4.3 9T55A, Tape Timing Test

This test checks tape timing controls for load channel timing, inter-record gap timing, and backspace-write timing to test for creep. Tape units are tested singly. Any number of units, through eight, on any channel can be tested. The test is divided into three sections.

Section I—Load Channel Timings: Checks reset load channel timing delay using the I-O check to indicate failures. Checks timing for write and read at load point, then write and read not at load point. With sense switch 5 up, delay timings used will be equal to the nominal correct timing, and just one attempt will be made for each timing condition. With switch 5 down, each timing condition will be tested, repeatedly increasing the delay each time until the failure point is reached. The last successful delay will be indicated.

Section II—Inter-record Gap Timings: A series of record groups is written with the GO line condition between records held at varying controlled up and down levels for set timings. These conditions are: 1) GO line down for approximately 10 milliseconds between write calls; 2) GO line down a variable length of time, stepping from 0.98 millisecond to 5.01 milliseconds; and 3) GO line up steadily between records. These records are read and the time for the gaps to pass the read head is measured and compiled. An error is indicated for any one gap exceeding high or low limits of 1.5 milliseconds to 2.5 milliseconds. After all record groups have been read, the lowest, average, and range from lowest to highest gap time for each type of GO line timing is indicated.

Section III—Write-Backspace-Write Timing for Creep: Four records are written, read, and checked and the gap length between the second and third records is saved. The third record is backspaced and rewritten. Then the gap is measured and checked for forward or backward creep. This is repeated 25 times and the average creep and direction are indicated, unless the forward creep exceeds 1.34 milliseconds per backspace-write operation or the creep is in a backward direction and has reduced the gap below the inter-record gap low limit. See Figure 2-1. In these cases, the creep summation print-out will occur immediately.

2.4.4 9T56, Tape Data Channel Trap Test

The tape data channel trap test uses tape to test the data channel trap conditions. Conditions resulting in channel trap are checked while enabled, not enabled, inhibited, and not inhibited. The correct trap location for each channel is tested, and the information stored by the trap is checked. Any failure is shown along with the correct information for the specific trap condition, and the probable area of failure is indicated. It uses only tape unit 2 on each channel and tests any number of channels up through eight. Channels are just tested singly, then concurrently on all channels called.

2.4.5 9T57, Diagnostic Recorder Program

This program tests internal channel conditions while using tape and indicates errors through the diagnostic recorder. It tests any one channel at a time.

2.5 729 II and IV Diagnostics for 7070 Systems

The diagnostic tests described here for the 729 II and IV were written for systems check-out of tape units.

2.5.1 Multiple Sync Random Test 8468

This diagnostic tests up to nine tape units on each channel. The number of tapes and the channel or channels used are selected by setting a switch control word. A specific digit position defines the number of tape units on each channel.

Each written record has 20 words of random numbers plus an identification word. The identification word defines the channel, tape unit addressed, and the record number. Selection circuits for each channel and tape unit can be checked for correct operation by reading the written record and comparing the identification word.

2.5.2 Multiple Channel RDW 8464

This diagnostic tests the ability of the synchronizers to handle information at the greatest possible frequency. Long records are written and read on each channel, using one record definition word for each word written. If the data written is signed Alpha, RDW's are required at maximum frequency. Priority is used.

When all synchronizers are used and records are written in high density, maximum memory access is established. For flexibility, when running the synchronizers at different densities, set the density manually.

INTER-RECORD GAP CHART			
IRG (Inches)		Time (ms) at 75 in/sec	Time (ms) at 112.5 in/sec
11/16"	.687	9.15	6.1
3/4"	.750	10.0	6.65
13/16"	.812	10.83	7.2
7/8"	.875	11.6	7.75
29/32"	.906	12.1	8.07

CREEP TEST CHART		
CREEP (Inches)	CREEP in ms at 75 in/sec	CREEP in ms at 112.5 in/sec
.05	.66	.44
.06	.80	.53
.07	.93	.62
.08	1.06	.71
.09	1.19	.80
.1	1.33	.89
.11	1.46	.98
.12	1.60	1.07
.13	1.73	1.16
.14	1.86	1.25
.15	2.0	1.34
.16	2.13	1.42
.17	2.26	1.51
.18	2.39	1.60
.19	2.52	1.69
.2	2.66	1.78

Figure 2-1. Inter-Record Gap and Creep Charts

2.5.3 *7TO1 Tape Reliability Program*

This diagnostic is designed to check 729 tape units, TAU, 7602 core controls and 7604 synchronizer. The test is made up of a series of short independent routines ordered from the simple to the more complex tape operations. A complete list of these operations is contained in the Method of Test section of the program.

2.5.4 *7TO2 Tape Interchangeability Test*

This test checks the accuracy of information written on one tape unit and read on another tape unit. It also tests a simultaneous read and write operation when two or more channels are used.

2.5.5 *7TO3 Inter-Record Gap Test*

This test measures the inter-record gaps of the tape unit, backspace write creep, and the amount of backspace into an inter-record gap. This diagnostic should be used to indicate and predict when Scheduled Maintenance is needed.

The test consists of 100 groups of records. These are written under six different conditions.

1. Minimum delay between two write operations.
2. Variable delay between two write operations from 1.5 to 8.4 ms in increments of 84 microseconds.
3. Variable delay between two write operations from 10 ms to 400 ms in increments of 10 ms.
4. A 5 second delay between write operation.
5. A 10 ms delay between write operations after writing a forward record.
6. A 10 ms delay between write operations after writing a variable length record from one to 100 words.

The time to read after backspacing is measured when backspacing over 1 word, and when backspacing over a variable length record. The amount of creep during a backspace write operation is measured when writing 1 word records and also when writing 100 word records.

2.5.6 *7TO4 Stacking Latch Test*

This is a stacking latch and tape stacking latch test designed to check all stacking latches in the system. When an error occurs, the program listing gives a suggested point at which to start troubleshooting.

2.5.7 *7TO5 Tape Synchronizer Reliability Test*

This program is designed to check the interaction between tape units and channels.

2.5.8 *7TO7 Tape Search and Generation Program*

This test generates and maintains an up-to-date diagnostic test tape.

2.6 Condensed Logic

This section contains simplified logic diagrams, including test information for direct troubleshooting, for electronic operations of the 729 II, III, and IV. Most of the information on these charts (Figures 2-2 through 2-10) is applicable to all three tape units.

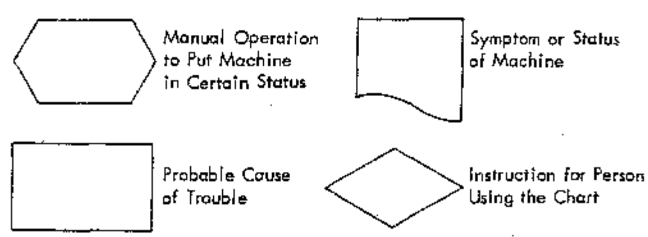
With the exception of the write amplifier circuits, for which a chart has been drawn for the 729 III and another for the 729 II and IV, all information, unless otherwise noted, is applicable to each of the tape units.

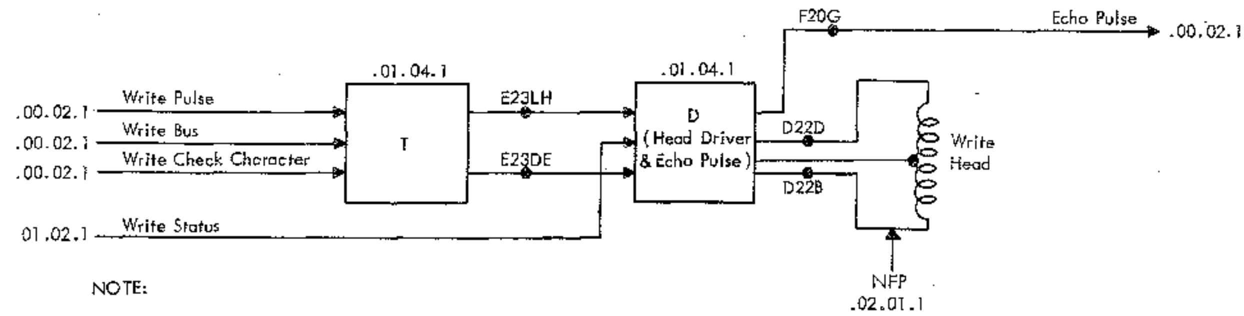
When information such as systems page number, line name, or test point on a line differs between the 729 III and 729 II and IV, the information in parentheses is applicable only to the 729 II and IV, and the other similar information is applicable to the 729 III. Information of this type is identical for the 729 II and IV. If there is only one piece of information at a given point, this information is applicable to all three models. If a complete circuit pertains to the 729 II and IV, it is designated by an asterisk (*) and a note.

2.7 Symptom and Sequence Charts

Symptom charts (Figures 2-11 and 2-12) may be used to trace cause and effect when troubleshooting. In conjunction with the sequence charts (Figure 2-13 through 2-16), the trouble can be isolated to a specific area. When the trouble operation has been determined, following through the symptom chart for that operation should pinpoint the trouble. The four symbols used on these charts are shown below.

The charts are applicable to the 729 II, III, and IV. Minor differences of the 729 II and IV are pointed out by notes.





NOTE:

1) Write pulse gated by write bus at trigger.
2) Write status line gates head driver.
3) Echo pulse ampl. is a part of head driver.

Figure 2-2. Write Amplifier, 729 II and IV, .01.04.01

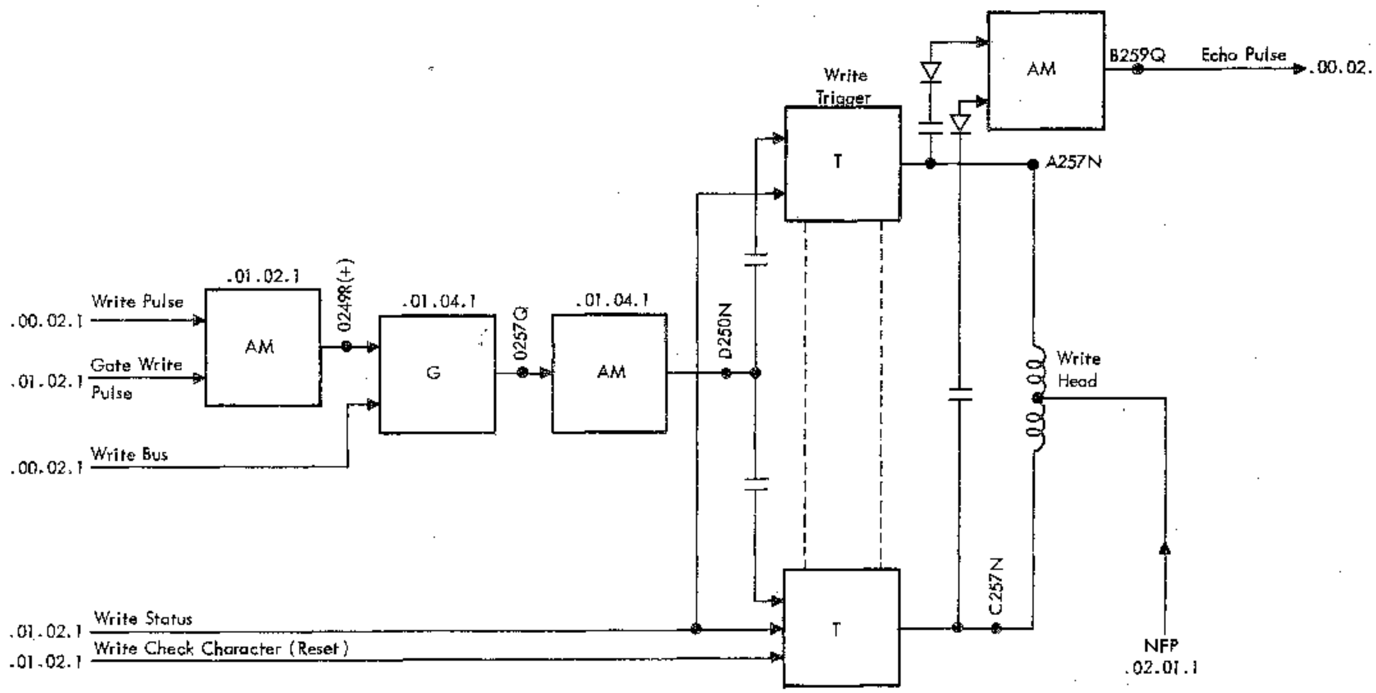


Figure 2-3. Write Amplifier, 729 III, .01.04.01

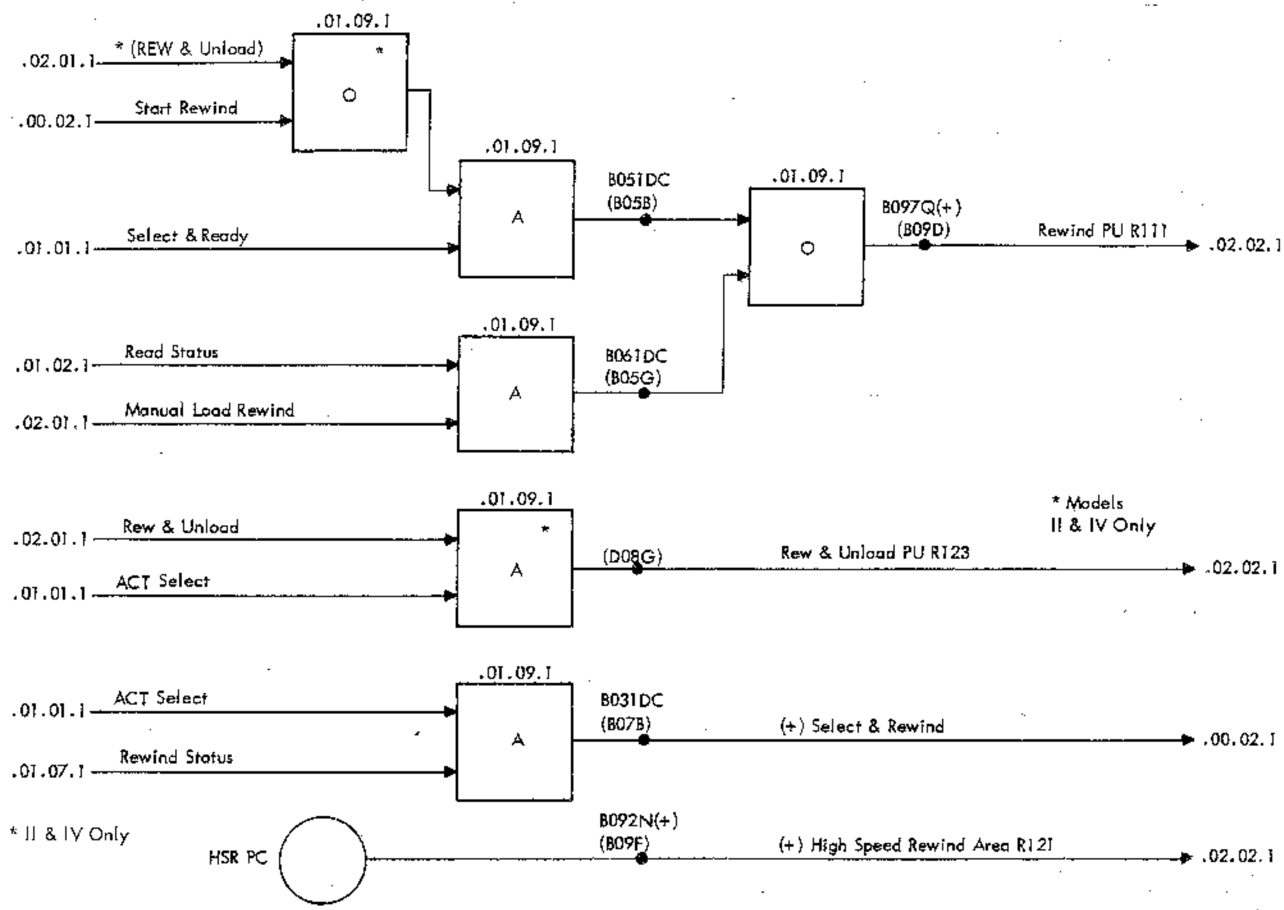


Figure 2-4. Rewind, 01.09.1

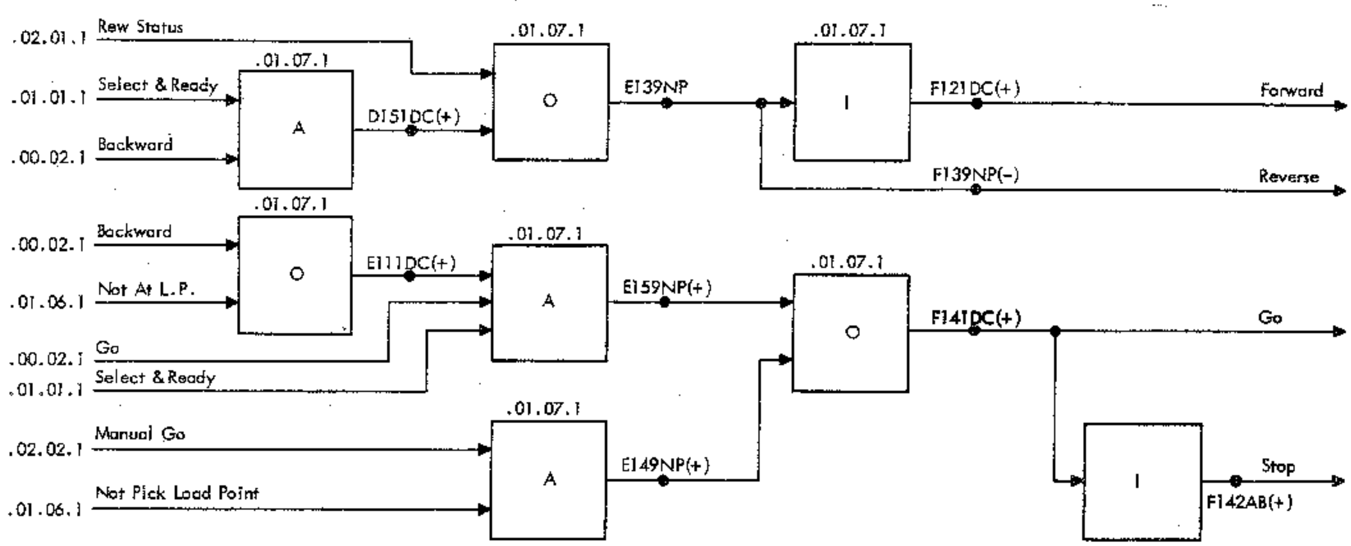


Figure 2-5. Start, Stop, Reverse Control, .01.07.01

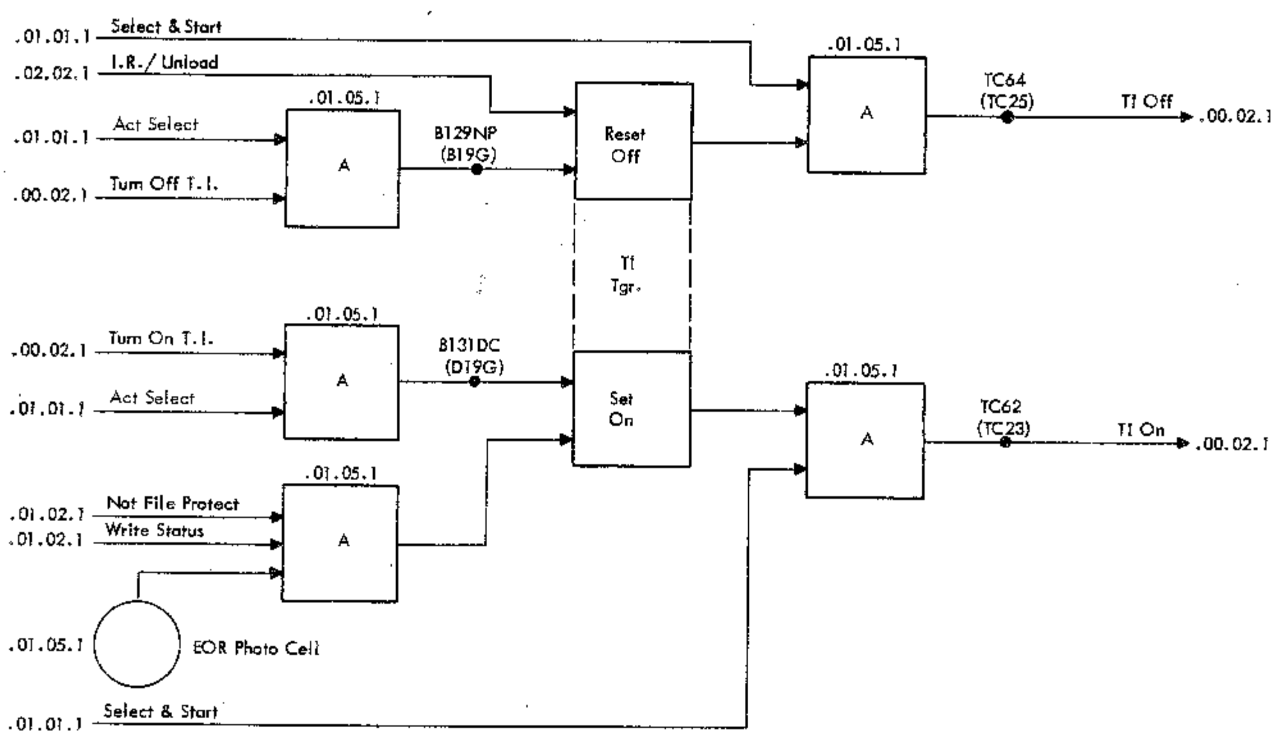


Figure 2-6. Tape Indicate, .01.05.01

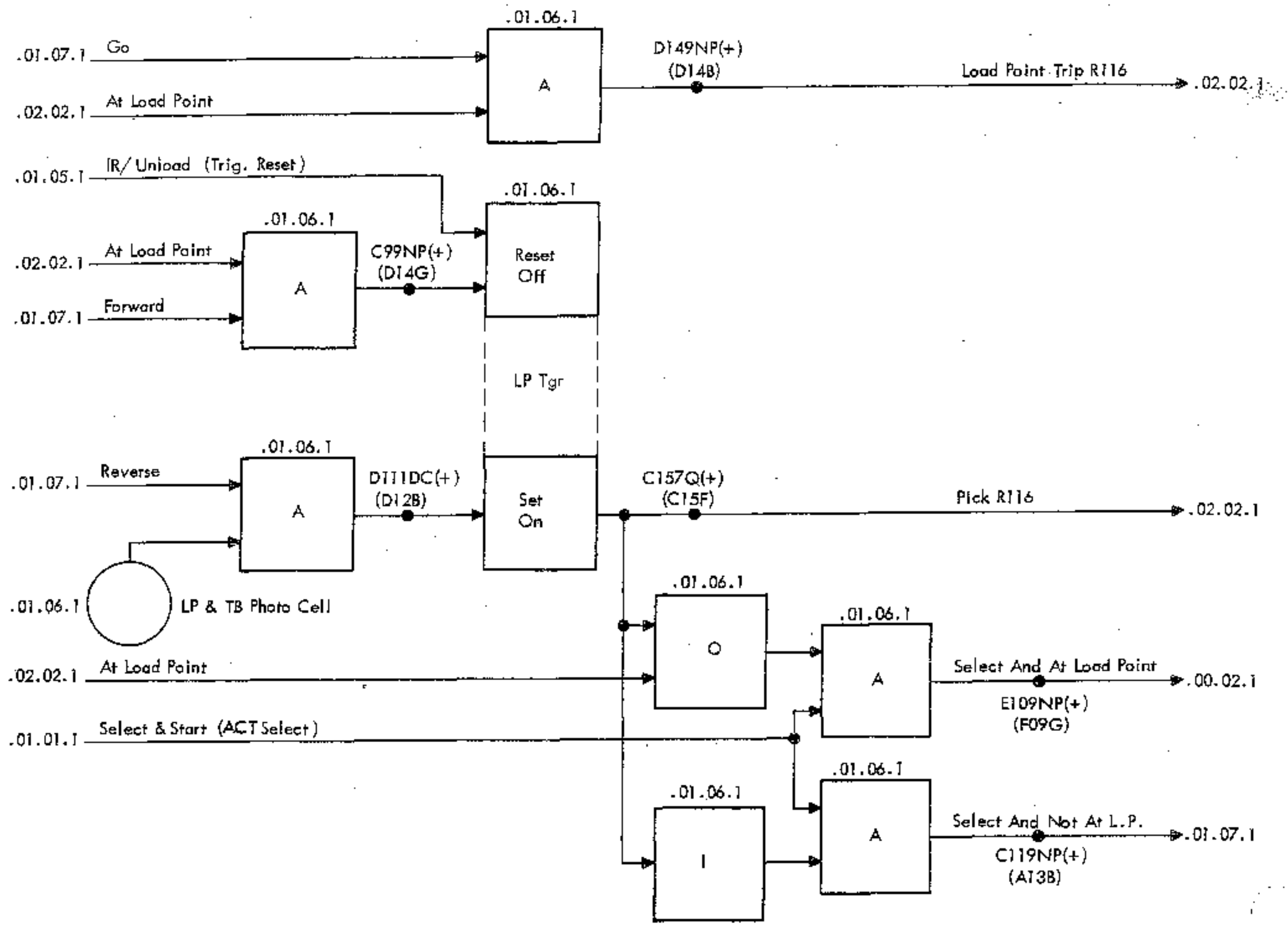


Figure 2-7. Load Point, .01.06.01

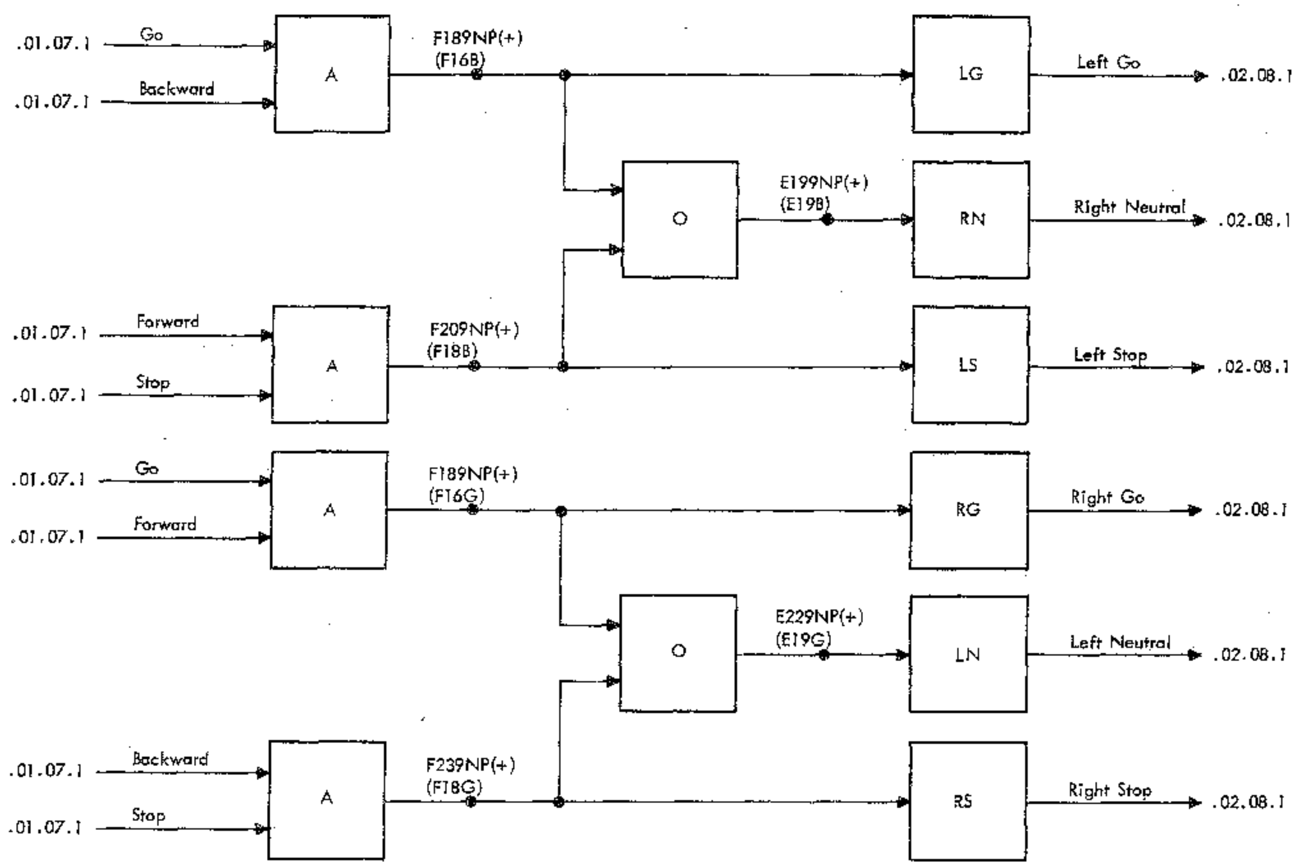


Figure 2-8. Prolay Drive Logic, .01.03.01

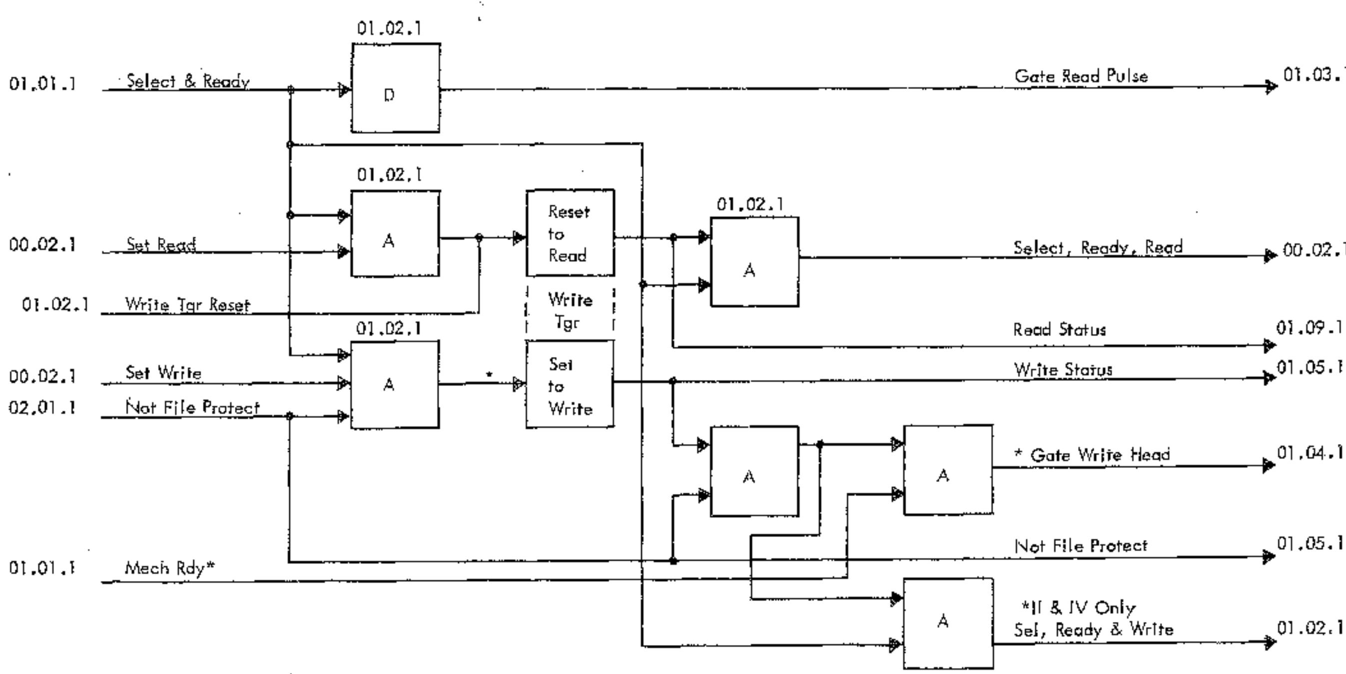


Figure 2-9. Read-Write Status, .01.02.01

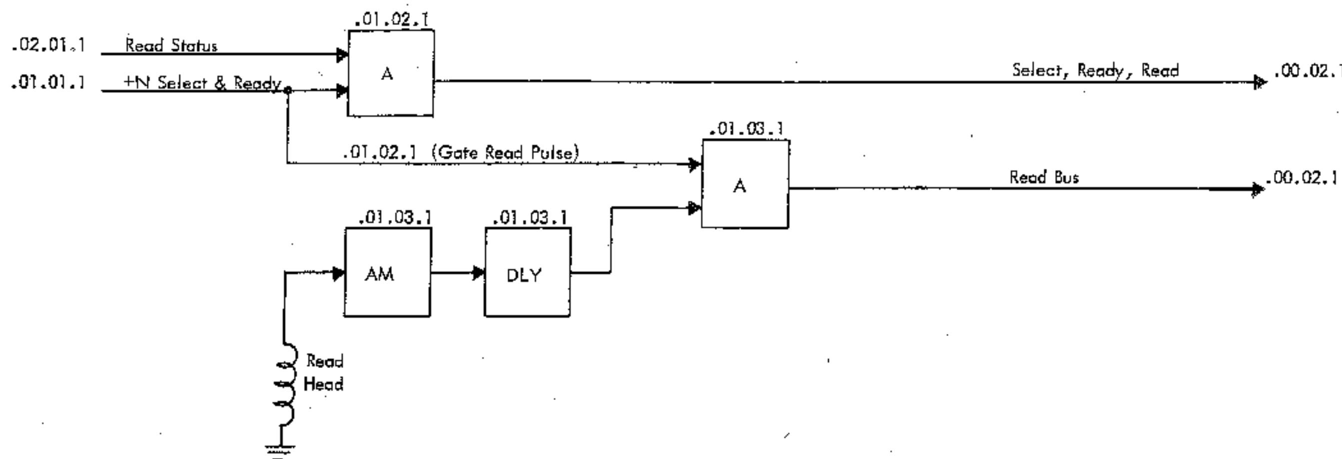


Figure 2-10. Read Logic, .01.03.01

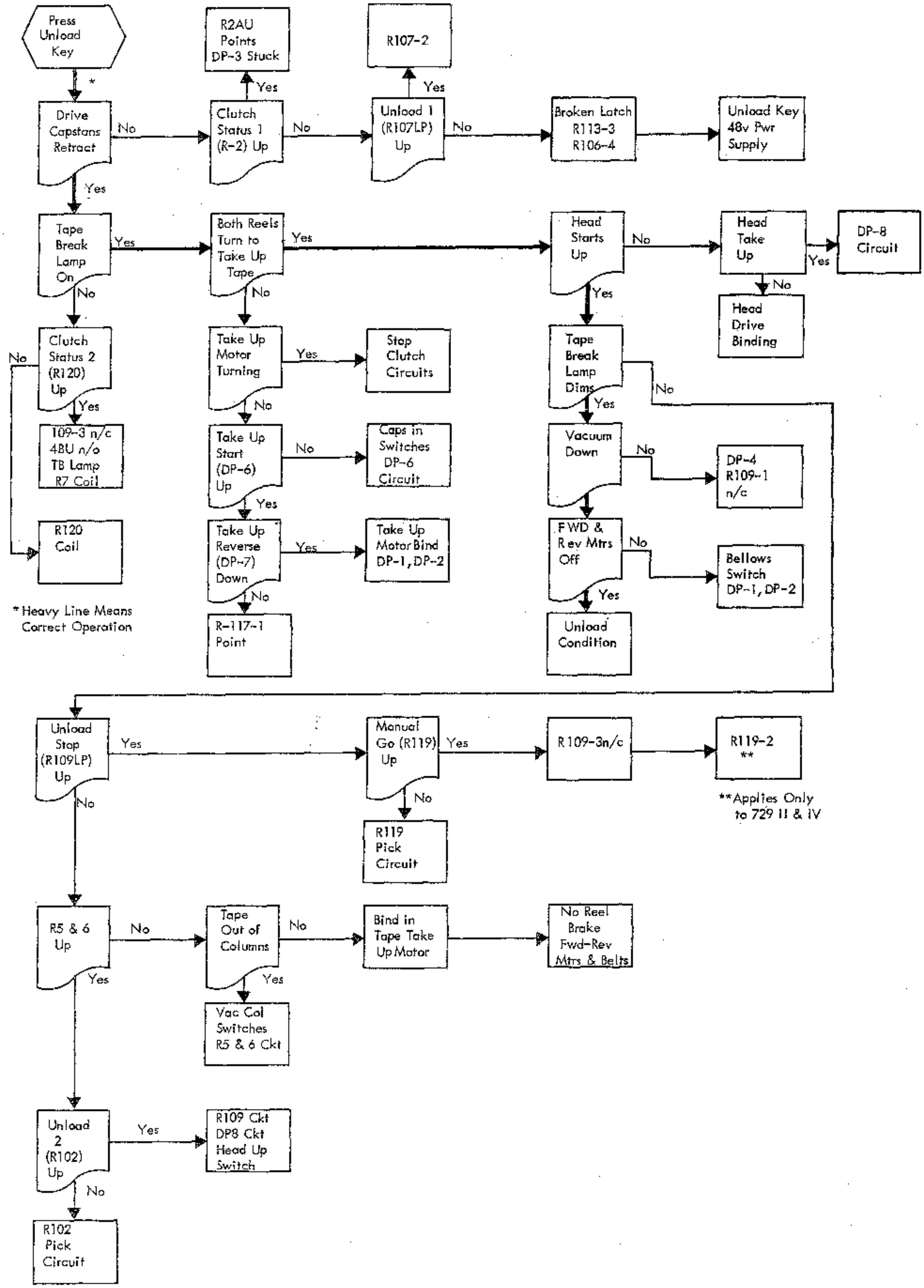


Figure 2-11. Unload Symptom Chart

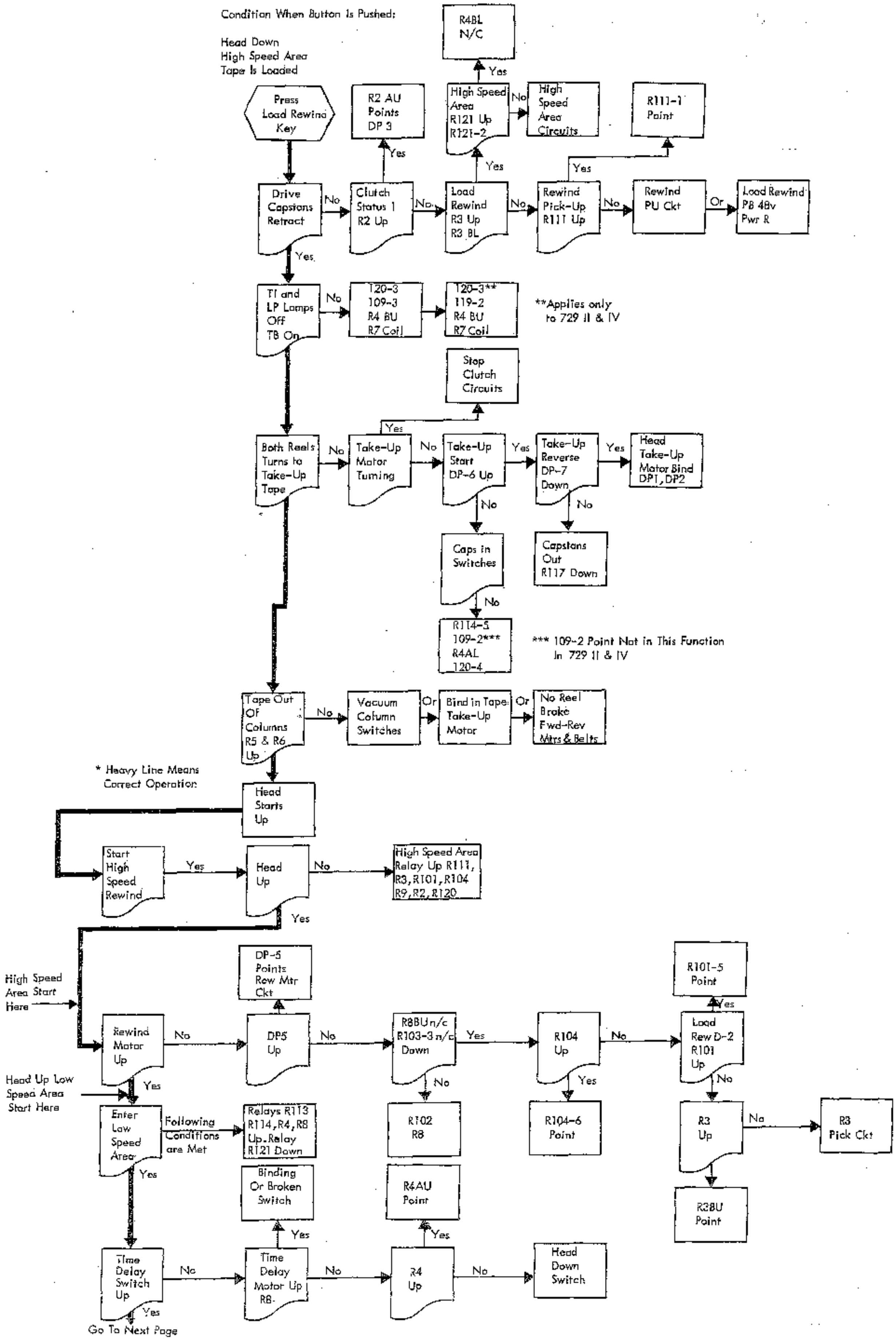


 Figure 2-12A. Rewind Symptom Chart

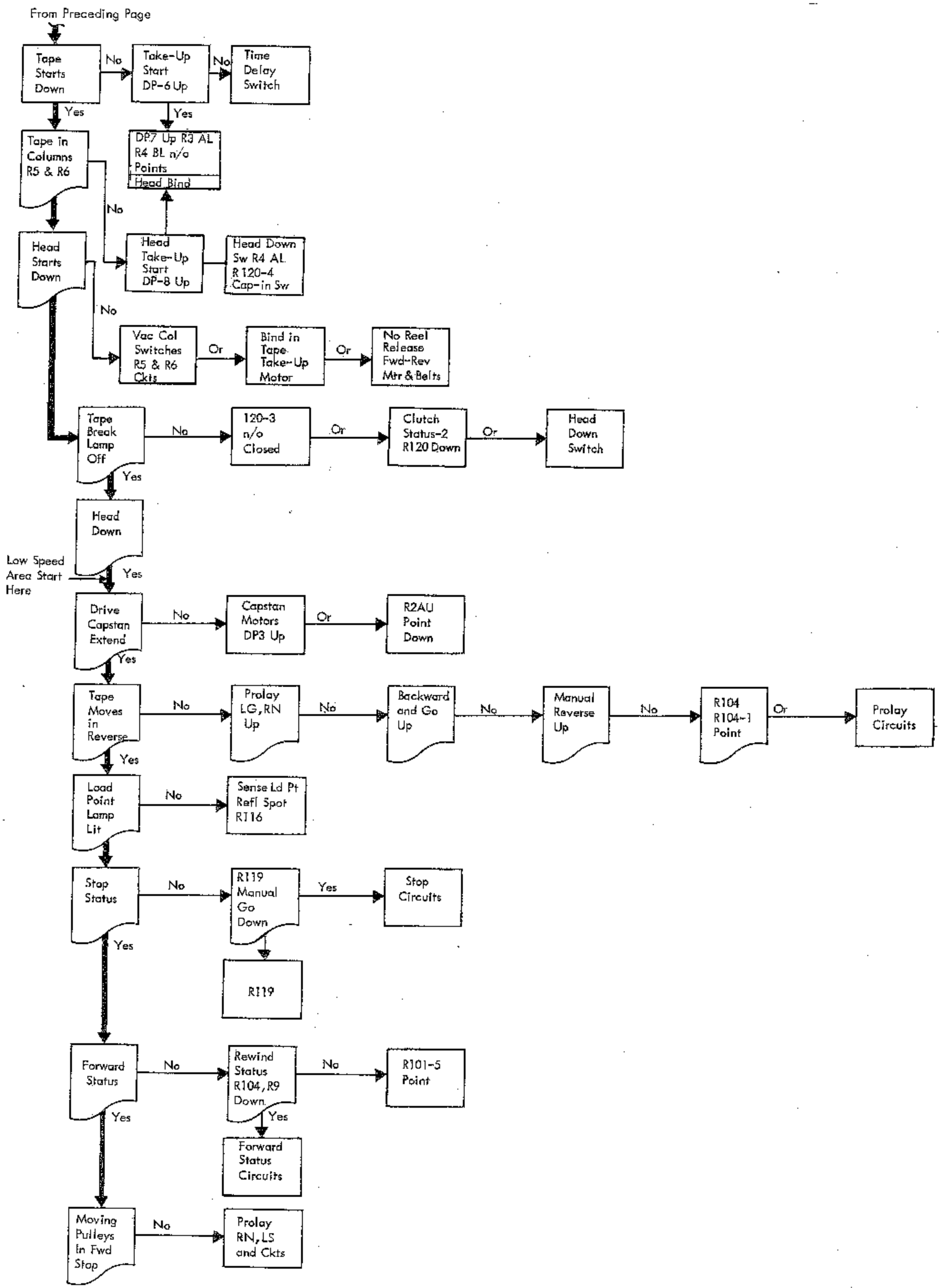


Figure 2-12B. Rewind Symptom Chart

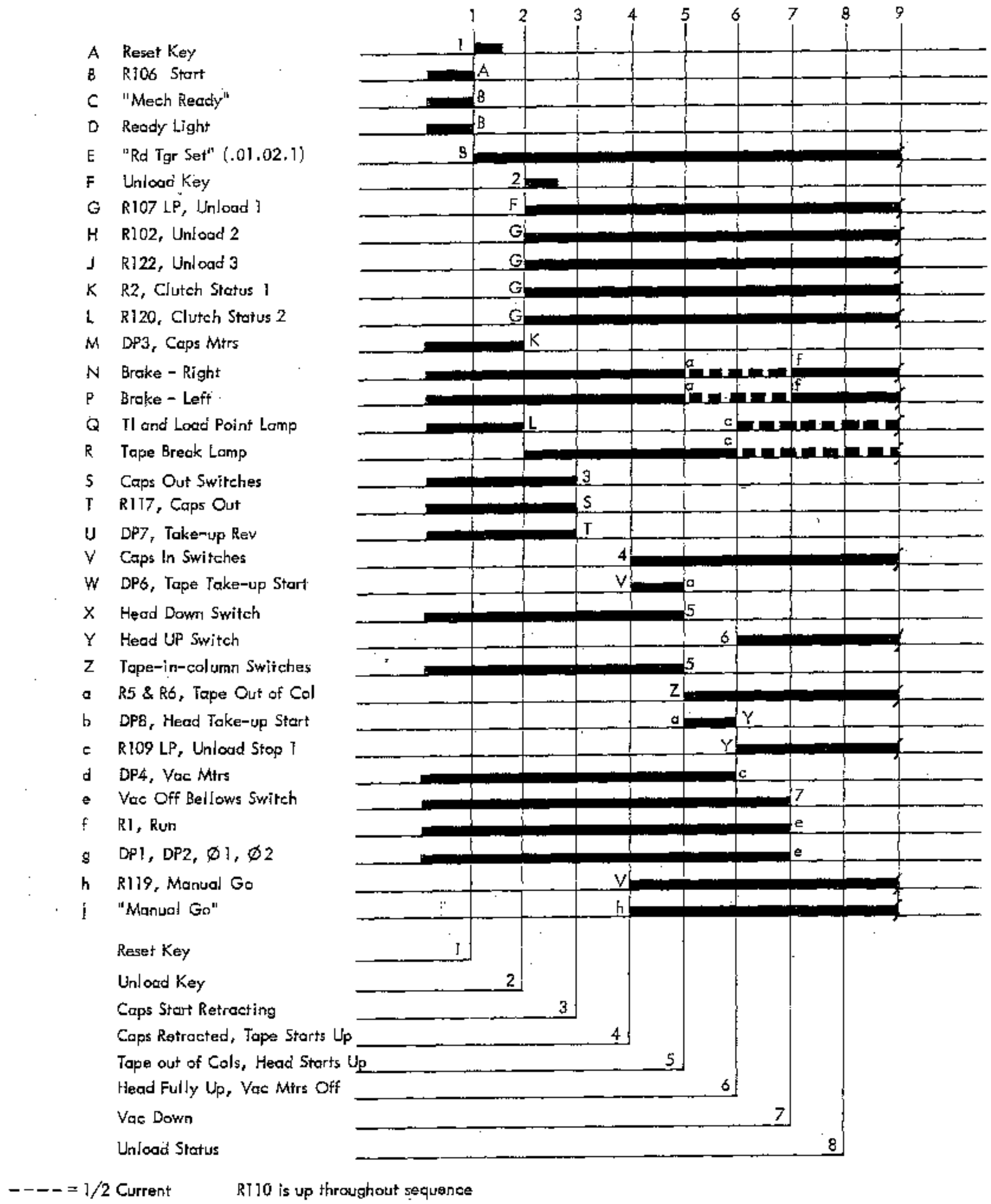


CHART 3. MANUAL UNLOAD, 729 II, III, and IV

● Figure 2-13. Manual Unload Sequence Chart

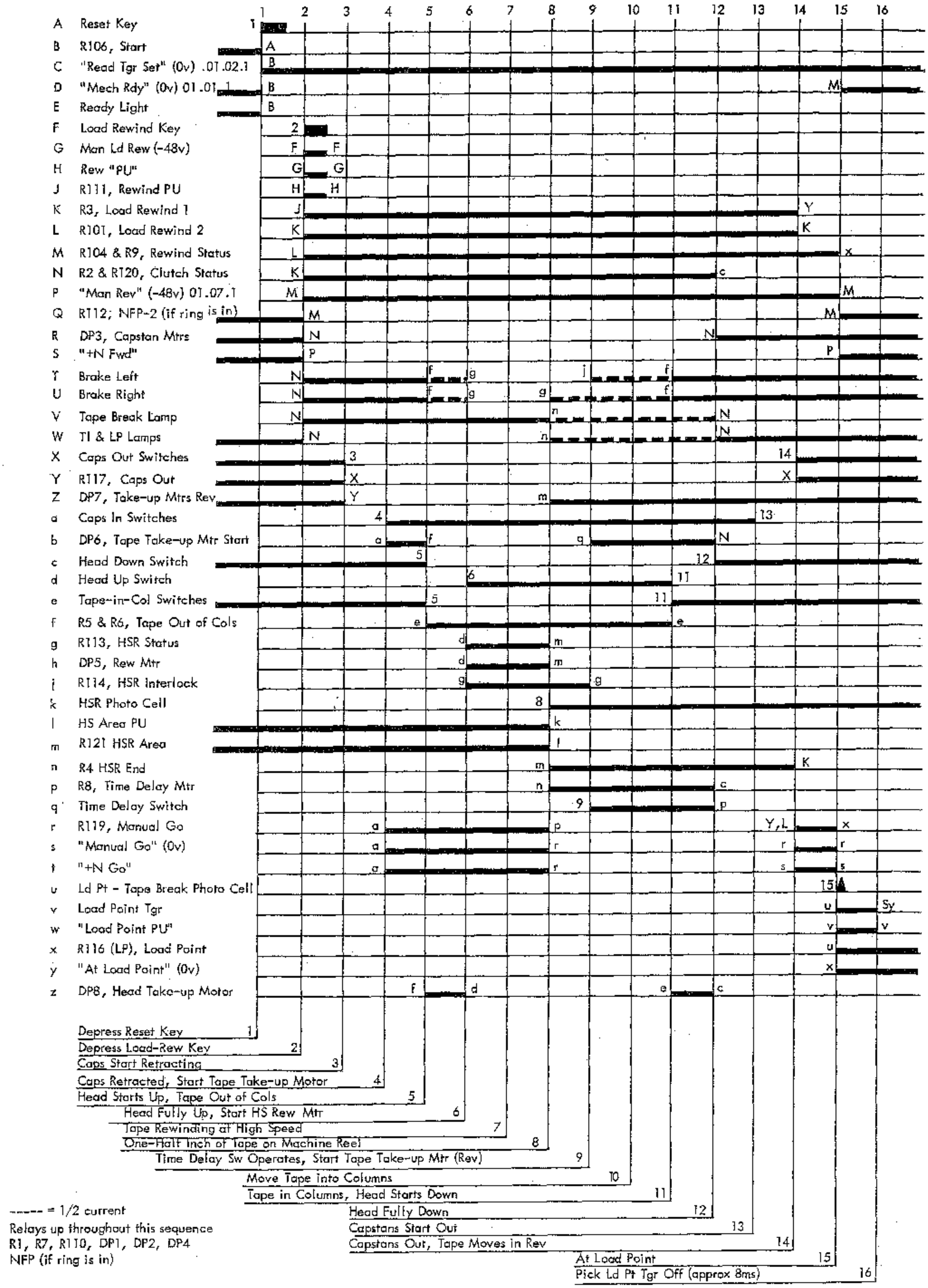


CHART 4. HIGH-SPEED LOAD REWIND, 729 II, III, IV
(Manual Operation; Tape Is Loaded, in High-Speed Area, and Ready

Figure 2-14. High-Speed Load Rewind

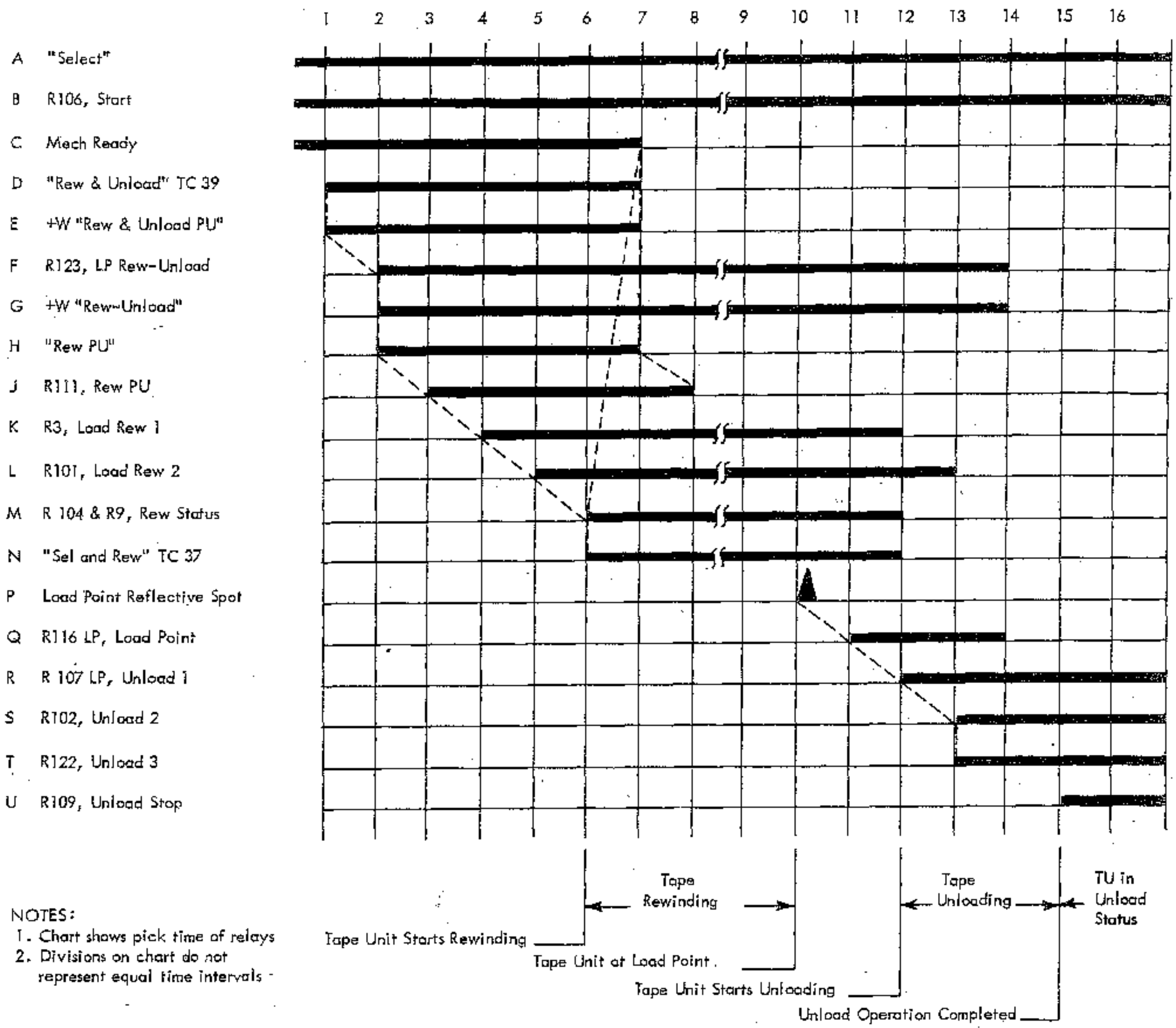
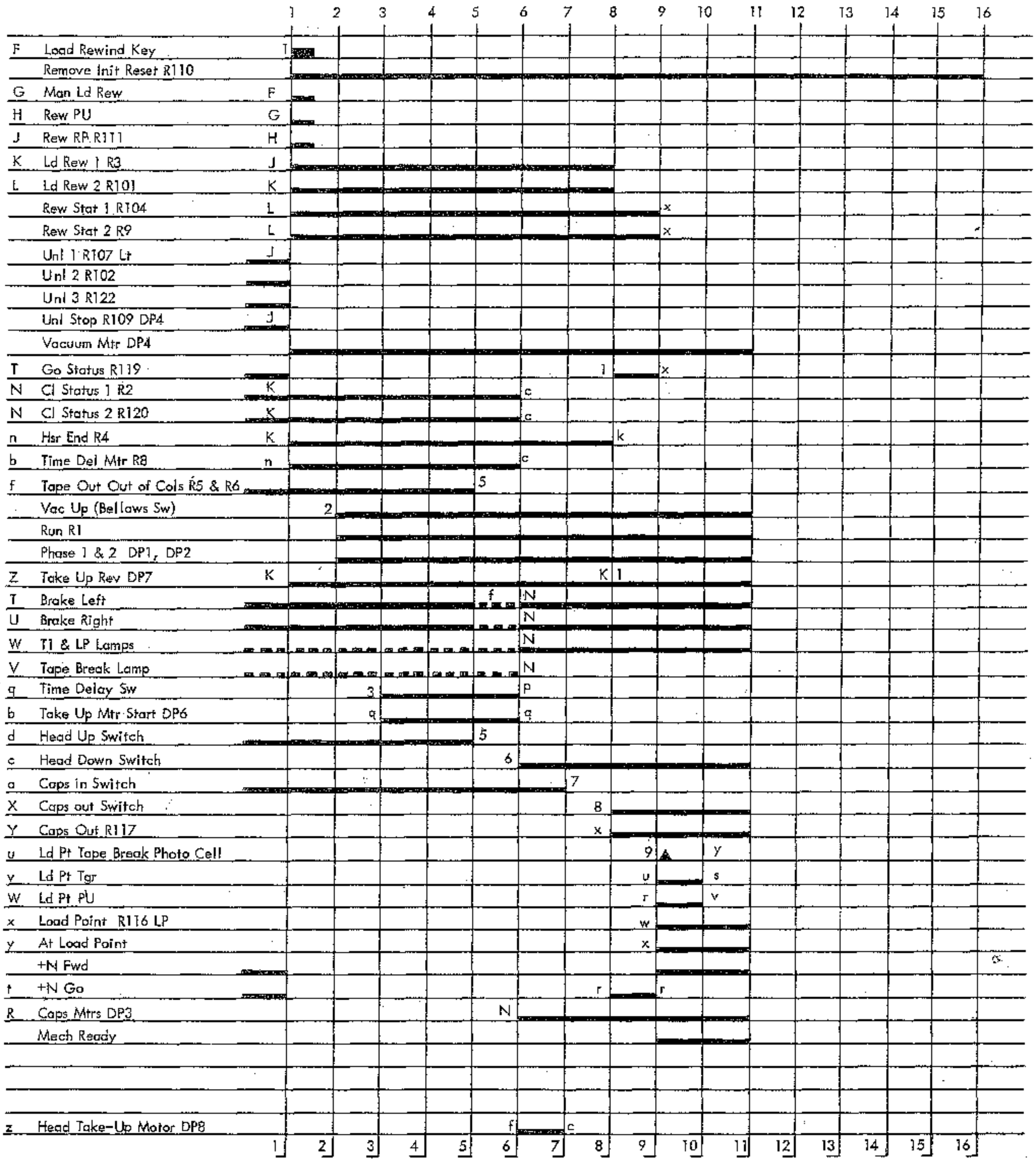


CHART 5. REWIND AND UNLOAD (729 II and IV ONLY)

Figure 2-15. Rewind and Unload, 729 II and IV Only



1-Load Rew Key (Start Vacuum and Time Del)
2-Vacuum Up
3-End Time Del-Start Take Up
4-Tape Starts Down
5-Tape Goes into Cols-Head Starts Down
6-Head Fully Down Start Caps Mtrs
7-Capstans Start Out
8-Capstans Out-Up Go
9-At Load Point
10-Ld Pt Tgr Off
11-Loaded and at LD Pt

*----=1/2 Current

Relays up throughout
this sequence
R7 R110

Figure 2-16. Low Speed Rewind Sequence Chart

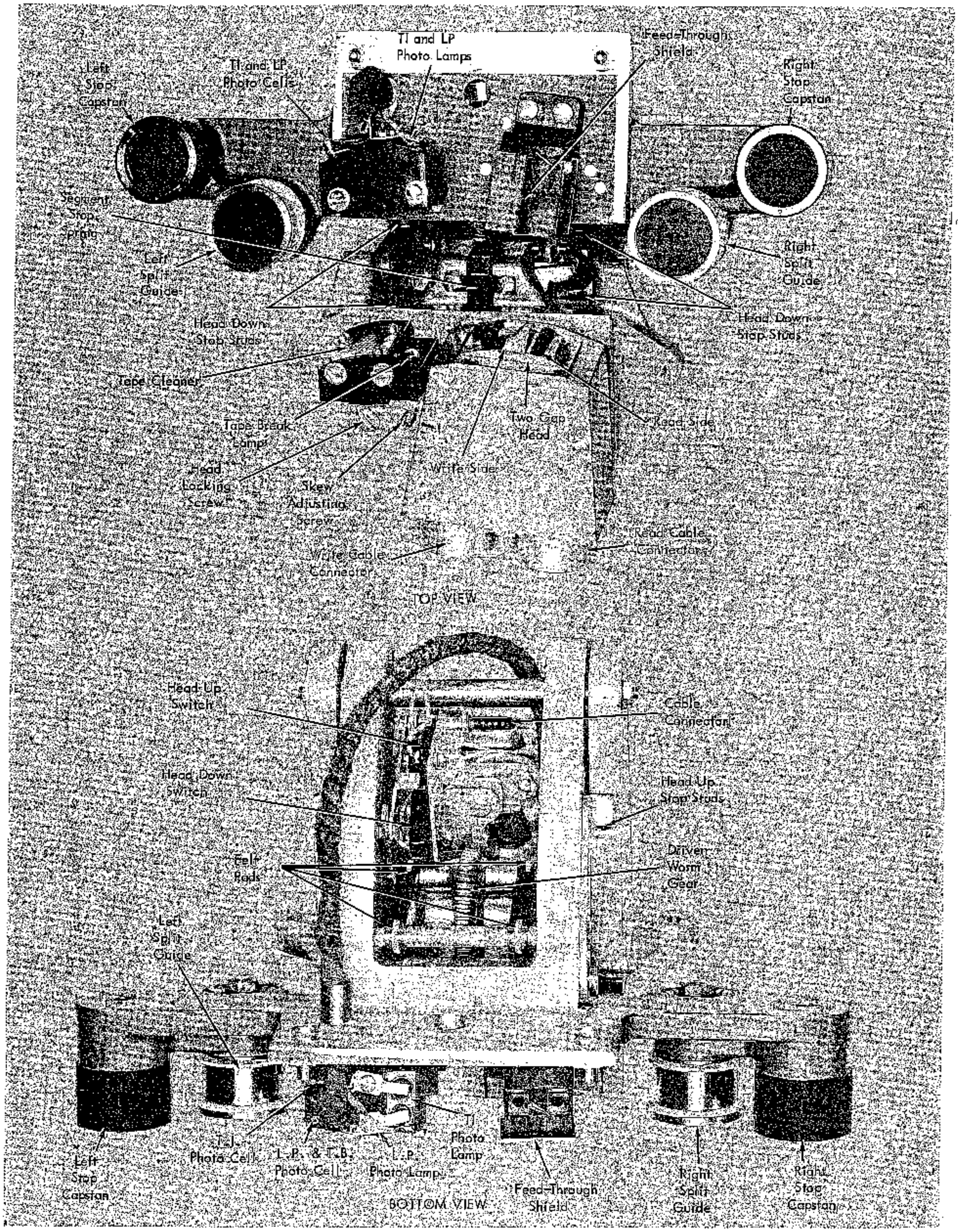


Figure 3-1. Head Assembly, Top and Bottom Views

SERVICING PROCEDURE CHART

Functional Unit	Item Description	Service Checks	Adjustment	Removals/ Replacement	Waveforms/ Levels
3.1 Head Assembly		25	25	25	-
	3.1.1 Read-Write Head	26	-	28	-
	3.1.2 H Shield Feed-Through	-	27	-	-
	3.1.3 Skew	27	27	-	-
	3.1.4 Write Current	28	28	-	-
	3.1.5 Split Guide Assembly	28	28	28	-
	3.1.6 Tape Cleaner	28	28	28	-
	3.1.7 Photosensing	29	29	29	-
	3.1.8 Rewind Idlers	29	-	30	-
	3.1.9 Preamplifiers	30	30	30	30
3.2 Tape Movement	3.2.1 Prolays	30	-	-	-
	3.2.2 Prolay Servicing	30	30	33	34
	3.2.3 Shimmed Prolays	36	-	-	-
	3.2.4 Stop Capstans	36	-	-	-
	3.2.5 Drive Capstans and Motors	36	37	37	-
	3.2.6 Sliding Glass Spring Drum Assembly	37	37	38	-
3.3 Vacuum System	3.3.1 Vacuum Columns	38	38	-	-
	3.3.2 Vacuum Column Switches	40	-	-	-
3.4 Reel Drive	3.4.1 Clutch Assemblies and High-Speed Rewind	40	40	41	-
	3.4.2 Jack Shaft Assembly	41	41	-	-
	3.4.3 High-Speed Rewind	42	42	-	-
3.5 Base	3.5.1 Motors	42	42	-	-
	3.5.2 Relays	43	43	-	-
	3.5.3 File Protect	43	43	43	-
	3.5.4 Circuit Breakers and Thermals	44	44	44	-
	3.5.5 Filters	44	-	44	-
	3.5.6 Power Supplies	44	45	-	-

3.1 Head Assembly (Figure 3-1)

Visual Inspection and Operational Check

A basic difference chart showing the difference between the head assemblies for the IBM 729 II, 729 III, and 729 IV Magnetic Tape Units is shown in Figure 3-2.

Inspect the head for uneven wear, scratches, nicks, and oxide build-up. Also check for loose cable connections.

Check head up-down limit switches by performing tape load and unload operations.

Measure the read coil output of each track with the machine in a write operation. This output should be 15 to 30 millivolts, peak-to-peak, with each pulse width less than 20 microseconds. Pulse symmetry of all seven pulses must be similar, and amplitude difference must not exceed ±5%.

Cleaning

Clean the head and transport mechanism with a clean, lint-free cloth moistened with tape cleaner.

Lubrication

Apply IBM 20 grease to the worm gear assembly used to drive the head assembly up and down.

Use IBM 6 lubricant on the felt oil pads and all pivot points.

Adjustments, Head Limit Switches

Close the head and lock. Set the head down-limit switch so that the normally open contacts just transfer and make contact.

Turn adjusting screw one-half turn counterclockwise, to insure switching transfer just before reaching lower limit of travel.

With a .030″ ±.010″ shim between the gear segment and stop spring, open the assembly to its full open position. Now, set the upper limit switch so that the wired normally open contacts just transfer. Do this by loosening the switch mounting screw and nut, and rotating the switch.

Remove the shim and replace the head assembly.

Check skew for mechanical alignment of head; check track C with track 1 only. Do not make any skew adjustments until you are sure that the head assembly is correctly and evenly installed.

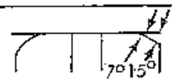
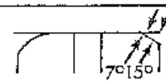
The head locking screw must be loosened before a skew adjustment is made, in order to remove the slack in the skew adjusting screw. Tighten the head locking screw after the adjustment is made until it seats against the lower casting and all the slack is removed from the adjusting screw. Recheck the skew adjustment for proper tolerance after tightening the head locking screw.

The complete skew adjustment procedure is described in Section *3.1.2*.

Removal, Head Assembly

Remove upper and lower decorative head covers. Pull the upper cover forward and upward. Remove the two screws from lower cover.

Remove the inner cover from the read-write head. Unplug the head cables.

HEAD COMPARISON CHART			
Type Head	729 II Two Gap	729 III Two Gap	729 IV Two Gap
1. Head Configuration			
2. Write Gap (inches)	.0005	.0005	.0005
3. Read Gap (inches)	.00025	.00025	.00025
4. Write Track (inches)	.048	.048	.048
5. Read Track (inches)	.030	.030	.030
6. Materials in Contact with Tape	+Hy-Mu 80, phos. bronze, Havar*, epoxy	Hy-Mu 80, phos. bronze, Havar, epoxy	Hy-Mu 80, phos. bronze, Havar, epoxy
7. Write Turns	100 turns C.T. #42	100 turns C.T. #42	100 turns C.T. #42
8. Read Turns	180 turns #42	120 turns #42	120 turns #42
9. Write Current (ma)	70 ma	60 ma	70 ma
10. Output	15-30 mv	15-30 mv	15-30 mv
11. Tape Speed	75 ips	112.5 ips	112.5 ips
12. Recording Density	200 bpi (15 kc) 555.5 bpi (41.7 kc)	555.5 bpi (62.5 kc)	200 bpi (22.5 kc) 555.5 bpi (62.5 kc)
13. Intertrack Shielding	Write (2) .0075 phos. bronze and 3 pcs. .002 Hy-Mu 80 sandwiched	Write (2) .0075 phos. bronze and 3 pcs. .002 Hy-Mu 80 sandwiched	Write (2) .0075 phos bronze and 3 psc. .002 Hy-Mu 80 sandwiched
14. Track Pitch	.070	.070	.070
15. Dist Between Gaps (inches)	.300	.300	.300

+ Trademark of Carpenter Steel Corp.
* Trademark of Hamilton Watch Co.

Figure 3-2. Head Comparison Chart

Remove the three nuts and flat washers that hold the assembly to the tape frame casting. Pull forward to remove the complete assembly.

DANGER: The upper head, if it is up, will snap shut from its own weight when the head assembly is disengaged from the jackshaft assembly and is pulled forward.

REPLACEMENT

Replacement procedures are the reverse of removal procedures except as follows:

CAUTION: Do not attempt to replace *any part* of the head assembly. The head must be replaced as a complete assembly.

1. When replacing the head assembly, keep it in the unlatched position to make replacement easier.
2. Be sure to line up the key in the head socket with the keyway in the plug. The key is located in rear of the head socket. Push up on the plug and turn the connector ring clockwise.
3. Make sure that head casting is seated evenly on the tape frame casting mounting studs before tightening the mounting nuts.
4. Check the tape unit for skew, and adjust as needed. See Section 3.1.2 for the skew adjustment procedure.

3.1.1 Read-Write Head

VISUAL INSPECTION AND OPERATIONAL CHECK

Inspect surfaces for pits, scratches, tarnish, and uneven wear. Uneven or worn surfaces provide poor tape contact and cause low signal strength, resulting in read-write errors.

CLEANING

For a tarnished head, use silver polish. Be sure to follow this use of polish by performing a regular head cleaning operation using regular tape cleaner. In cleaning the head, always wipe it in the direction of the tape movement. Make sure the head is clean before performing skew and preamplifier adjustments. Amplitude can increase 10 to 40 percent as oxide builds up on the head. Whenever the head is being cleaned, also clean underside of the ceramic guide with a typewriter brush.

REMOVAL AND REPLACEMENT

For removal and replacement of the read-write head see "Head Assembly." The read-write head assembly should be replaced when:

1. Output is out of specifications (amplitude and skew).
2. The head is worn (trenched).

3.1.2 H Shield Feed-Through

ADJUSTMENT

The H shield should be adjusted for minimum feed-through as follows:

1. Unplug the right capstan motor, and manually extend the capstan.
2. Write 1's on all tracks from the tape drive tester.
3. Observe the signal on the read bus.
4. Adjust the H shield for minimum feed-through signal on all channels.
5. Feed-through specifications are:

   729II $\leqq$ 0.6v peak to peak.

   729III and IV $\leqq$ 0.4v peak to peak.

3.1.3 Skew

OPERATIONAL CHECKS AND ADJUSTMENTS

An operational or adjustment check is required when the combined skew of a tape unit and its associated final amplifiers exceeds 1.0 microsecond, reading or writing all bits. Before commencing the check, do the following:

1. Correctly adjust the prolays.
2. Clean the tape transport, capstans, nylon pulleys, rewind idlers, ceramic guides, tape cleaner blade, and read-write head, using a lint-free cloth and approved cleaning solution.
3. Calibrate the oscilloscope.
4. Compensate the oscilloscope probes.

MEASUREMENT TECHNIQUES

When checking or adjusting skew on the read bus, observe the following:

1. Use the maximum vertical gain possible on the oscilloscope, and if necessary, use direct probes.
2. Use the vertical position control to pass one oscilloscope trace through the other, in order to display small amounts of skew more easily.
3. When using master tape, use a full pass, to insure even wear throughout.
4. *Adjust* skew while scoping the read bus. This should be done at this point for two reasons:

   The possibility of adjusting the tape unit to compensate for delay in the final amplifiers in the data channel or synchronizer is eliminated. Such a condition could produce compatibility problems, both in written data on tapes and between tape units and channels.

   System time required to set skew is minimized or eliminated.

ADJUSTMENTS, MECHANICAL SKEW

1. Mount master skew tape 556 BPI P/N 461096 (replaces P/N 460680).

2. Return all read delays to zero. (This is omitted if checking only.)

3. Check that all preamplifier outputs are equal. The amplitude will depend on the condition of the master tape. Adjust if necessary. When adjusting skew using the Tektronix 310 oscilloscope and 60 C/S chopper, reset the amplitude of the reference track after final checking.

4. Connect an oscilloscope and check 1 and C bits, synchronizing on either one (negative on 729 II and IV, positive on 729 III).

5. Loosen head locking screw and adjust vernier screw for coincidence of the 1 and C bits. Make sure that 1 and C bits being scoped are both in the same character. This may be done by comparing A and 4, B and 2, C and 1.

6. Tighten the head locking screw and recheck to be sure the adjustment has not changed.

ADJUSTMENTS, READ SKEW

Proper mechanical skew is a prerequisite. Read skew is always checked or adjusted before write skew.

To adjust read skew:

1. Using master skew tape, return all read delays to zero.

2. Check preamplifier outputs as in step 3 of the mechanical skew adjustment procedure.

3. Determine which channel is lagging most (last bit) and synchronize the oscilloscope on this track (negative for 729 II and IV, positive for 729 III).

4. Adjust the read delays for optimum coincidence with the most lagging track. The most lagging track must occur within 0.25 microseconds of the most leading track when considering only the tape unit skew and within 1.0 microseconds when considering the combined skew of the tape unit and final amplifiers.

ADJUSTMENTS, WRITE SKEW

Proper read skew is a prerequisite. Adjust write skew as follows:

1. Mount a good reel of tape.
2. Return all write delays to zero (not necessary if performing only operational check).
3. Write 1's on all tracks, at high density.
4. Connect the oscilloscope to the read bus and observe all tracks.
5. Determine the most lagging track (last bit) and synchronize on it.
6. Adjust the write delays so that all tracks coincide with the most lagging track.
7. Reset write triggers after moving taps, to insure that all tracks are being written in phase.

OPERATIONAL CHECK OF SKEW

Skew can be *checked* either on the read bus or at the output of the read register in TAU or the data synchronizer. When checking skew, always use 1's written on all tracks; random information should not be used.

For measurement only, the read register output may be the most convenient point to observe, as it will display a sharp pulse waveform.

When skew is thought to be within the final amplifier, the following checking procedure can be used. Feed *one* track from the tape unit to the suspected track, and to another that is considered correct; i.e., jumper the two final amplifier inputs together. On the data synchronizer, this can be done at the edge connectors above pluggable units A1 through A7. On TAU, two tracks can be jumpered together at the edge connectors on the preamplifier panel in the tape unit.

3.1.4 Write Current

The check for correct write current is made by observing the voltage drop across the resistors in the collector circuit of the output in each of the 14 head drivers. The procedure described here is for an off-line, static condition. A typical waveform is shown in Figure 3-3.

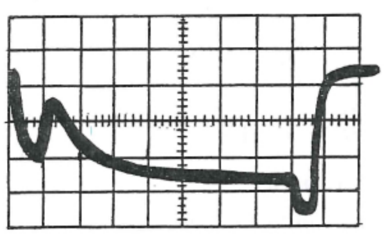
ADJUSTMENT

There must be 70 (+1.2, −9.9) ma, steady state, passing through one of the write coils of each track when writing continuous 1's. The checking procedure is as follows:

1. Load the tape unit with a test tape and set the unit to write status, writing continuous 0's in the track being checked. Use a tape unit tester for control purposes. The tape need not be moving.
2. Compensate the probe and calibrate the scope as per approved procedures.

DANGER: *Do not float the scope.*

3. Ground the scope at electrical ground of the card being checked and probe the voltage across the resistors in the output of the head driver circuit.
4. Adjust the scope to line up the voltage trace with the center graduation on the face of the scope.
5. Check the voltage trace on the face of the scope relative to the reference graduation line selected in step 4. If write current is flowing through the write coil, the voltage drop across these resistors will be approximately 15v. If no voltage drop is observed, tweak the opposite half of the driver circuit with a −6v at the cross couple input, and repeat steps 3, 4, and 5. If the voltage drop and the value observed are outside the specified values, check through for causes, such as maladjusted or no −6v power supply or faulty components in the head driver circuitry. (Faulty components can be located by substituting new cards.) If the read-write head must be replaced, follow the procedures outlined in Section *3.1.1*. Skew must be checked and readjusted if the head is moved.
6. Repeat steps 3, 4, and 5 for the remaining head driver circuits.



Writing continuous 1's
5v/cm 2us/cm
DC input
Internal sync

Figure 3-3. Write Current Waveform

3.1.5 Split Guide Assemblies

VISUAL INSPECTION AND OPERATIONAL CHECK

Check the front and rear ceramic washers for cracks, chips and dirt. Check for loose mounting screws and physical damage to the metallic surface over which the tape is transported.

CLEANING

Clean split guides with a typewriter brush.

REMOVAL

The entire assembly is never removed from the head casting. Only the guide hub and ceramic washers are disassembled in the field. To remove the guide hub and ceramic washers:

1. Insert a 5/64 inch Allen wrench into the face of the guide hub.
2. Loosen the Allen screw and remove the hub.
3. If the assembly is removed only for cleaning, mark the relative position (with pencil or other marker) of the hub and ceramic washers.

REPLACEMENT

Replace the hub and ceramic washers by reversing the removal procedure. Be careful not to overtighten the center body screw because it may break.

CAUTION: Never tamper with Glyptal* cement covering the guide mounting stud on the back side of the head assembly casting. Disturbance of the guide mounting stud alters tape alignment and affects skew.

3.1.6 Tape Cleaner Blades (Figure 3-1)

VISUAL INSPECTION AND OPERATIONAL CHECK

The tape cleaner blade is mounted on a phenolic block on the left side of the read-write head. Remove the top cover by pulling it forward and visually inspect for signs of physical damage and excessive oxide build-up on the cleaner blade.

CLEANING

Replace the tape cleaner blade if it is damaged, by removing the four screws that hold the blade to the phenolic block. The tape should not contact the leading or trailing edge of the cleaner blade.

ADJUSTMENT

The approach angle of tape to the head is set at the factory for an angle of 7¼°. An approach angle of less than 7° can trap an air bubble, which will cause a loss in contact between tape and head surface. An air bubble can also be produced by a wrap angle of greater than 7°. This usually becomes apparent at about 10°, but this bubble is usually less pronounced. However, a wrap angle of more

*Trademark of General Electric Company.

than 7¼° is undesirable because it allows more head-to-tape contact and thus more oxide build-up.

Check the Wrap Angle as follows:

1. Apply silver polish (Gorham's or International Silver Polish is preferred) to the entire head surface sparingly; allow the polish to dry, forming a white powder.
2. Load a work tape (not intended for processing) and run continuously forward until there are about 1½ radial inches of tape on the machine reel; then rewind.
3. Unload the drive and observe the head; the powder will be wiped off the head where the tape has contacted the surface. Visual inspection should show that the apex at point A (Figure 3-4) has been wiped completely clean, indicating a tape approach of just over 7°.
4. Clean the tape transport and columns thoroughly with tape transport cleaner to remove any polish that is deposited.

Check for Air Bubbles as follows: A normal start/stop setup is used, reading all bits. In extreme cases, the air bubble can be detected at the read head. It will show as a dip in the normal waveform envelope (Figure 3.9). The time (from GO) will depend on whether the angle is less than 7¼° (largest exposure is here) or more than 7¼° (this angle has to be radically incorrect, to about 10°). If the wrap angle is small, the dip in the envelope will appear about 7 ms to 8 ms from GO. A large wrap angle will produce a dip about 12 ms from GO.

Frequently, this loss in contact cannot be detected at the read head. The write head can be used to "read" the signal for detecting the bubble. Disconnect one or more tracks (three wires each) of the write head at the edge connectors in the logic gate. Observe the output of the opened write tracks on a scope. A direct probe — and possibly a high-gain preamplifier in the scope — is necessary. The envelope will be similar to the usual start/stop envelope. A distinct decrease in amplitude, by as much as 50%, or even to zero, indicates loss in contact. A small wrap angle will produce a dip about 4 ms from GO.

The read head is best to use for detecting loss in contact when tape is moving backward.

Incorrect wrap angle can cause excessive read or write errors, and possibly bits in the IR gap. It is recommended that head assemblies causing such failures be replaced by a new assembly.

3.1.7 Photosensing (Figure 3-1)

VISUAL INSPECTION AND OPERATIONAL CHECK

Visually inspect the high-speed rewind brake, tape indicator, and load point lamps for equal brilliance. Inspect photocells for physical damage. Access to the high-speed rewind lamp is provided through the control panel door. The high-speed rewind photocell is accessible after removal of the plastic cover between the two tape reels. Load point and tape indicator lamps are located in the photosensing block in the upper head assembly. The tape break lamp is mounted in the tape cleaner block.

To check the load point and tape indicator circuits, position two reflective spots on the tape about six inches apart and place tape unit in the write auto-cycle mode. The tape unit will reverse direction each time a reflective spot is sensed. The tape break circuit can be checked by placing masking tape over the high-speed rewind photocell and an opaque card across the read-write head and tape cleaner blade. After the file reel begins to rotate, remove the card. The file reel should stop.

ADJUSTMENTS

Adjust R7 (500 ohm potentiometer) so that voltage across the two bulbs in the load point and tape indicator bulb assembly (when tape is in columns) is 6.5 ±0.2 volts. Set 50 ohm potentiometer for 4.0 (+1.0, −0.5) volts across the high-speed rewind lamp.

On all models, load point, tape indicate and tape break circuits should operate when the voltage across the combined load point and tape indicator bulbs (when tape is in the columns) is 5.5 (+1, −.5) volts.

REMOVAL, High-Speed Rewind Lamp (Figure 3-1)

1. Remove the plastic cover by loosening the retaining thumb screws.
2. Remove the lamp from its socket.

CAUTION: Be careful not to damage lamp and socket; both are fragile.

REMOVAL, High-Speed Rewind Photocell (Figure 3-1)

1. Snap open the finger guard by pulling forward and twisting.
2. Remove the retaining clip and screw.
3. Using long-nose pliers, unplug the photocell from its socket.

REMOVAL, Load Point and Tape Indicate Lamps

1. Place the head assembly up.
2. Snap off the upper decorative cover.
3. Loosen the retaining spring and screw.
4. Rotate the retaining spring out of the way and remove the lamp.

REMOVAL, Load Point and Tape Indicate Photocells

1. Place head assembly up.
2. Snap off the upper decorative cover.
3. Unsolder the leads and remove the photocells.

REMOVAL, Tape Break Lamp

1. Remove the lower head decorative cover.
2. Loosen the lamp retaining spring and screw on the underside of the tape cleaner block.
3. Rotate the spring out of the way and catch the lamp as it falls from its position.

3.1.8 Rewind Idlers

VISUAL INSPECTION AND OPERATIONAL CHECK

Check for binds. The idlers must spin freely, without excessive end play.

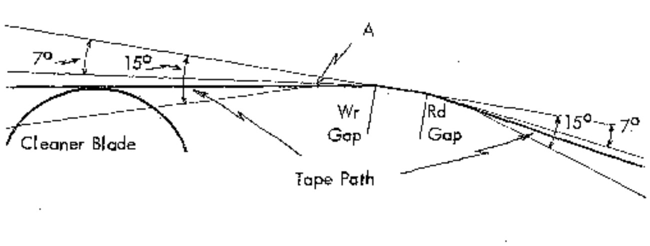


Figure 3-4. Tape Cleaner Wrap Angle

CLEANING

Clean with a lint-free cloth and the approved cleaning fluid. Carefully using a pen knife, remove all loose particles. These particles result from the pressing of the idler on the shaft.

REMOVAL

1. Remove the capstan motor. (See Section 3.2.5.)
2. Remove two mounting screws.
3. Remove the rewind idler.

• 3.1.9 *Preamplifiers*

VISUAL INSPECTION AND OPERATIONAL CHECK

Preamplifier outputs can be measured at the output of each tape track. The voltage at these test points should be approximately 8.8 volts peak-to-peak, as measured with an oscilloscope.

Visually inspect each preamplifier card for signs of physical damage and damaged components.

CLEANING

Clean the read-write head and tape transport mechanism as required.

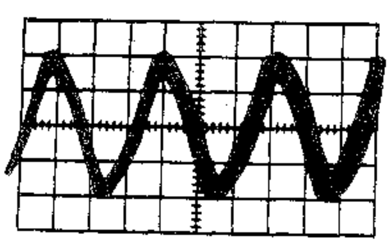
ADJUSTMENT

NOTE: Before adjusting preamplifiers, compensate the scope probes or use a direct probe.

Gain. Install a new reel of tape on the machine and write continuous 1's on each track. Insert a ³⁄₆₄″ Allen wrench into the gain adjustment potentiometer on each of the seven amplifier cards. Adjust the potentiometers for 8.5v to 8.8v peak-to-peak (low density) or 7.8v to 8.8v peak-to-peak (high density). See Figure 3-5. The measurements should be made on the read bus of each amplifier while writing. Move as little tape as possible while setting preamplifier gain.

Preamplifiers must be capable of producing a minimum of 10v output with the gain potentiometer adjusted for maximum.

Preamplifiers may break into a 600 KC oscillation with an amplitude of 1v to 2v, particularly on the last tape unit of a line of five. This oscillation should not cause trouble because it is discriminated by the final amplifiers.



Read while writing continuous 1's
Direct probe   Centerline on 0v
2v/cm   10ms/cm
AC input
Internal sync

Figure 3-5. Read Preamplifier Waveforms

REMOVAL AND REPLACEMENT

Amplifier cards are located at positions MO7 and are accessible through the preamplifier door. Cards are easily removed by the application of a slight outward pulling force.

New cards are inserted into their receptacles as required. Different preamplifier cards are used in the 729II and 729IV. *These cards must not be interchanged.* Part numbers are:

729II: P/N 370100 and 370099
729IV: P/N 371925 and 371926

• 3.2 Tape Movement

3.2.1 *Prolay Specifications*

1. Start times: backward and forward, 2.2 ms, ± .3 ms (Figure 3-6).
2. Stop times: forward, start *minus* stop forward; backward stop *plus* forward start for backward.
3. Coast time at full amplitude (stop envelope): .9 ms for 729IV, 1.2 ms for 729II and 729III.
4. Noise burst: < 1.5v p/p.
5. No glitching.
6. Up to full amplitude: by 3 ms to 4 ms on count five.
7. Consistent start time: (< .2 ms variation) with GO down time varied from 10 ms to 100 ms.
8. No gaps, drive or start, less than .003″ (use feeler gage).

3.2.2 *Prolay Servicing*

CLEANING AND INSPECTION

Check frequently for: dirty or burned Nylon idlers and glazed drive capstans. Replace burned idlers; buff glazed drive capstans.

Prolays should be disassembled and cleaned every four to six weeks (three-shift operation), or if significant changes occur in inter-record gap tests. If any signs of wear or corrosion are evident on fork arm pivots or armature pivot after cleaning, the entire arm assembly should be replaced. All shafts must be clean; if they cannot be cleaned, replace them.

LUBRICATION

Apply a thin film of Aeroshell 14 to the armature and forked arm pivots. Use a small amount of IBM 4 on the Nylon pulley shaft, taking care not to get the lubricant on the Mylar* residuals or pole pieces. Any prolay assemblies that are chronically troublesome, even with this type of maintenance, should be replaced.

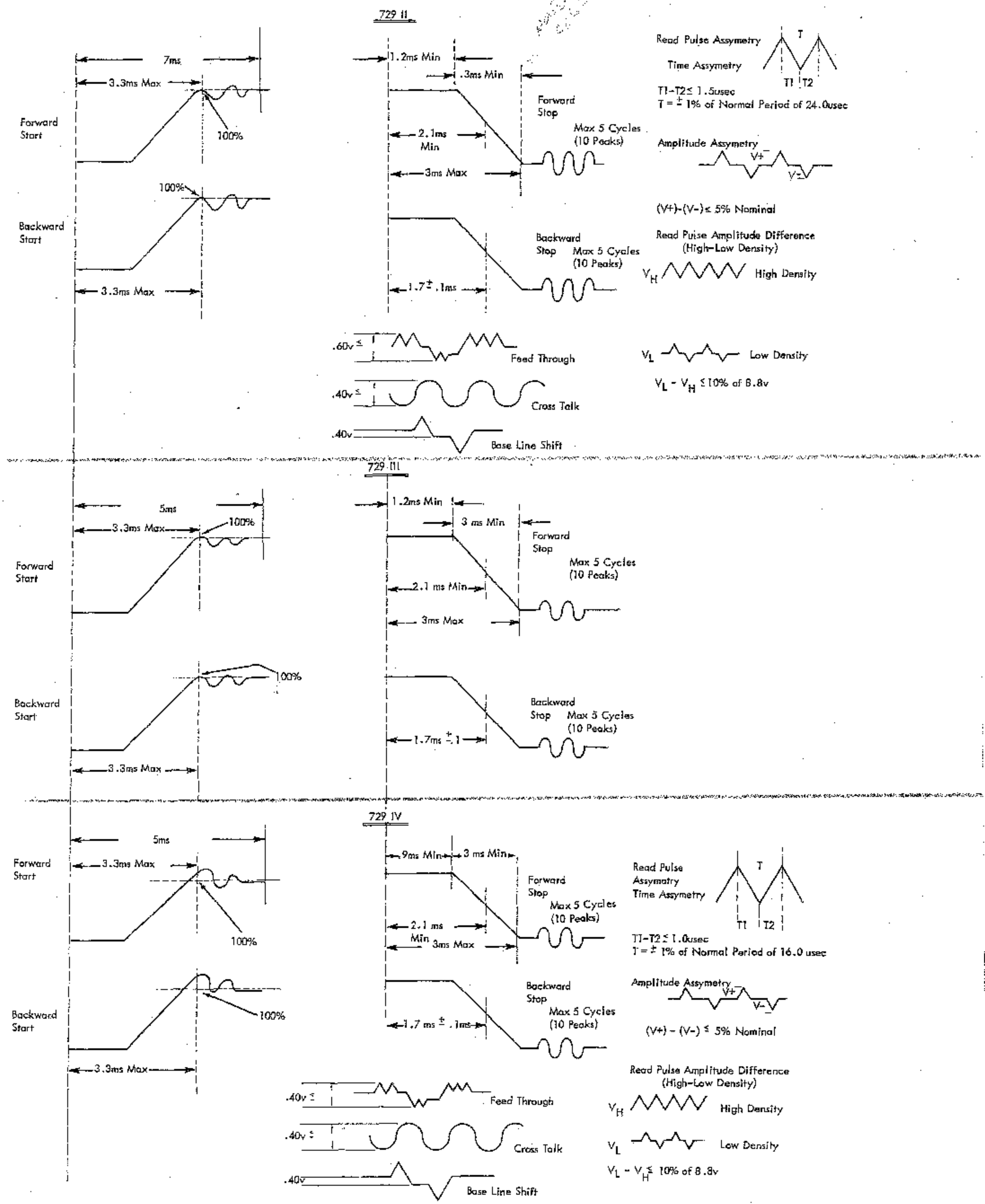
ADJUSTMENTS (FIGURE 3-7)

Prerequisites to the adjustment procedure are clean, lubricated prolays and a clean transport. The tape unit must not be at load point. *Do not use tape that is intended for systems use (customer's tape).*

With a prolay installed on the tape unit, adjust it as follows:

1. Loosen bottom mounting bolt.
2. Loosen two top mounting bolts one quarter-turn to allow prolay to pivot.

*Trademark of E. I. duPont de Nemours & Co. (Inc.)



≥ Greater than or equal to
≤ Less than or equal to

Figure 3-6. 729 II, III and IV Start-Stop Timings

3. Adjust steady state current:

a. Drive current: adjust potentiometer for 4v drop across TB11-8 and 9.

b. Neutral current: adjust potentiometer for 3v drop across TB11-6 and 7.

To adjust the steady-state current through the forward and reverse prolay drive coils, measure the voltage drop across the 2 ohm, 25 watt parallel resistors located on TB11-8 and TB11-9 and adjust the 0.5 ohm, 50 watt potentiometer for a 4v indication (4 amperes), with the tape unit in a static condition (Figure 3-21). The terminal boards and potentiometers are located on the prolay control panel directly under the backward capstan drive motor. Access is provided with the main rear gate open.

To adjust the steady-state current through the prolay neutral coils, measure the voltage drop across the 2 ohm, 25 watt resistors in parallel, located on TB11-6 and TB11-7, and adjust the neutral potentiometers for a 3v indication (3 amperes). See Figure 3-21.

4. Adjust switching current:

a. Switching is controlled by four single-shots.

b. Use single-shots to turn off shunts during prolay transfer.

c. Any one single-shot firing cuts off both drive shunt

d. Adjust potentiometers on single-shot cards for 4 ms square wave.

Using a tape drive field tester, synchronize on the rise of GO to observe a GO UP ss and on the fall of GO to display the GO DOWN ss. Timings in both cases should be set to 4 ms. A convenient point to observe is F14C or D.

Switch to plus internal; synchronize on the oscilloscope; and operate the FWD to BKWD switch on the tester. The timings of these single-shots should also be 4 ms.

NOTE: Certain types of failures in the prolay driver sink units will cause faulty start-stop waveforms because of short or missing ss pulses to the prolay. This condition may

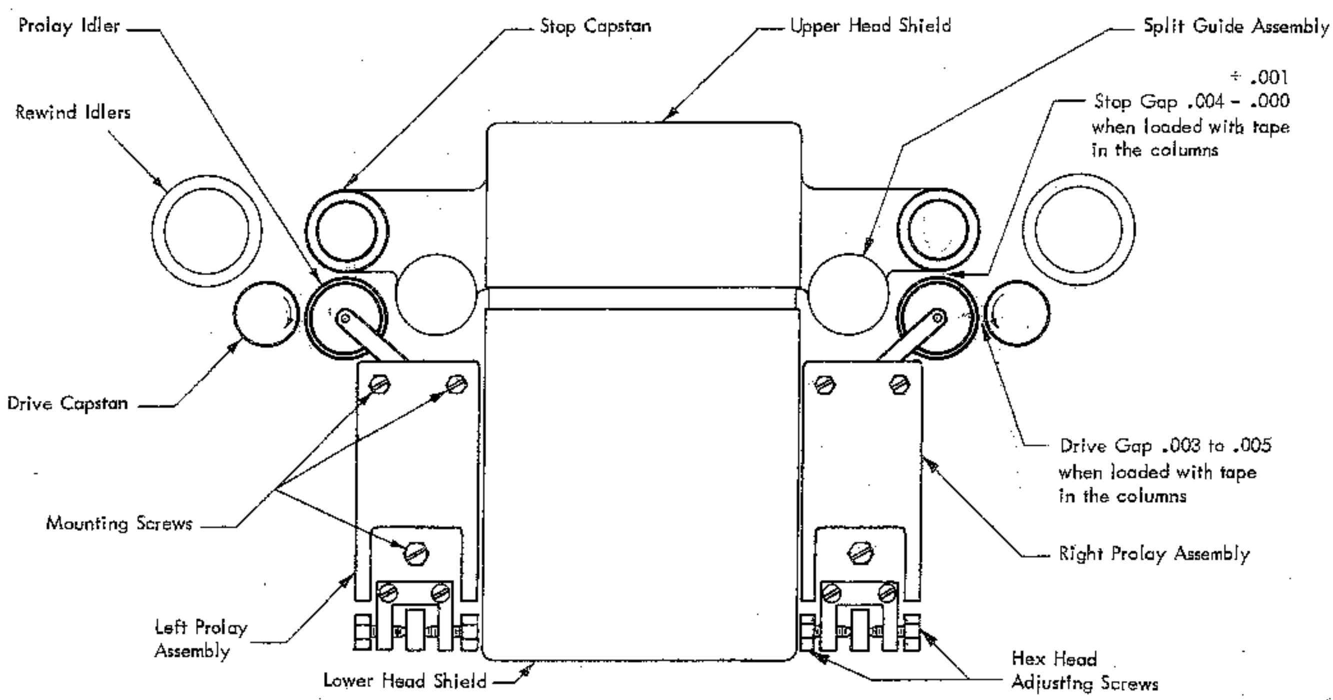


Figure 3-7. Prolay Drive and Stop Gap Adjustment

not show up when looking at the F14C point. When such a failure is suspected, use a differential amplifier in the oscilloscope, and look at the voltage pulse across the .333 ohm resistors (three 1-ohm resistors in parallel) in the neutral and drive circuits, TB11, 1 and 2 for the drive, and TB11, 4 and 5 for neutral.

5. Initially, set gaps as follows:
   Drive gaps, .0045 to .005 inches
   Stop gaps, .005 inches

NOTE: Before initially adjusting the drive and stop gaps, proceed as follows:

a. Trip the door interlock; this will stop the capstan motors.
b. Manually pull out the right capstan; this allows adjustment of the right prolay.
c. Depress the load-rewind key and pull out the left capstan; this allows adjustment of the left prolay.

6. Check forward start waveform and attempt to adjust start time to 2.2 ms. If glitching of the envelope occurs, decrease start gap until waveform is free of it. Glitching or breaking in the start waveform at about 2 ms from the rise of GO is caused by one of two conditions: (1) too large a drive gap on the driving prolay; or (2) too small a drive gap on the nondriving prolay, resulting in an overshoot through neutral to the drive capstan.

7. Repeat step 6 for backward start.

8. Adjust forward stop (left stop) to obtain appropriate difference specification (forward start minus forward stop). In adjusting stop gaps, begin with the coast potentiometers fully ccw (no delay). When desired stop time is obtained, check for noise burst and minimize by opening stop gaps as necessary, still maintaining sum and difference specifications.

9. Check to be sure that minimum full speed coast specification has been met.

The time required to pass a given character from the write head to the read head (about .3″) is 2.7 ms for a 729III or IV and 4.0 ms for a 729II. GO is held up by the control unit for 3.0 ms (II), 1.7 ms (III), or 2.0 ms (IV) after WRITE CHECK CHARACTER (A in Figure 3-8). This delay requires that tape remain at full speed for at least 1.0 ms (II and III) or .7 ms (IV), after the fall of GO, to insure reading every written character (B, Figure 3-8).

Adding a .2 ms safety factor, obtain minimum full-speed coast times of 1.2 ms (II and III) and .9 ms (IV) by means of the coast potentiometer adjustment. No more full coast than absolutely necessary should be used. Watch for instability characterized by a burst of noise after the fall of the envelope. This is extremely undesirable and the full coast potentiometer should be adjusted for a somewhat shorter stop envelope, if necessary, to eliminate this condition.

Viewed from behind the 729: the left potentiometer controls backward coast; the right potentiometer controls forward coast. Clockwise rotation increases the amount of coast on both potentiometers.

10. Check that stop gap is not less than .003″. If less than .003″, open gap as required. Recheck to be sure that sum and difference specifications have been met.

11. Check prolays for binds by making sure that the change in start time is equal to or less than .2 ms when varying GO down time from 10 to 100 ms.

12. Check for a count five condition by operating the GO switch at intervals at least five seconds apart.

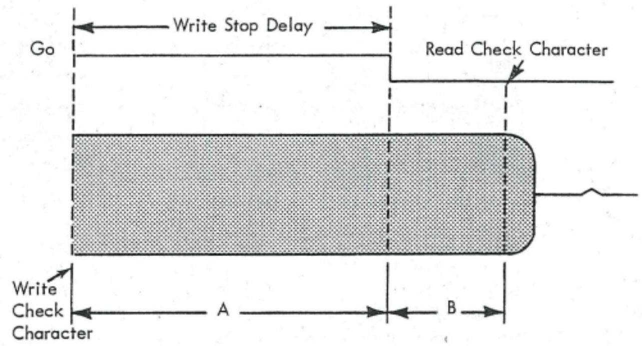


Figure 3-8. Stop Envelope

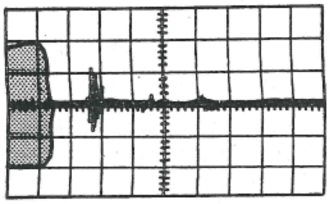
NOTE: Some prolays may indicate good start envelopes on continuous start-stop and yet indicate a very slow acceleration after a five-second or longer idle period. This is referred to as "count five" condition. Check this with a normal start-stop setup. See Figure 3-9. Manually bring up GO after about a five-second delay. Repeat this several times and watch for a slow start envelope. If this occurs, it may be minimized by adjusting the drive gap within the previously specified limits after making sure that the prolay is not binding. To check for a binding prolay, observe start time while varying GO down time from about 10 ms to 100 ms. If start time changes by more than .2 ms, the prolay is binding. Check write backspace creep by use of proper tape motion diagnostic, 5TU04B for IBM 705III, 7T03 for IBM 7070, or 9T5S for IBM 7090.

REMOVAL (ARM ASSEMBLY)

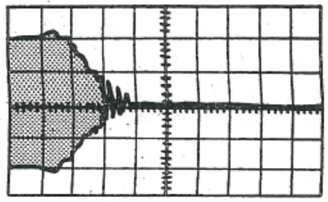
Nearly all tape units in use are now fitted with the removable arm prolay (Figure 3-10). To remove an arm assembly from a prolay when the prolay is mounted on a tape unit:

1. Make sure that the head assembly is up and all power is removed from the machine. (This prevents magnetic attraction of the armature to the pole pieces.)
2. Remove the head assembly lower covers.
3. Remove the front cover of the prolay so that the main pivot shaft is exposed.
4. Loosen the setscrew holding the main pivot shaft.
5. Withdraw the main pivot shaft by gripping the protruding knurled portion.
6. Withdraw the fork arm and armature assembly. Whenever an arm assembly is removed for lubrication or inspection, the top of the armature should be marked for reference. To make certain that the armature is properly oriented when reinstalling the arm assembly, the reference mark must remain on top. In some cases, turning the armature 180° (reversing it on its shaft) will significantly alter prolay operating characteristics. This reversal could cause a count five condition.

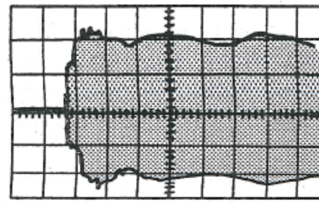
CAUTION: When removing, and particularly when replacing, fork arm assemblies, take extreme care not to damage the Mylar shims on the pole faces. Some pole face



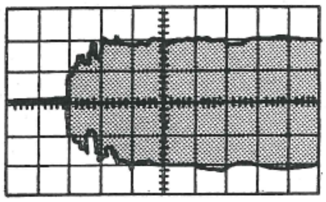
Sync: Fall of Go
Input: A04A-B6 767
Defl: 5v/CM
Sweep: 1 MSC/CM
Prolay Stop Gap Too Small.



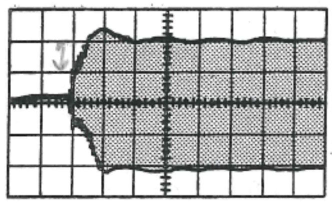
Sync: Fall of Go
Input: A04A-B6 767
Delf: 5v/CM
Sweep: 1MSC/CM
Prolay Stop Gap Too Large.



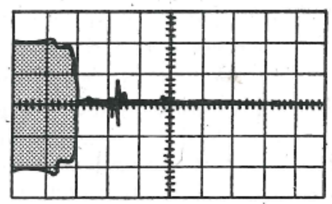
Sync: Rise of Go
Input: A04A-B6 767
Defl: 5v/CM
Sweep: 1MSC/CM
Prolay Drive Gap Too Small.



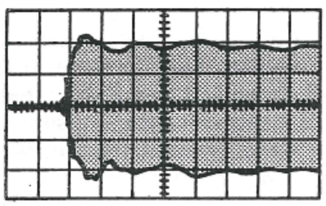
Sync: Rise of Go
Input: A04A-B6 767
Defl: 5v/CM
Sweep: 1MSC/CM
Prolay Drive Gap Too Large.



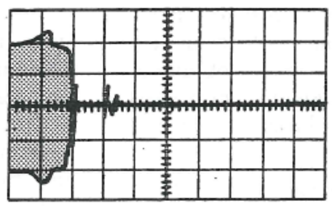
Sync: Rise of Go
Input: A04A-B6 767
Defl: 5v/CM
Sweep: 1MSC/CM
Good Forward Start Envelope.



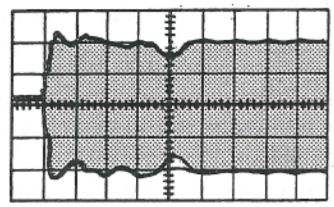
Sync: Fall of Go
Input: A04A-P6 767
Defl: 5v/CM
Sweep: 1MSC/CM
Good Stop Envelope.



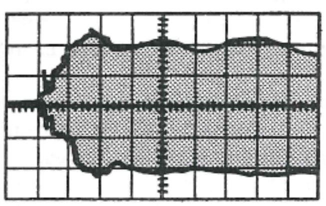
Sync: Rise of Go
Input: A04A-B6 767
Defl: 5v/CM
Sweep: 1MSC/CM
Good Backward Start Envelope.



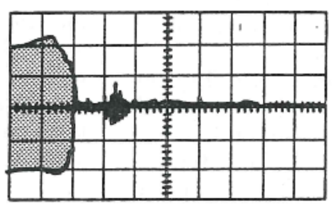
Sync: Fall of Go
Input: A04A-B6 767
Defl: 5v/CM
Sweep: 1MSC/CM
Signal Decreases at 1.5MSC Full Coast Set Correctly.



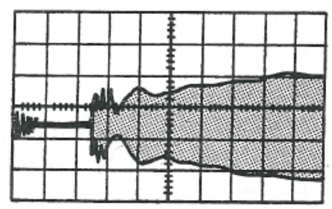
Sync: Rise of Go
Input: A04A-B6 767
Defl: 5v/CM
Sweep: 2MSC/CM
Signal Loss 10MSC After Rise of Go.



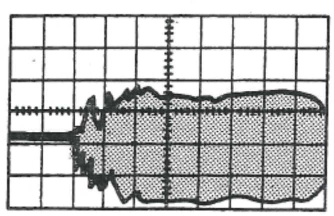
Sync: Rise of Go
Input: A04A-B6 767
Defl: 5v/CM
Sweep: 1 MSC/CM
Forward Start Set to Compensate for a Bound Prolay.



Sync: Fall of Go
Input: A04A-B6 767
Defl: 5v/CM
Sweep: 1MSC/CM
Signal Up for 1.8MSC Full Coast Too Long.



Sync: Rise of Go
Input: Read Bus
Defl: 2v/CM
Sweep: 1MSC/CM
Typical "Count Five" Start Envelope.



Sync: Rise of Go
Input: Read Bus
Defl: 2v/CM
Sweep: 1MSC/CM
Typical "Glitching" of Start Envelope.

Note: All test points refer to 729 III.

Figure 3-9. Waveforms

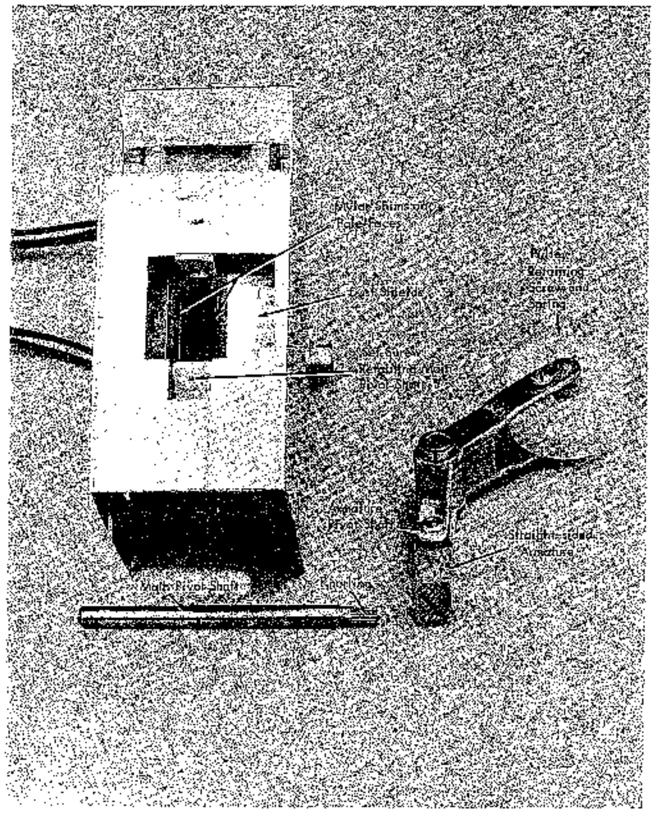


Figure 3-10. Removable Arm Prolay

assemblies may be fitted with Mylar shims that have the cut-out portion (used with the earlier type "humped" armature). In these cases, be sure that the armature does not damage this cut-out portion. Turned, warped, or distorted shims will cause prolay malfunctions.

Replacement

Replacement of the removable fork arm is the reverse of the removal procedure, but make certain of the following points:

1. Armature bevels line up with neutral pole pieces (upper right and lower left).
2. Retaining wire screw for armature is toward the rear.
3. Retaining wire screw for Nylon pulley is toward the front.
4. No binds in armature and fork arm.
5. No burns (armature and nylon pulley).

Removal (Complete Prolay Assembly)

1. Drop power on tape unit.
2. Remove lower head decorative cover.
3. Disconnect two Jones plugs (above and neutral).
4. Loosen hex-head adjusting screws at bottom of prolay.
5. Remove prolay front cover.
6. Using standard cover T wrench, remove three mounting bolts.
7. Remove prolay.

Disassembly

Binding prolays can cause erratic tape motion that is very difficult to diagnose and isolate. This condition is seldom perceptible by feel without disassembling the prolay. Binds can cause split characters, record length checks, missing records, skew, or unreadable records.

The binding may occur at either the forked arm pivot or the armature pivot. The erratic tape motion may also be aggravated by the full coast potentiometer or the positioning of the prolay or the stop capstan.

Replace prolay arm assemblies and readjust prolays every four to six weeks, or when IRG tests indicate a significant change from previous readings or when low gap lengths are outside specifications (Figure 2-1).

To disassemble the prolay:

1. Remove front and side shields.
2. Loosen two screws on neutral pole piece clamps.
3. Remove clamp and neutral coils.
4. Remove five screws holding GO and STOP magnets.
5. Remove fork arm pivot pin.
6. Remove magnets and arm assembly.
7. Remove armature pin.

Note: On removable arm assembly prolays it is not necessary to remove and disassemble the complete prolay to check and correct binds. The fork arm can be removed.

Reassembly

Reassembly procedures are the reverse of disassembly except:

1. The assembled prolay should have .001" to .003" nylon idler end play.
2. All pivots must be free from binds.
3. Be sure that the laminated bar connecting the neutral pole pieces is replaced with the rivets facing outward, so that the flux will flow through the laminations and not across them.
4. Make certain that the two beveled corners of the armature go to the neutral pole piece.
5. Make sure that residuals are clean and free from oil; residuals must not be torn or loose and must lie flat across the pole pieces.
6. Be sure that star-shape Mylar shields are not binding.
7. Make certain the two felt dust guards are not interfering with the arm travel.
8. Be sure that the covers are not binding on the arm.
9. Check that the .005" shim is in the proper place: lower right corner for right prolay; upper left corner for left prolay. To change a prolay from one side to the other, rotate the magnet assembly 180° and reposition the dust wicks.
10. Be sure that the armature clip retaining screw is to the rear of the prolay.
11. Position the cable clamp so that it does not touch the magnet bar.
12. Clean facings on the prolays and machine.

Replacement

Replace the prolay assembly on the tape unit as follows:

1. When installing prolay, turn stop capstan to low dwell.
2. Mount prolay with pivot pin in pivot bushing.
3. Insert three mounting bolts after checking that the prolay is seated against the mounting surfaces.
4. Connect the Jones plugs. Check that the left prolay neutral plug and cable are routed to the left of the access door stop. This will avoid interference from the spring rod when the door is closed.

3.2.3 *Shimmed Prolays*

Starting in December 1960, prolays contain .003-inch shims on each side of the main casting, making a total shimming of .006 inch. See Figure 3-10A. These prolays can be identified by a marking on the bottom of the prolay casting:

Unshimmed 

Shimmed 

Shimming the prolay has essentially increased the force available to penetrate the drive capstan. The higher force overcomes count five tendencies.

Short IR Gaps at Low Go Down Times

Using shimmed prolays, short IR gaps become more prominent at critical low GO down times, between 2.0 ms and 3.0 ms. At these low GO down times the right prolay is signaled to GO just as it is reaching maximum acceleration away from the drive capstan, as the result of the previous stop signal about 2.5 ms earlier. This condition is aggravated on a shimmed prolay, because the Nylon pulley is "thrown" away from the drive capstan by means of its previous deeper penetration into the capstan rubber surface.

IR gap tests will show that machines with shimmed prolays produce shorter gaps in the low GO down time range. The IR gap is likely to fall below the 6.1 ms specification on 729III and IV machines.

Removal of Neutral and Drive Shunts

To minimize this short IRG condition the neutral and drive shunt transistor assemblies can be removed from the machine. These are the power transistor drivers fed by the four 4 ms single-shots that provide pulse current to the prolays. The single-shot logic cards are also removed. All other circuitry, including wiring is unchanged; neutral and drive currents are set at 3 amp and 4 amp respectively.

Adjustment and Modifications to Start-Stop Specifications

1. Set drive gaps to a nominal .005″ ± .001″.
2. Set drive and neutral currents to 4 amp and 3 amp respectively.

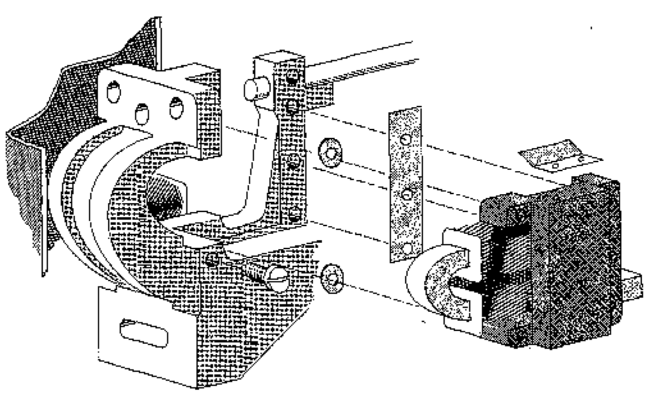


Figure 3-10A. Shimmed Prolay

3. Reducing the neutral current to 2 amp to 2.5 amp may help when IR gaps remain consistently short.

The start-stop specifications are modified as follows:

1. With a 5-second GO down time (count five), the initial 100% amplitude must not be later than 3.3 ms. By adjusting the drive gap .001″ either side of the nominal .005″ setting, the fastest time at which 100% amplitude level is first reached, can be obtained. This applies to both forward and backward start.
2. The 50% amplitude point of forward stop should not be less than 2.1 ms. Adjust the left stop capstan for the longest possible envelope without exceeding the noise burst specification (that is, the left stop capstan must control stopping). Therefore, the stop envelope must be at zero amplitude no later than 3.0 ms. If IRG tests indicate short IR gaps, the forward full coast potentiometer may be used to fill in the forward stop envelope.
3. The 50% amplitude for backward stop should be set to 1.7 ms ± .1 ms. The backward stop capstan should be adjusted on line to meet creep specifications.
4. When the adjustments have been completed, the following conditions should have been met:
   a. Maximum noise burst following the stop envelope should not exceed 5 pulse cycles (10 peaks).
   b. Drive and stop gaps should not be less than .003″.
   c. Minimum full coast on stop envelope is:
      729II and III 1.2 ms
      729IV 0.9 ms
   d. The start envelope must not drop below 95% full amplitude after:
      729II 7 ms
      729III and IV 5 ms
   e. There should be no glitching of either forward or backward start envelope.

3.2.4 *Stop Capstans*

Visual Inspection and Operational Check

Check stopping area for cracks in rubber or worn flat surfaces. Imperfect surfaces cause irregularities in start and stop times and may cause skew problems.

Cleaning

Clean with a lint-free cloth and approved cleaning fluid.

3.2.5 *Drive Capstans and Motors*

Visual Inspection and Operational Check

Inspect the drive shaft for dirt, chips, ridges and binds. Sloppy bearings can usually be altered by feeling the capstans for vibration. Worn bearings will cause poor start-stop break-up in start envelope, and variation or modulation of read signal.

All motors turn in the same direction when input power is phased 1, 2, 3. Phasing is reversed for one motor in the AC raceway. The arrow showing rotation is for factory inspection only. When in the machine, one motor will turn in a direction opposite to the arrow.

Cleaning

Clean the drive capstan surface and surrounding area with a lint-free cloth. In extreme cases, the oxide build-up cannot be removed by tape transport cleaner. In these cases, the drive capstan can be cleaned by the judicious use of IBM cleaner, P/N 450608. Make certain to keep this cleaner away from the tape.

LUBRICATION

Lubricate the capstan motors with IBM 6 oil. Never allow oil to come in contact with the rubber capstan drive surface. For the front bearing (capstan end) proceed as follows:

1. Lubricate the shaft directly with one or two drops of oil on the end of a finger.
2. Move the shaft back and forth to move it into bearings. Make sure the shaft is clean and not over-lubricated. This procedure will permit a lubrication frequency of two to three months.

For the rear bearing, use two to three drops in the oil tube every three months.

ADJUSTMENTS, Drive Capstan Limit Switches

Remove all power from the tape unit and push the capstan motor shaft to both the in and out extreme positions. An audible sound can be heard when these switches operate. If either or both switches do not operate, loosen the appropriate switch, move tug screws and alter their physical position as required. See Figure 3-11.

REMOVAL

Drive capstan motors are mounted on the reverse side of the main casting and access is provided through the rear main panel gate. To remove the motor:

1. Turn power off.
2. Disconnect the motor cables and limit switch wires.
3. Remove three 7/16 inch hex head mounting screws.
4. Twist motor slightly and pull it out.

REPLACEMENT

Replacement procedures are the reverse of removal procedures. Note, however, that drive capstans are individually fitted to the capstan drive motor shaft at the factory, and, therefore, a worn or defective drive capstan must be replaced by installing a complete capstan motor assembly.

CAUTION: When replacing capstan drive motors, use care to seat the motor properly against the base casting. Facing the rear of the machine, rotate the left motor clockwise to lock and the right motor counterclockwise to lock. Misalignment can result if the motor is turned in the wrong direction.

3.2.6 *Sliding Glass Spring Drum Assembly*

The sliding glass spring drum assembly controls the sliding glass panel of the front door (Figure 3-12). A spring drum assembly is located on each side of the inside of the door, as shown in Figure 3-13.

LUBRICATION

Lubricate pulley shafts, front sliding door pulley and front sliding door spring motor with IBM 6 lubricant.

REMOVAL, Inner or Outer Cable

1. Remove the lower outside mounting panel cover by removing the four mounting screws.
2. Remove the mounting bracket from the upper pulleys by removing the two holding screws.
3. Remove the cable by loosening the three screws on the upper pulley and untying the knot.
4. Loosen the three screws on the lower drum assembly (Figure 3-14).

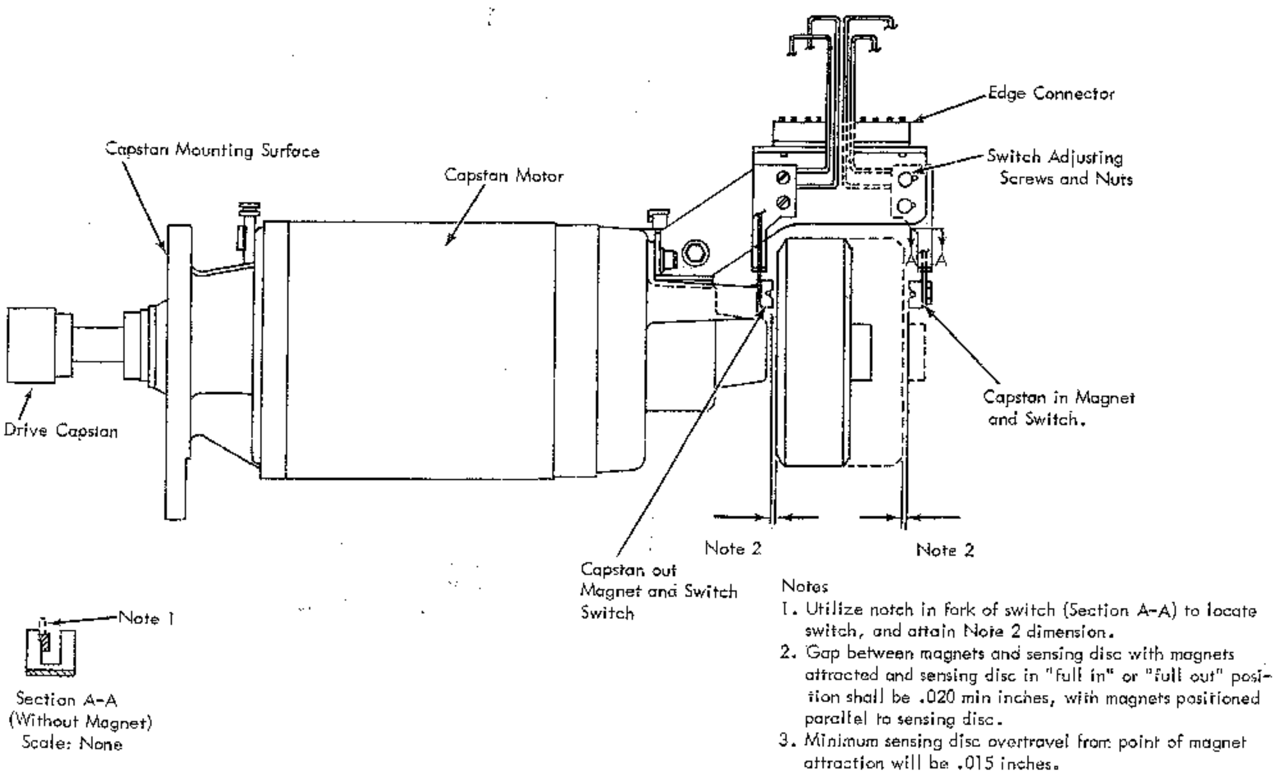


Figure 3-11. Drive Capstan Assembly

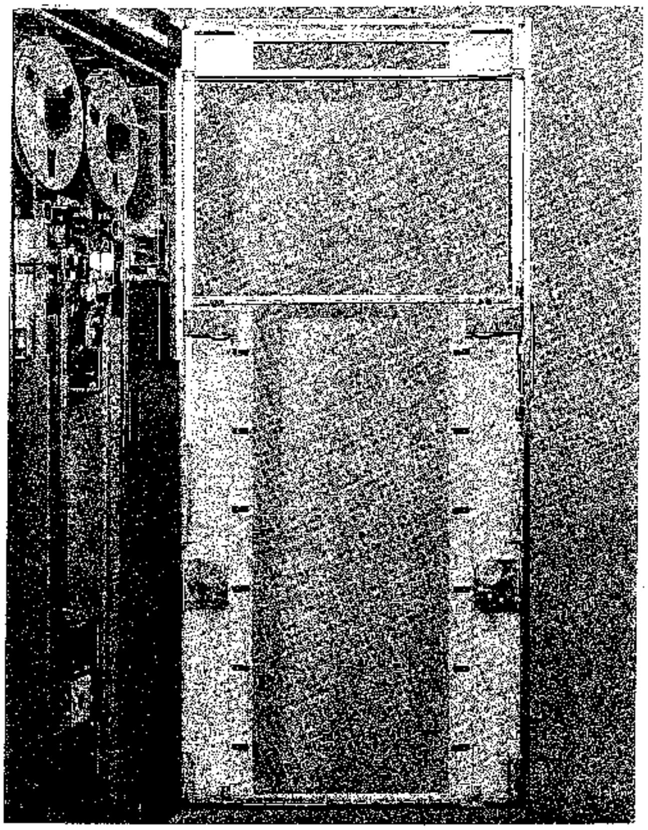


Figure 3-12. Sliding Glass Assembly

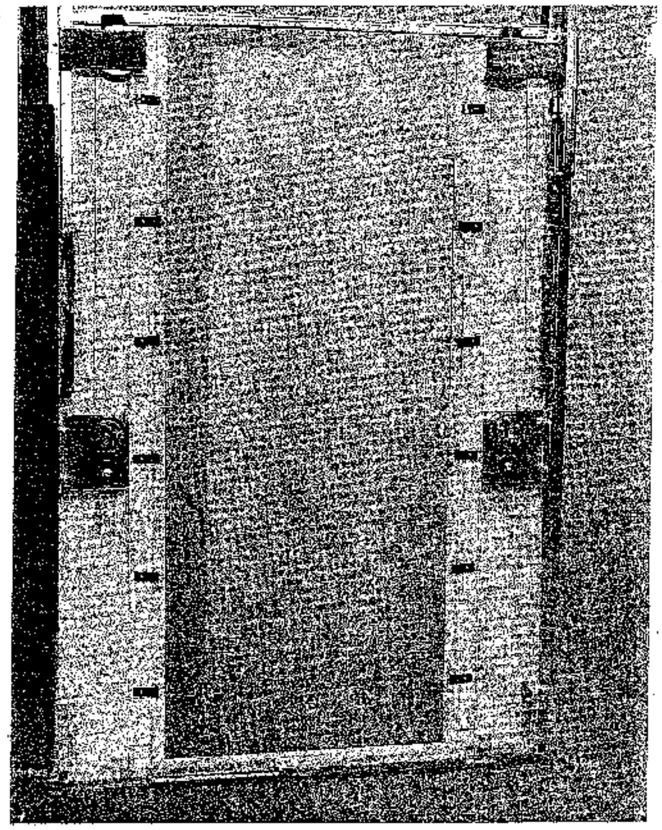


Figure 3-13. Sliding Glass Spring Drum Assembly

REPLACEMENT, Glass Pulley (Inner) Cable

See Figure 3-15. After removing old cable from negator drum (taking care not to damage spring), mount new sliding glass cable as follows:

1. Bring sliding glass down to the stops.
2. Thread hooked end of cable through small hole in sliding glass mounting bracket.
3. Insert hooked end of cable through eyelet in pulley disk.
4. With sliding glass down to the stops, and the pulley held at 3 or 9 o'clock, the cable must be taut. (Right and left glass pulleys are mirror images.) If there is slack in the cable or if the glass moves up from the rubber stops, adjust stop assembly by moving stop screws up or down as required.
5. Move glass to closed position, keeping assembled cable taut on glass pulley.

REPLACEMENT, Drum Pulley (Outer) Cable

Refer to Figure 3-15. After removing old cable from negator drum and mounting new cable, proceed as follows:

1. Thread new cable through eyelet, being careful to leave enough slack to double-knot the cable and tie it down under lock washers. Keep the knot small, taut, and as flat as possible against the eyelet.
2. Remount the pulley mounting bracket.
3. Turn the spring drum assembly one turn.
4. Holding the spring tight, wind the cable five or six turns around the drum.
5. Bring the cable through the slot on the drum.
6. Tie the cable down under the three lock washers.
7. Slide the glass up and down a few times to make sure the cable does not bind on the drum.

CAUTION: Do not disassemble the cable pulleys; they are assembled at the factory.

3.3 Vacuum System

3.3.1 Vacuum Columns (Figure 3-15)

VISUAL INSPECTION AND OPERATIONAL CHECK

Check the manifold mounting screws for tightness. Loose manifolds cause vacuum leaks. Check, for cracks or looseness, the plastic tubes connecting the vacuum switches to the vacuum column take-off ports.

CLEANING

Clean inside surfaces with a lint-free cloth and approved cleaning fluid. Remove all bits of tape and other dirt from the screen at the bottom of the columns. See Figure 3-15.

ADJUSTMENTS

Push Rod. The vacuum switch push rod should have 1/64-inch clearance between the adjusting nuts and the switch transferring contact strap. Position the adjusting nuts as required to attain this condition. See Figure 3-16.

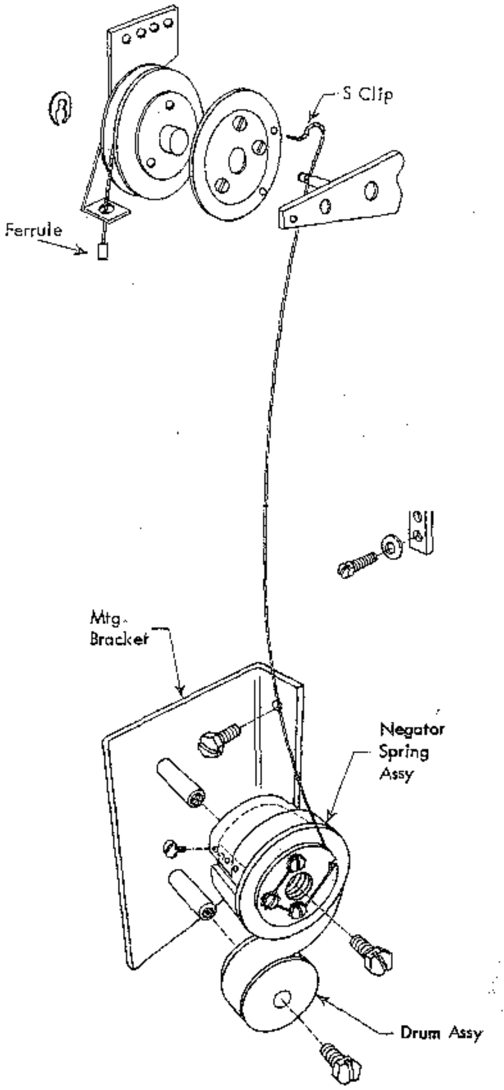


Figure 3-14. Sliding Glass Spring Drum Pulley Assembly

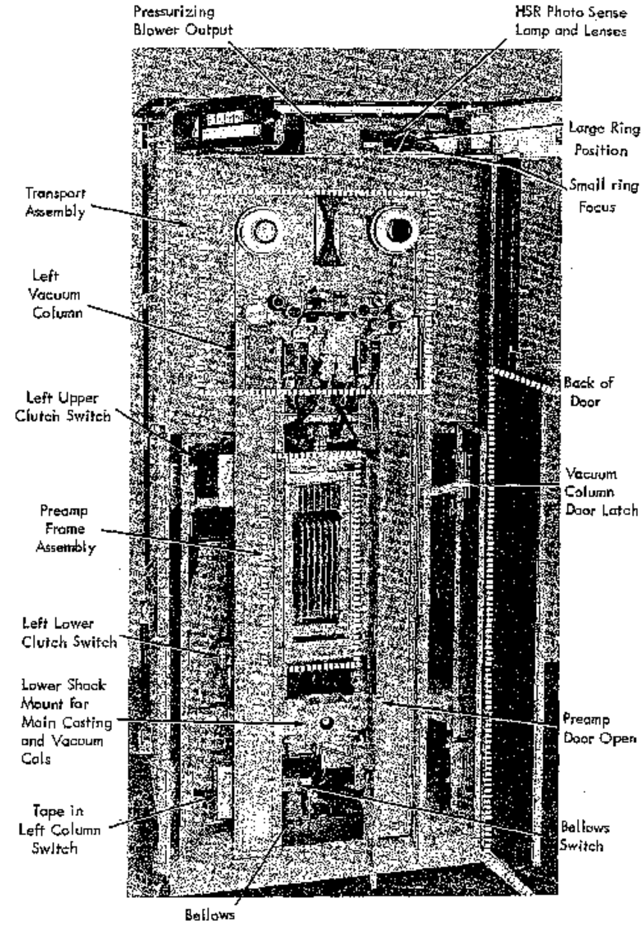
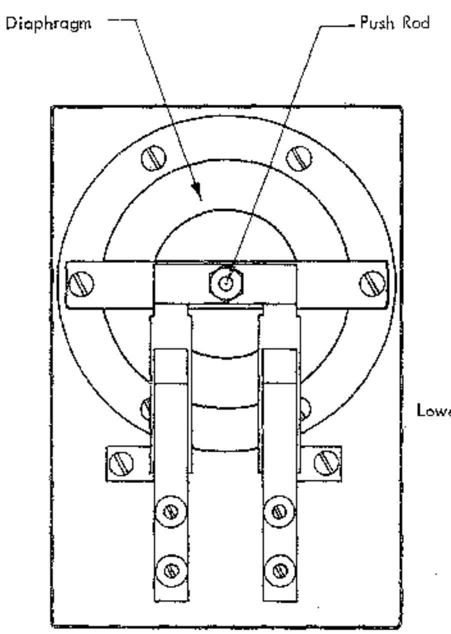


Figure 3-15. Front View, Tape Unit



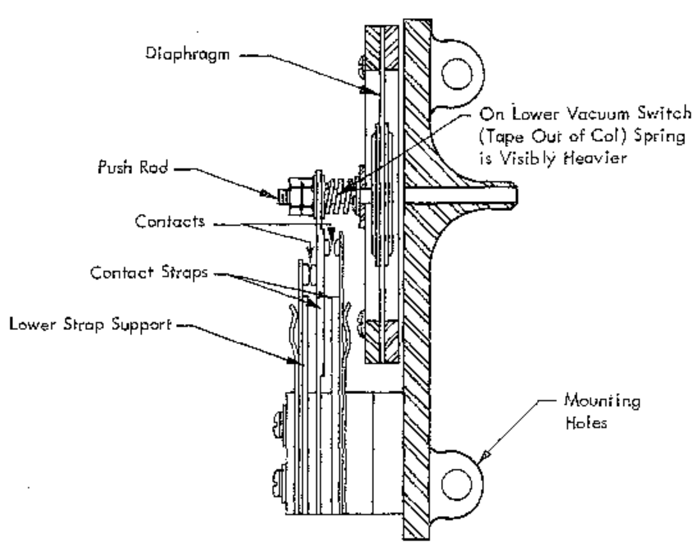


Figure 3-16. Vacuum Column Switch

Vacuum Safety Switch. Remove both tape reels and turn on the door interlock cheater switch. Open the preamplifier access door, place the tape unit in the power-on status, and press the load-rewind key. Since there is no tape in the columns, the loading operation will continue indefinitely. Turn the bellows spring loaded adjusting screw clockwise until the loading operation stops. Rotate the adjusting screw counterclockwise until the loading operation starts, plus an additional ¼ turn. See Figure 3-17.

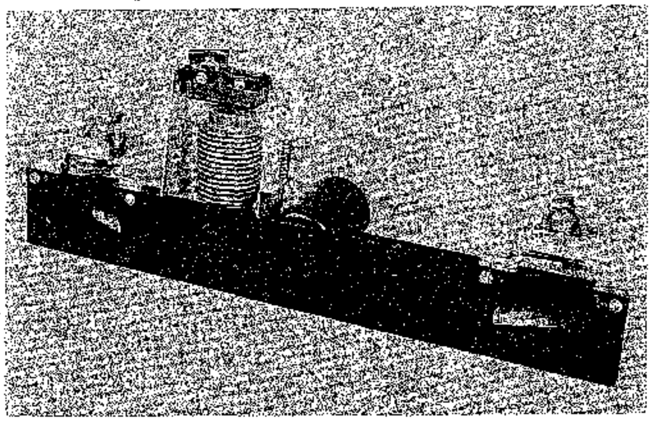


Figure 3-17. Vacuum Safety (Bellows) Switch

LUBRICATION

Apply IBM 17 lubricant to the vacuum column door latches.

CAUTION: Do not lubricate any other part of the vacuum columns except the door latches. Lubricant in any other area will contaminate the tape.

3.3.2 Vacuum Column Switches (Figure 3-16)

VISUAL INSPECTION AND OPERATIONAL CHECK

Visually inspect the vacuum column switches for dirty, pitted or misaligned contacts, and loose diaphragm nuts and mounting screws. Also inspect for cracked or damaged diaphragms and dirt or foreign particles.

Check the tape unit for load, unload, and rewind operations. Excessive tape breakage during these operations may be due to defective or maladjusted vacuum column switches.

To check the switch operation, simulate tape loading without tape to bring up the vacuum. Connect a short piece of tape (15 inches) to the outside of the column and alternately lower and raise this tape into the column. Observe the action of each vacuum column switch.

Vacuum Safety Switch (Bellows). The vacuum safety switch removes power from the tape unit run-relays DP 1 and DP 2 when the vacuum in either column drops below the safe operating point. This switch is operated by two flapper valves located on the top of the vacuum manifold.

To check the vacuum safety switch adjustment, unload the tape drive and hold one of the two flapper valves open. Press the load-rewind key; the machine should not load until the flapper valve is released.

CLEANING

Remove dirt, dust, and foreign particles from the general area with a vacuum cleaner and a dry, lint-free cloth as required.

3.4 Reel Drive

3.4.1 Clutch Assemblies and High-Speed Rewind

VISUAL INSPECTION AND OPERATIONAL CHECK

Check for worn or cracked brushes, loose Jones plugs, and frayed or broken wires. Check all clutches for powder leaks; powder leaks will show up as a fine black powder on the covers and surrounding area. (Do not mistake black rubber deposits from drive belts as powder leaks.)

Clutches. Check that clearance between brushes and slip ring is .040-.068 inches.

Reel Drive Hubs. Inspect the rubber reel latch ring for uneven wear, breaks, cracks, dirt and elasticity.

Reel Drive Shafts. Check the reel drive shafts for lost motion due to loose or worn taper pins used to connect the reel drive hub to the reel drive shaft.

Reel Drive and Brake Clutch Assemblies. Check the reel drive clutch bearings for binding and excessive wear. Rotary motion should be smooth and free, with no lateral end play. Check the clutch commutator rings for carbon deposits and excessive pitting.

CLEANING

Reel Drive Hubs. Clean the rubber surface with a clean, lint-free cloth and approved cleaning fluid.

Reel Drive and Brake Clutches. Burnish the clutch commutator-rings with a fine crocus cloth, as required, to provide good electrical contact and to prevent arcing.

Belts. Belt tension should be ½ inch deflection with a ½ pound force applied in the center of the V-belt.

LUBRICATION

Reel Drive Hubs. If necessary, apply small amount of talcum powder on the rubber ring surface to prevent the tape reel from sticking.

Reel Drive and Brake Clutch Assemblies. Do not lubricate any portion of the clutch drive assembly, as this may cause permanent damage to the clutches.

Stop Clutch Worm Gear. Apply IBM 20 grease as required.

MECHANICAL ADJUSTMENTS

Figure 3-18 shows the tape unit drive mechanisms.

Belt Alignment and Tensions. Position the drive motors in their slotted holes for .5 inch belt deflection in the center. Deflection may be accurately checked by using a .5 inch spring scale.

Clutch and Brake Shaft Assembly End Play. End play on these shafts can be reduced by adjusting the nut on the involved end of the shaft.

CAUTION: Do not make this adjustment too tight, as this will cause burned bearings and excessive drive motor load. If this adjustment does not eliminate shaft end play, replace the entire assembly.

ELECTRICAL ADJUSTMENTS

Brush-to-Clutch Commutator Ring Contact Resistance. See Figure 3-18. With the tape unit power cut off, connect an ohmmeter to the brush and commutator ring of eac clutch. This resistance should not exceed 25 ohms.

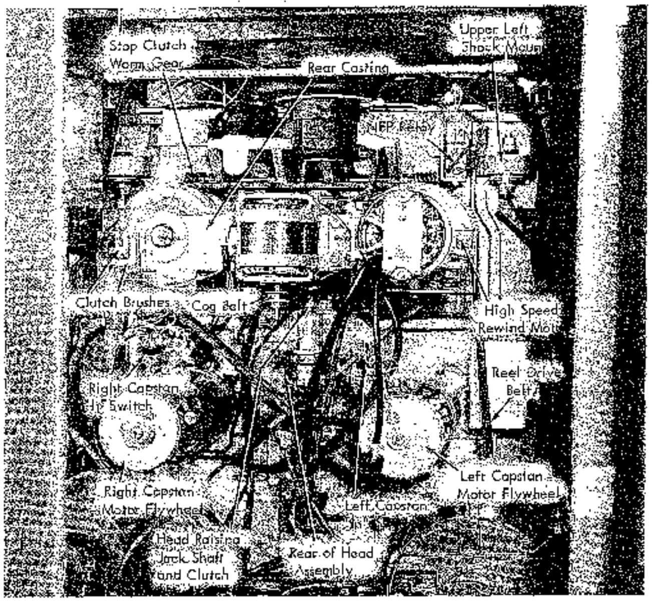


Figure 3-18. Drive Mechanisms

Brush to Commutator Ring Adjustment. To prevent arcing (which is a source of noise) make sure there is .040-.068 inch clearance between the brush block and the commutator ring.

Reel Drive Clutch Energizing Voltage. Place the tape machine in the forward read or write, power-on status and check for at least 52 volts DC across one of the two 200-ohm resistors in the resistor box. Normal current to drive clutches (with two 200-ohm resistors in series) should be 260-270 ma. With only one 200–ohm resistor in series, current is about 400 plus ma. With about 300 ma, tape wrinkle may occur.

REMOVAL, UP AND DOWN CLUTCHES

Up and down clutches at rear of tape unit are best removed individually without removing the complete assembly.

1. Remove both side covers and top cover (four bolts, two on each side). If right clutch is to be serviced, remove the clutch filter box housing.
2. Support both left and right clutch assemblies with cord or wire suspended over the cross members supporting the air filter assembly. NOTE: do not bend clutch shaft. Walk belts off sheaves on clutch.
3. Remove wires from brush assembly between stop and center clutch. It is not necessary to remove wires on rear clutch brush assembly.
4. Loosen setscrew in high-speed rewind motor coupling.
5. Remove two dowel pins from rear support casting.
6. Remove four Allen head bolts securing rear support casting to main clutch support.
7. Remove rear support casting, including high-speed rewind motor, and lay across AC raceway and drive motors.
8. Remove adjusting nut, retainer, and bearing from rear of shaft.
9. Remove rear clutch from the shaft. Shims may be fitted here.
10. If center clutch is to be reworked, remove Woodruff key for rear clutch.
11. Slide center clutch to the rear as much as possible by hand.
12. Remove two screws holding brush block support bracket. The top one is best removed with a long screwdriver from the top; this is the only reason for removing the top cover. After removing the bracket, slot the top hole so that future removals will require only that the top screw be loosened.
13. Remove the two halves of the split space between the middle clutch and stop clutch.
14. Slide the middle clutch to the front of the machine and remove its Woodruff key.
15. Slide middle clutch off the back of the shaft.

REMOVAL, Stop Clutch

1. Remove both side and top cover.
2. In most cases it is not necessary to remove the long vertical side covers to drive the pin from the hub housing. Adequate swing on the hammer can be obtained by driving the pin upward. If the pin is extremely tight, however, it may be necessary to remove these interior covers (either side of front door).
3. Support shaft with V-block and drive pin from clutch hub.
4. Do steps 2 through 7 and 12 in removal procedure for up and down clutches.
5. Remove clutch assembly from the rear of the machine.
6. To remove stop clutch from shaft, remove the two halves of the split spacer after separating the stop and center clutches as much as possible by hand.
7. Slide the stop clutch to the rear of the shaft and remove its Woodruff key.
8. Slide clutch off front of shaft.

Reassemble in reverse order. Be sure to replace all shims in their original locations. When replacing nut on back of shaft, adjust for .005″ end play and lock with retainer.

CLUTCH RECHARGING

1. Remove four screws and cover plate.
2. Remove outer (white) felt washer and inner (black) felt washer and discard.
3. Check bearing for binds. Replace if necessary (P/N 535626).
4. Install new inner felt washer, P/N 533208, and rotating disk.
5. Fill chamber with entire vial of powder, P/N 332770. The vial contains a premeasured amount (22 grams) of powder. Fill chamber from outer periphery, tapping and rotating the chamber and disk.
6. Thoroughly clean edge where cover sits on the clutch.
7. Install new outer felt washer, P/N 535627.
8. Replace cover and secure with four screws.

3.4.2 Jack Shaft Assembly (Figure 3-18)

VISUAL INSPECTION AND OPERATIONAL CHECK

Check for binds by manually rotating the shaft through at least one complete revolution. To rotate the shaft:

1. Place the head in the unlatched position.
2. Release clutch tension by pushing down on the friction clutch disk.

LUBRICATION

Lubricate with IBM 24 lubricant by placing a little oil on the fingers and running them along the shaft.

3.4.3 High-Speed Rewind

Operational Check

Run the tape unit through the high-speed rewind cycle and compare the performance against the following requirements:

1. With just over ½″ of tape on the machine reel, the tape unit should begin rewinding.

2. At the point with ½″ of tape on the reel, the tape unit should kick out of high speed and begin applying brake to the machine reel.

3. When rewinding a full reel, the tape unit should brake smoothly to a stop, so that there is ⅟₁₆″ of tape on the machine reel before loading tape.

4. The tape unit should not move tape (both reels at a complete stop) for approximately 1.5 to 2 seconds after the reels have stopped, before the head comes down to load tape into the columns.

5. The tape unit should take between 40 to 70 seconds for rewinding a full reel. Approximately two-thirds of this time should be in high speed and one-third in low speed.

If the operation does not meet the requirements, adjust as necessary.

Adjustments

1. Check the voltage drop across the high-speed rewind photo lamp. The drop should be 4v (+ 1, −0.5v). If it is not, reset by adjusting potentiometer 1, the top potentiometer on the right-hand side of the relay gate.

2. Focus and position the high-speed rewind light so that the vertical slot of light is centered on the photocell in the finger guard between the reels.

The light and focusing mechanism are located behind the operator's panel, on the right side. To adjust, open the panel and remove the light cover. The large knurled ring is used for positioning and the small ring for focusing.

3. Run one-half inch of tape onto the machine reel, and place the tape unit into unload status.

4. Pull the finger guard cover forward and turn clockwise for unobstructed view of photocell hole.

5. Using the large positioning ring, move the light beam so that the shadow of tape on the machine reel just cuts across the top edge of the photocell hole.

6. Set the time delay motor to 7 seconds.

7. Set the machine reel brake adjusting potentiometer at mid-position. This is potentiometer 3 on the relay gate panel.

8. Hand wind approximately 25 more turns of tape onto the machine reel.

9. Press the load rewind key.

If the adjustments to this point are correct, the unit should go into high-speed rewind. If it does, go on to the next step; if not, recheck the shadow on the photocell (steps 3, 4, and 5) and repeat steps 8 and 9.

10. Run a full reel of tape onto the machine reel.

11. Rewind the full reel and check the results against the requirements listed in "Operational Check." To meet these requirements, it is necessary to adjust the time delay motor for 1.5 to 2 seconds and the brake adjusting potentiometer for ⅟₁₆″ of tape before loading.

Check the results of each adjustment by rewinding a full reel.

3.5 Base

3.5.1 Motors

An extra take-up motor has been added to the 729 II, III, and IV. Previously, one motor was used for both tape take-up and head take-up. Now a separate motor is used for each of these functions. See Figure 3-18.

Visual Inspection and Operational Check

Check all 13 motors for binding shafts. On forward and reverse motors, remove drive belts and spin each motor shaft by hand. They should coast to a smooth stop. Bent shafts can also be detected by turning the shaft through 360° by hand and feeling for sticking or dragging.

Check all pulley and coupling setscrews and taper pins for tightness, on the following: drive capstan motors, blower motors, forward and reverse pulleys, high-speed rewind coupling, and the two take-up motors.

All resilient motors have a bond wire across the rubber resilient mounting. The frames of all motors are grounded through a green wire to the machine frame. All motors have a Jones plug for quick disconnecting.

Check all motor plugs for loose connections (Figure 3-19). Inspect all drive belts for wear. The plug shell is completely insulated inside. All motor leads have a heavy PVC sleeve or tape which extends well down inside the shell

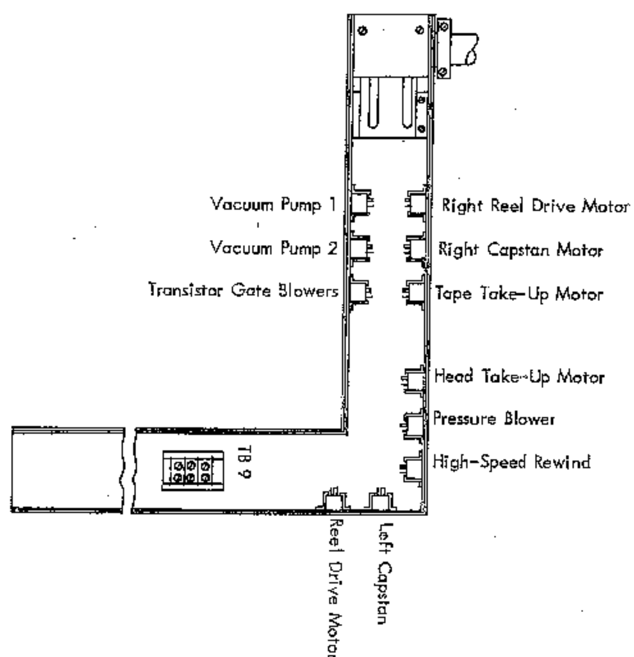


Figure 3-19. AC Raceway Plug Location

and is securely held by the clamp. It is important to make sure that this sleeving is pushed well down inside and clamped after being removed for servicing.

3.5.2 *Relays*

VISUAL INSPECTION AND OPERATIONAL CHECK (Figure 3-20)

Duo Relays: Check for dirty points, sticky pivots, loose cores, loose contact points and contact piles, and for correct armature-core air gap.

Wire Relays: Check for burnt or bent wire contacts, the armature for clearance, the block for tightness (red dust), and the residuals for pound-out.

Heavy Duty Relays: Check for free armature movement, dirty contact points, and simultaneous make-break operation.

CLEANING

Recondition relays by following procedures outlined in the *Customer Engineering Reference Manual, Relays,* Form 225-5857.

LUBRICATION

Lubricate duo relay operating pads with IBM 17 and the pivots with IBM 6.

ADJUSTMENTS

Duo Relays: Set the armature-to-core gap (when open) between .017″ to .019″. Set the air gap for all contact points between .001″ and .006″ when a .007″ gage is inserted between the armature and the brass armature stop pin. See that the gage does not interfere with the rivets holding the phenolic actuating pad to the armature. Use the same gage for making all adjustments.

Other Relays: Follow the adjustment procedure outlined in the *Customer Engineering Reference Manual, Relays,* Form 225-5857.

3.5.3 *File Protect*

VISUAL INSPECTION AND OPERATIONAL CHECK

The file-protect circuitry is controlled by a relay plunger mounted above and behind the file reel and extending through the main casting. When the plunger is depressed, either manually or by a plastic ring on the tape reel, the tape is not file protected, and information can be rewritten on it. The file-protect relay is energized through its own contacts and can be disengaged by pressing the unload key or by removing power to the machine.

To check the file-protect operation, manually depress the file-protect plunger. The file-protect indicator lamp will light and stay lit. Press the file-protect-off key located just beneath the file reel. The file-protect lamp will momentarily go out. Press the unload key, and the file-protect lamp will go out.

Visually inspect the file-protect plunger for binding and mechanical damage. Inspect the plunger and brake clutch assembly for clearance.

CLEANING

Clean the file-protect plunger and surrounding area with a clean, lint-free cloth and approved cleaning fluid.

LUBRICATION

Apply IBM 6 oil sparingly, as required.

ADJUSTMENTS

Bend and form the file-protect relay strap for proper operation when the file-protect plunger is depressed and released. Loosen the relay mounting screws and position the strap in its elongated holes as required.

REMOVAL AND REPLACEMENT

To remove the file-protect relay, disconnect the file-protect relay wires and remove the mounting screws. To replace, reverse the above procedure.

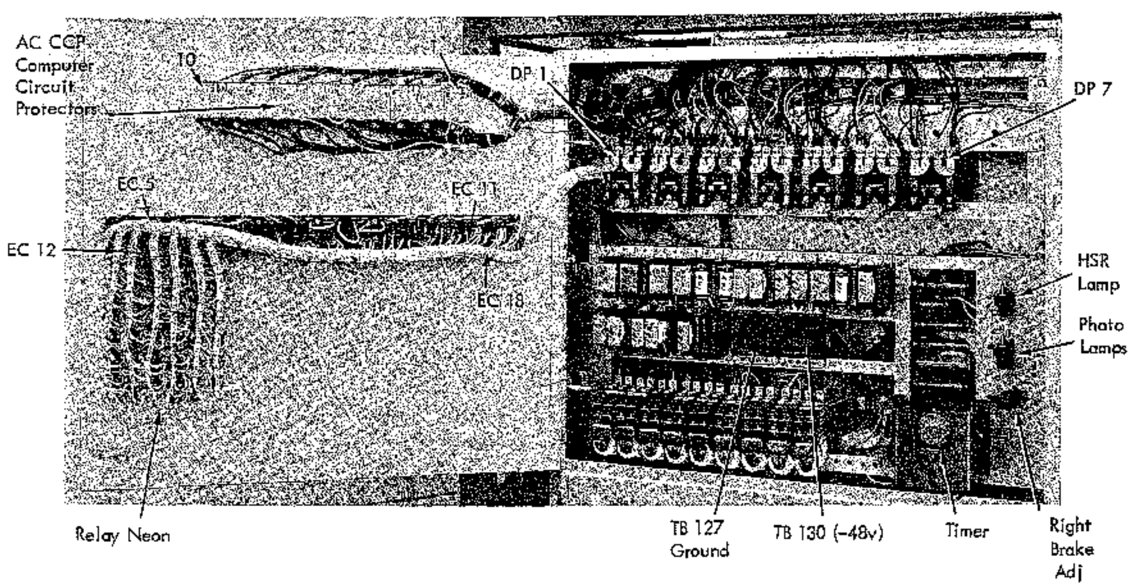


Figure 3-20. Relay Gate

3.5.4 *Circuit Breakers and Thermals*

VISUAL INSPECTION AND OPERATIONAL CHECK

Refer to Figures 3-20 and 3-21.

Circuit Breakers: Check circuit breakers for fault-free mechanical operation and for circuit continuity. Manually actuate each of the ten AC and nine DC CB's with power on. Check the power-on contactor for dirty or burnt points and trouble-free mechanical operation. Replace faulty circuit breakers.

Thermals: Check the circuitry of the high-speed rewind motor thermal. Use a dummy plug that shorts pins 1 and 2 in the connector of the thermal cable coming from the motor. Substitute this plug for the connector during a high-speed rewind operation. Under proper operation, the tape drive should immediately go into low-speed rewind.

3.5.5 *Filters*

VISUAL INSPECTION AND OPERATIONAL CHECK

Inspect three filters for dirt. One filter is directly above the high-speed rewind motor and the other two are at the bottom of the transistor panel gate. Replace filters when dirty.

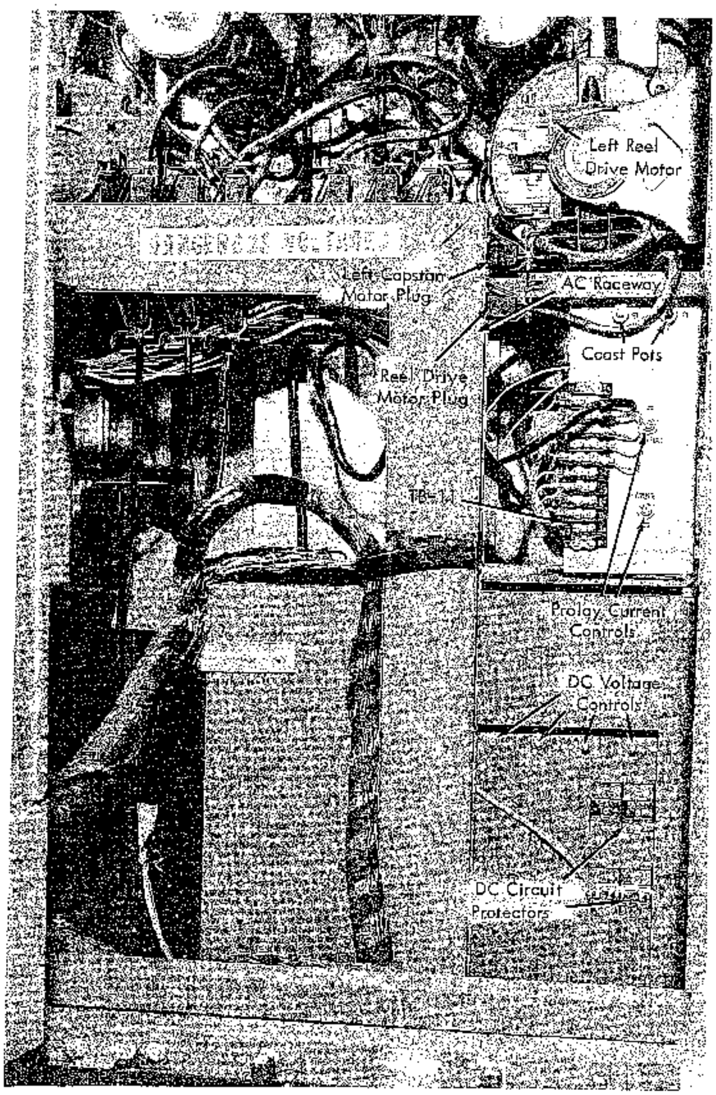


Figure 3-21. Prolay Current and DC Voltage Controls

3.5.6 *Power Supplies*

The 729II, III, and IV units are now using power supplies at three different design levels. These supplies are designated Phase I, II, and III:

PHASE I

IBM P/N	PART NAME
526251	Frame assembly
597415	± 6v and ± 12v drawer
529077	− 48v and +62v drawer from 729III
529079	+ 140v and − 7.5v drawer from 729III
370181	Positive transistor card P/N 6200014*
370179	Negative transistor card P/N 6200015*

PHASE II

IBM P/N	PART NAME
526497	Frame assembly
597473	+ 6v and + 12v drawer
597400	− 48v and + 62v drawer
597461	+ 140v and − 7.5v drawer
370182	Positive transistor card P/N 6200017*
370180	Negative transistor card P/N 6200018*

PHASE III

IBM P/N	PART NAME
316103	Frame assembly
316105	± 6v and ± 12v drawer
316106	−48v, +62v, +140v, and −7.5v drawer
316104	Ferro-resonant transformer drawer
371920	Positive transistor card
371921	Negative transistor card

*Cards used on some old machines, replaced by existing P/N.

VISUAL INSPECTION AND OPERATIONAL CHECK

Visually inspect the tape unit power supply for loose terminals, broken wires, damaged cables and leaking or defective filter condensers. Measure all power supply output voltages and waveforms and inspect functioning of all switches and lights. Check door interlocks.

In the 729 II and IV, the ±6v and ±12v power supplies should not have more than 100 mv drop in the voltage distribution system. Before checking this drop, set the 729 in write status. When the drop exceeds 1%, check the distribution circuitry. Voltages at the power supply should be within +4% and −3% for all cases.

There are no finite ripple specifications except those asterisked in Figure 3-22. The values given are the practical maximums to be used as criteria. Maximum ripple exists with maximum current load. Ripple should be measured with the machine in a static condition to avoid confusion with load variations.

In the 729 II and IV, the circuit protectors are moved into the power supply series regulators so that any drop across the circuit protector is compensated for.

SHORTING OF DIODES ON PHASE I AND II SUPPLIES

The short distance between mounting centers of the diode heat sink mounting bracket can allow the heat sink on some units to move sufficiently to ground the stud of the diodes to the CP panel. If this happens: loosen the bracket mounting screws slightly and move the bracket to position the heat sink parallel to the CP panel; securely tighten the screws. For further protection, a 6″ length of ¾″ wide electrical tape may be fitted on the back side of

Voltage	Regulation	Max Ripple (Peak to Peak)	Notes
± 6v	+4% - 3%	15 mv	Except +6 on 729 III
± 12v	+45 -3%	100 mv	Except -12 on 729 III
-48v / 2.5 amp	± 10%	1.5 mv	
-48v / 30 ma	± 10%	*100 mv	
-7.5v	± 20%	100 mv	
-140v / 1.0 amp	± 10% II & IV	4.5v	± 20% on 729 III
-140v / 5 ma	± 10% II & IV	*100 mv	± 20% on 729 III
62v	± 10% peak		(Read with scope)

Figure 3-22. Power Supply Variations

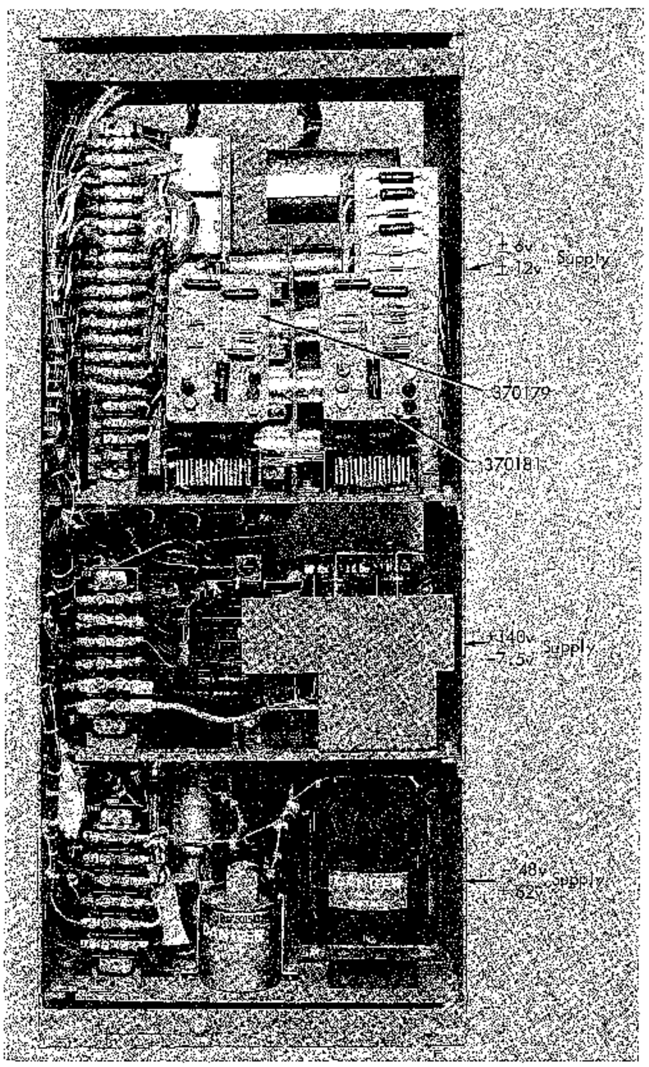


Figure 3-23. Phase I Power Supply

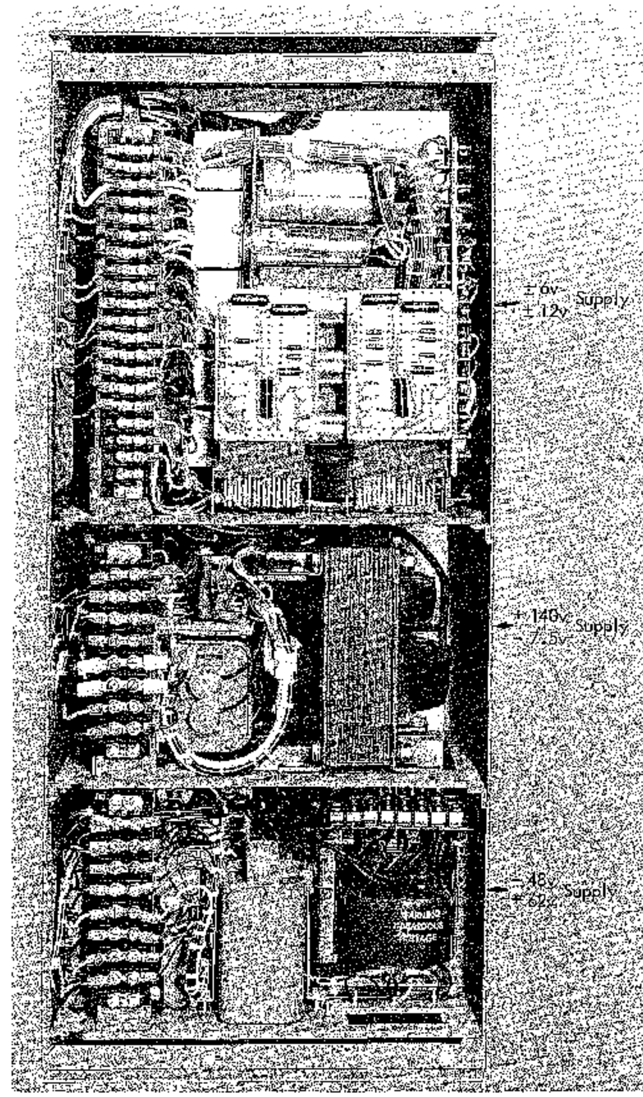


Figure 3-24. Phase II Power Supply

the CP panel in line with each of the two rows of diodes to prevent grounding.

Cleaning

Vacuum the dust and dirt from the power supply and surrounding area.

Adjustments

Power supply voltage adjusting Autotransformers or potentiometers are on the rear of the power supply at the lower right side of the tape unit. Each potentiometer is identified with the supply voltage it controls. See Figure 3-22 for required adjustments.

Voltages should be set with the machine in write status. Measure the ±6v and ±12v lines on the logic panel.

In the 729 III, contact resistance in the Variacs can cause poor regulation, as a result of worn contacts or low spring tension. Variacs with worn contacts should be replaced.

Figure 3-23, 3-24 and 3-25 show the power supplies for the three models of 729 tape units.

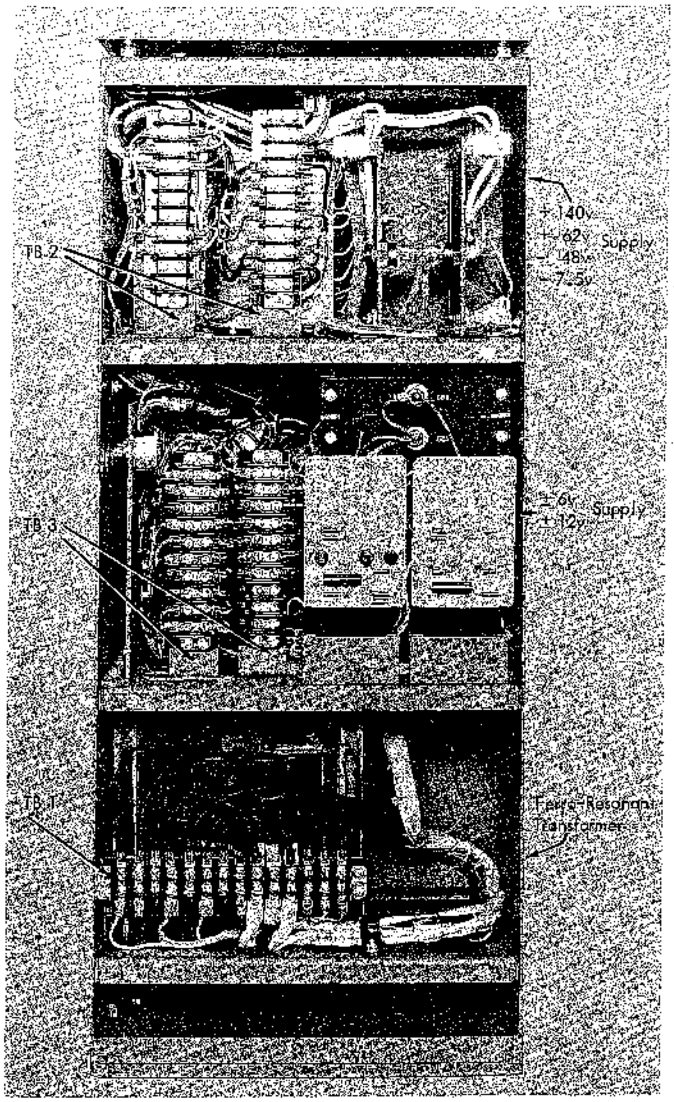


Figure 3-25. Phase III Power Supply

Contents

4.1 General Troubleshooting Hints

The possible causes for the troubles listed in the following subsections were uncovered through experience on similar machines and through extensive tests on the equipment.

4.1.1 Signal Drop-Out

This term indicates that the voltage amplitude of a signal was decreased to such a value that it could not be correctly detected as a 1-bit. There are two main causes for this:

1. An irregularity on the tape surface may physically lift the tape away from the read-write head when a 1 is being written. This reduces the resulting voltage amplitude obtained when reading. Surface imperfections can be caused by magnetic oxide clumps or backing particles.
2. The lack of magnetic coating, caused by wear at the point where a pulse is supposed to be recorded, is another source of signal drop-out.

DROP-OUT FAILURES

Dirt is one of the major causes of errors in a tape system, whether on the tape or any of the surfaces on which the tape travels. The slightest lifting of the tape from the reading head, when reading a 1, has a marked effect on the signal output waveform and amplitude, resulting in a signal drop-out.

Another source of signal drop-out is "trenching," that is, a groove or trench in the read-write head. This groove is the result of extended operation, where the tape literally "saws" a trench in the head. Trenching is visible and is also indicated by excessive skew and dropped bits (especially the 1-bit and C-bit tracks).

Intermittent reading failures have been caused by foreign material on the tape. The following method is suggested for locating foreign material.

When the machine stops, indicating an error, mark the tape where it crosses both split idlers. Unload the tape unit and inspect the tape between the marks on the tape. The error will have occurred in this area.

When excessive skew or flutter seems to be a problem, check the split idlers for binds. A bind at this point can give the indication of excessive skew.

4.1.2 Noise Pulses (Pickup)

The difference between signal drop-outs and noise is that drop-outs are usually caused by the magnitude of the distance between tape and head or the magnitude of oxide discontinuity. Noise is generally a function of the rate of change of the movement between tape and head or the rate of change of the discontinuity. Similarly, noise errors arise from discontinuities in the oxide. Surface irregularities also contribute to noise.

Other sources of noise or signal drop-outs are metal chips which may change the reluctance of the magnetic path of the flux. Oxide clumps push the tape away from the head and also change the magnetic reluctance of the flux path.

To eliminate any errors originating from the above causes, inspect the tape drive and associated areas for any accumulations of dirt, oxide clumps, or foreign material.

4.1.3 Noise and Ground Loops

Low signal levels and fast switching time of transistor circuits require the noise level to be very low on all ground wires and service voltage wires. It is important, in the 729 III, that there be no more than the one central grounding point on the back of the preamplifier box, right side. Two other frame ground points on the left side of the preamplifier box are for the preamplifier itself. Some of the read bus shields may also be tied to the left side.

To check for ground loops, disconnect all common ground points on the preamplifier and check continuity between the frame and any ground wire other than the preamplifier box. Be sure to check the ground buses on the transistor logic (back) gate. NOTE: Remove the signal cable. Use the Rx100 scale. There should be no measurable deflection (infinite resistance).

Check also the tape signal cables for shorts to ground. On 729 III's using summary punch connector, open the cable shoe, and check particularly the wires in the bottom rows. These are the read bus wires for the 729 III. The shielding for the center conductor of each track is also the return (ground potential) for that track from the data synchronizer. Each shield is separated from the others throughout the signal cable, the cable shoe, and the receptacle in the drive. They are tied together at one point *only*, the top back of the preamplifier box. They are also tied to frame ground at this point.

4.1.4 False Noise Records

False noise records can occur because of improper filtering of a vacuum column switch, usually caused by broken leads on the filter assembly. To check for this, place the tape unit in read status with the capstan motors disconnected. Manually position the tape so that it oscillates about one of the sensing ports.

Observe the read bus for transient noise pulses, at the same time lightly vibrating the vacuum switch cover. Check all ports in this manner.

4.1.5 Load-Unload-Rewind Failures

LOAD FAILURES

A failure on load-rewind operation may be corrected by adjusting the bellows switch.

A loose manifold on one drive may cause tape to spill in the column.

A loose connection on the tape break lamp will cause loading failures.

In cases where tape billows out upon loading into columns after high-speed rewind, check the rewind idlers and split idlers. The idlers must be absolutely free running with no binds. End play of .001" is allowable on the rewind idlers.

Other causes of load failures are:

- Load point photocell has low dark resistance.
- Flapper valves are binding.
- Friction clutch compression spring will cause head to bind.
- Vacuum column switch transfer strap binding or cracked.
- Head-down microswitch loose.
- Timer arm binding.
- Magnetic clutch brush blocks loose.
- Magnetic clutches leaking powder.
- Burned out load point lamp.
- Head cover binding.
- Tape reel not seated properly.
- Vacuum leaks.
- Tape chips in column.

UNLOAD FAILURES

Tape too tight at the end of an unload can be caused by the one-half brake adjustment.

A bellows switch that is out of adjustment has caused tape to break at the end of an unload operation.

Other causes of unload failures are:
Binding flapper valves.
Binding capstan shafts.
Capstan sensing switches out of adjustment.
Magnetic clutches leaking power.
Weak tension on clutch commutator brushes.
Dirty commutator rings.

REWIND FAILURES

When the tape unit goes into a high-speed rewind but the high-speed rewind motor fails to start because of excessive drag on the reels, check the clutch demagnetizing circuit and check for binds in clutch shafts (no power on machine).

Tape may be raised too slowly in the right column because of a worn brush to the right-reel-up clutch.

An adjustment of one-half brake may be required to prevent tape breakage on high-speed rewind.

A hang-up or long delay between the high-speed area and low-speed area can be caused by a high contact resistance in the time delay microswitch.

Wrinkled tape can be caused by a jerky stop after a high-speed rewind, just before loading tape to go into the low speed area.

4.1.6 Tape Contamination

Reel Hub Knob. Metallic particles are sometimes found inside the hub. A tenacious lubricant such as IBM 24 should be applied to alleviate this condition.

Rewind Idlers. Loose particles may be found, resulting from the pressing of the idler on the shaft. These particles may be removed with a pen knife lest they be thrown into the system.

4.1.7 Tape Breakage

HIGH SPEED AREA

Brake or timer out of adjustment.
High resistance between N/C points on timer microswitch.
Binding timer.
High speed rewind idler binding or too much end play.

HEAD AREA

Binding head covers.
Head up and down microswitches loose.
Tape cleaner bent and out of adjustment.

SHORTED WRITE HEAD CABLE

If a short to ground occurs anywhere in the write cable, the write head may be burned out. Therefore, if a burned-out head is found, the write cable should be thoroughly checked for shorts before mounting a new head. Also, the cable connector clamp should be screwed onto the connector tightly before the cable is clamped. A loose cable connector clamp can greatly aggravate a worn cable condition.

CAPSTANS

Sensing microswitches loose and out of adjustment.
Drive shaft binding; lubricate periodically.

MAGNETIC CLUTCHES

Brush blocks loose.
Dirty commutator rings.
Powder leaking, resulting in binds.

COLUMNS

Vacuum leaks.
Tape chips in column.
Bellows switch out of adjustment.
Vacuum column switch transfer strap broken.
Flapper valves binding.
Column tops with rough edges.

MISCELLANEOUS

Improper tape handling (loading).

If the tape drive door is opened just after the tape has risen from the columns, thus causing the tape to be stopped by the capstans instead of coming to a normal stop, tape may break. Tape breakage has also been traced to poor alignment of the rewind motor. Excessive vibration within the tape frame during high-speed rewind makes it possible for the capstans-in switches to drop out of the circuit and cause tape breakage.

4.1.8 Magnetic Clutches

CAUSES OF CLUTCH FAILURE

To check operation or to troubleshoot up-or-down clutch and associated relays and vacuum switches: load tape and stop immediately (to prevent dump if either clutch fails). Open the door and use the reel release button to place tape below the lower vacuum switch to test up-clutch, or above the upper vacuum switch for down-clutch. Unplug the reel drive motors. Hold the reel being tested and close the door interlock. Rotate the reel back and forth, being careful not to pass the vacuum switch opening (as this applies full brake). Watch the clutch brushes for arcing. Compare "feel" of right and left clutches.

Dirty brushes or contact rings may work at one point and fail at another, so try rotating quickly one way, then the other, to check for momentary loss of grip by the clutch.

In troubleshooting a solid clutch failure, the reel may be held in position by a piece of scotch tape applied to the back plate while checking relay points and other sources, until clutch operation is restored.

CLUTCH POWDER LEAKAGE

Clutch design permits the loss of a certain quantity of powder without impairing machine operation.

Loss of magnetic powder from a clutch decreases the torque capacity and, thereby, the response time of the clutch. The result is that the tape loop in the vacuum column will have to travel further than it would normally. Because this abnormal condition is visual, it can be used as an approximate clutch performance indicator.

To insure standard observations, use this procedure:

When the machine is running continuously in either a forward or reverse direction, and with a full reel of tape first on the left reel and then on the right reel, the tape loop in the vacuum column will always be less than seven inches above the upper sensing hole. Any excursion farther than seven inches beyond the sensing holes will be considered a failure. Before the clutch assembly is replaced, check the following items to determine their condition:

Vacuum column switch adjustments and resultant response.

Reel clutch contact brush assemblies for proper contact and tension.

If these items are satisfactory, then the clutch assembly should be removed.

4.1.9 *PCT Write Errors*

Check tape.

Check ground connections on the read and write bus shielded cabling. These ground wires should stand a fair pull without coming loose.

Check to see that the read and write bus edge connectors are not shorting against adjacent pins.

Check the ground connections on the read and write head plug for tightness.

Check the read and write head plugs for tightness.

Match checks can be caused when the upper head H shield does not seat properly during the load operation or creeps up during subsequent writing. This improper adjustment causes excessive feed-through. Two brass screws control lateral movement by squeezing the mounting block. The screws should be adjusted to allow free vertical movement with a minimum of lateral movement. After the shield is properly adjusted, apply Glyptal (or fingernail polish) so that the screws cannot loosen.

The upper head mu-metal shield will sometimes prevent the head from seating properly; forming the shield eliminates this.

Position the upper head cover to provide clearance for the lower head cover when the head is down.

A defective delay line card can cause intermittent flipping of the write trigger. A small amount of ringing on the write pulse is normal, but an excessive amount will cause trouble. Scope the input to the delay lines and the inputs to the write trigger.

Be sure there is clearance between the prolay mu-metal cover and the lower head mu-metal cover. If they are touching the prolay, motion can be transferred to the head, resulting in skew.

Dirty contacts on R112-3 and R112-4 can cause low voltage to the center tap of the write head, resulting in low write current and low read signals.

4.1.10 *Miscellaneous Failures*

Photosense High-Speed Rewind

The large halo around the light beam of the new style photosense high-speed rewind may make adjustment difficult. By adjusting the lamp voltage to its minimum, the halo is eliminated and better focusing is allowed.

Tape Address Selection

An unused tape unit should be in reset status.

Rewind Motor Coupling

Breakage of the rewind motor coupling is usually caused by misalignment of the rewind motor and clutch shaft.

4.2 SMS Cards

Cleaning and Lubricating

The following procedure should be used to clean SMS card tab contacts which have not been lubricated or are visibly contaminated with foreign particles, such as dust This procedure will insure a low contact resistance and will reduce wear of the gold-plated contact surface. If there is any doubt about the contamination of the card tabs, relubricate them. The cleaning and lubricating procedure permits relubricating any number of times, without affecting contact reliability.

1. Use SMS card contact lubricant (which is to be released) or its equivalent. The equivalent is 5% (±2%) petrolatum by weight in 1,1,1 trichloroethane.

2. The lubricant may be applied indirectly by saturating a clean piece of cheesecloth or lint-free industrial tissue, or directly by wetting all 16 card tabs with the lubricant.

3. Clean and lubricate the card tabs by wiping with a moistened cloth or tissue from the leading edge toward the component section of the card.

4. Next, rub the contact with a clean piece of cloth or tissue until there is no visible trace of lubricant. The application material will not darken if the contacts have been properly cleaned.

5. Repeat the procedure if the application material darkens.

Emergency Repair of Printed Circuit Cards

Nonavailability of spares may make field repair of cards necessary to some degree.

The printed circuit is comparatively easy to troubleshoot, since conductors and components are easily accessible. The replacement of defective components is not difficult if reasonable care is used. The printed card, however, can be damaged by excessive heat during the unsoldering or resoldering of components, or if strong-arm methods are used to remove a component. Overheating will deteriorate the adhesive bond between the conductor and insulating base material. Also, conductors are unable to withstand heavy stresses applied by component leads if these stresses tend to pull the conductor away from the laminate or attempt to shear the bond. The conductors are practically immune to stresses directed toward the laminate, as shown in Figure 4-1.

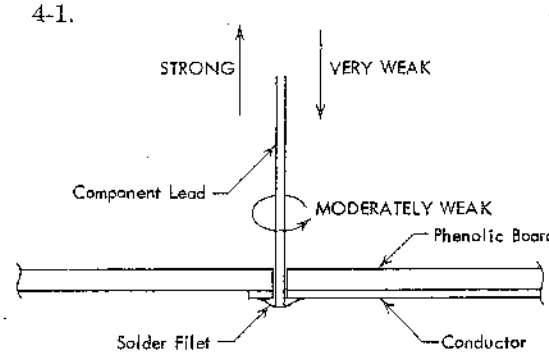


Figure 4-1. Stress Applied to Component Leads

The following procedure for replacing a component on a printed card is the recommended method for most repairs.

REMOVAL

Cut defective component leads as close to the base on the component side of the plastic card as possible. All components, including transistors, should be removed by using diagonal pliers with care, so as not to damage the card or adjacent components. Leads of "Jetec" package transistors can be cut with a knife.

With a clean and tinned soldering iron, heat the leads at the printed circuit land pattern side. When the solder just begins to flow and with the card in hand, a rap of the hand on the work surface will cause the solder and remaining piece of wire to leave the hole.

In most cases this will provide a clean hole in which to install properly a new component. If the hole is not large enough to insert a component lead, as little heating as possible should be applied to clean the hole properly.

INSTALLING NEW COMPONENT

Insert component and cut leads, leaving approximately 1/16 inch of lead to bend over and down on the land pattern.

Apply heat to the component lead and allow the solder to run down the lead to the hole and land pattern. Use just enough solder and heat to fill the hole and make a good electrical connection. If heat is applied equally to the component lead and the land pattern, the land pattern may be damaged before the component lead is hot enough to solder.

Wash the general area of repair, using a typewriter cleaning brush and IBM cleaning fluid (P/N 450608); wipe the area with a clean piece of cloth or tissue.

INSPECTING CARD AFTER REPAIR

Visually inspect resistors, inductors, and capacitors for signs of physical damage, discolored value bands, melted wax and other signs of card overheating.

Inspect for damaged printed circuit card contacts and leading edge of card.

Inspect for solder splashes and short circuited printed wiring.

Check for improper soldered components on the printed circuit board.

This procedure is partially destructive to the removed component because the leads are cut. Where the leads of the component must be preserved and the leads are bent over on the conductor side of the card, care must be taken to apply no force tending to separate the conductor from the board when straightening the leads. The leads can be straightened with the tip of the iron or long nose pliers (Figure 4-2). This operation usually requires the iron to remain on the card longer than in the first procedure, and should be used only when necessary. Once the leads are straightened, the component leads can be heated and pulled from the board.

A raised or delaminated conductor should be clipped off to a point where the bond is not broken and then treated as above for breaks.

In every case, before a repaired card can be considered repaired it must be tested dynamically in a machine or test instrument.

NOTE: Keep in mind that printed cards are delicate and, without proper precautions, can be easily damaged. It is best to use a low wattage iron to apply heat. Remove the iron from the joint quickly. Be careful not to apply excessive heat to any of the transistor leads, as this may ruin the transistor.

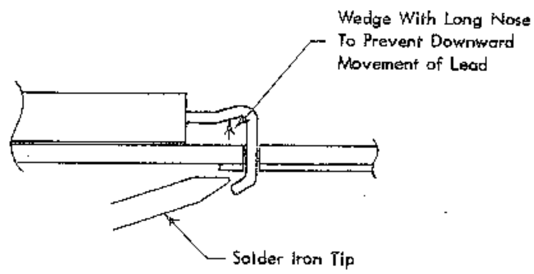


Figure 4.2-2. Component Removal

4.3 Tape Handling

The durability of IBM Magnetic Tape is so good that any limitation to successful use is virtually always caused by physical damage, by the presence of cumulative wear products, or by contaminating foreign particles such as dust. Consequently, proper care in tape handling must be exercised at all times to protect and extend the life of tape. 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 in the machine room.

Dust, dirt, or damage to the tape can drastically 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.

Since recorded information comes within .024 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. After continued use, however, normal wear products may be generated and collect on the tape. Foreign material may accumulate if proper handling procedures and precautions are not observed. Also, the tape may be inadvertently damaged.

Foreign material, wear products, a crease, or any condition which causes the tape to be lifted as little as .0005 inch from the read-write unit will cause a signal loss of 60%. Lifting the tape away from the read-write unit .001 inch will result in a signal loss of 87%, thus reducing the signal below the effective sensitivity of the read-write unit.

These errors will not be confined only to the area directly under a particle. They will also be produced in any adjacent area of tape which does not achieve physical contact as it travels over the read-write unit.

4.3.1 *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.

TAPE WRINKLE

Excessive torque on reel clutches will cause tape wrinkle.

Irregular Winding

Normally, tape will wind on the reel with some of the edges slightly protruding. These irregularities usually result from high-speed rewinding. The great speed at which tape moves during rewinding causes air to be trapped between adjacent layers of tape and produces the slightly irregular wind. Another contributing factor may be static electricity.

In itself, this condition will not interfere with the proper operation of tape. But it does require 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

There are two conditions which can give magnetic tape the appearance of having a wavy edge. One of these conditions 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 will tend 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 will not interfere with proper operation.

Another condition which can cause magnetic tape to exhibit a wavy 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 will cause 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 after continued use will prove unpredictable and generally unsatisfactory. The read errors encountered are usually of the random, nonrepetitive type.

Cupped Tape

The outside layers of tape will 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 will not interfere with the proper operation of the tape and will disappear after a few passes.

Reel Warpage

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

One of the common reasons that a reel wobbles or appears to be warped during use is that the reel may not be seated properly on the tape drive hub. The same effect is produced if the file protect ring is not inserted completely and 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.

4.3.2 Procedures and Precautions

The recommended conditions of temperature and relative humidity for operating and storing IBM Magnetic Tape are itemized below.

Recommended Operation and Storage Conditions

	RELATIVE HUMIDITY	TEMPERATURE
Acetate	40 – 60%	65 – 80°F
Mylar	0 – 100%	40 – 120°F

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

The conditions of prolonged storage of acetate tapes can be extended to those recommended for Mylar, provided tapes are hermetically sealed in moisture-proof plastic bags. Before re-use, tapes must be reconditioned to operating conditions for a length of time equal to the time they were stored (up to a maximum reconditioning period of 24 hours). Reels of tape should always be kept in their plastic containers when not in use.

Acetate can be temporarily stored outside the range of recommended conditions (up to four hours) without hermetic sealing. Before being reused, however, these tapes must be reconditioned to operating conditions for a length of time equal to the time they were temporarily stored.

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 which 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 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 button 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 drive 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. 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 tap 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 to the solvent should be avoided since it can result in damage to the tape.

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. Subsequent use of the reel and tape may be 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 in order 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 tap 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.

4.4 Transistors

4.4.1 Identification and Substitution

TRANSISTOR TYPE	PART NO.	TYPE	NOTES
12	340709	PNP	——
13	344892	PNP	1
14	345763	PNP	——
20	526795	PNP	——
21	526796	PNP	——
22	526898	PNP	4
23	526899	PNP	5
25	318322	PNP	2
33	318324	PNP	3
54	345749	NPN	——
63	344891	NPN	6
75	318323	NPN	7
83	318325	NPN	8

Notes:
1 Type 13 *can* be used for type 33 or 25
2 Type 25 *cannot* be used for type 33
3 Type 33 *can* be used for type 25
4 A Delco 2N174 *can* be used for type 22
5 A Philco 1229 *can* be used for type 23
6 Type 63 *can* be used for type 83 or 75
7 Type 75 *cannot* be used for type 83
8 Type 83 *can* be used for type 75

4.4.2 Voltage Level and Special Lines

Color Coding

Gray	+12v
Purple	−12v
Orange	+ 6v
Brown	− 6v

Voltage Levels

N	+ .4v	− .4v
P	− 5.6v	− 6.4v
W	0.0v	−48.0v
X	+10 v	−30.0v

Special Lines

Write Status Gate	+10.0v	0.0v
Reset Write Triggers	0.0v	−12.0v
Prolay Drive (1434)	+ 6.0v	− 6.0v
Prolay Power Driver	0.0v	− 7.5v
Echo Buses	+ 6.0v	− 6.0v
Read Bus Output	+ 4.0v	− 4.0v

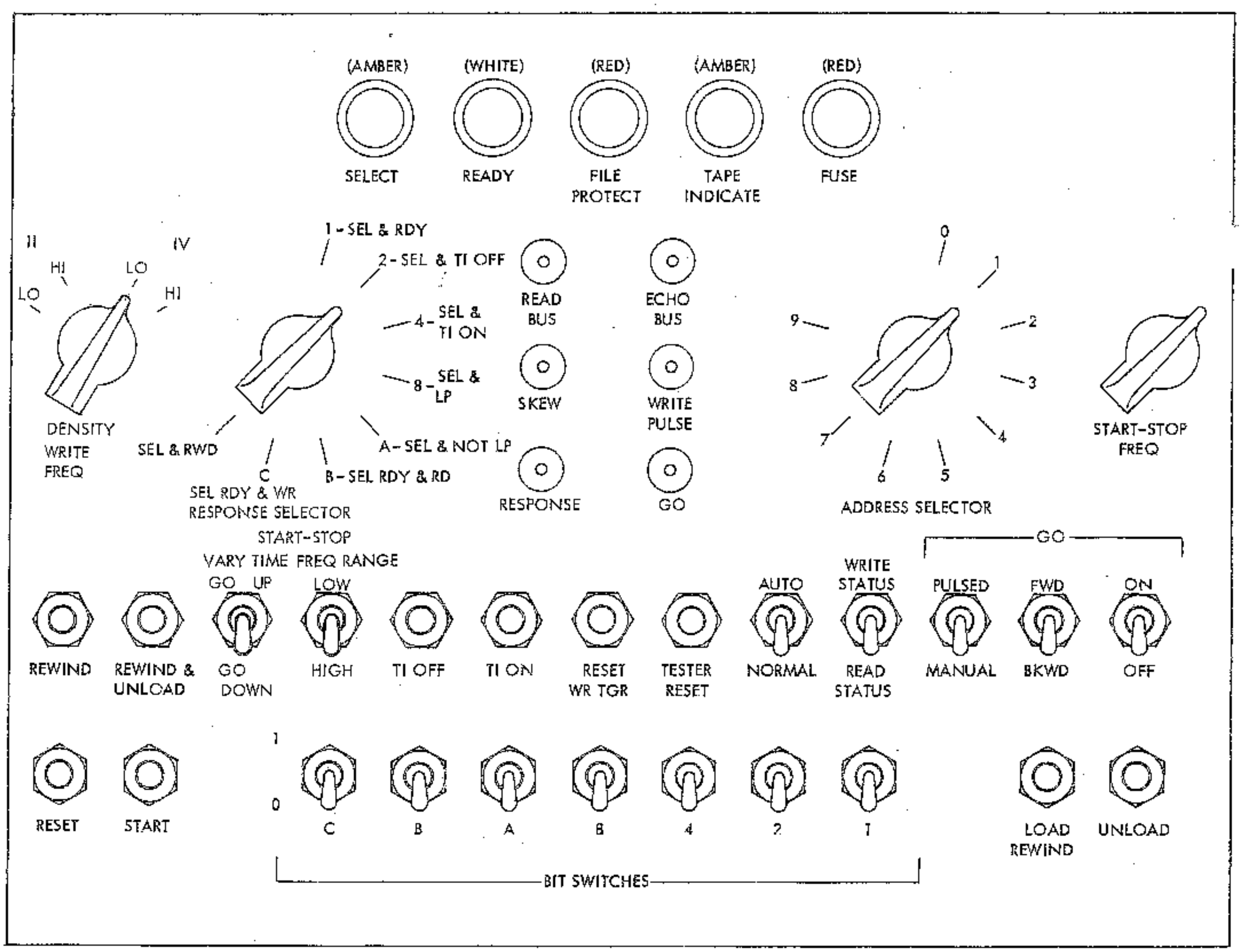


Figure 5-1. Switch Panel, 729 II and IV

Contents

5.1 729 II and IV Portable Tape Drive Field Tester

5.1.1 General

This tape drive tester (TDT) tests mechanical and electrical functions of the 729 II and IV (Figure 5-1). All signals to and from the tape unit are checked by the tester.

The tester is mounted in a carrying case approximately 16 inches long, 9 inches wide and 8 inches high. The switch panel is under a removable front cover. Prints of the tester circuitry are held by two clips inside the cover.

Circuitry of the field tester is located on ten transistor cards mounted in 8-card SMS sockets. Two external cables are used with the tester, an 8-foot signal cable terminated with low voltage AMP connectors, and an 8-foot control cable with Jones plug terminals. All power for the tester is supplied by the tape unit under test.

To service the components of the tester, remove the front tester switch panel by removing the six screws.

5.1.2 Indicating Lights

All the indicating lights on the tester (Figure 5-2) perform the same operations as those located on the tape unit.

Select Light. The select line is turned on when the tape drive and TDT have their address selector switch set to the same address.

Ready Light. This light is on when the tape drive is in a ready status. The tape drive is in a ready status when the start key is depressed and the tape drive is loaded, the door interlock is closed, and the drive is not in a load or rewind operation. Manual control is indicated when the ready light is off.

File Protect. This light is on when writing on the tape is to be suppressed. This condition is met by leaving the file protect ring out of the groove on the file reel. The light is also on: (a) during a load and rewind operation, and (b) going into, and in, an unload status.

Tape Indicator. The tape indicator is turned on by: (a) sensing the end-of-reel reflective spot while in write status, (b) by pushing the TI ON button on the tester. The tape indicator is turned off by: (a) depression of the TI OFF button on the tester, (b) depression of the unload key.

Fuse. This light should be on whenever an AC or DC circuit breaker is tripped in the tape unit.

5.1.3 Switches (Figure 5-1)

Address Select. This switch has ten positions (0-9), corresponding to the dial switch of the tape unit. If the tape unit address selector switch is set to the same address as the TDT address switch, the tape drive is selected by the TDT and the select light is turned on. This permits testing of all select lines to the tape unit.

Bit Switches. These seven switches determine whether ones or zeros are written in the corresponding tracks when the tape is moved in write status.

Go Forward-Backward. This switch sets either forward or backward motion of the tape when the go line is conditioned by the GO ON-OFF switch.

Response Selector. This rotary switch has two wafers. One wafer is used to select the various read buses. The common of this section is connected to the read bus hub. The other wafer is used to select the various response lines. The common of this section is connected to the response hub. The tape unit response lines that can be observed at this hub are: Select and ready, select and TI off, select and TI on, select and at load point, select and not at load point, select ready and read, select ready and write, select and rewind, and density.

Read-Write Status. This switch sets the status of the tape unit to either read or write. When set to write, it allows the multivibrator pulses to be observed at the write pulse hub. When set to read, it allows the preamplifier output of the selected track to be observed at the read bus hub.

Write Frequency. This switch provides dual density of 67 μs and 24 μs for the 729II and 24 μs and 16 μs for the 729IV.

Rewind. Depressing this key causes the tape to rewind if the tape unit is selected and ready and the auto-cycle normal switch is in normal.

Rewind and Unload. Depressing this key causes the tape unit to rewind to load point and unload. If the tape unit is at load point at the time the key is depressed, the tape unit will unload only.

TI ON. This switch causes the tape indicator to be turned on in the tape unit and the tape indicator light to be turned on in both the tape unit and the tester.

TI OFF. This switch turns off the tape indicator and lights when the auto-normal switch is in the normal position.

Reset Write Triggers. All seven write triggers are reset off by depression of this switch.

Pulsed-Manual. In the pulsed position, the go multivibrator controls the frequency of starting and stopping the tape. The desired frequency is set by the start-stop frequency dial and has a range of .25-13.5 milliseconds. In the manual position, the GO multivibrator is removed from the circuit. In this position tape is moved at a constant speed provided the GO ON-OFF switch is on.

Both pulsed and manual may be used for writing and reading.

Tester Reset. This switch resets the trigger in the tester which is turned on when TI or LP is sensed, depending on the setting of the forward-backward switch. The go line is gated by this trigger, and tape motion is not possible until it is reset.

Go Up/Go Down. This switch provides a choice of varying GO up or GO down time by means of the start-stop frequency potentiometer.

Hi-Lo. This switch provides two ranges of GO up or GO down time—LO range: 2-110 ms; HI range: 1-7 seconds.

Reset. This key resets the tape drive to manual control (except the tape indicator) and can stop any tape operation that has been started, with the exception of an unload operation.

Unload. This switch initiates an unload operation. It is inoperative unless the tape drive is in manual control. The tape indicator is reset by depression of this key.

5.1.4 Hubs (Figure 5-2)

Echo Bus. The write echo of all seven tracks can be observed at this hub.

Read Bus. The output of the preamplifier selected by the response-select switch can be observed at this hub.

Go. This is the output of the multivibrator. This hub is used for a scope sync when measuring start-stop time.

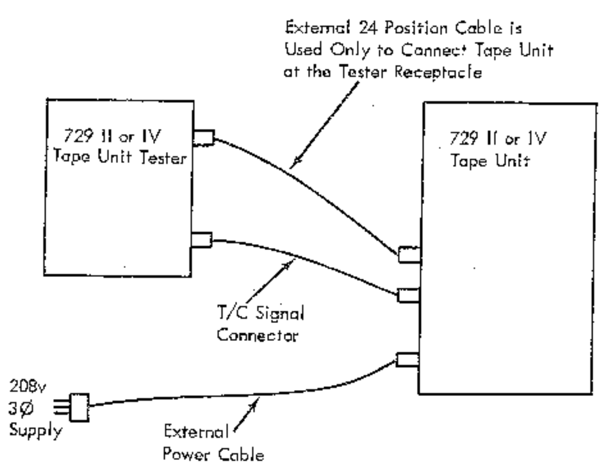


Figure 5-2. Tape Drive Tester Connections, 729 II and IV

Tape Unit Response. Logical lines from the tape drive, as specified by the response-select switch, may be observed here.

Skew Sync. The track 1 output of the read bus is brought here for convenience in syncing the scope when measuring skew.

Write Pulse. Write pulses as they are sent to the tape unit are available here. The read-write switch must be in write status.

5.1.5 Operation

Preliminary. To operate a tape drive from the TDT, connect the signal and control cables and turn on power in the tape unit. The tape should have a load point and an end-of-reel marker. For proper operation, a file protect ring should be in place. Press the start key on the tape drive and put the tape unit under external control. Select the tape drive by setting the address selector and the TDT to the same address. Turn off TI if it is on, and set the forward-backward switch to FWD.

Writing. To write, set the switches as shown in the operation chart. The ON-OFF switch is the last switch operated. If the tape indicator is not on, the tape moves forward and bits are written on those tracks whose bit switches are set to "1". Observe write pulses with the scope at the write pulse hub. Turning the GO ON-OFF switch off stops the writing operation.

Reading. To read a tape, set the read-write switch to read and the GO ON-OFF switch to ON. Tape moves forward in read status. The preamplifier output of the track selected by the response select switch can be observed with a scope at the read bus hub. Switching the GO ON-OFF to OFF stops the operation.

Auto-Cycle. The auto-cycle feature on the TDT may be used to check the following operations: end-of-reel (EOR) sensing, load-point sensing, high-speed rewind, vacuum switches, flapper valves, and associated circuitry. The function of the auto-cycle feature is to read or write the tape in a forward direction until an EOR reflective spot is sensed. The drive then rewinds the tape back to load point. Upon reaching the load point, the tape starts reading or writing again the cycle is repeated.

Start-Stop. Before operating the tape unit in a start-stop status, set the write frequency and write 1's on all tracks. To move tape in a forward direction, depress the following switches:

1. Pulsed-normal to pulsed.
2. FWD-BKWD to FWD.
3. GO on-off to ON.

To move tape backward, use the same procedure but put the FWD-BKWD switch in the BKWD position.

During start-stop operation, the GO line and read bus can be monitored at their respective hubs.

Tape Indicator. To test the correct operation of the tape indicator, place an EOT reflective spot a few feet from the LP reflective spot. The switches on the tester should be in the following positions:

1. Set write frequency.
2. Set write status.
3. Auto-normal to NORMAL.
4. GO FWD-BKWD to FWD.
5. On-off to ON.

Skew. The operation of the tester when checking skew can be divided into three sections: mechanical skew, write skew, and read skew. Switch settings for these checks are listed in Figure 5-3.

MECHANICAL SKEW	WRITE SKEW	READ SKEW
1. Set read status 2. FWD BKWD to FWD 3. GO on-off to OFF 4. Response select to the C track. (Mechanical skew can then be adjusted for coincidence of the 1 and C tracks.)	1. Set write status 2. Set write frequency	1. Set read status 2. Sync on the most lagging track 3. Use the response select switch to observe each track

Figure 5-3. Tester Switch Settings for Checking Skew

The following sequence of operation occurs during a cycling operation:

1. The tape, moving in a forward direction, senses the EOR reflective strip, and the tape indicator is turned on.
2. A line from the TI photo cell turns on a trigger in the TDT. This trigger's output, combined with the auto-cycle normal switch in auto-cycle status, causes the TI to be turned off and the tape drive to rewind.
3. The tape unit in rewind status causes "select and ready" to fall which resets the trigger in the TDT.
4. "Select and ready" comes up when the tape is rewound to load point and the tape moves forward. The cycle is then repeated.

By placing the EOR reflective spot a few feet from the load point, the cycle can be made very short and the load point and EOR photo cells and single shots can be checked. If the EOR reflective spot is placed farther back on the tape so the tape drive can just go into a high-speed rewind upon sensing the spot, and the load point is placed just before this area, then the operation of the vacuum system and associated switches can be observed at a frequent rate.

With a full reel of tape on the tape drive and the EOR spot at the end of the tape, the tape drive can be auto-cycled to check the rewinding of a full reel at high speed.

The TDT and the tape drive can be left to read or write and rewind for a period of time to check the reliability of a high-speed rewind.

The pulsed-normal switch may be set to pulsed and used in conjunction with the auto-cycle operation. A normal auto-cycle operation results, with the exception that the tape is started and stopped at the start-stop frequency.

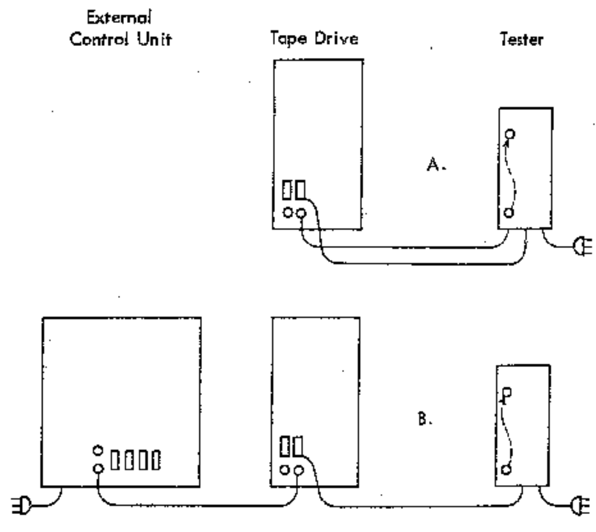


Figure 5-4. Tape Drive Tester Connections, 729 III

5.2 729 III Tape Drive Tester

5.2.1 *Power Connections*

There are three methods of connecting power when using the Tape Drive Tester, as shown in Figure 5-4.

1. The normal method; the TDT supplies power for both itself and the tape unit.
2. The TDT supplies its own power, but the external source supplies the power for the tape unit.
3. The external source supplies power for both the tape unit and TDT.

5.2.2 *Switches (Figure 5-5)*

Address Select. This switch has 11 positions (0 to 9), corresponding to the dial switch on the tape drive, and an OFF position. If the tape drive address selector switch is set to the same address as the TDT address switch, the tape drive is selected by the TDT and the select light is turned on. This permits testing of all select lines to the tape drive.

Bit Switches. These seven switches determine whether 1's or 0's are written in the corresponding tracks, when the tape is moved in write status.

Motion Control. This switch directs the output of the go-backward trigger (T_B) in the TDT to either the go line or the backward line in the tape drive unit.

Read-Write. This switch performs several functions. It sets the status of the tape drive to either read or write. When set to write, it allows the multivibrator to develop write pulses under control of the write frequency dial. When the read-write switch is set to read with the start-stop switch on, the multivibrator is under control of the start-stop frequency dial.

Response Select. This dial switch has six wafers. Two select the particular track to be observed at the read bus or echo bus hubs. A third wafer determines the logical line that can be observed at the tape unit response hub. These lines are: "select and rewind," "select and at LP," "select and TI on," "select and TI off," "select ready and read," and "select ready and write." The last three wafers are used for auto cycle.

729 III Read Bus. This switch selects the particular track to be observed at the read bus.

Rewind. Depressing this key causes the tape to rewind if the tape drive is selected and ready.

Start. Depressing this key turns on the go-backward trigger (T_B), to bring up either "go" or "backward." This also turns on the start neon.

Start-Stop. This switch is used only when the read-write switch is set to READ. Turning it on allows pulses, developed by the multivibrator (and gated by "select, ready and read"), to operate the go-backward trigger binarily. Therefore, if the motion control switch is set to GO, tape starts and stops at a frequency determined by the start-stop frequency dial. If the switch is set to FWD-BKWD, the prolays alternate.

Stop. Depressing this key turns off the go-backward trigger and thus brings down the go line, or the backward line, depending on the position of the motion control switch.

Start-Stop Frequency. This dial determines the frequency of the multivibrator over a range of about 7 to 20 ms when the read-write switch is set to read.

TI Set/Reset. This switch directly sets or resets the tape indicator trigger in the tape drive. When the tape indicator is on, neither "go" nor "backward" may be brought

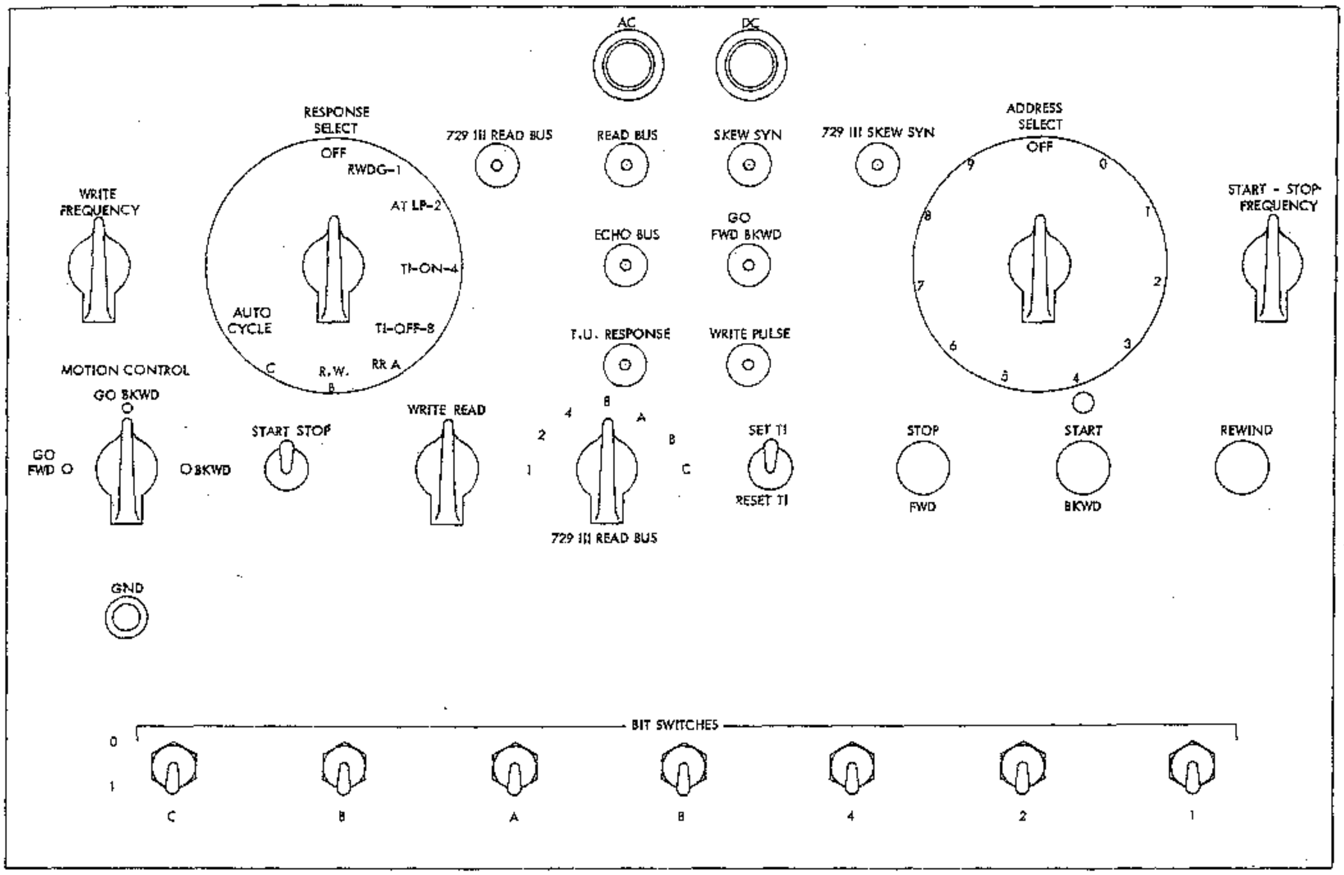


Figure 5-5. Tape Drive Tester Panel, 729 III

up by the tester. "Select and TI on" holds off the go-backward trigger. If TI is turned on while writing on tape, the tape is stopped.

Write Frequency. This dial determines the frequency of the write pulses initiated by the multivibrator over a range of about 7 to 80 microseconds. It should be set for a period of 16μs using a calibrated scope. The write pulse is 4 microseconds, determined by the write pulse (SS_e) single shot.

5.2.3 Hubs

Echo Bus. The write echo of the track selected by the response-select switch can be observed at this hub.

Read Bus Hubs. The output of the preamplifier selected by the response-select switch can be observed at each of these hubs.

Go/Fwd-Bkwd. This is the output of the go-backward trigger. This hub is used for a scope sync when measuring start-stop time or prolay transfer time. Go down time is variable.

TU Response. Logical lines from the tape drive, as specified by the response-select switch, may be observed here.

Skew Sync Hubs. The track 1 output of the read bus is brought to these hubs for convenience in syncing the scope when measuring skew.

Write Pulses. Write pulses are available here when the tape drive is in "select, ready, and write" status, and the go-backward trigger (T_B) is on.

5.2.4 Operation

PREPARATION

To operate a tape unit from the TDT, connect the signal and power cables and turn on power. Load the tape unit in the normal manner. The tape should have a load point and end-of-tape marker. Press the start key on the tape drive to put it under external control. Select the tape drive by setting the address selector switch of both the drive and the TDT to the same address. Set the start-stop switch to OFF, both the manual forward-reverse switch and TI switch to neutral, and the motion control switch to GO.

WRITING

To write, turn the read-write switch to write, set bit switches as desired, and push the start key. If the tape indicator is not on, the tape moves forward and bits are written on those tracks whose bit switches are set to "1". Observe write pulses with the scope at the write pulse hub and adjust the write frequency dial for a period of 16 microseconds between pulses. Echo pulses of the track selected by the response select switch can be observed at the echo pulse hub. The writing operation is stopped by pressing the stop key.

When the start key is depressed, a shift from the go-backward trigger turns on the "write trigger reset single shot" sending out a 100μs "reset write triggers" pulse. At the same time, write pulses (already being developed because the read-write switch is set to write) are gated to the tape drive. It is possible that the fall of the reset write trigger's pulse could coincide with the fall of a write pulse because there is no synchronization between them. In this case, some of the write triggers might be turned on and some turned off. These triggers would be flipping out of step with each other for the rest of that writing period. This condition could be observed at the write trigger neons when the writing is stopped. Usually, however, all triggers are either on or off. The write trigger neons indicate proper operation of the triggers.

Reading

To read a tape, set the read-write switch to read and press the start key. Tape moves forward in read status. The preamplifier output of the track selected by the response select switch can be observed with a scope at the read bus hub. The operation is stopped by depressing the stop key.

When in read status, the tape may be read in start-stop fashion if the start-stop switch is turned on. The start-stop frequency dial controls the frequency of starting and stopping the tape. Unless the manual switch is used, tape cannot be read when the tape indicator is on.

Auto-Cycle

The function of the auto-cycle feature is to write the tape in a forward direction until an EOT reflective spot is sensed. The drive then rewinds the tape back to load point. Upon reaching load point, the tape unit starts writing again and the cycle is repeated. The auto-cycle feature on the TDT may be used to check the following operations of the tape drive: end-of-tape (EOT) sensing, load-point sensing, high-speed rewind vacuum switches, and flapper valves.

To put the machine into auto-cycle operation, the response select switch is set to auto-cycle and the read-write switch is set to write. Pressing the start key then puts the tape drive into auto-cycle operation.

This operation is accomplished in the following manner. Upon sensing the EOT reflective spot, the signal "select and tape indicator on" goes through the response select switch and back to the tape drive as "rewind." This signal causes the tape to rewind. The signal "select unit rewinding" comes from the tape drive through the response select switch and returns to the tape drive as "reset tape indicator." The response select switch deconditions "select and tape indicator on" which normally turns off the go-backward trigger. When the tape is rewound to load point, the ready line comes up and the tape drive starts writing again.

By placing the EOT reflective spot a few feet from the load point, the cycle can be made very short and the load point and EOT photo cells and single shots can be checked. With a full reel of tape and the EOT spot at the end of the tape, the tape drive can be auto-cycled to check the rewinding of a full reel at high speed. The tester and tape drive can also be left to write and rewind for a period of time to check the reliability of high-speed rewind.

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