

IBM Customer Engineering Reference Manual

729 II, III, IV Magnetic Tape Units

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This manual, Form 223-6868-3, obsoletes Form 223-6868-2 and all earlier editions. All major maintenance information has been revised and now includes subjects covered in 700-7000 Customer Engineering Memorandums through 130 and Unit Record Machine CEM's through 62.

Sections that have been revised or added since the previous printing are indicated by an asterisk in the Contents.

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*Revised or added since previous printing.

Safety

Personal safety cannot be overemphasized. 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.

Observe caution whenever IBM Tape Developer Medium and Tape Transport Cleaner, P/N 517960, is used; be familiar with CEM 1203-76, or GP General CEM 24.

If the tape unit is placed in a high-speed rewind operation without a reel on the left side, the metal latch ring can fly off. When checking high-speed rewind circuitry, it is essential that a reel always be on the left side of the tape unit (with the hub tightened).

SCHEDULED MAINTENANCE ROUTINE CHART

| CODE | UNIT or ROUTINE | FREQ | OPERATION | OBSERVE | PAGE | | | | | | | | | | | | | | | | | | |
|-------------|-------------------------|------------|--|--|-------------------|--------|------------|------------|------|------|------------|------|------|-------------|------|---|------------|------|------|------------|------|------|----|
| 0 | ROUTINE 0 | 4 | Scope start-stop time | Waveforms and timings | 32, 33 | | | | | | | | | | | | | | | | | | |
| | | | Lubricate armature and arm pivot shafts with Aeroshell 14. Lubricate nylon idler pivot shaft with IBM 4 | Replace defective parts. Do not lubricate prolay dust seals | 30 | | | | | | | | | | | | | | | | | | |
| 0 | FILTERS ROUTINE 1 | 13 | Visually check filters; replace as required | Blower motors for proper operation | | | | | | | | | | | | | | | | | | | |
| | | | Use tape tester to move tape continuously | Tape operation in vacuum columns (sluggish operation may indicate powder leakage from magnetic clutch). Check tape break circuit and high-speed rewind operation | 41, 42, 45, 53 | | | | | | | | | | | | | | | | | | |
| 2 | ROUTINE 2 | | Clean base if required | Capstan motors and high-speed rewind idlers for binds. Vacuum switches for broken or cracked straps and pitted points. Tape cleaner blade for damage. Belts for wear and tension. Capstan motor mounts and front bearings for play | 37 | | | | | | | | | | | | | | | | | | |
| 9 | MISC LUBRICATE | | IBM 6 - Capstan shaft and motor bearings, head assembly felt oil pads, and pivot points. IBM 17 - Vacuum column cover latches | No lubricant should be introduced into the vacuum column area | 44 | | | | | | | | | | | | | | | | | | |
| 3 | ROUTINE 3 | | Check H shield for binds and cocking | Position with respect to gaps | 25 | | | | | | | | | | | | | | | | | | |
| | | | Check magnetic clutch brushes | Wear and arcing | 42 | | | | | | | | | | | | | | | | | | |
| | | | Check for write feed-through | With no tape movement (disconnect capstan motors) write 1's in all tracks. At the read bus there must be less than the following peak to peak voltage present: 0.40 | 33 | | | | | | | | | | | | | | | | | | |
| 8 | POWER SUPPLY | 26 | Check voltage levels and ripple at specified points | <table border="0"> <tr> <td>Voltage</td> <td>Ripple</td> <td>Test Point</td> </tr> <tr> <td>- 6 ± 0.24</td> <td>0.48</td> <td>F31K</td> </tr> <tr> <td>+ 6 ± 0.24</td> <td>0.48</td> <td>F31L</td> </tr> <tr> <td>- 7.5 ± 1.5</td> <td>3.30</td> <td>*</td> </tr> <tr> <td>-12 ± 0.48</td> <td>0.96</td> <td>F31M</td> </tr> <tr> <td>+12 ± 0.48</td> <td>0.96</td> <td>F31Q</td> </tr> </table> <p>* Power transistor panel 6-9</p> | Voltage | Ripple | Test Point | - 6 ± 0.24 | 0.48 | F31K | + 6 ± 0.24 | 0.48 | F31L | - 7.5 ± 1.5 | 3.30 | * | -12 ± 0.48 | 0.96 | F31M | +12 ± 0.48 | 0.96 | F31Q | 48 |
| Voltage | Ripple | Test Point | | | | | | | | | | | | | | | | | | | | | |
| - 6 ± 0.24 | 0.48 | F31K | | | | | | | | | | | | | | | | | | | | | |
| + 6 ± 0.24 | 0.48 | F31L | | | | | | | | | | | | | | | | | | | | | |
| - 7.5 ± 1.5 | 3.30 | * | | | | | | | | | | | | | | | | | | | | | |
| -12 ± 0.48 | 0.96 | F31M | | | | | | | | | | | | | | | | | | | | | |
| +12 ± 0.48 | 0.96 | F31Q | | | | | | | | | | | | | | | | | | | | | |

Scheduled Maintenance

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.

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.

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 the Scheduled Maintenance Routine Chart. During normal scheduled maintenance, perform only the operations listed on the chart for that scheduled maintenance period. Details on adjustments, serv-

ice checks, and removal and replacement are on the pages listed in the index column of the chart.

Electronic Circuits

Diagnostic programs, marginal checking, and pulse checking are the three basic tools used in scheduled maintenance of electronic circuits; all 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.

Mechanical Units

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

Scheduled Maintenance Routine Chart

Read the preceding sections before doing scheduled maintenance. Observe all safety practices.

Diagnosis

Approach to Trouble Diagnosis

Each troubleshooting problem must be approached individually. However, there are basic rules that help in locating troubles:

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 the Service Aids section.

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

| 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 1. Inter-record Gap and Creep Charts

Diagnostic Programs

Diagnostic programs are an important tool in scheduled maintenance. They indicate whether 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 system in which they are used. 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 complete description of the diagnostic available at each installation.

729 III Diagnostic Programs

5TU04B, Tape Motion Test

This diagnostic is used with the IBM 767 Data Synchronizer to measure the inter-record gaps. (See Figure 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. co line up continuously between two writes; no delay while writing.
2. co line down for about 1.5 ms; minimum delay while writing.
3. co line down for varying time (between 1.5 to 7.5 ms); variable delay while writing.
4. co 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 are typed out.

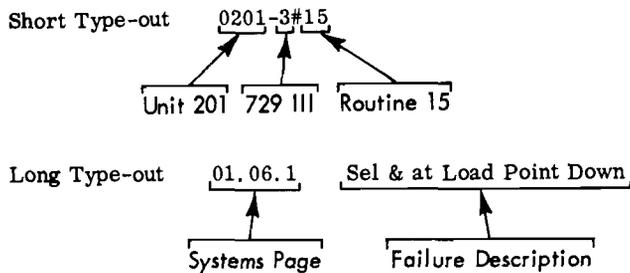
The next section of the test measures the inter-record gap while operating the tape unit with the co line down for 400 ms prior to each write operation. The time to cross 50 groups of inter-record gaps is measured, and the average, minimum, and range are computed. The results are typed out. The delay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

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 occurs 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 before 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. Because 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.

5TUH1A, Tape Interchangeability Test

This test checks for read and write errors by generating a multirecord 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.

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 the

tape gap is out of specifications. For more exact information, use diagnostic 5TU04B.

Diagnostic 5TUT2A is made up of a series of cupels that 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.

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.

729 II and IV Diagnostic Programs for 7090

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.

9T53, Tape Multiple Channel Data Flow Test

The tape multiple 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.

9T55B, 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 four sections.

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

Section II—Inter-record Gap Timings: A series of record groups is written with the co line condition between records held at varying controlled up and down levels for set timings. These conditions are:

1. co line down for approximately 10 ms between write calls.

2. co line down a variable length of time, stepping from 0.98 ms to 5.01 ms.

3. co 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 ms to 2.5 ms. After all record groups are read, the lowest, average, and range from lowest to highest gap time for each type of co 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 ms 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 1. In these cases, the creep summation print-out will occur immediately.

Section IV—Graph Print-Out: The graph print-out is obtained by depressing key 35 when setting up 9IOC. This graph is a plot of acceptable record gaps (6.0 ms to 8.2 ms) vertically, against co line down time (1 ms to 4 seconds) horizontally. An ideal print-out is a straight line at approximately the 7.0 ms to 7.5 ms gap ordinate. The tape unit needs adjustment if:

1. The print-out of the gaps is above 8.2 ms or below 6.0 ms before the graph is printed.

2. The gaps are predominantly high (above 7.5 ms) or low (below 7 ms).

3. Results are scattered with no definite pattern.

4. A count five indication is shown by a slump in the graph as the down time reaches 0.1 seconds and above.

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; the probable area of failure is indicated. This test uses only tape unit 2 on each channel and tests any number of channels up through eight. Channels are first tested singly, then concurrently on all channels called.

9T57, Diagnostic Recorder Program

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

9TR03, Tape Reliability Test

This program tests the writing and reading of varying length records in either binary or BCD coding. After each write pass, the program automatically reads ten times the records that have been written. The write pass and the ten read passes make up one complete pass. 9TR03 uses the standard 9IOC control; sense switch 5 controls the amount of tape written.

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.

Multiple Sync Random Test 8468

This diagnostic tests up to nine tape units on each channel. The number of tape units 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 and 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.

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.

7T01 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.

7T02 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.

7T03 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 μ s.
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 operations.
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 one word, and when backspacing over a variable length record. The amount of creep during a backspace write operation is measured when writing one-word records and also when writing 100-word records.

7T04 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.

7T05 Tape Synchronizer Reliability Test

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

7T07 Tape Search and Generation Program

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

Condensed Logic

This section contains simplified logic diagrams for electronic operations of the 729 II, III, and IV, and test information for direct troubleshooting (Figures 2 through 10). 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—applies 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 applies only to the 729 II and IV; the other similar information applies 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 applies to all three models. If a complete circuit pertains to the 729 II and IV, it is designated by an asterisk (*) and a note.

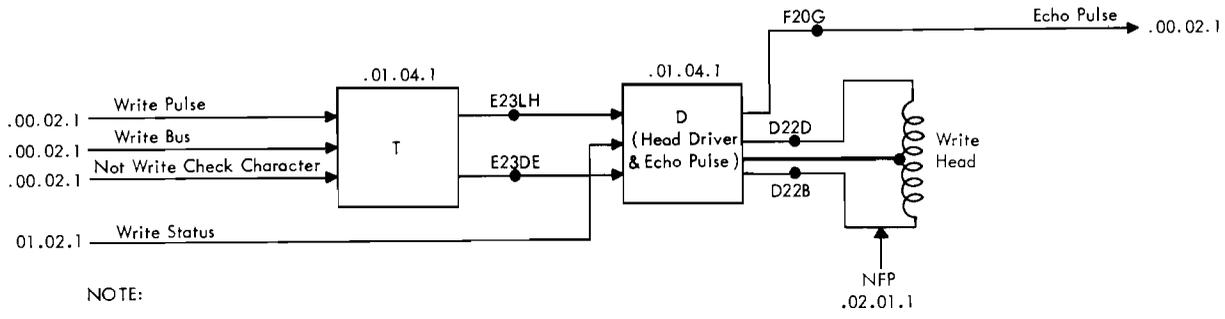


Figure 2. Write Amplifier, 729 II and IV, 01.04.01

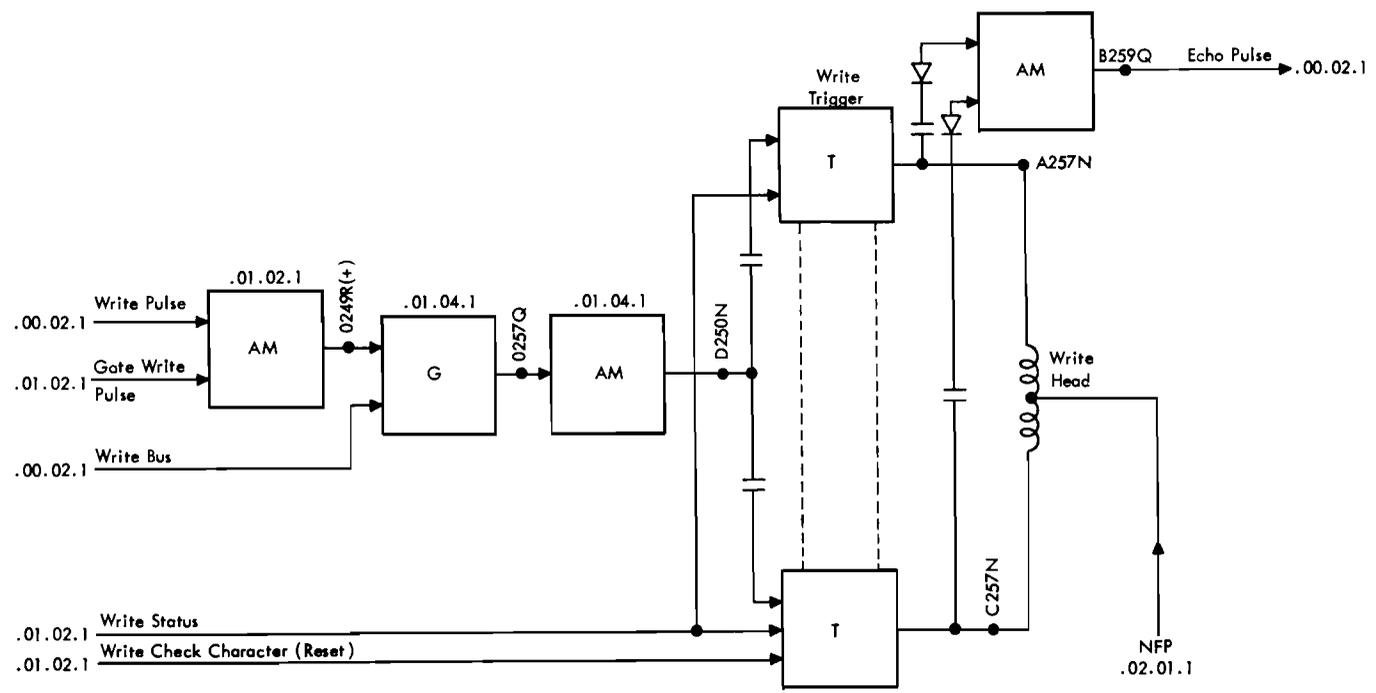


Figure 3. Write Amplifier, 729 III, 01.04.01

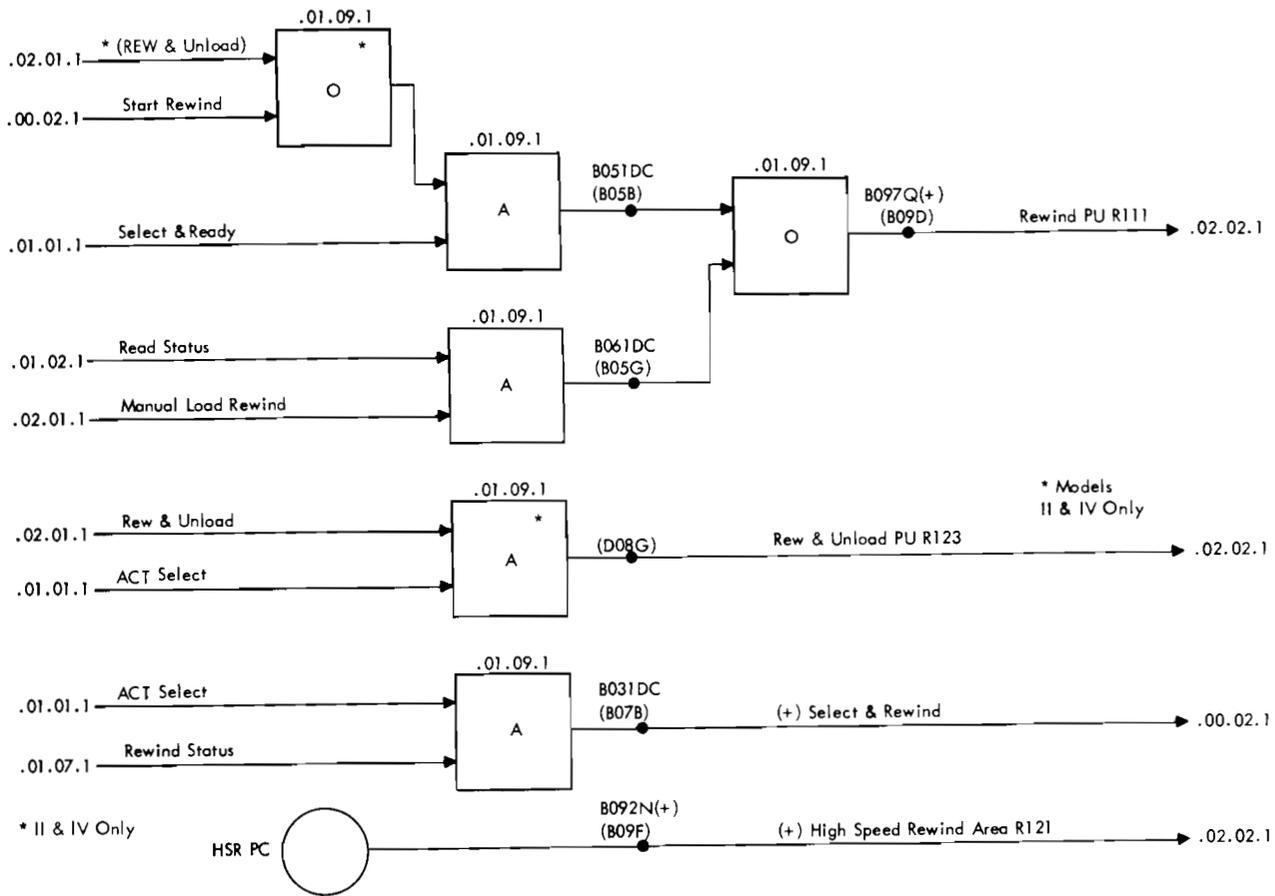


Figure 4. Rewind, 01.09.1

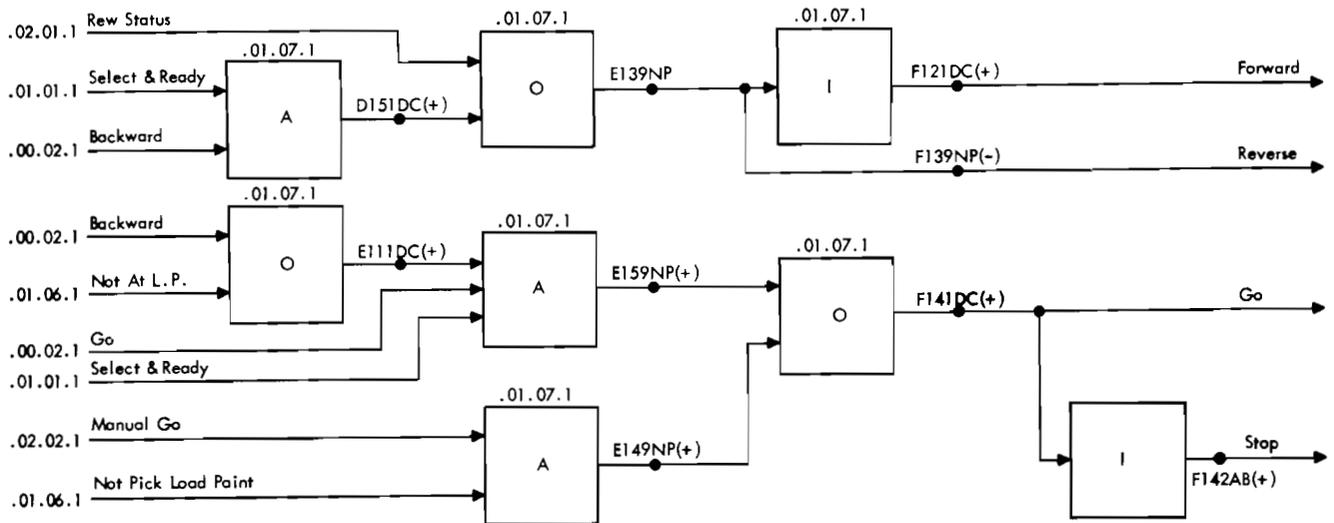


Figure 5. Start, Stop, Reverse Control, 01.07.01

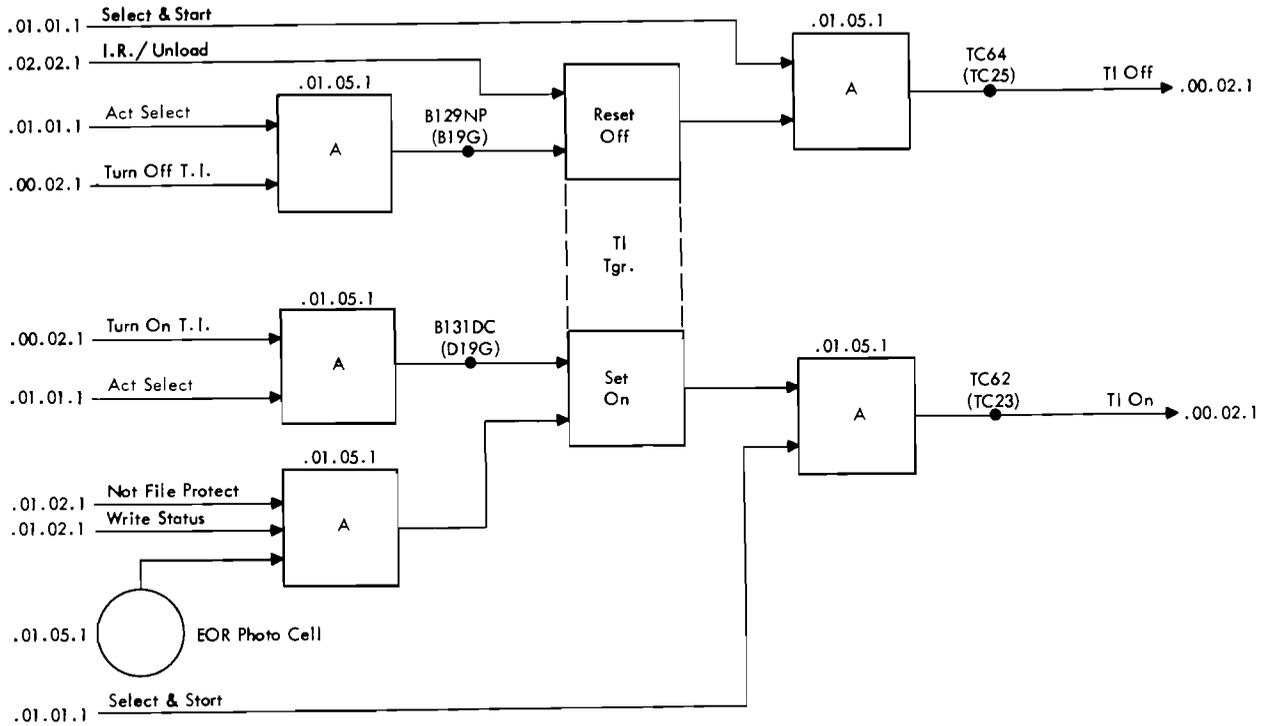


Figure 6. Tape Indicate, 01.05.01

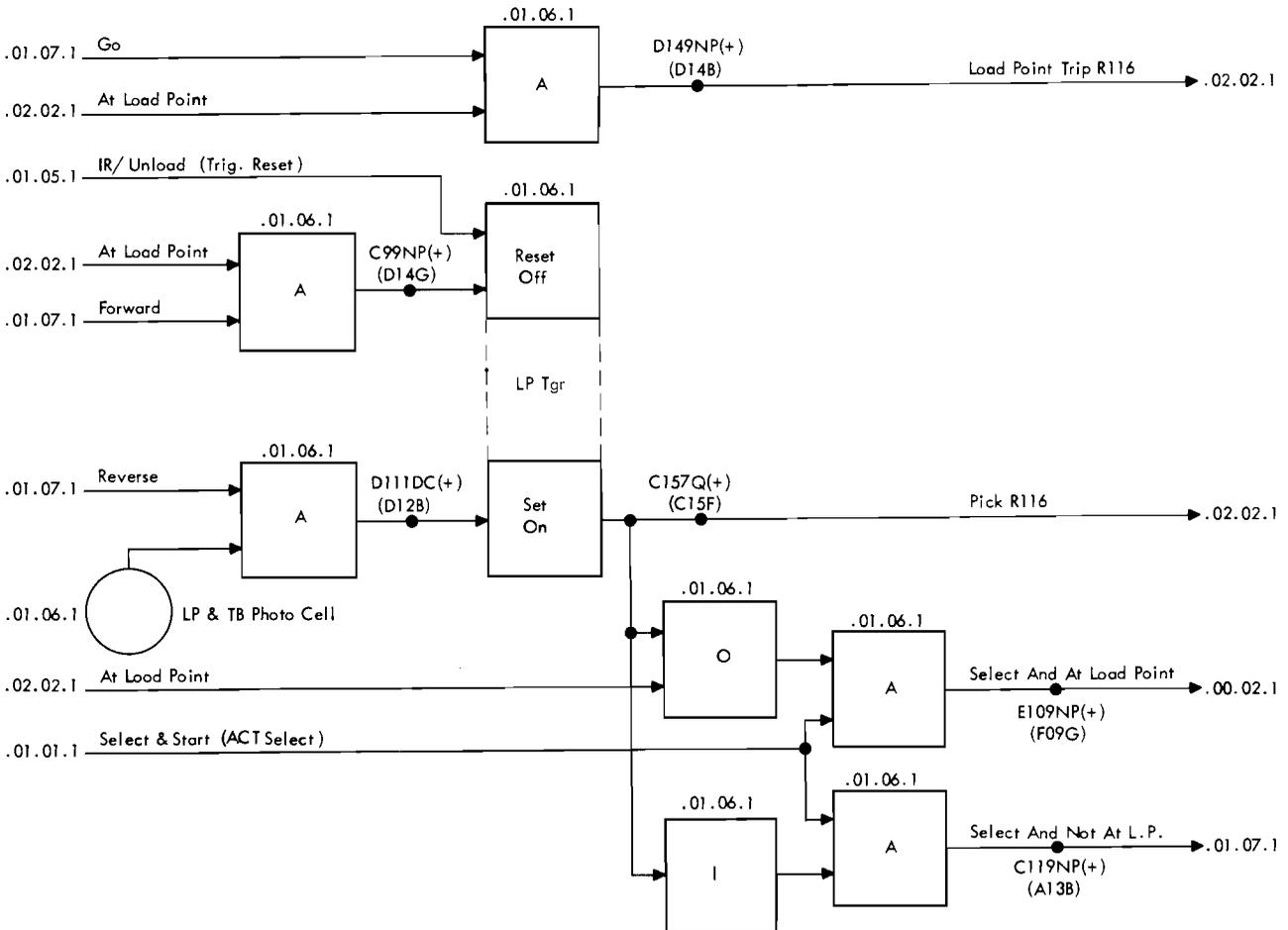


Figure 7. Load Point, 01.06.01

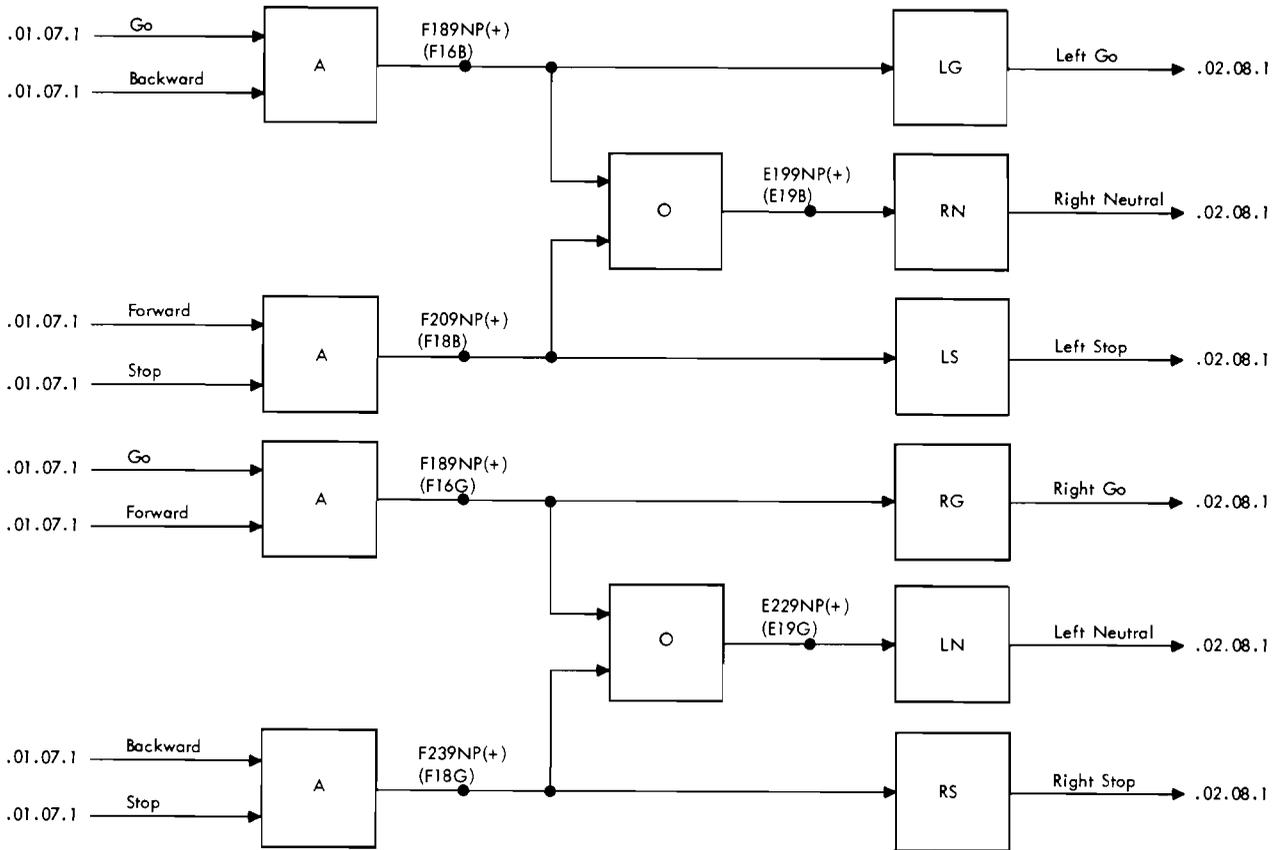


Figure 8. Prolay Drive Logic, 01.03.01

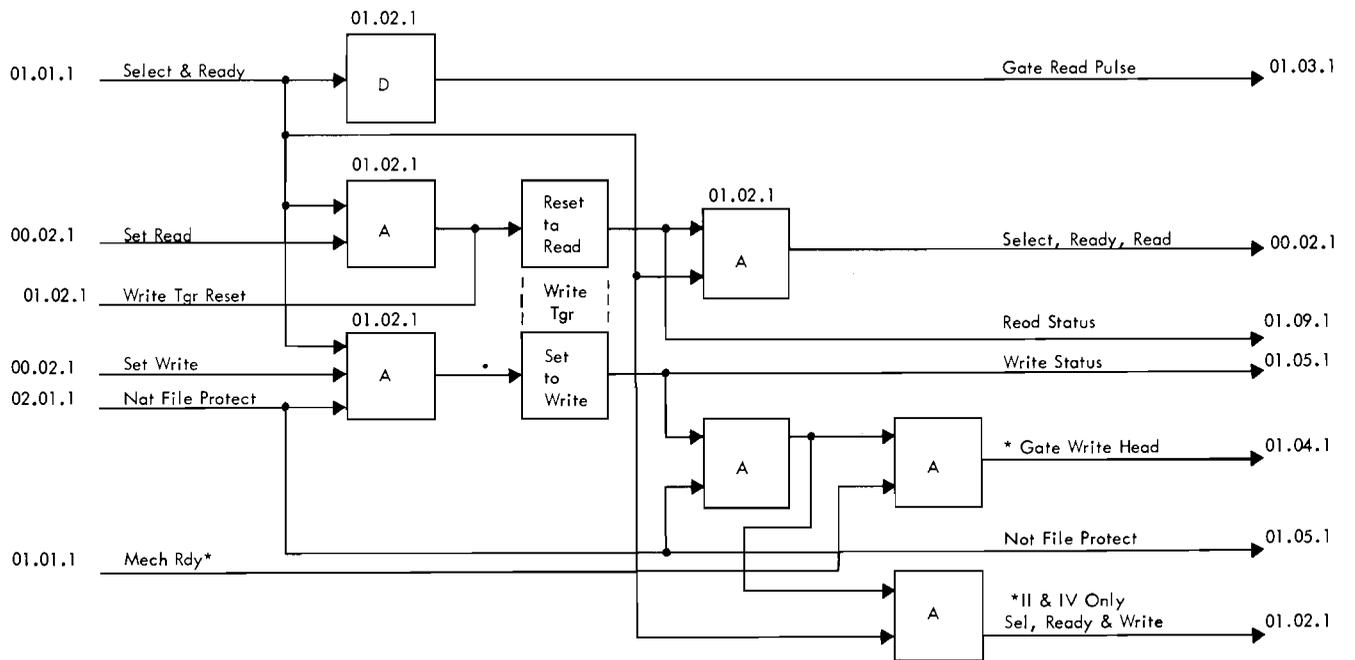


Figure 9. Read-Write Status, 01.02.01

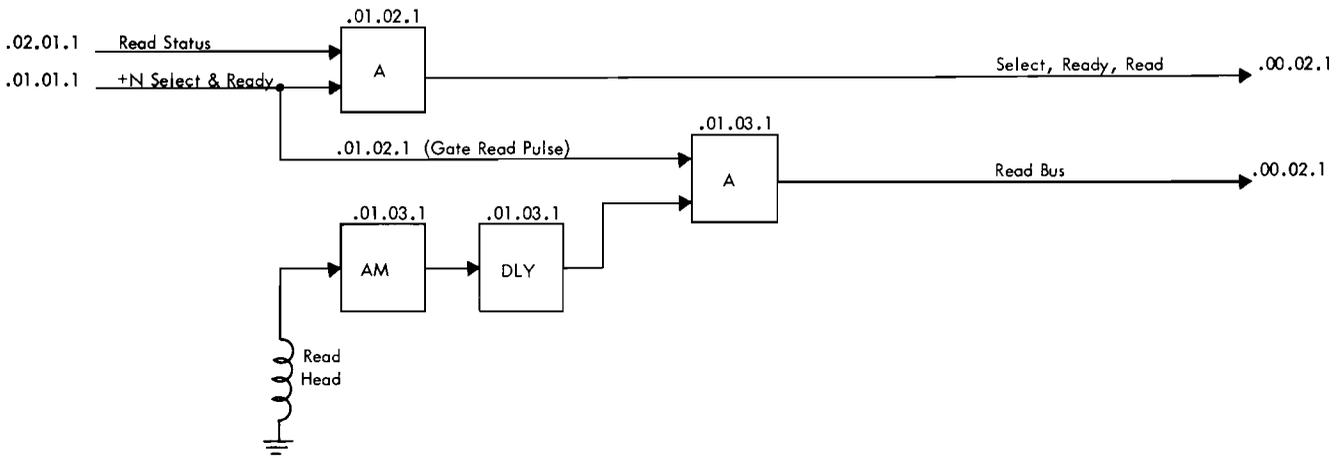
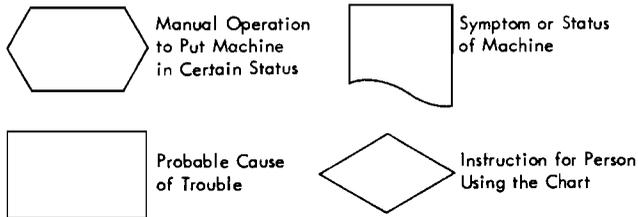


Figure 10. Read Logic, 01.03.01

Symptom and Sequence Charts

Symptom charts (Figures 11 and 12) may be used to trace cause and effect when troubleshooting. When the symptom charts are used with the sequence charts (Figures 13 through 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.



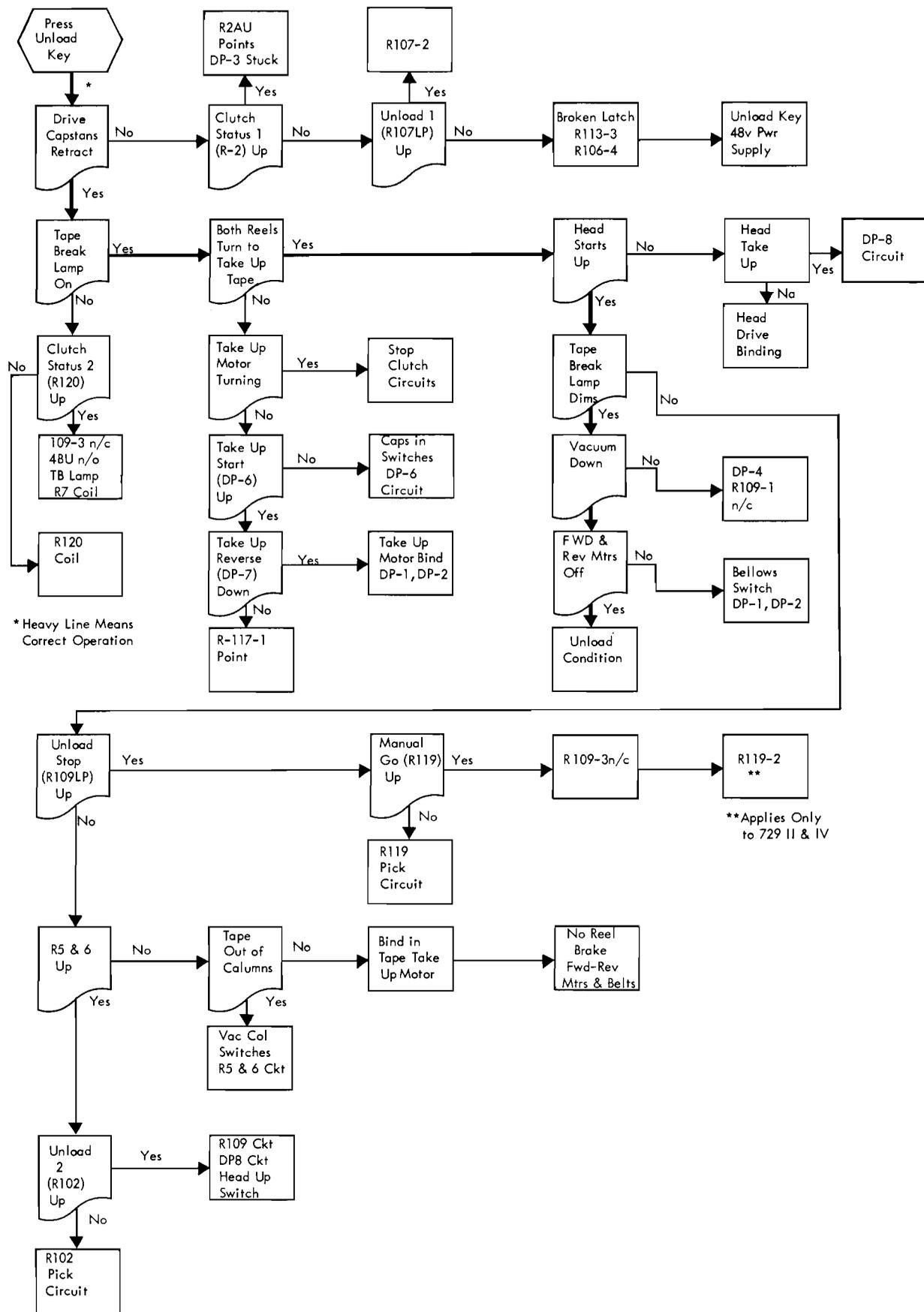
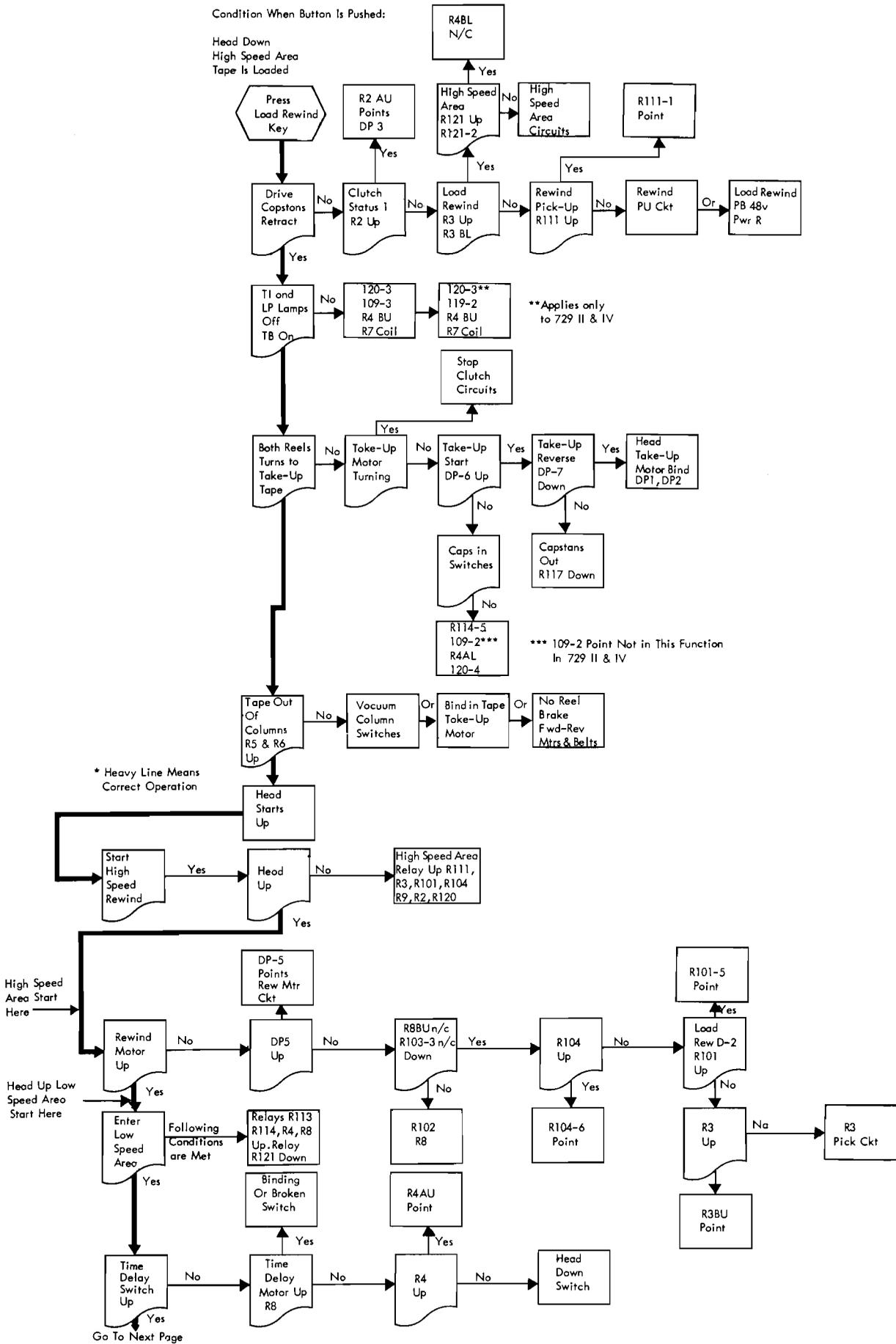


Figure 11. Unload Symptom Chart

Condition When Button Is Pushed:

Head Down
High Speed Area
Tape Is Loaded



16 Figure 12A. Rewind Symptom Chart

From Preceding Page

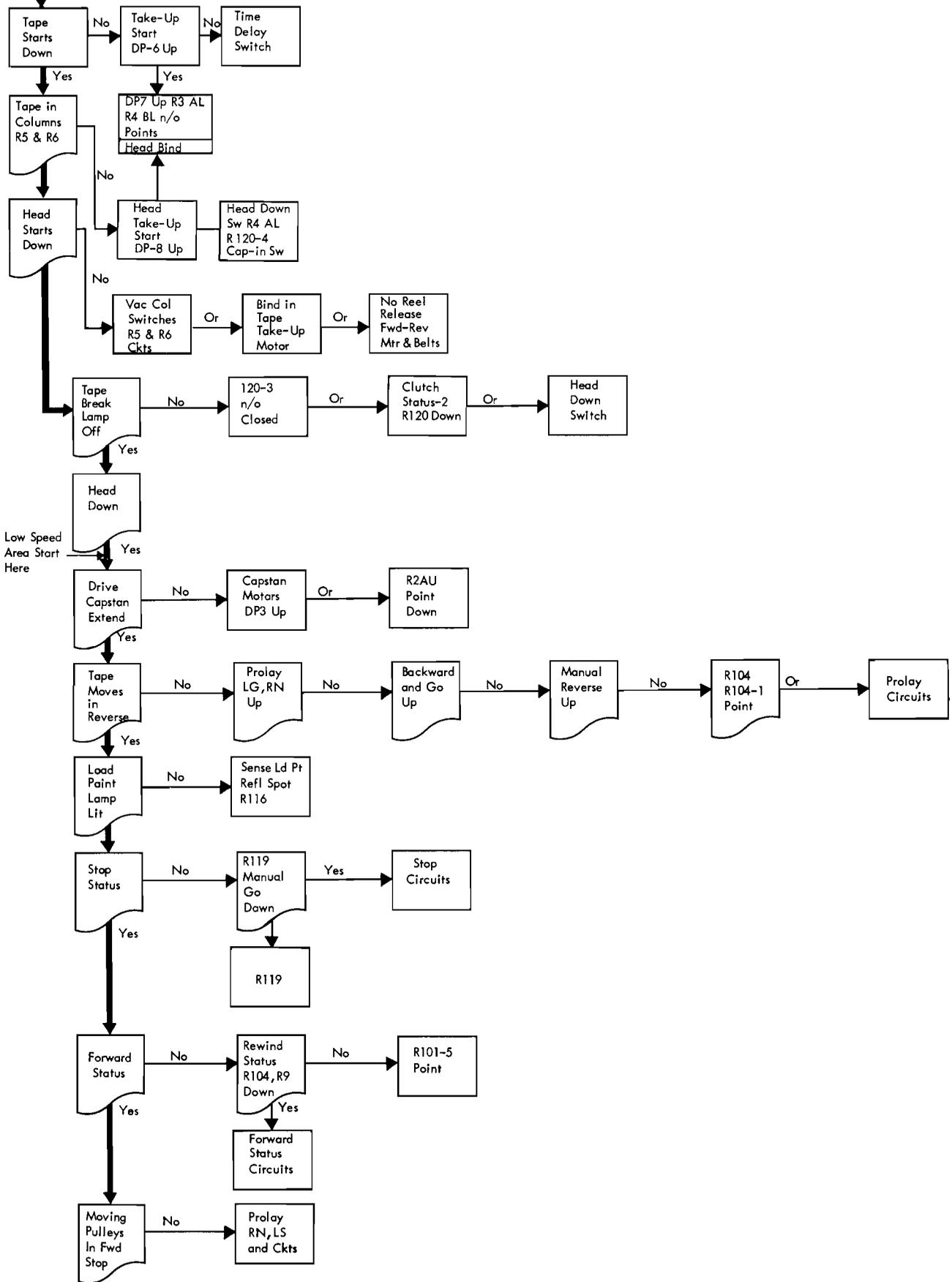
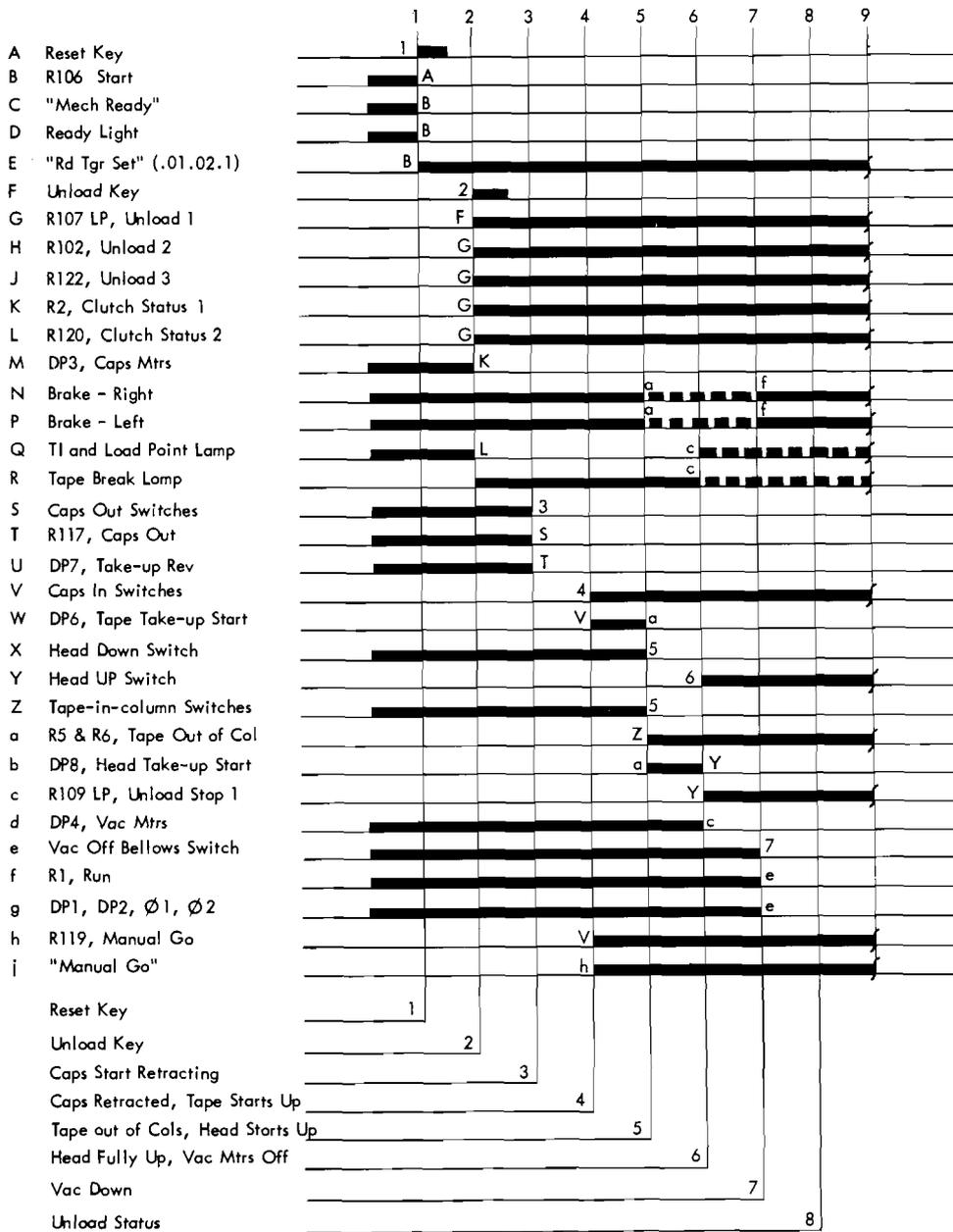


Figure 12B. Rewind Symptom Chart



----- = 1/2 Current R110 is up throughout sequence

Figure 13. Manual Unload Sequence Chart

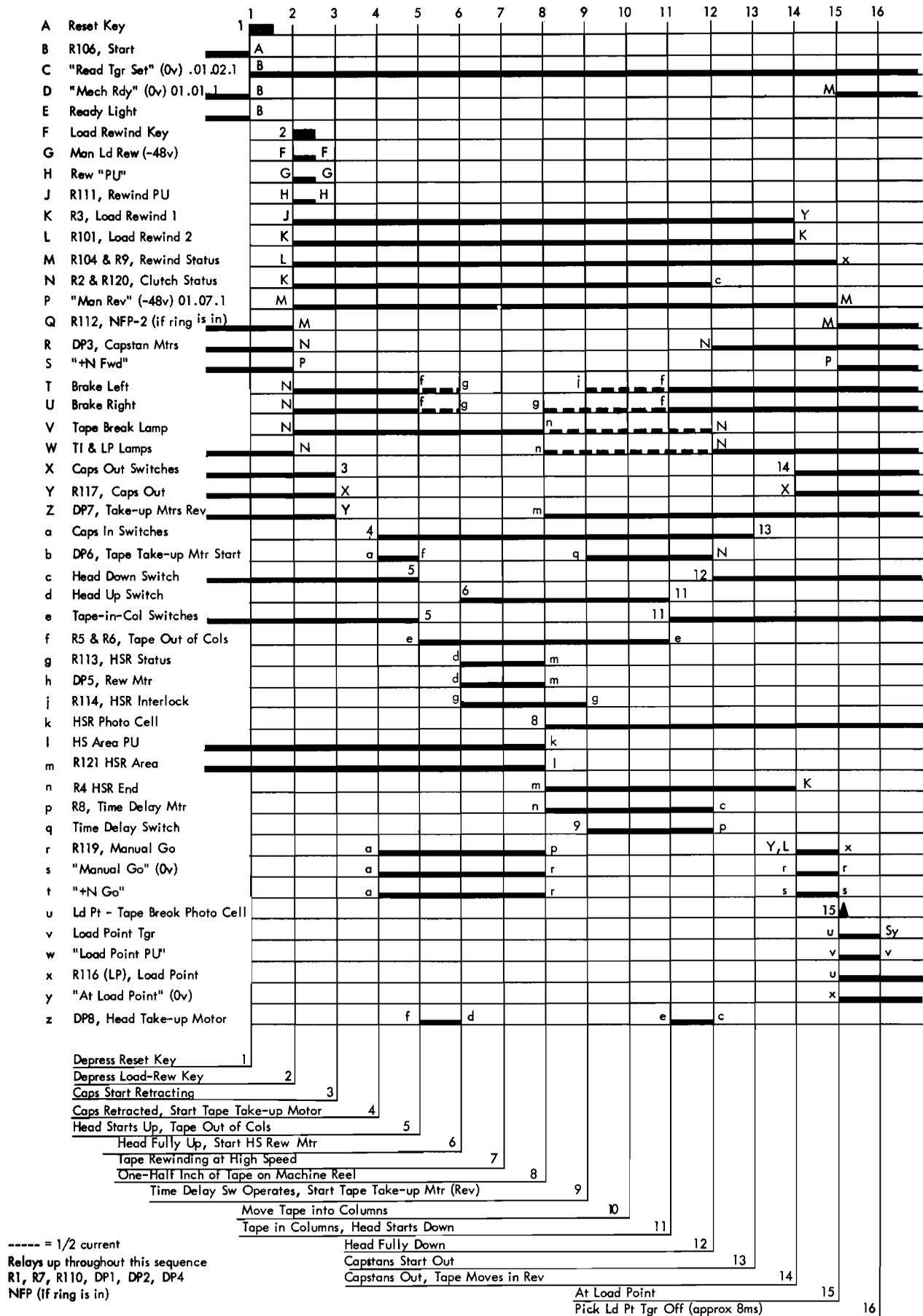


Figure 14. High-Speed Load Rewind

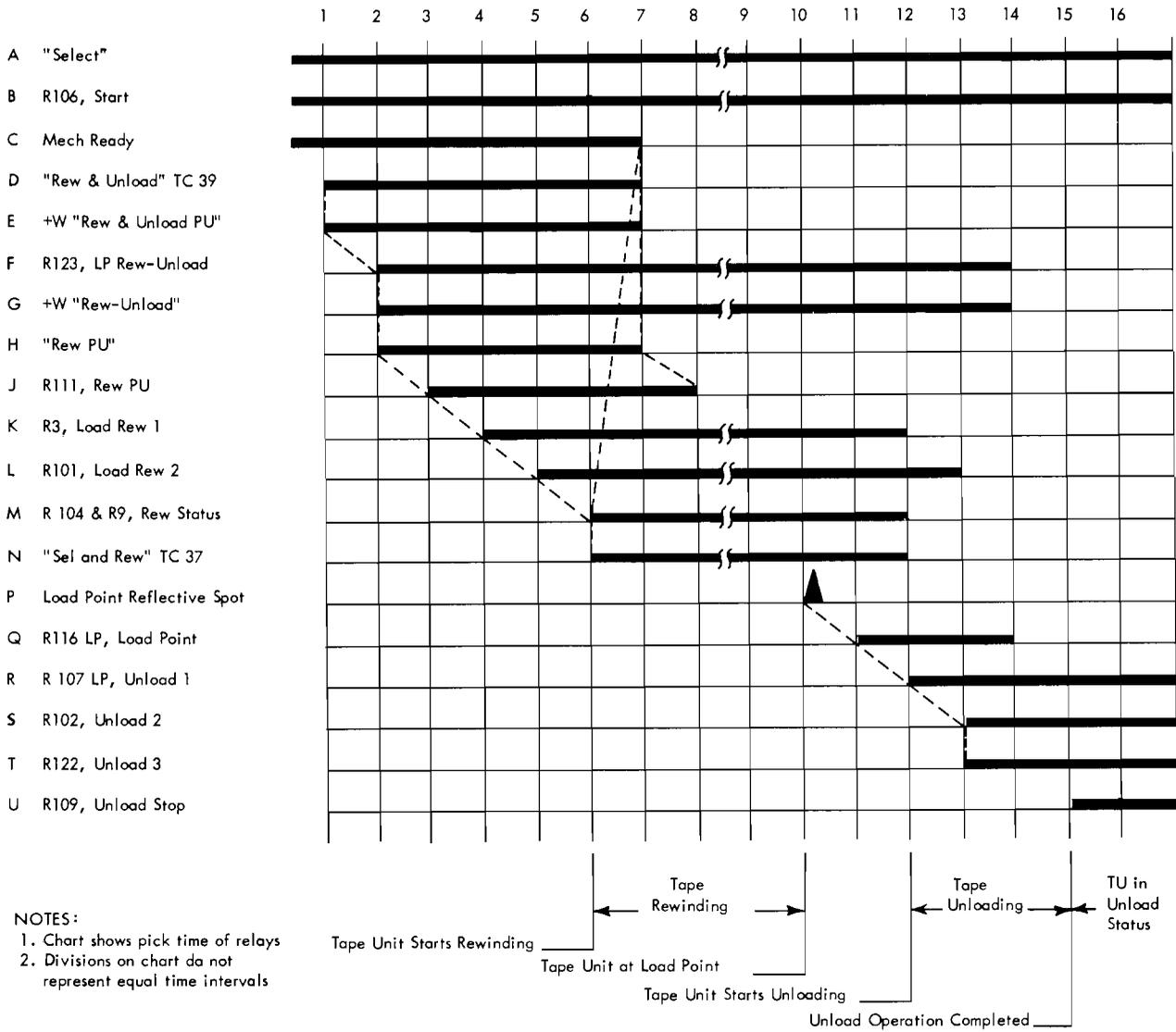
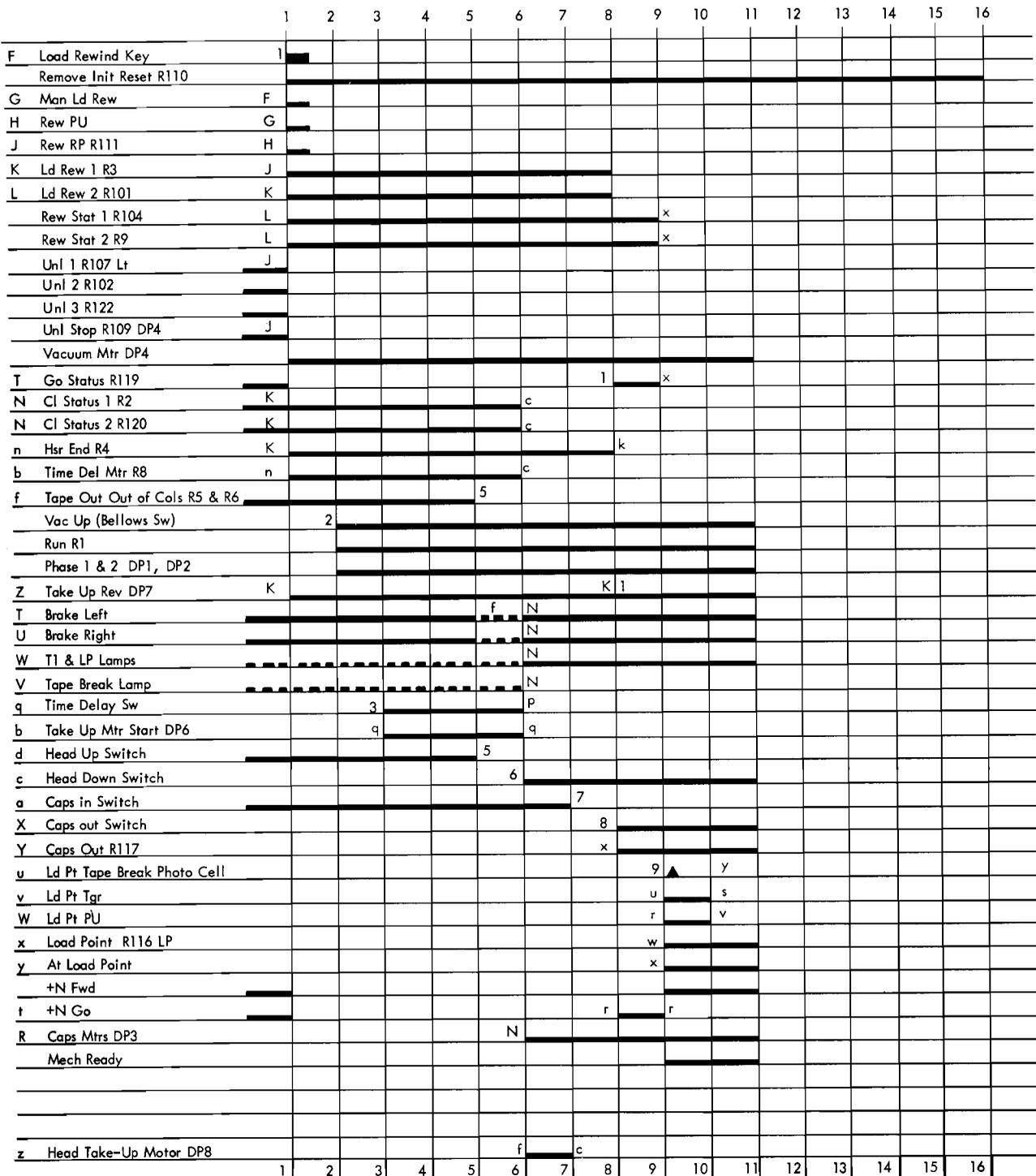


Figure 15. Rewind and Unload, 729 II and 729 IV Only



- 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 Coils-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 on at LD Pt

*----=1/2 Current
 Relays up throughout
 this sequence
 R7 R110

Figure 16. Low-Speed Rewind Sequence Chart

Servicing Procedures

SERVICING PROCEDURE CHART

| Functional Unit | Item Description | Service Checks | Adjustment | Removals/ Replacement | Waveforms/ Levels |
|---|---|----------------|------------|--------------------------|----------------------|
| Head Assembly | Read-Write Head | 22 | 22 | 22 | - |
| | H Shield Feed-Through | 25 | - | 25 | - |
| | Skew | - | 25 | - | - |
| | Write Current | 26 | 26 | - | - |
| | Split Guide Assembly | 27 | 27 | - | 27 |
| | Tape Cleaner Blades | 27 | 27 | 27 | - |
| | Photosensing | 28 | 28 | 28 | - |
| | High-Speed Rewind Lamp | 29 | 29 | 29 | - |
| | Rewind Idlers | 29 | - | 29 | - |
| | Preamplifiers | 30 | 30 | 30 | 30 |
| | Tape Movement | Prolays | 30 | - | - |
| Proloy Servicing | | 30 | 31 | 35 | 33 |
| Short Inter-record Gap at Low Go Down Times | | 37 | - | - | - |
| Stop Capstans | | 37 | - | - | - |
| Drive Capstans and Motors | | 37 | 38 | 38 | - |
| Front Door Assembly | | 39 | 39 | 39 | - |
| Operator's Panel Signal Lamps | | 41 | - | 41 | - |
| Vacuum System | Vacuum Columns | 41 | 41 | - | - |
| | Vacuum Column Switches | 41 | - | - | - |
| Reel Drive | Clutch Assemblies and High-Speed Rewind | 42 | 42 | 43 | - |
| | Jack Shaft Assembly | 44 | 44 | - | - |
| | High-Speed Rewind | 45 | 45 | - | - |
| Base | Motors | 45 | 45 | - | - |
| | Relays | 46 | 46 | - | - |
| | File Protect | 46 | 46 | - | - |
| | Circuit Breakers and Thermols | 47 | 47 | - | - |
| | Filters | 47 | - | 47 | - |
| | Power Supplies | 48 | 49 | - | - |

Head Assembly (Figure 17)

VISUAL INSPECTION AND OPERATIONAL CHECK

Figure 18 shows the basic differences between the head assemblies for the IBM 729 II, 729 III, and 729 IV Magnetic Tape Units.

Inspect the head for uneven wear, scratches, nicks, and oxide build-up. 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 tape unit in a write operation. This output should be 15 to 30 millivolts, peak-to-peak, with each pulse width less than 20 μ s. Pulse symmetry of all seven pulses must be similar, and amplitude difference must not exceed $\pm 5\%$.

CLEANING

Clean the tape unit transport mechanism at least once every 8 hours or after every ten full reel passes, whichever occurs first.

Cleaning materials required are: typewriter brush, clean lint-free cloth, and IBM Tape Developer Medium and Tape Transport Cleaner, P/N 517960. Do not use Vythene IBM Cleaning Fluid, P/N 450608.

CAUTION

When cleaning the transport area, do not allow the tape transport cleaner to come into contact with the magnetic tape.

The cleaning fluid should never be in contact with the user's skin. To facilitate cleaning, wrap the cleaning cloth around the handle of the typewriter brush and

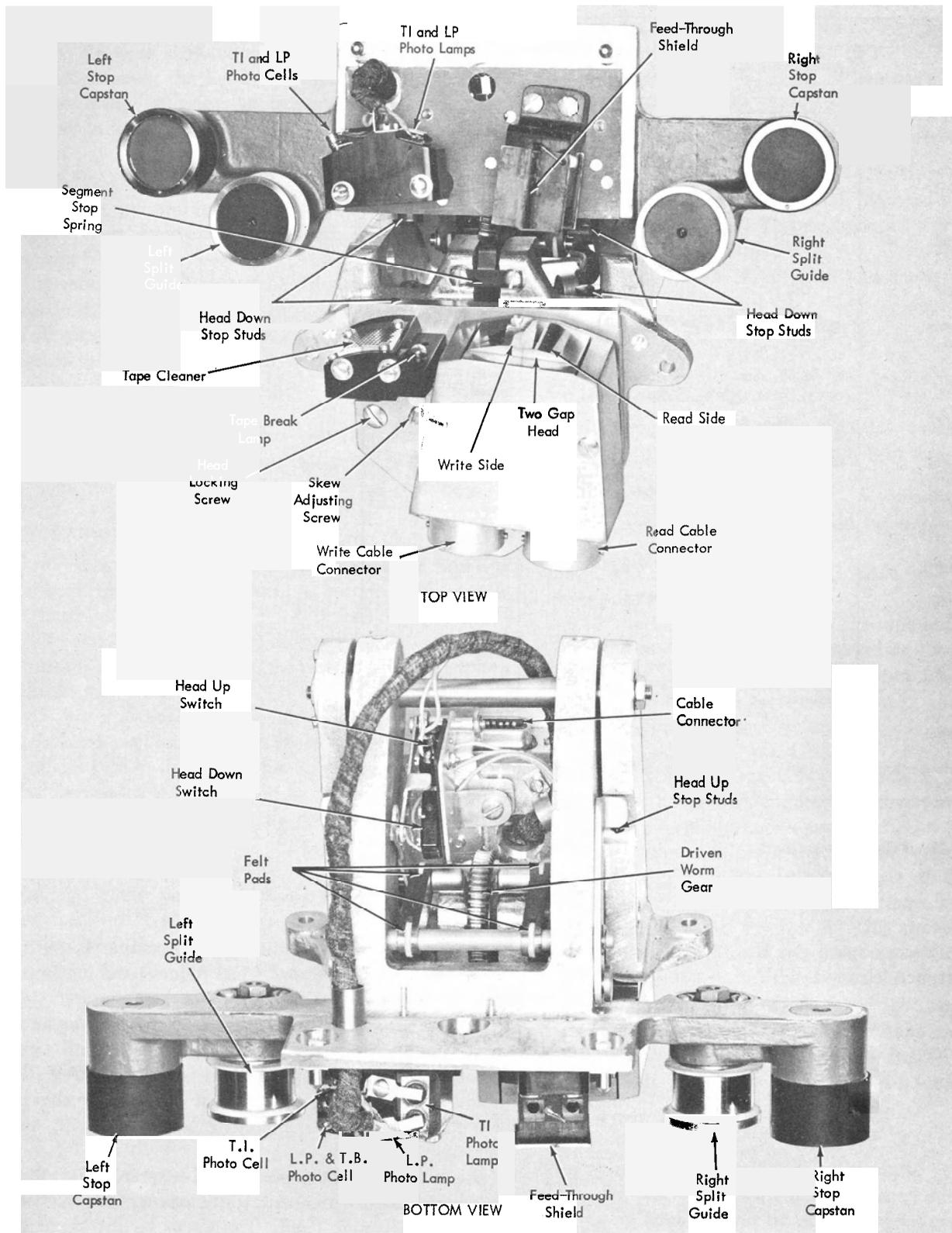
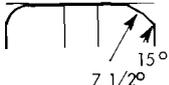
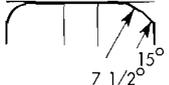
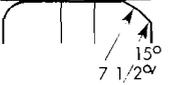


Figure 17. Head Assembly, Top and Bottom Views

| 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) | 70ma | 60ma | 70ma |
| 10. Output | 15-30mv | 15-30mv | 15-30mv |
| 11. Tape Speed | 75 ips | 112.5 ips | 112.5 ips |
| 12. Recording Density | 200bpi (15kc) 555.5 bpi (41.7 kc) | 555.5bpi (62.5kc) | 200bpi (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 pcs. .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 18. Head Comparison Chart

apply the cleaner sparingly. Use this procedure on all parts that are cleaned with the transport cleaner.

DANGER

Observe caution whenever the transport cleaner, P/N 517960, is used; be familiar with CEM 1203-76, or GP General CEM 24.

LUBRICATION

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

Use IBM 6 lubricant on all pivot points.

ADJUSTMENT, 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" ± .10" shim between the gear segment and stop spring, open the assembly to its full open position. Now, set 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 shim and replace 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.

Before a skew adjustment is made, the head locking screw must be loosened to remove slack in the skew adjusting screw. After the adjustment is made, tighten

the head locking screw until it seats against the lower casting and all the slack is removed from the adjusting screw. Recheck skew adjustment for proper tolerance after tightening the head locking screw.

The complete skew adjustment procedure is described in the Skew section.

REMOVAL, HEAD ASSEMBLY

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

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

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 the Skew section for skew adjustment procedure.

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 cleaning the head with tape cleaner. In cleaning the head, always wipe it in the

direction of tape movement. Make sure the head is clean before performing skew and preamplifier adjustments. Amplitude can increase 10 to 40 per cent as oxide builds up on the head. Whenever the head is cleaned, also clean the 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).

H Shield Feed-Through

Feed-through is signal pick-up on the read head from the write tracks when the tape unit is in write status.

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 unit 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:
 $729 \text{ II} \leq 0.6\text{v peak to peak}$
 $729 \text{ III and IV} \leq 0.4\text{v peak to peak}$

6. When a tape unit is adjusted for minimum feed-through, excessive temporary write checks may occur because of the position of the H shield. If the center of the H shield is located to the left of the center laminations of the head (Figure 19), extra bits can be introduced into τAU register B. This shows up as a bit pickup and gives a compare error, causing the temporary write check. To correct this condition the H shield should be moved to the right, so that the center of the H shield is to the right of the center head laminations. This must be done even though minimum feed-through is sacrificed.

CLEANING

The underside of the H feed-through shield should be cleaned with a typewriter brush.

Skew

Check skew adjustments every 13 weeks. Skew must be adjusted whenever any parts are changed in the transport area. These parts include nylon idlers, forked arms, and prolays.

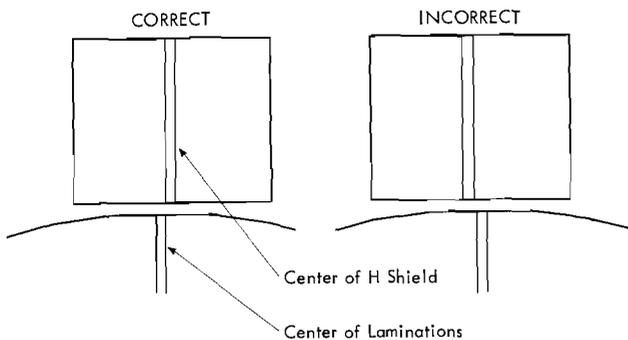


Figure 19. H Shield Adjustment

OPERATIONAL CHECK AND ADJUSTMENT

An operational or adjustment check is required when the combined skew of a tape unit and its associated final amplifiers, reading or writing all bits, exceeds $1.5 \mu\text{s}$ on a 729 III or 729 IV or $2.3 \mu\text{s}$ on a 729 II. Before starting the check:

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. To display small amounts of skew more easily, use the vertical position control to pass one oscilloscope trace through the other.
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:
 - a. 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.
 - b. System time required to set skew is minimized or eliminated.

ADJUSTMENT, 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 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.

ADJUSTMENT, 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 $1.5 \mu\text{s}$ (of the leading track) on 729 III and 729 IV units, and within $2.3 \mu\text{s}$ on 729 II units.

ADJUSTMENT, WRITE SKEW

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

1. Mount a reel of tape known to give good performance.

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 because 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 (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.

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 20.

ADJUSTMENT

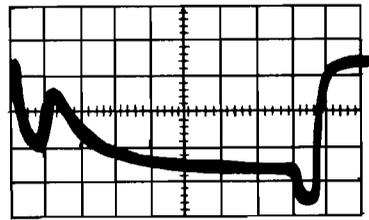
There must be 70ma (+1.2, -9.9ma), steady state, passing through one of the write coils of each track when writing continuous 1's. The checking procedure is:

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, using 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.



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

Figure 20. Write Current Waveform

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 the Read-Write Head section. Skew must be checked and readjusted if the head is moved.

6. Repeat steps 3, 4, and 5 for the remaining head driver circuits.

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 3/4 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.

Tape Cleaner Blades (Figure 17)

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

Use a lint-free cloth moistened with IBM Tape Developer Medium and Tape Transport Cleaner, P/N 517960. Do not rub hard on the cleaner block.

CAUTION

Do not allow the tape transport cleaner to come in contact with the magnetic tape.

REPLACEMENT

Replace the tape cleaner blade if it is damaged; four screws 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 $7\frac{1}{4}^\circ$. 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 than $7\frac{1}{4}^\circ$ 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 $1\frac{1}{2}$ 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 21) has been wiped completely clean, indicating a tape approach of just over 7° .

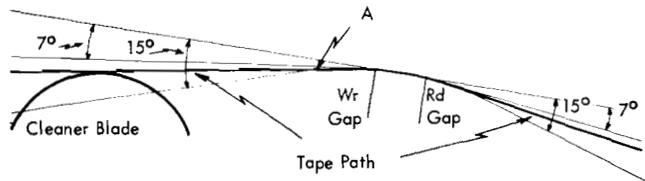


Figure 21. Tape Cleaner Wrap Angle

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 27). The time from *co*) will depend on whether the angle is less than $7\frac{1}{4}^\circ$ (largest exposure is here) or more than $7\frac{1}{4}^\circ$ (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 *co*. A large wrap angle will produce a dip about 12 ms from *co*.

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 *co*.

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.

Photosensing (Figure 17)

VISUAL INSPECTION AND OPERATIONAL CHECK

Visually inspect the high-speed rewind, tape break, tape indicator, and load point lamps for equal bril-

*Trademark of General Electric Company.

liance. 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.

On some tape units, the photosensing cable assembly is being worn by the plastic dust shield mounted on the 729 base. This is done when the head is raised up and the cable assembly is pinched between the head and dust shield. This condition can be corrected by insuring that the cable clamp positions the cable out of the way.

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.

ADJUSTMENT

Adjust P2 (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 $6.0 \text{ v} \pm 0.2 \text{ v}$. Set P1 (50-ohm potentiometer) for $4.0 \text{ v} (+1.0 \text{ v}, -0.5 \text{ v})$ 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 column) is $5.5 \text{ v} (+1, -.5 \text{ v})$.

ADJUSTMENT, HIGH-SPEED REWIND LAMP

Failure of the high-speed rewind lamp will result if the lamp image misses the photocell. Remove the high-speed rewind lamp cover (P/N 528343) to adjust the lamp. After adjusting the lamp and replacing the cover, check the photocell to make sure the cover did not move the lamp.

The high-speed rewind lamp socket, P/N 517846, does not hold the lamp rigidly. Route the lamp's wires through the mounting bracket, P/N 527357, to prevent the lamp from being moved by the wires.

Black electrical tape should be placed on the back side of the finger guard to prevent light rays from passing through the guard and activating the photocell. The activated photocell will prevent the tape unit from entering high-speed rewind status.

REMOVAL, HIGH-SPEED REWIND LAMP

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

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.

Rewind Idlers

VISUAL INSPECTION AND OPERATIONAL CHECK

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

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

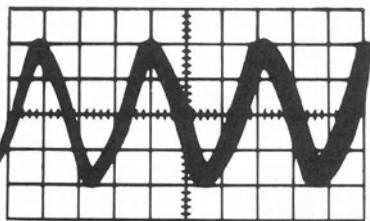
1. Remove the capstan motor. See "Drive Capstans and Motors."
2. Remove two mounting screws.
3. Remove the rewind idler.

Preamplifiers

VISUAL INSPECTION AND OPERATIONAL CHECK

Check preamplifier gain on the read bus while writing on an average tape (10 to 100 passes in high density). See Figure 22. Set gain, if necessary, to an average 8.8v peak-to-peak. Use a $\frac{3}{4}$ " Allen wrench to adjust the gain potentiometer on each of the seven amplifier cards.

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



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

Figure 22. Read Preamplifier Waveforms

CLEANING

Clean the read-write head and tape transport mechanism before making adjustments.

ADJUSTMENT

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

Periodically check the preamplifier outputs using the Standard Signal Level Tape, P/N 461103, while writing in high density (10 to 100 passes). Move as little tape as possible while making the adjustment. A check using the standard signal level tape is a means of testing the condition of the average tape used for normal gain adjustment.

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 not recognized by the final amplifiers.

REMOVAL AND REPLACEMENT

Amplifier cards are located at positions mo7 and are accessible through the preamplifier door. Cards are easily removed by pulling outward.

New cards are inserted into their receptacles as required. Different preamplifier cards are used in the

729 II and 729 IV. *These cards must not be interchanged.*

Part numbers are:

729 II: P/N 370100 and 370099

729 IV: P/N 371925 and 371926

Tape Movement

Prolay Specifications

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 23. 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. All prolay information now refers to these shimmed prolays.

1. Drive and stop gaps should not be less than .003".
2. The start envelope must not drop below 95% full amplitude after 7 ms (729 II) or 5 ms (729 III and IV). See Figures 24 and 25.
3. There should be no "glitching" of either forward or backward start envelope.
4. Maximum noise burst following the stop envelope should not exceed five pulse cycles (ten peaks).

Prolay Servicing

CLEANING AND INSPECTION

Check frequently for dirty or burned nylon idlers; buff glazed drive capstans. Prolays should be inspected and cleaned every four to six weeks (three-shift operation) or if significant changes occur in inter-record gap

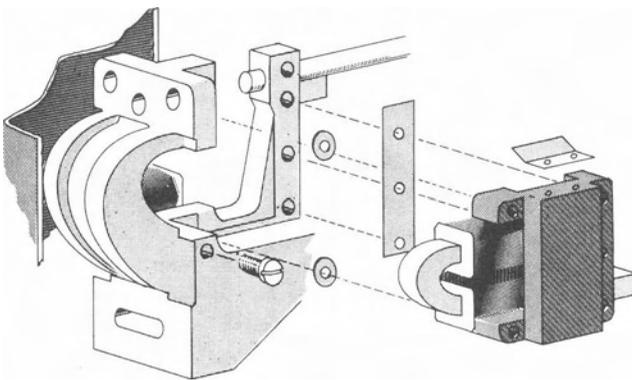
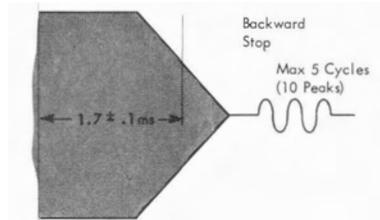
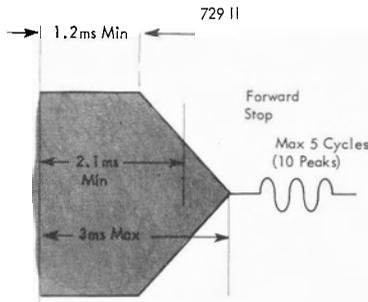
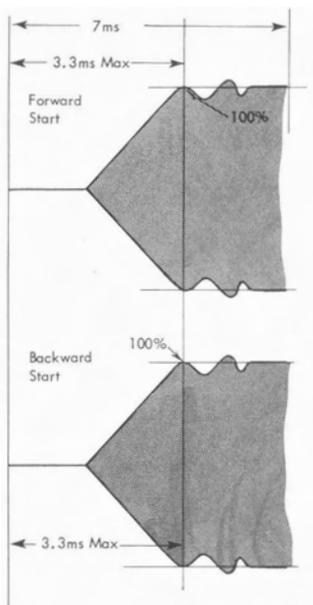


Figure 23. Shimmed Prolay



Read Pulse Assymetry
Time Assymetry
 $T_1 - T_2 \leq 1.5 \mu\text{sec}$
 $T = \pm 1\%$ of Normal Period of 48.0 μsec

Amplitude Assymetry
 $(V^+) - (V^-) \leq 5\%$ Nominal

Read Pulse Amplitude Difference (High-Low Density)

V_H High Density

$.40v \leq$ Feed Through*

$.40v \leq$ Cross Talk**

$.40v$ Base Line Shift

V_L Low Density

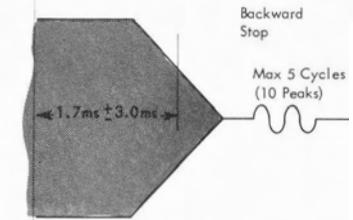
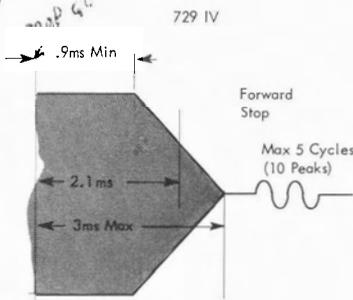
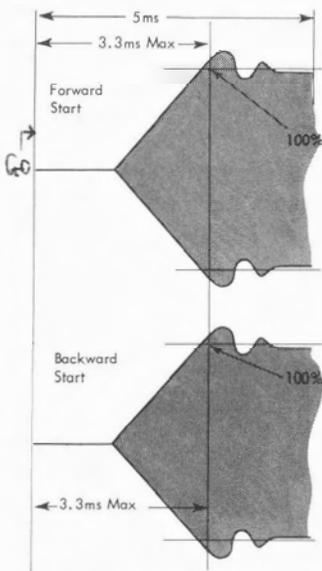
$V_L - V_H \leq 10\%$ of 8.8v

*Feed Through - Signal picked up on the read head from write tracks while in write status

**Cross Talk - Signal picked up from adjacent read tracks, in read status

DSO = 5ms EACH 10 = 1ms TIME

750
NET RECORD 12 BIT
2.25 W4
.350 RH
.2250
CHUCK CHINE



Read Pulse Assymetry
Time Assymetry
 $T_1 - T_2 \leq 1.0 \mu\text{sec}$
 $T = \pm 1\%$ of Normal Period of 32.0 μsec

Amplitude Assymetry
 $(V^+) - (V^-) \leq 5\%$ Nominal

Read Pulse Amplitude Difference (High-Low Density)

V_H High Density

V_L Low Density

$V_L - V_H \leq 10\%$ of 8.8v

$.40v \leq$ Feed Through

$.40v \leq$ Cross Talk

$.40v$ Base Line Shift

TAPE MOVES .1125 IN PER SEC AT TOP SPEED

Figure 24. 729 II and 729 IV Start-Stop Timings

\geq Greater than or equal to
 \leq Less than or equal to

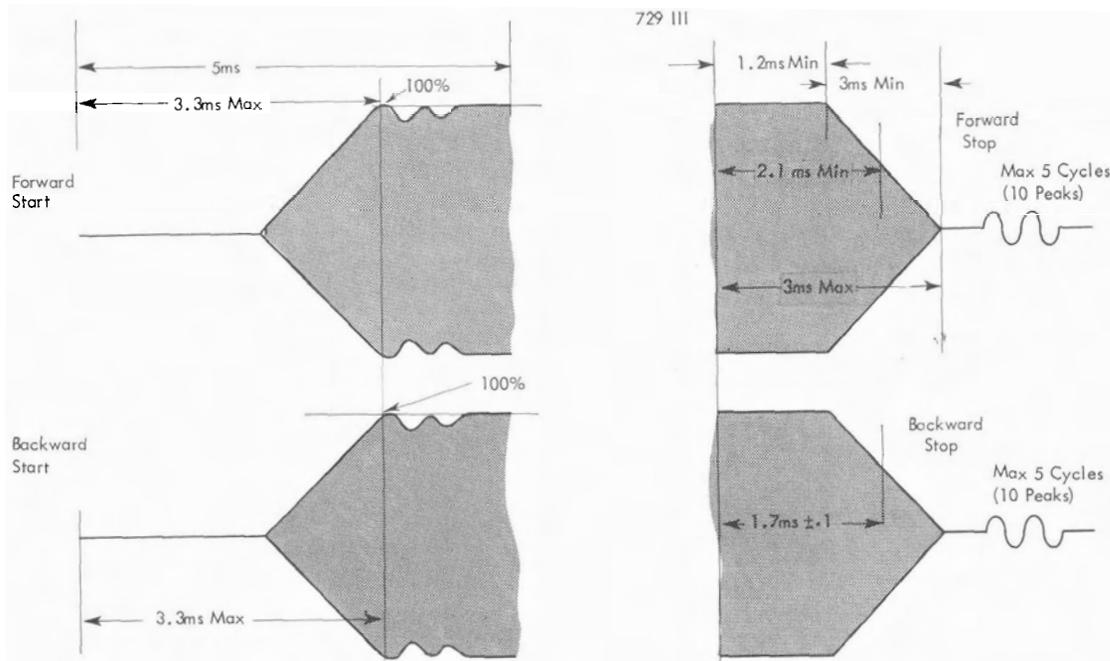


Figure 25. 729 III Start-Stop Timings

tests. If any signs of wear or corrosion are evident on fork arm pivots or armature pivots after cleaning, the entire arm assembly should be replaced. All shafts must be clean; if they cannot be cleaned, replace them. After cleaning and inspection, check prolay start-stop wave forms.

When a nylon idler, fork arm or entire prolay assembly has been replaced, check mechanical skew (1 and C tracks). If it varies from the original skew by more than $1 \mu\text{s}$, closely inspect the new nylon idler and replace it if the surface finish appears rough. A rough surface finish of the nylon idler can also cause a complete or partial collapse of the start envelope after 100% amplitude has been reached, usually 5 to 7 ms after ω is brought up. This condition will cause the envelope to closely resemble an "arrowhead," and usually indicates a rough idler on the left side. See Figure 27.

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 idler 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.

ADJUSTMENT (FIGURE 26)

Prerequisites to the adjustment procedure are clean lubricated prolays and a clean transport. The tape unit must not be at load point.

CAUTION

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.
3. Adjust steady state current:
 - a. Drive current: adjust potentiometer for 4v drop across TB 11-8 and 9.
 - b. Neutral current: adjust potentiometer for 3v drop across TB 11-6 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 on TB 11-8 and 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 41). 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.

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

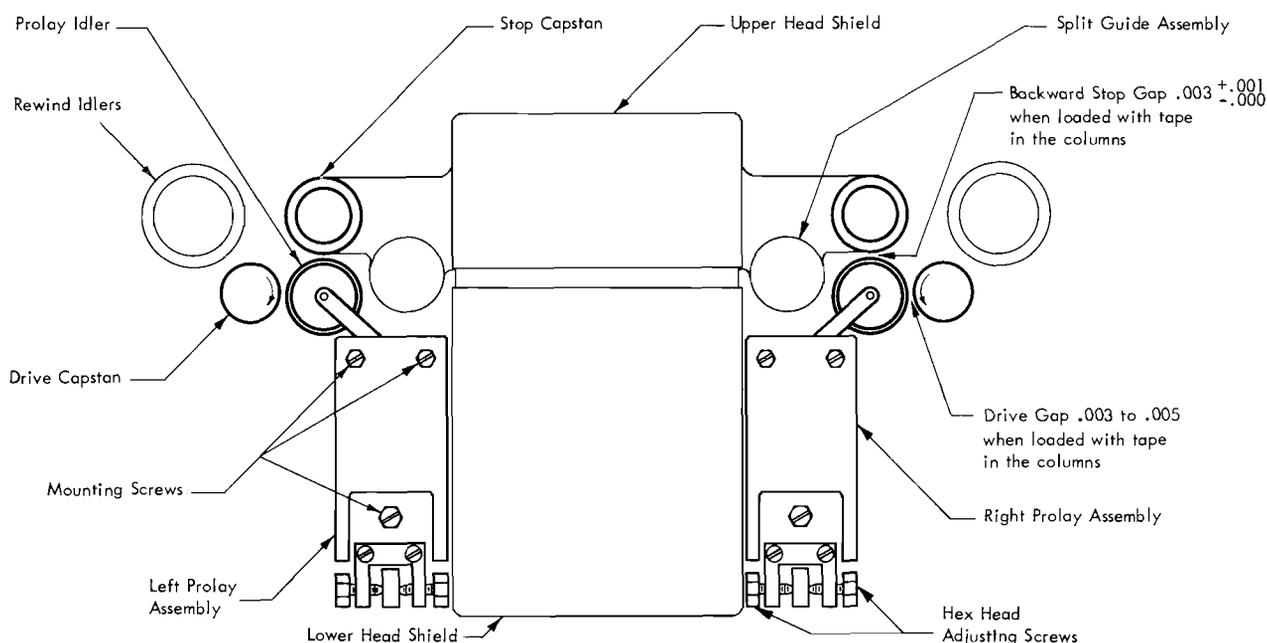


Figure 26. Prolay Drive and Stop Gap Adjustment

To adjust the steady-state current through the prolays neutral coils, measure the voltage drop across the 2 ohm, 25 watt parallel resistors, located on TB 11-6 and TB 11-7, and adjust the neutral potentiometers for a 3v indication (3 amperes). See Figure 41.

4. 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 prolays.
- c. Depress the load-rewind key and pull out the left capstan; this allows adjustment of the left prolays.
- d. Check that the coast potentiometers are turned fully counterclockwise (minimum coast). Initially adjust the drive and stop gaps as follows:

Drive gaps $.005'' \pm .001''$ nominally

Stop gaps $.004'' \pm .001''$ nominally

5. Check forward start waveform, and attempt to adjust start timings to Figure 24. 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 co is caused by one of two conditions:

- a. Too large a drive gap on the driving prolays; or
- b. Too small a drive gap on the non-driving prolays causes an overshoot through neutral, allowing the nylon idler to hit the drive capstan.

6. Repeat step 5 for backward start.

7. Adjust the forward stop gap to obtain the timings shown in Figure 24. 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 (i.e., the left stop capstan must control stopping).

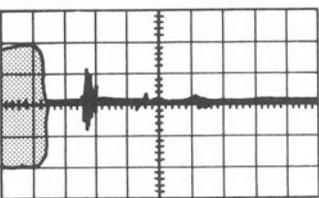
Therefore the stop envelope must be at zero amplitude within 3.0 ms. If inter-record gap tests indicate short gaps, the forward full coast potentiometer may be used to fill in the forward stop envelope.

8. Adjust the backward stop gap, to obtain the timings shown in Figure 24. The backward stop capstan should be adjusted on-line to meet creep specification.

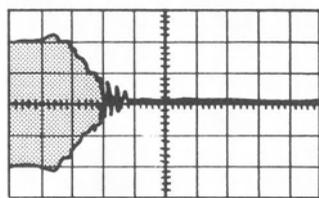
9. Check that the minimum full coast times have been met.

The time required to pass a given character from the write head to the read head (about 0.3") is:

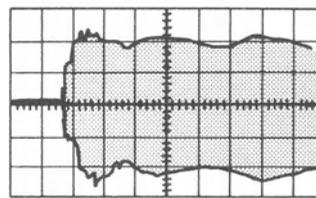
| | |
|----------------|--------|
| 729 II | 4.0 ms |
| 729 III and IV | 2.7 ms |



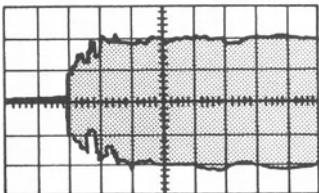
Sync: Fall of Go
 Input: A04A-B6 767
 Defl: 5v/CM
 Sweep: 1MSC/CM
 Prolay Stop Gap Too Small



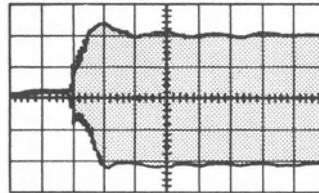
Sync: Fall of Go
 Input: A04A-B6 767
 Delf: 5v/CM
 Sweep: 1MSC/CM
 Prolay Stop Gap Too Large



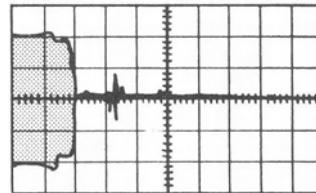
Sync: Rise of Go
 Input: A04A-B6 767
 Defl: 5v/CM
 Sweep: 1MSC/CM
 Prolay Drive Gap Too Small



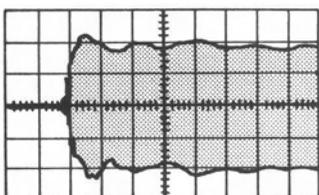
Sync: Rise of Go
 Input: A04A-B6 767
 Defl: 5v/CM
 Sweep: 1MSC/CM
 Prolay Drive Gap Too Large



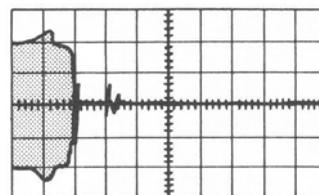
Sync: Rise of Go
 Input: A04A-B6 767
 Defl: 5v/CM
 Sweep: 1MSC/CM
 Good Forward Start Envelope



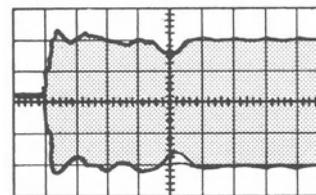
Sync: Fall of Go
 Input: A04A-B6 767
 Defl: 5v/CM
 Sweep: 1MSC/CM
 Good Stop Envelope



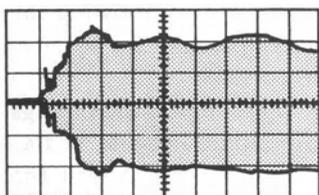
Sync: Rise of Go
 Input: A04A-B6 767
 Defl: 5v/CM
 Sweep: 1MSC/CM
 Good Backward Start Envelope



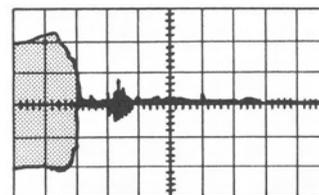
Sync: Fall of Go
 Input: A04A-B6 767
 Defl: 5v/CM
 Sweep: 1MSC/CM
 Signal Decreases at 1.5MSC Full Coast
 Coast Set Correctly



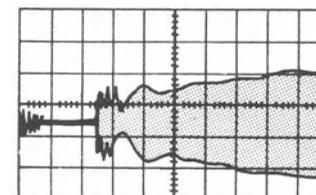
Sync: Rise of Go
 Input: A04A-B6 767
 Defl: 5v/CM
 Sweep: 2MSC/CM
 Signal Loss 10MSC After Rise of Go



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

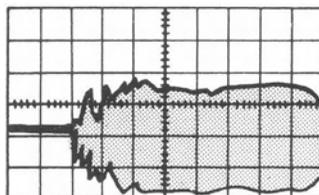


Sync: Fall of Go
 Input: A04A-B6 767
 Defl: 5v/CM
 Sweep: 1MSC/CM
 Signal Up for 1.8MSC Full Coast
 Too Long



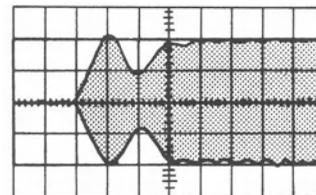
Sync: Rise of Go
 Input: Read Bus
 Defl: 2v/CM
 Sweep: 1MSC/CM
 Typical "Count Five"
 Start Envelope

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



Typical arrowhead start envelope
 caused by rough surface finish on
 prolay pulley

Sync: Rise of Go
 Input: Read Bus
 Defl: 2 v/CM
 Sweep: 1 MSC/CM



Note: All test points
 refer to 729 III

Figure 27. Waveforms

The control unit holds up GO, after WRITE CHECK CHARACTER (A in Figure 28) for the following:

| | |
|---------|--------|
| 729 II | 3.0 ms |
| 729 III | 1.7 ms |
| 729 IV | 2.0 ms |

This delay requires that tape remain at full speed for at least 1.0 ms (729 II and III) or 0.7 ms (729 IV) after the fall of GO, to insure reading every written character (B in Figure 28). Adding a 0.2 ms safety factor, obtain minimum full speed coast times of 1.2 ms (729 II and III) and 0.9 ms (729 IV) by means of the coast potentiometer adjustment. Use no more full coast than absolutely necessary. The left potentiometer (viewed from behind) controls forward coast. Rotate both potentiometers clockwise to increase the amount of coast.

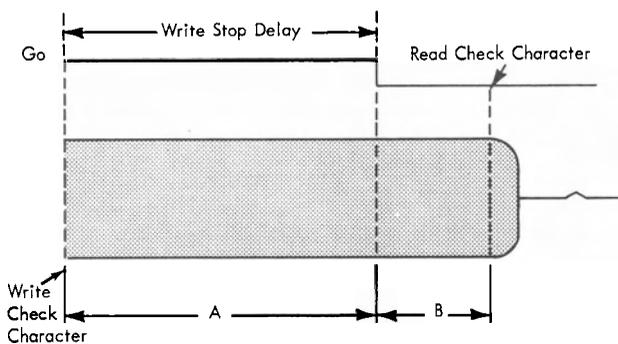


Figure 28. Stop Envelope

10. Check prolays for binds by making sure that the change in start time is equal to or less than 0.2 ms when varying GO down time from 10 to 100 ms.

11. Check for a count five condition. This is a very slow acceleration after a 5 second or longer idle period, on prolays which may otherwise indicate a good start envelope on continuous start-stop. The initial 100% amplitude must not be later than 3.3 ms. By adjusting the drive gap 0.001" either side of the nominal .005" setting, the fastest time at which 100% amplitude level is reached can be obtained. This applies to both forward and backward start.

PROLAY ADJUSTMENT (ALTERNATIVE PROCEDURE)

The following is an alternative adjustment procedure which has been found to minimize "glitching" of the start-stop envelope.

1. Rotate the stop capstans to allow maximum stop gaps (i.e., dot on the face of the capstan is down).
2. Set wide drive gaps (about .010") by eye.
3. Operate the tester to move tape forward in stop-start status. If the tape does not move, close the right prolay drive gap slightly until tape moves forward.

4. With tape moving forward, close the left drive gap to the point where the start envelope breaks up; this is "glitching." An audible click may be heard when the left prolay overshoots from stop through neutral and touches the left drive capstan. Open up the drive gap from this point. NOTE: Keep overshooting conditions to a minimum to prevent damage to the tape and/or nylon pulley.

5. Move tape backward in stop-start status. Close the right drive gap until the backward start envelope breaks up, again accompanied by an audible click. Open up the drive gap from this point. Ensure that drive gaps are opened up sufficiently to prevent "glitching," and still meet start-stop specifications.

6. Having adjusted the drive gaps until "glitching" has disappeared, vary the GO down time through the lower ranges from 1.5 ms to 10 ms. In this critical low GO down time range there will be a tendency for more overshoot. The drive gaps may have to be increased.

NOTE: Worn pivots, usually at the main fork arm or the nylon pulley, may prevent correcting overshoot without encountering other problems, such as count five.

7. Adjust the stop capstans for 2.4 ms forward stop and 1.7 ms backward stop to the 50% point. Recheck step 6.

8. The preceding technique usually produces a .004" to .005" drive gap. Check that drive or stop gaps are not less than .003". Check that full amplitude start time is no later than 3.3 ms for all GO down times. Check that the envelope is completely stabilized by 5.0 ms.

9. Final adjustment of stop capstans can be made on line, if necessary, to satisfy creep requirements.

NOTE: Inter-record gap diagnostics (5TU04, 7T03, 8TU04, 9T55, etc.) cannot be depended upon to indicate the previously described break-up or "glitching" caused by a prolay overshoot condition. For this reason it is not a good practice to make prolay adjustments (as opposed to stop capstan adjustments) without using a scope.

REMOVAL (ARM ASSEMBLY)

To remove an arm assembly from a prolay (Figure 29) 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.

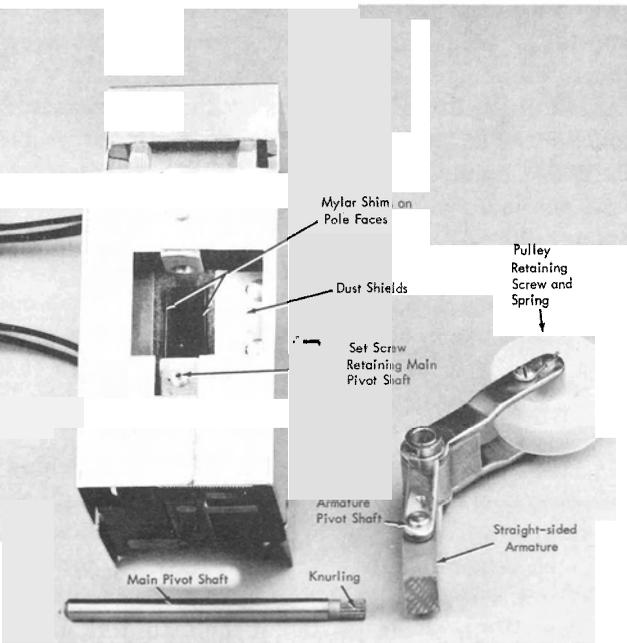


Figure 29. Removable Arm Prolay

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 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). See Figure 30.
2. Retaining wire screw for armature is toward the rear.

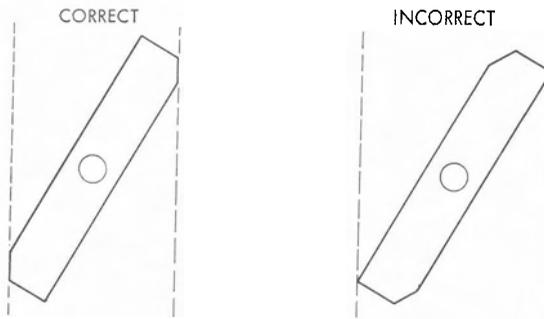


Figure 30. Prolay Armature, Reassembly

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 inter-record gap tests indicate a significant change from previous readings or when low gap lengths are outside specifications (Figure 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.

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. See Figure 30.
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.

Short Inter-record Gaps at Low Go Down Times

All prolays now in use contain .003" shims as each side of the main casting, making a total shimming of 0.006". See Figure 23.

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

Using shimmed prolays, short inter-record gaps become more prominent at the 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 a 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.

Inter-record gap tests will show that machines with shimmed prolays produce shorter gaps in the low go down time range. On the 729 III and IV machines, the inter-record gap is likely to fall below the 6.1 ms specification. If this occurs, reducing the neutral current to 2.5 amp or 2 amp may help when the gaps remain consistently short.

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 the stop capstan where the nylon pulley contacts it. Use the handle of a typewriter brush wrapped with a lint-free cloth moistened with IBM Tape Developer and Tape Transport Cleaner, P/N 517960.

CAUTION

Do not allow the tape transport cleaner to come in contact with the magnetic tape.

Drive Capstans and Motors

VISUAL INSPECTION AND OPERATIONAL CHECK

Inspect the drive shaft for dirt, chips, ridges and binds. Sloppy bearings can usually be detected 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 moistened with IBM Tape De-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.

Do not clean the drive capstan while it is rotating. Use a typewriter brush handle wrapped with the clean-

ing cloth and scrub vigorously. The capstan must be rotated manually.

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. Do not over-oil.
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.

ADJUSTMENT, 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 31.

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 $\frac{3}{8}$ 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.

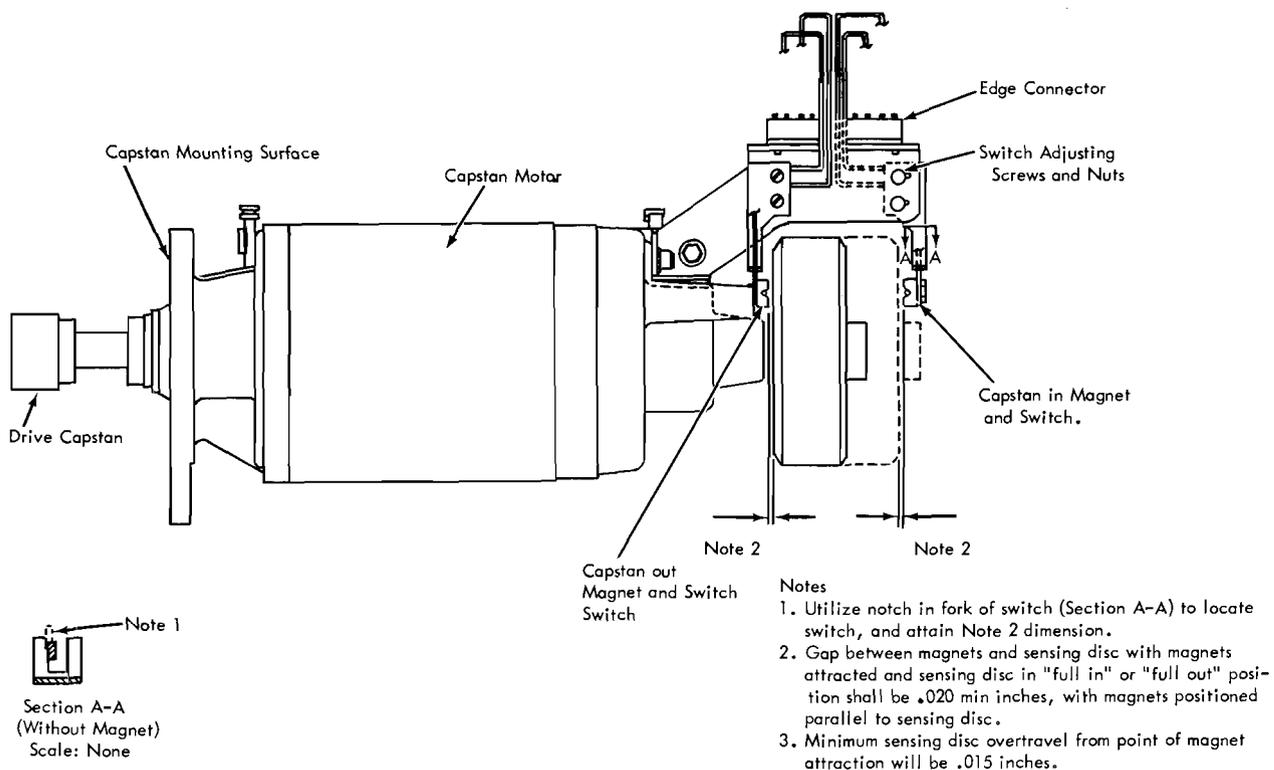


Figure 31. Drive Capstan Assembly

Front Door Assembly

The sliding glass spring drum assembly controls the sliding glass panel of the front door (Figure 32). A spring drum assembly is located on each side of the inside of the door, as shown in Figure 33.

LUBRICATION

The following lubrication should be performed every four to six months, or more frequently depending on usage.

1. Lubricate pulley shafts, front sliding door pulley and front sliding door spring motor with IBM 6 lubricant.
2. Apply IBM 22 grease sparingly on door cables; this will reduce breakage.
3. Lightly oil all studs and negator spring with IBM 6.
4. Use a grease stick, P/N 461077, on the:
 - a. Door check latch cam face, which is at the lower right of the door to detent it while it is open.
 - b. The sliding glass nylon tube seal surfaces that guide the sliding glass.
5. Apply IBM 17 grease sparingly to the door latch.

GUIDE ADJUSTMENT

When the guides are being adjusted, the sliding glass should be completely up because the glass is narrower at the top than at the bottom.

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 34).

REPLACEMENT, GLASS PULLEY (INNER) CABLE

See Figure 35. 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.

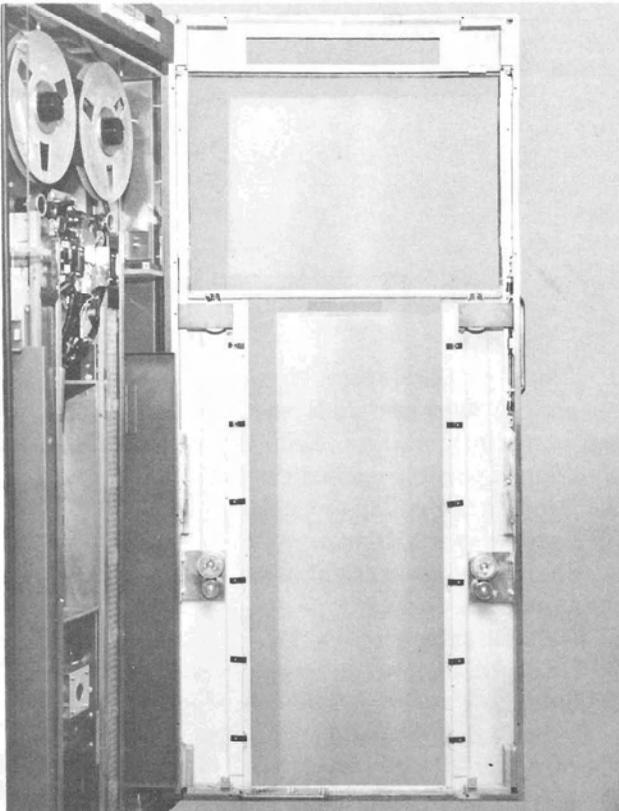


Figure 32. Sliding Glass Assembly

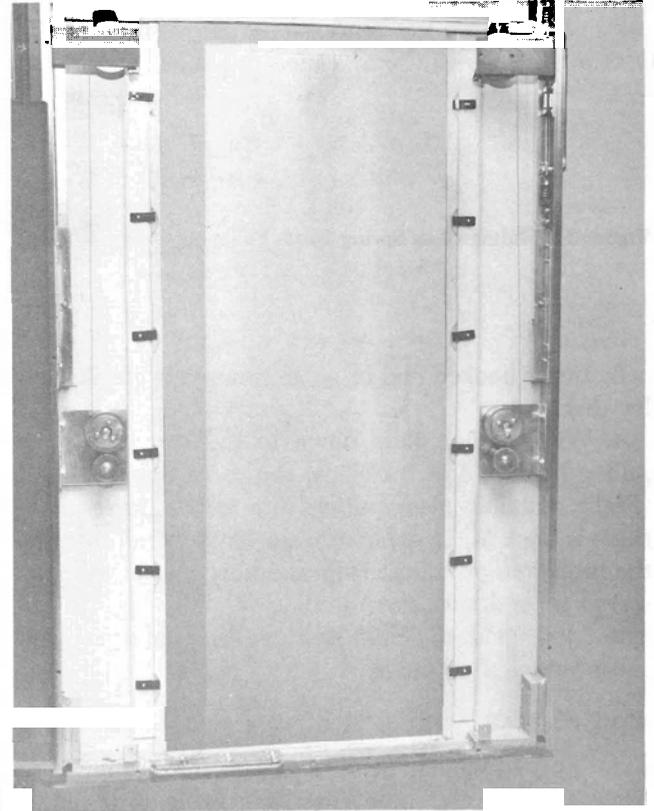


Figure 33. Sliding Glass Spring Drum Assembly

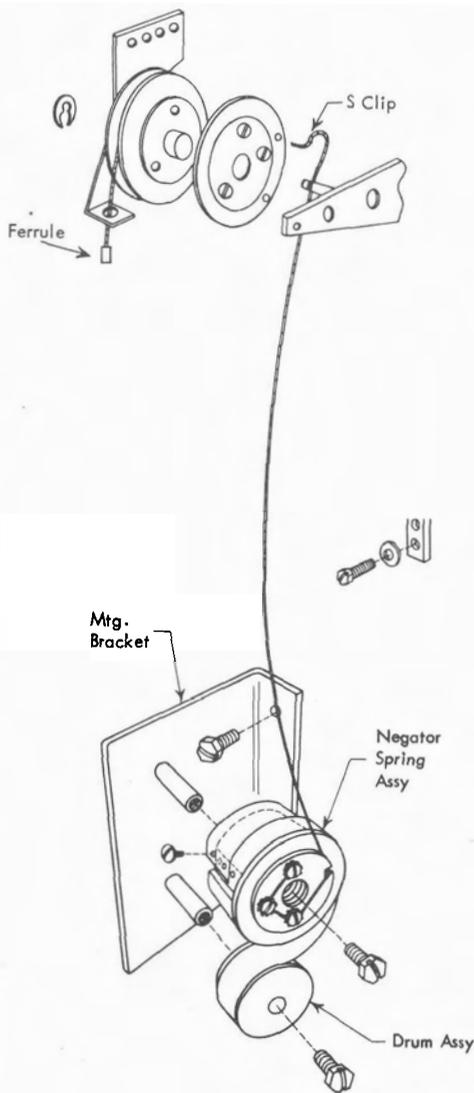


Figure 34. Sliding Glass Spring Drum Pulley Assembly

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 35. After removing old cable from negator drum and mounting new cable, proceed as follows:

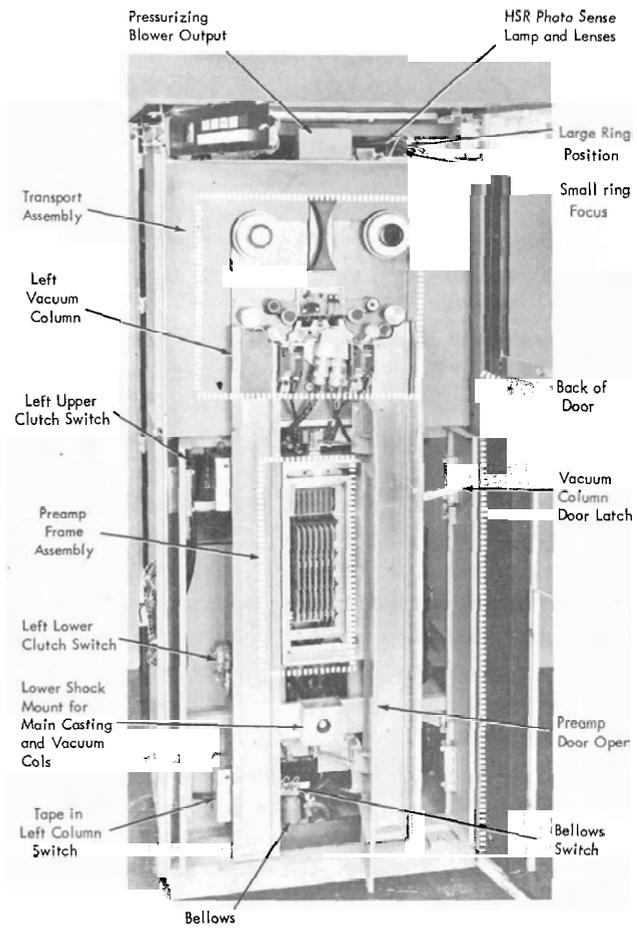


Figure 35. Front View, Tape Unit

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.

Operator's Panel Signal Lamps

Use only 55B lamps, P/N 344987, as replacements in the operator's panel. Do not use 55C lamps, P/N 308346, because they have a shorter life than the 55B type. The type number and suffix are stamped on the base of the lamp.

REMOVAL

To remove panel lamps, use a laminar bus extraction tool, P/N 461074.

Vacuum System

Vacuum Columns (Figure 35)

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 35.

ADJUSTMENT

Push Rod: The vacuum switch push rod should have $\frac{1}{4}$ -inch clearance between the adjusting nuts and the

switch transferring contact strap. Position the adjusting nuts as required to attain this condition. See Figure 36.

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 counter-clockwise until the loading operation starts, plus an additional $\frac{1}{4}$ turn. See Figure 37.

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.

Vacuum Column Switches (Figure 36)

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.

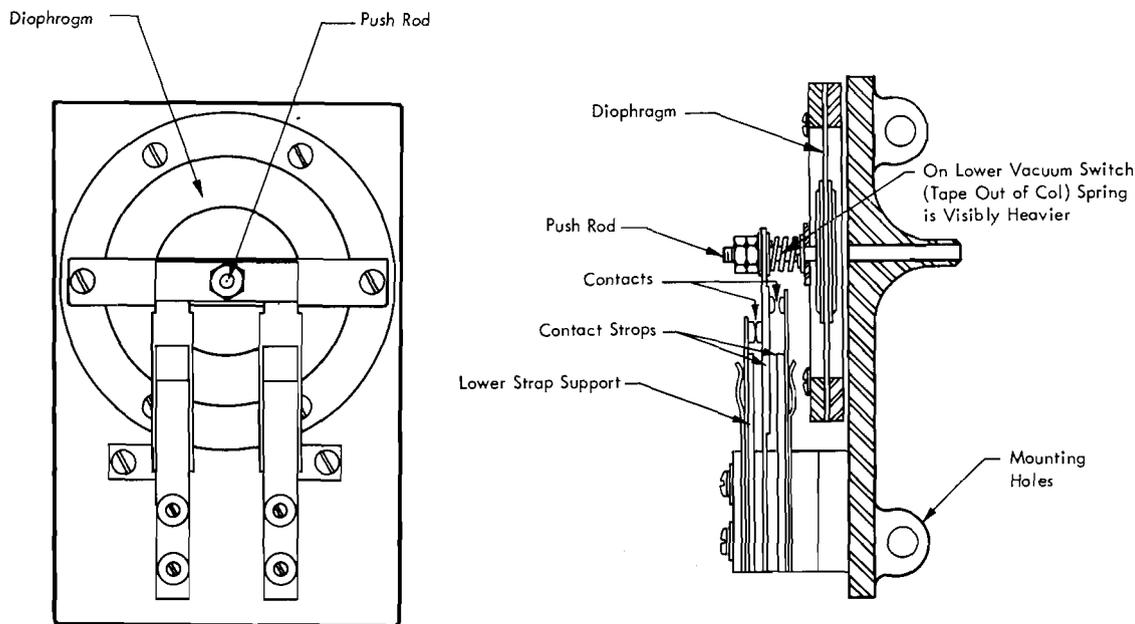


Figure 36. Vacuum Column Switch

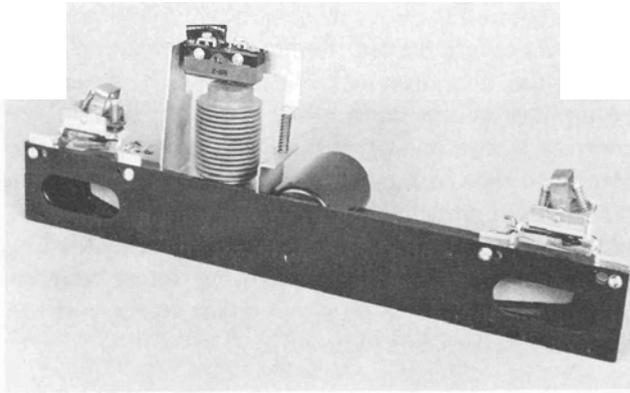


Figure 37. Vacuum Safety (Bellows) Switch

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.

Reel Drive

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 brush holder and slip ring is .040-.068".

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 38 shows the tape unit drive mechanisms.

Belt Alignment and Tensions: Position the drive motors in their slotted holes for .5" belt deflection in the center. Deflection may be accurately checked by using a .5" 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 38. With the tape unit power cut off, connect an ohmmeter to the brush and commutator ring of each clutch. This resistance should not exceed 25 ohms.

Brush to Commutator Ring Adjustment: To prevent arcing (which is a source of noise) make sure there is

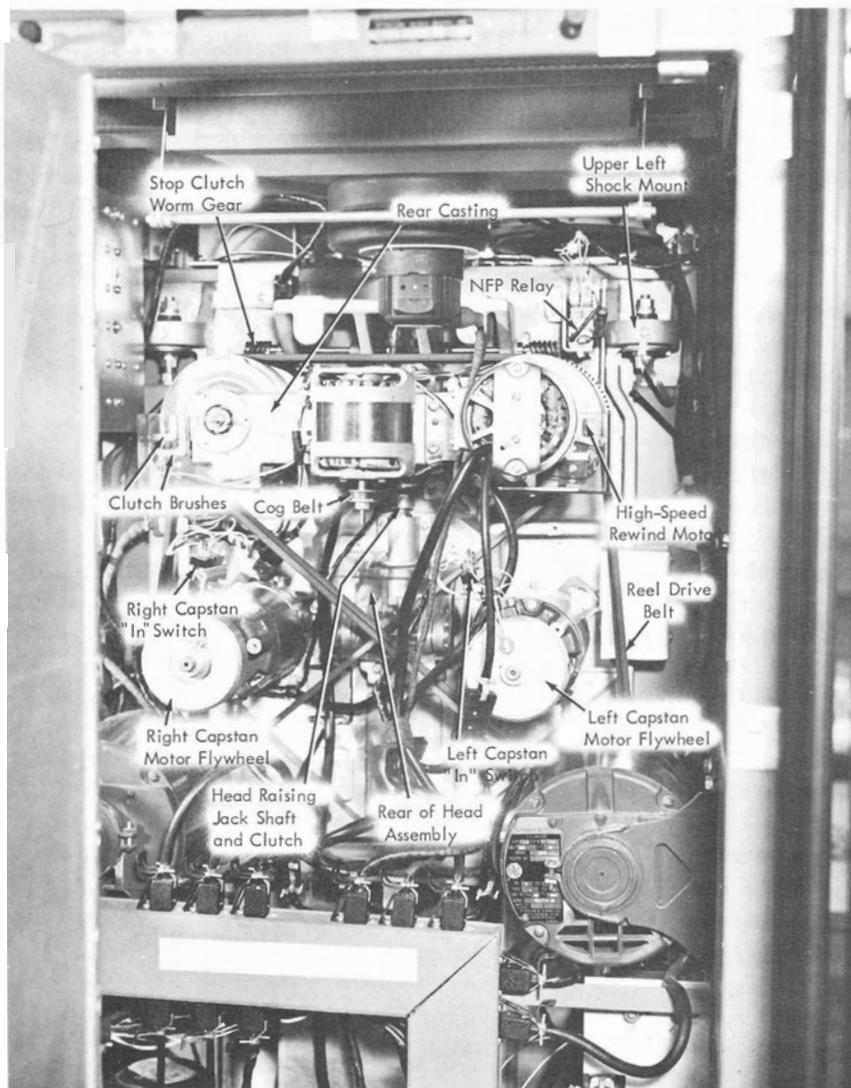


Figure 38. Drive Mechanisms

.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 spacer 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 BRUSH REPLACEMENT

1. Completely disassemble brush block assembly.

2. For block assemblies that do not have soldered pigtailed: Locate .250" from unbent end in center of strap. Punch and drill .052" hole (No. 55 drill). Coun-

tersink 82° x .093" diameter both sides (No. 42 drill). Hole should be centered over brush.

3. On block assemblies with soldered pigtailed, unsolder the pigtail, keeping the hole clear of solder.

4. Insert new brush into block so that it seats properly on its shoulder.

5. Insert new spring over pigtail and allow to sit on brush.

6. Locate brass strap in position, allowing the pigtail to extend up through the drilled hole. Do not tin more than 1/8" of pigtail.

7. Solder pigtail to brass strap. File solder flush to within 1/2".

CAUTION:

Care should be used when soldering. Solder should completely fill the hole in the brass strap, but not be allowed to flow down the pigtail lead. Apply solder sparingly; soldering will stiffen the lead and in some cases of continued flexing, the lead will break. The lead should have enough slack to allow twisting of the brush. If the lead is not slack, the twisting action will pull the brush away from the slip rings.

8. Check brush for free action and full return to normal position.

9. Check resistance from brush to strap for a good soldered joint.

10. Clean slip rings with fine crocus cloth or polishing stick, P/N 450503. *Do not use tape cleaning fluid or lubricants of any kind.*

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.

Jack Shaft Assembly (Figure 38)

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.

High-Speed Rewind

DANGER

If the tape unit is placed in a high-speed rewind operation without a reel on the left side, the metal latch ring can fly off. When checking high-speed rewind circuitry, it is essential that a reel always be on the left side of the tape unit (with the hub tightened) whenever the tape unit is in 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 $\frac{1}{2}$ " of tape on the machine reel, the tape unit should begin rewinding.
2. At the point with $\frac{1}{2}$ " 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 $\frac{1}{8}$ " 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.

ADJUSTMENT

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 $\frac{1}{8}$ " of tape before loading.

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

Base

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 38.

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 39). 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 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.

Relays

VISUAL INSPECTION AND OPERATIONAL CHECK

Refer to Figure 40 for relay locations.

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.

ADJUSTMENT

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*.

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 ener-

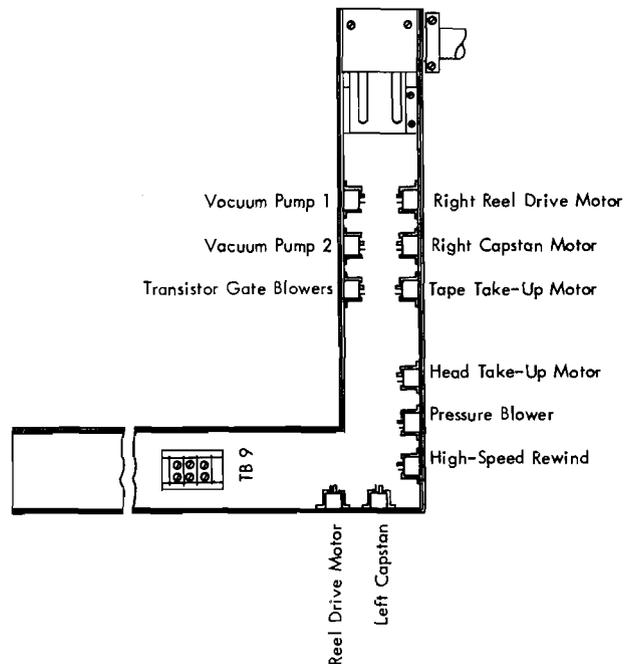


Figure 39. AC Raceway Plug Location

gized 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.

ADJUSTMENT

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.

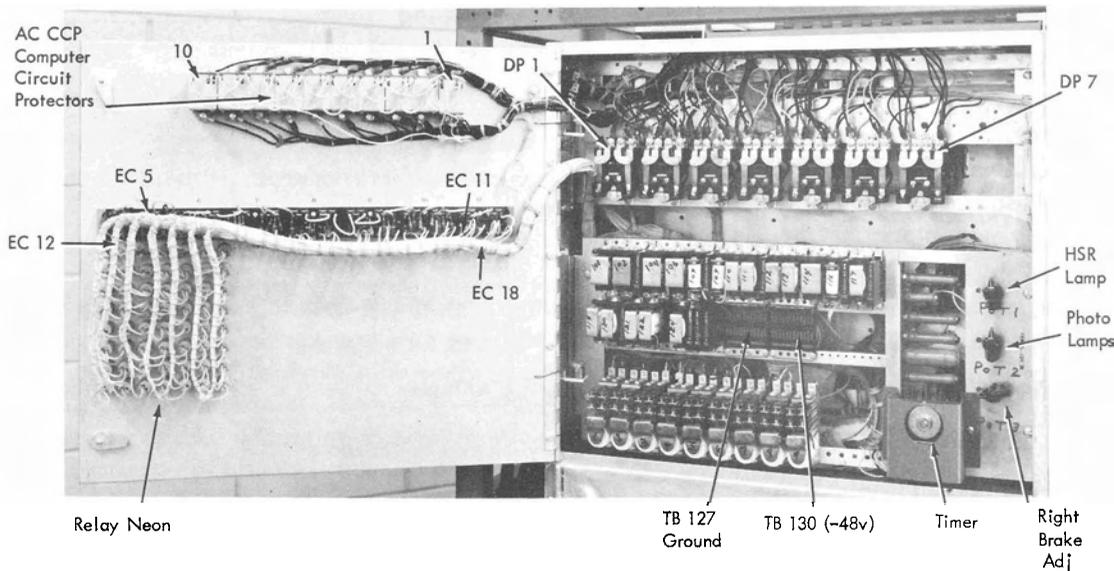


Figure 40. Relay Gate

Circuit Breakers and Thermals

VISUAL INSPECTION AND OPERATIONAL CHECK

Refer to Figures 40 and 41.

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 unit should immediately go into low-speed rewind.

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.

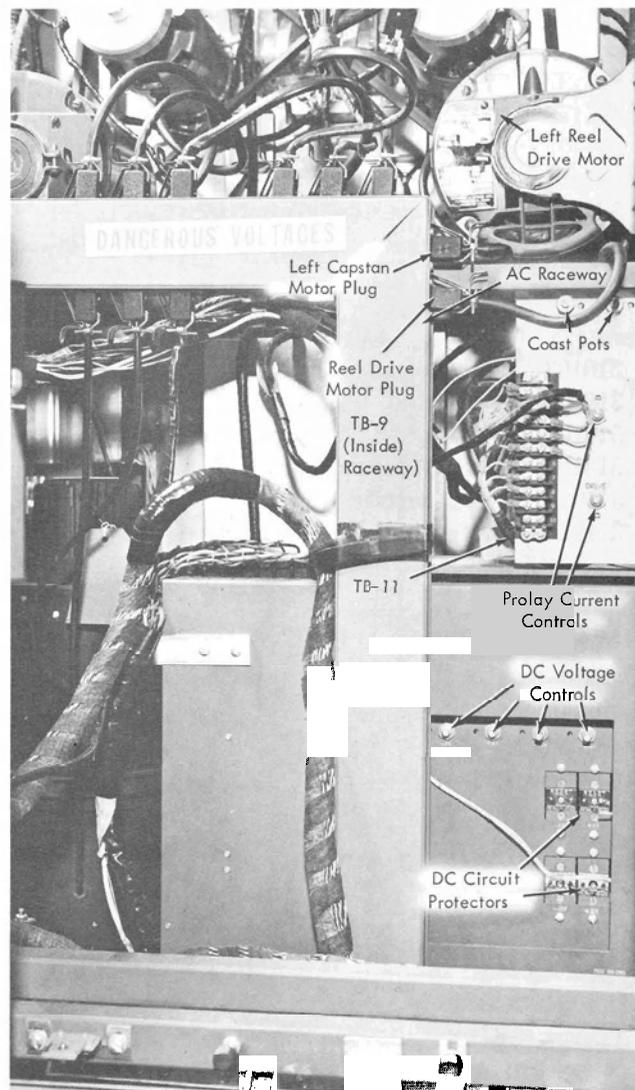


Figure 41. Prolay Current and DC Voltage Controls

Power Supplies

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

NOTE: It is recommended that Engineering Changes 248713A and 248679 be installed to provide circuit protect (CP) protection for the power factor (PF) capacitors.

PHASE I

| IBM P/N | PART NAME |
|---------|---------------------------------------|
| 526251 | Frame assembly |
| 597415 | $\pm 6v$ and $\pm 12v$ drawer |
| 529077 | -48v and +62v drawer from 729 III |
| 529079 | +140v and -7.5v drawer from 729 III |
| 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 | $\pm 6v$ and $\pm 12v$ 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 $\pm 6v$ and $\pm 12v$ 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 42. The values given are the practical maximums to be used as criteria. Maximum ripple

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

Figure 42. Power Supply Variations

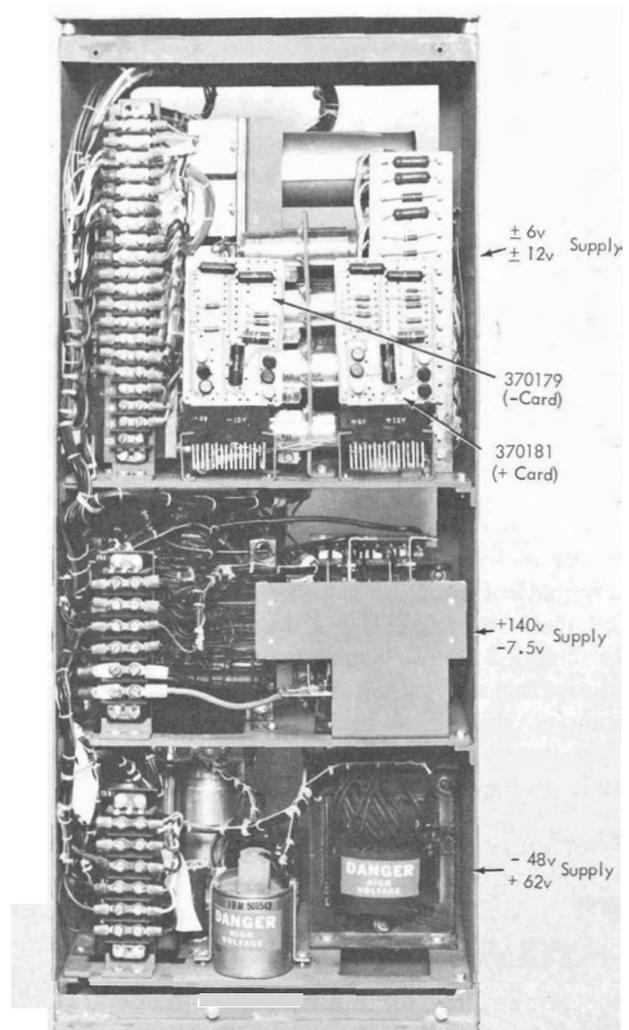


Figure 43. Phase I Power Supply

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 3/4" wide electrical tape may be fitted on the back side of 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.

ADJUSTMENT

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 42 for required adjustments.

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

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

Figures 43, 44, and 45 show the power supplies for the three models of 729 tape units.

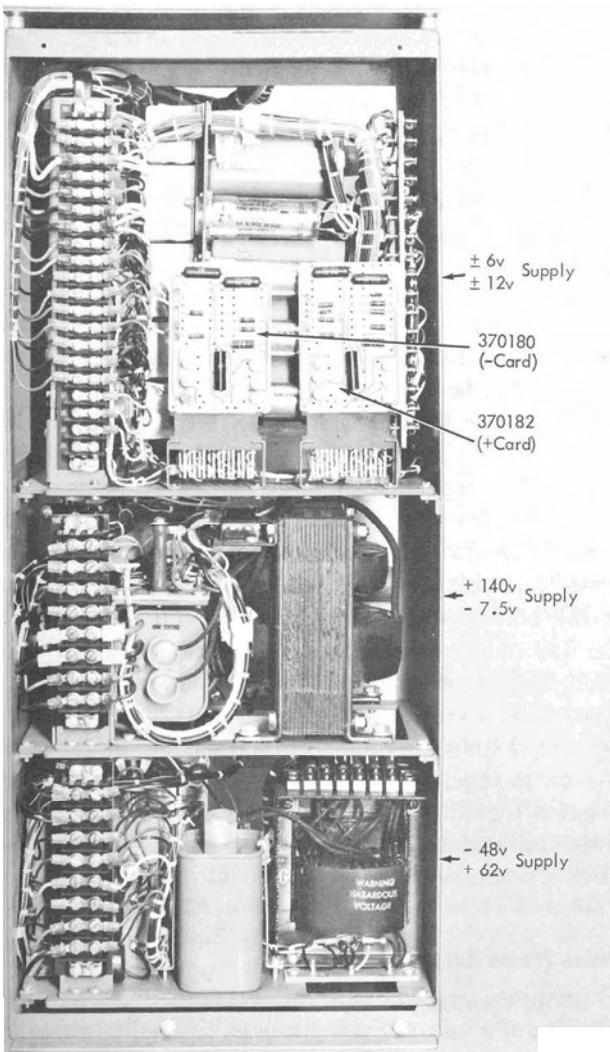


Figure 44. Phase II Power Supply

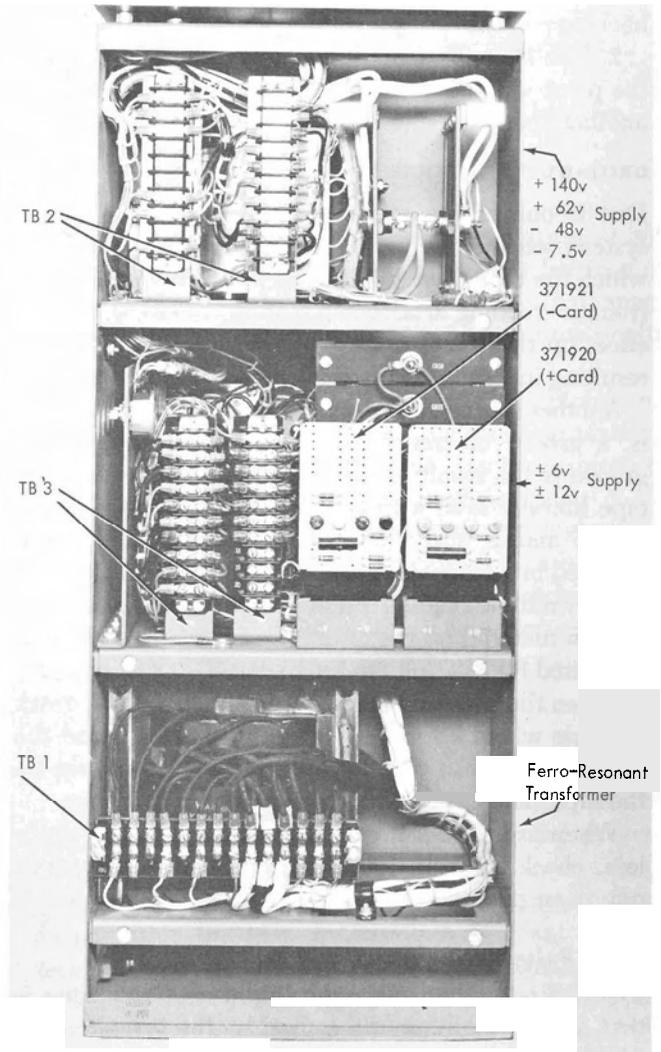


Figure 45. Phase III Power Supply

Service Aids

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.

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.

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.

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 $\times 100$ 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.

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.

Check for faulty bypass capacitors or diodes.

INTER-RECORD GAP NOISE

Before backspacing or rewinding while in write status, most tape systems automatically write forward first. This erases tape ahead of the last good record so that the next inter-record gap is clean when repositioning to this point for the next write operation.

Caution should be used if a tape unit is manually unloaded at this last record area (in write status). After reloading tape and reading forward to this same last record, remember that the tape ahead of this last good record has not been erased. Up to $\frac{1}{8}$ " of old record information may be left in what will be the next inter-record gap when writing is resumed.

This condition occurs because GO is dropped later in read status than in write status. Therefore, when repositioning the tape in read status, the write head will be positioned well beyond the write status stopping point of tape. The difference in stopping points is about $\frac{1}{10}$ " to $\frac{1}{8}$ ".

Operators should be warned of this possibility of leaving bits in the inter-record gap when manually unloading tape in write status.

INTERMITTENT READ BUS NOISE

Magnetic clutch brush wires should be dressed away from clutch pulleys. If the wires are allowed to drag on the pulleys, the insulation will wear through. This condition can be a source of intermittent read noise.

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 powder.

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.

Tape Contamination

Reel Hub: Installing Engineering Change 242958 will reduce the number of cracked reels and prevent stripping of knob shaft threads.

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 should be removed with a pen knife or they may be thrown into the system.

Tape Breakage

HIGH-SPEED AREA

- Brake or timer out of adjustment.
- High resistance between N/C points on timer micro-switch.
- 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

On capstan motors manufactured after September 1, 1960, and identified by suffixes LW, LX, LY, or LZ to the right of the five digit number on the name plate, the spring bushing may collapse and allow the capstan to extend too far forward, causing the following:

1. Contamination of the bearings or slowing of the motor because of the bushing particles. Permanent damage to the motor can result from excessive heat.
2. Possible damage to the capstan-out sensing switch assembly.
3. Inoperative machine if the capstan-out switch transfers.

The fault condition can be identified by:

1. Persistent R/W errors caused by the decrease in motor speed.
2. Noise caused by the flywheel rubbing against the switch magnet or rear oil cup.
3. Measuring the distance between the vacuum column door and the capstan while the motor is running. The distance should be not less than $\frac{1}{2}$ ".

If trouble is experienced, remove the motor and loosen the housing screws, sliding the front bell housing forward. Do not remove the taper pins. Use a small mirror and flashlight to inspect the bushings.

In addition to the above fault, check for loose or out-of-adjustment microswitches.

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.

IMPROPER TAPE HANDLING (LOADING)

If the tape unit door is opened just after the tape has risen from the columns, 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.

TAPE DUMPING CAUSED BY BRAKE CLUTCH

Clutch powder deterioration and leakage will affect clutch response and cause tape dumping in the columns. Study of the functions of the three clutches shows that the brake clutches cause tape dumping more often than a faulty up clutch.

Requirements of Up Clutch: The function of the up clutch is to accelerate the reel from a stopped position to capstan speed (112.5" per second for 729 III and IV) before the tape loop can bottom in the column. The up clutch is energized when the tape loop goes below the lower vacuum port.

Requirements of Down Clutch: The function of the down clutch is to accelerate the reel from a stopped position to capstan speed before the tape is pulled out of the column. The down clutch is energized when the tape loop goes above the upper vacuum port.

Requirements of Brake: The brake must respond to a condition worse than that encountered by either the up clutch or the down clutch. This condition presents itself when the direction of the tape over the head is reversed. Consider the condition where tape is told to go backward just as the tape loop passes the upper port while traveling down in the left column. At this time tape is being dumped in the column by the reel at approximately 280" per second (considering a full reel of tape) and by the capstan at 112.5" per second. The brake *must stop the reel* before the loop reaches the lower port. The up clutch cannot be relied upon to prevent the tape from dumping if the brake has *not* stopped the reel before the loop reaches the lower

vacuum port. It is most important here to distinguish between *reel* motion and *tape* motion in the column. To function properly, the up clutch must depend on the *reel's* being *stopped* by the time tape passes the lower port. Therefore, the tape going below the lower port during a tape reversal is usually due to a poor brake. A poor brake will also cause tape to pull out of the column if the down clutch and the column upper port are considered.

A variation of the tape reversal dumping occurs in a loading operation. An additional factor that can give the appearance of a faulty brake is a jitter brake with insufficient tension. When the tape in the column motor is de-energized, the momentum of the clutch housings will continue to load tape into the column for a time, although the brake clutch has stopped *reel* motion with *respect to the brake housing*. If the *reel* is still loading tape into the column as tape passes the lower port, the up clutch cannot reliably overcome this added motion. When these conditions occur, the tension on the jitter brake should be increased to ensure that the brake housings and gear train are stopped before tape reaches the lower port.

Summary: If tape dumps:

1. While processing in one direction—check the appropriate up clutch.
2. While changing direction during processing—check the appropriate brake clutch.
3. While loading—check jitter brake tension and possibly the brake clutch.

Other causes of tape dumping are faulty vacuum switch bypass capacitors or diodes or dirty or slow-acting vacuum switch contacts (insufficient spring tension).

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.

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.

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.

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" 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.

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

Two conditions 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 $\frac{3}{8}$ 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 $\frac{3}{8}$ 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, non-repetitive 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 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.

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 finger hold on its surface. Rotating the reel with the finger in the cut-out will nick or curl the guiding edge of the tape.

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

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

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

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

GENERAL HANDLING PROCEDURES

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

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

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

When necessary to clean tape, gently wipe the tape with a clean, lint-free cloth moistened with the proper tape transport cleaner. Extended exposure 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 and make their subsequent use unsatisfactory.

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

STORAGE PROCEDURES

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

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

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

If shipping of tape reels is necessary, the tape and reel should be packed in the plastic container provided

for this use. The container should be hermetically sealed in a plastic bag. Additional support should be obtained by packing in individual stiff cardboard shipping boxes.

Transistors

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

Voltage Level and Special Lines

COLOR CODING

| | | | |
|--------|------|--------|------|
| Gray | +12v | Orange | + 6v |
| Purple | -12v | Brown | - 6v |

VOLTAGE LEVELS

| | | |
|---|--------|--------|
| N | + 0.4v | - 0.4v |
| P | - 5.6v | - 6.4v |
| S | 0.0v | -12.0v |
| W | 0.0v | -48.0v |
| X | +10.0v | -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 |

729 II and IV Portable Tape Unit Field Tester

This tape unit tester tests mechanical and electrical functions of the 729 II and IV (Figure 46). All signals to and from the tape unit are checked by the tester.

The tester is 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.

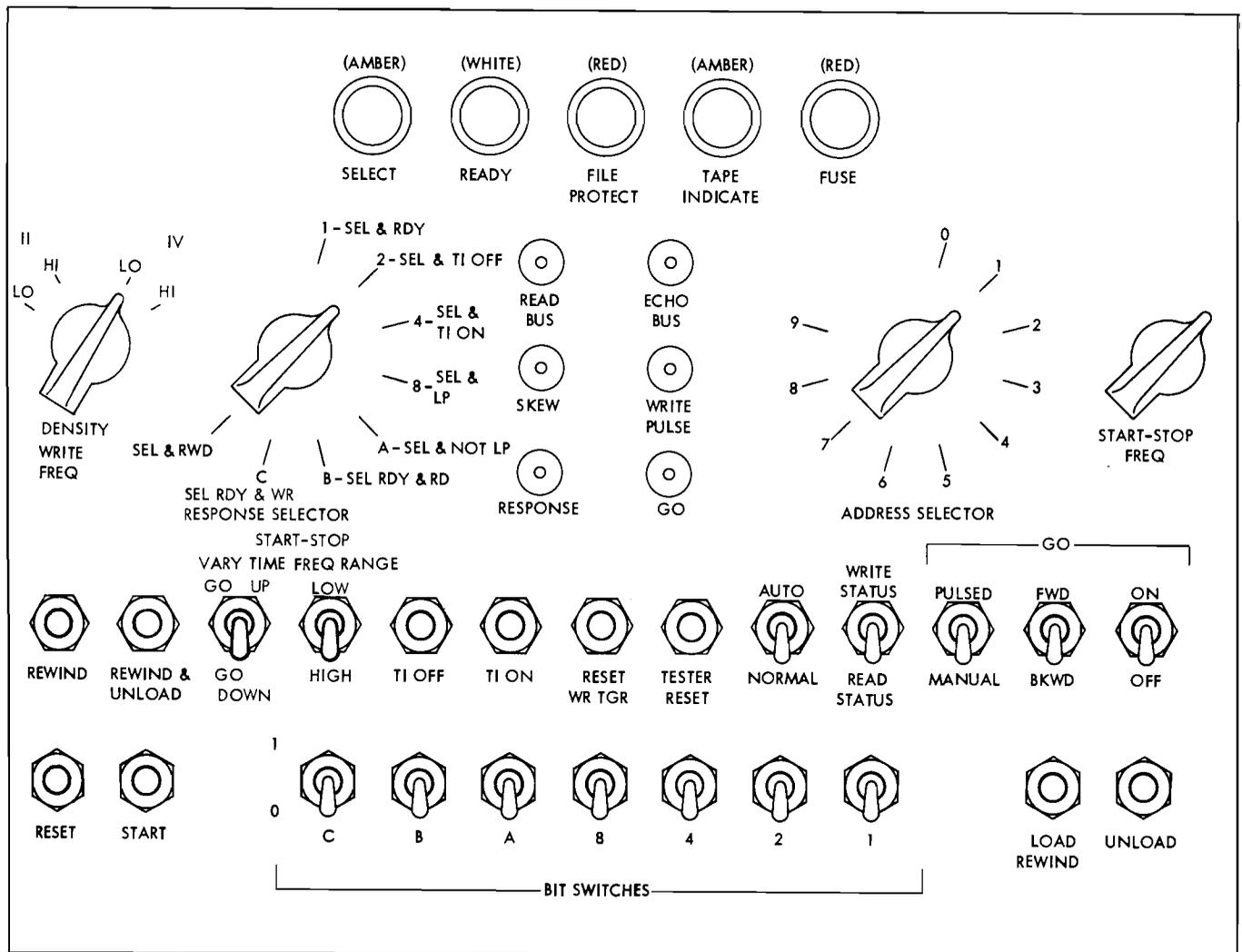


Figure 46. Switch Panel, 729 II and IV Tape Unit Tester

Indicating Lights

All indicating lights on the tester (Figure 47) perform the same operations as those located on the tape unit.

Select Light: The select light is turned on when the tape unit and the tester have their address selector switches set to the same address.

Ready Light: This light is on when the tape unit is in a ready status. The tape unit is in a ready status when the start key is depressed and the tape unit is loaded, the door interlock is closed, and the unit 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 π ON button on the tester. The tape indicator is turned off by: (a) depression of the π 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.

Switches (Figure 46)

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 tester address switch, the tape unit is selected by the tester 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 co line is conditioned by the CO 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 π off, select and π 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 pre-amplifier output of the selected track to be observed at the read bus hub.

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

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.

π 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.

π 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 CO 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 0.25-13.5 milliseconds. In the manual position, the CO multivibrator is removed from the circuit. In this position tape is moved at a constant speed provided the CO 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 π or LP is sensed, depending on the setting of the forward-backward switch.

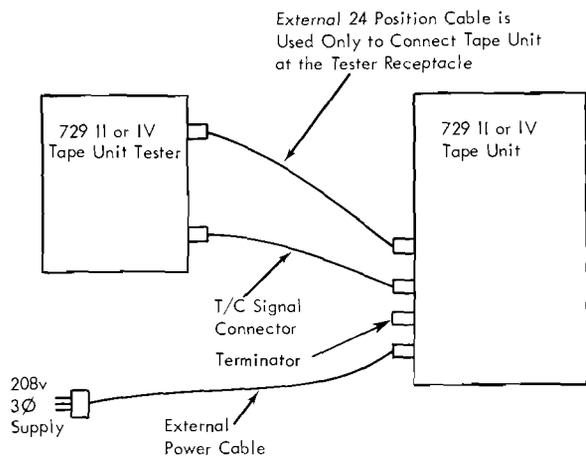


Figure 47. Tape Unit Tester Connections, 729 II and IV

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 unit 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 unit is in manual control. The tape indicator is reset by depression of this key.

Hubs (Figure 46)

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.

Tape Unit Response: Logical lines from the tape unit, 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.

Operation

Preliminary: To operate a tape unit from the tester, 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 unit and put the tape unit under external control. Select the tape unit by setting the address selector and the tape unit tester 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 tape unit tester 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 unit then rewinds the tape back to load point. Upon reaching the load point, the tape starts reading or writing and 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 48.

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 photocell turns on a trigger in the tester. This trigger's output, combined with the auto-cycle normal switch in auto-cycle status,

MECHANICAL 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 I and C tracks.)

WRITE SKEW

1. Set write status
2. Set write frequency

READ SKEW

1. Set read status
2. Sync on the most lagging track
3. Use the response select switch to observe each track

Figure 48. Tester Switch Settings for Checking Skew

causes the π to be turned off and the tape unit to rewind.

3. The tape unit in rewind status causes "select and ready" to fall which resets the trigger in the tester.
4. "Select and ready" comes up when the tape is re-wound 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 photocells and single shots can be checked. If the EOR reflective spot is placed farther back on the tape so that the tape unit 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 unit and the EOR spot at the end of the tape, the tape unit can be auto-cycled to check the rewinding of a full reel at high speed.

The tape unit tester and the tape unit 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, except that the tape is started and stopped at the start-stop frequency.

729 III Tape Unit Tester**Power Connections**

There are three methods of connecting power when using the tape unit tester, as shown in Figure 49.

1. In the normal method, the tester supplies power for both itself and the tape unit.
2. The tester 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 tester.

Switches (Figure 50)

Address Select: This switch has 11 positions (0 to 9), corresponding to the dial switch on the tape unit, and an OFF position. If the tape unit address selector switch is set to the same address as the tester address switch, the tape unit is selected by the tester 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 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 tester to either the GO line or the backward line in the tape unit.

Read-Write: This switch performs several functions. It sets the status of the tape unit 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

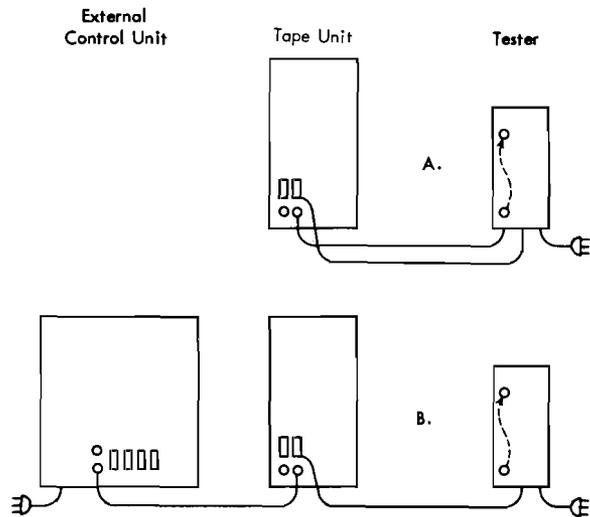


Figure 49. Tape Unit Tester Connections, 729 III

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 unit, 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.

Operation

PREPARATION

To operate a tape unit from the tape unit tester, 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 unit to put it under external control. Select the tape unit by setting the address selector switch of both the unit and the tester to the same address. Set the start-stop switch to OFF, both the manual forward-reverse switch and π 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 μ s 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 100 μ s "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 unit. 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 unit 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 tester may be used to check the following operations of the tape unit: end-of-tape (EOT) sensing, load-point sensing, high-speed rewind vacuum switches, and flapper valves.

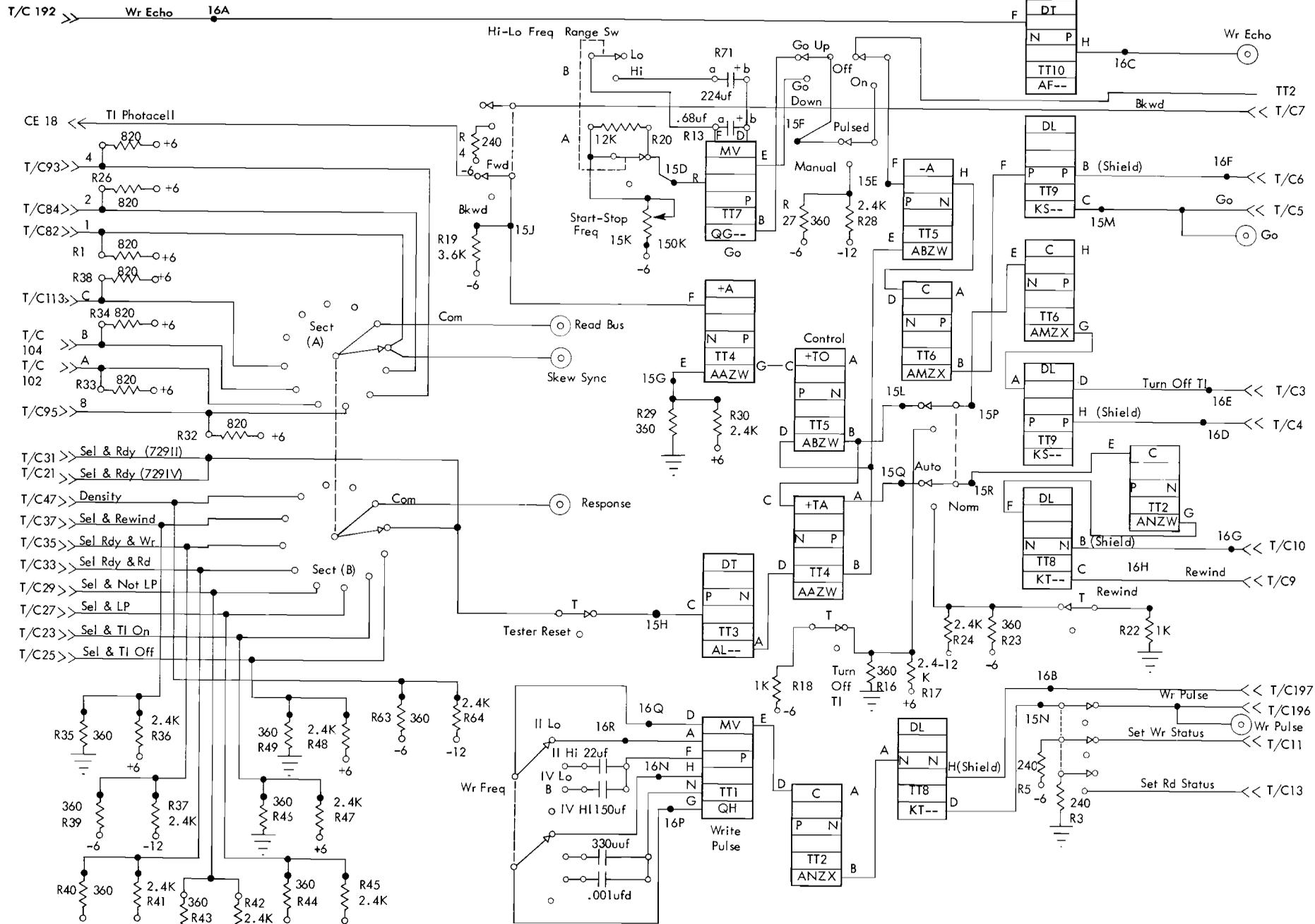
To put the machine into auto-cycle operation, the response select switch is set to auto-cycle and the read-write switch is set to write. Pressing the start key then puts the tape unit into auto-cycle operation.

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 unit as "rewind." This signal causes the tape to rewind. The signal "select unit rewinding" comes from the tape unit through the response select switch and returns to the tape unit 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 unit 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 photocells and single shots can be checked. With a full reel of tape and the EOT spot at the end of the tape, the tape unit can be auto-cycled to check the rewinding of a full reel at high speed. The tester and tape unit can also be left to write and rewind for a period of time to check the reliability of high-speed rewind.

Control Logic and Manual Controls

Figures 51 and 52 show control logic and manual control circuitry for the magnetic tape unit testers.



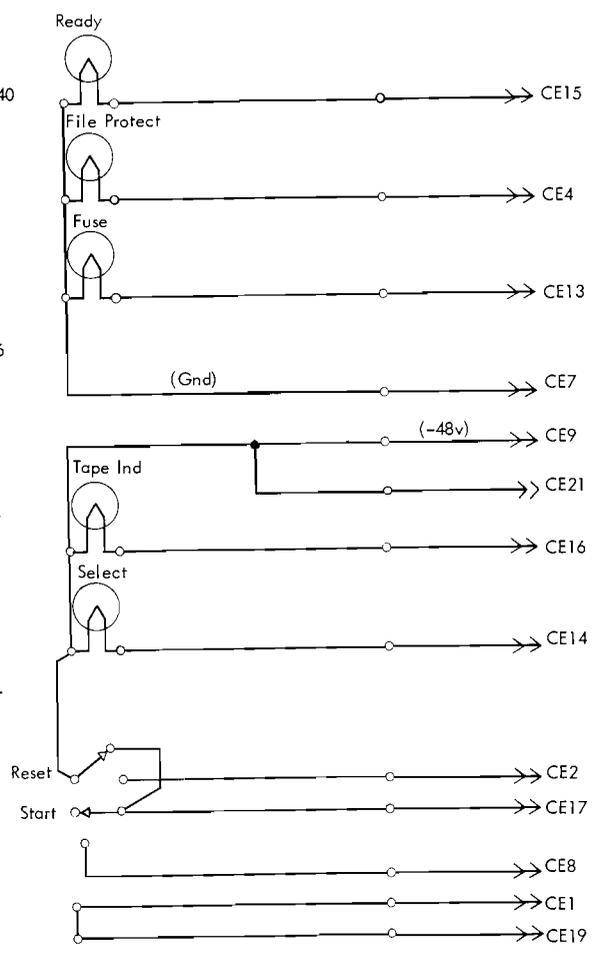
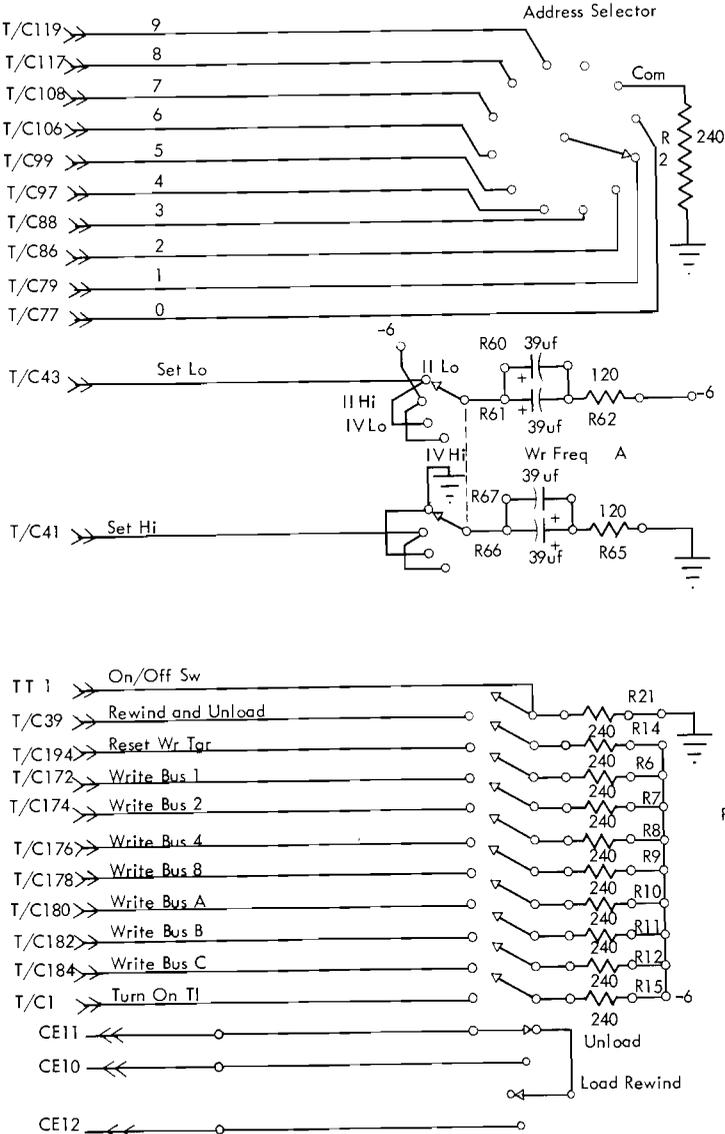


Figure 52. Tape Tester Manual Controls

Tape Switching

IBM 729 II and 729 IV Magnetic Tape Units may be modified to permit switching of tape unit logic between any two magnetic tape channels that are not in operation. The tape unit switches the data and control lines through relays that are manually operated from the IBM 7155 Switch Control Console. Modified tape units may be operated with either of two tape channels of a computer system. Possible operation of the modified units include connections between:

1. Two tape channels of one computer system.
2. A tape channel of two computer systems.
3. A tape channel of a computer system, and a tape channel of an off-line system.

The 7155 Switch Control Console controls as many as eight different tape units. Four keys are assigned to each tape unit. Two keys are for a stand-by condition, where the tape unit is not connected to either channel. The other two keys select the channel to which the tape unit will be connected. The depressed key will light up, making it easy to determine the status of the tape unit.

A modified tape unit will be the terminating unit on a channel, regardless of the channel to which the tape unit is connected. Because a modified tape unit must terminate each channel, two extra signal receptacles are required. They are mounted above the normal signal receptacles, with vertical pairs for each channel. (See Figures 53 and 54.)

Two toggle switches and 12 relays are added to the modified tape unit (Figure 55). One of the toggle switches is the remote-local control (R/L). When the R/L switch is in the REMOTE position, the 7155 Switch Control Console controls the tape unit. If the R-L switch is in the LOCAL position, the tape unit is under

control of the other toggle switch, labeled A-B. The A-B switch controls the channel with which the tape unit will be associated.

The relays are in groups of six, each group controlling the lines entering and leaving the tape unit. Only one group of relays can be energized at one time. The energized relays select the channel that will control the tape unit.

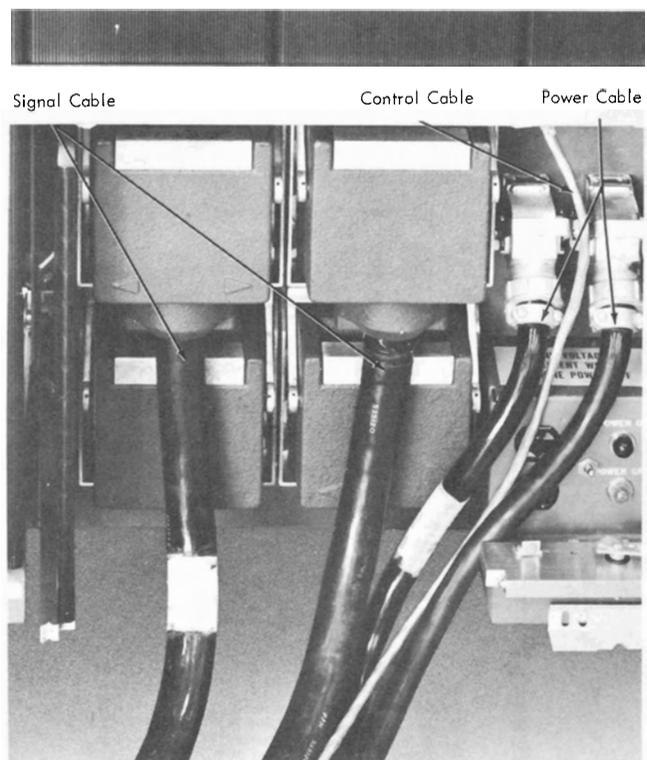


Figure 53. Tape Switching Connectors on 729 Magnetic Tape Unit

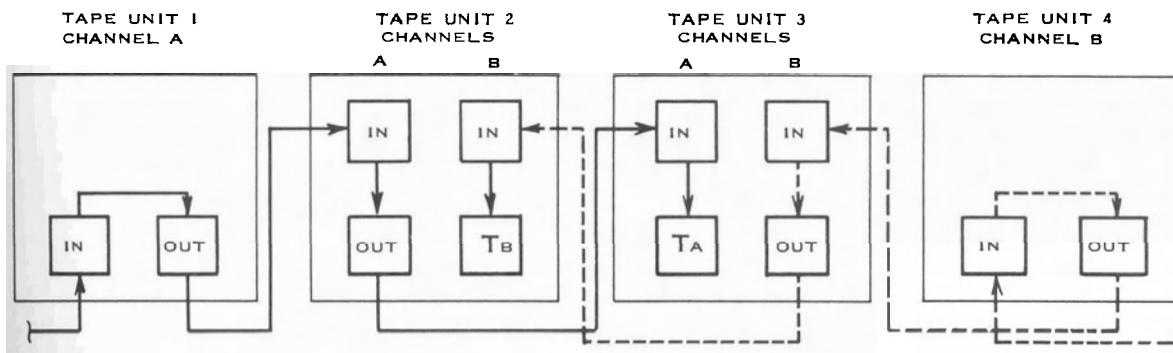
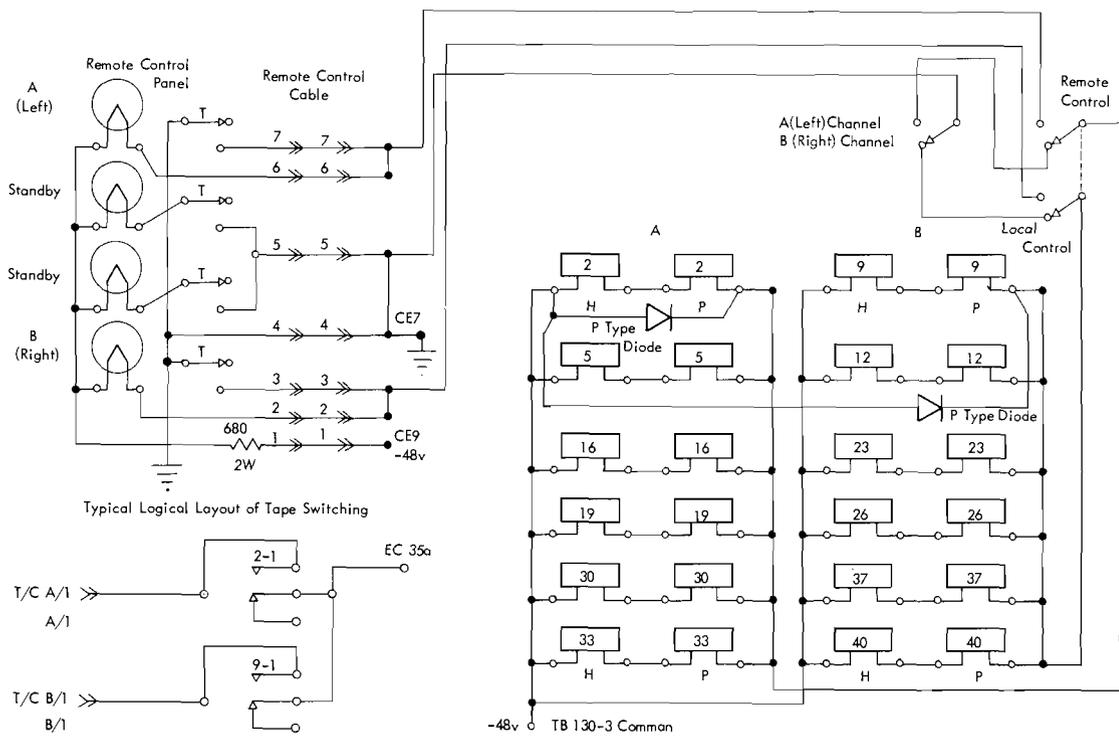


Figure 54. Receptacles and Cable Connections with Tape Switching (T_A = Terminator for Channel A; T_B = Terminator for Channel B)



TAPE SWITCHING RELAY CONTACT CHART

| T/C | Name | Channel A Relay Contact | Channel B Relay Contact | T/C | Name | Channel A Relay Contact | Channel B Relay Contact |
|-----|--------------------|-------------------------|-------------------------|-----|------------------|-------------------------|-------------------------|
| 1 | Turn On TI | R2-1 | N/O | 83 | Shield | R33-4 | N/O |
| 2 | Shield | R2-2 | N/O | 84 | Read Bus 2 | R33-6 | N/O |
| 3 | Turn Off TI | R16-8 | N/O | 85 | Shield | R33-4 | N/O |
| 4 | Shield | R16-7 | N/O | 86 | Sel TU 2 | R30-4 | N/O |
| 5 | Ga | R16-9 | N/O | 87 | Shield | R30-5 | N/O |
| 6 | Shield | R16-7 | N/O | 88 | Sel TU 3 | R30-6 | N/O |
| 7 | Bkwd | R2-3 | N/O | 89 | Shield | R30-5 | N/O |
| 8 | Shield | R2-2 | N/O | 92 | Shield | R33-4 | N/O |
| 9 | Start Rewind | R2-4 | N/O | 93 | Read Bus 4 | R33-7 | N/O |
| 10 | Shield | R2-5 | N/O | 94 | Shield | R33-4 | N/O |
| 11 | Set Write Status | R2-6 | N/O | 95 | Read Bus 8 | R33-8 | N/O |
| 12 | Shield | R2-5 | N/O | 96 | Shield | R30-8 | N/O |
| 13 | Set Read Status | R16-10 | N/O | 97 | Sel TU 4 | R30-7 | N/O |
| 14 | Shield | R16-11 | N/O | 98 | Shield | R30-8 | N/O |
| 16 | | | | 99 | Sel TU 5 | R30-9 | N/O |
| 17 | | | | 102 | Read Bus A | R33-9 | N/O |
| 18 | | | | 103 | Shield | R33-4 | N/O |
| 19 | | | | 104 | Read Bus B | R33-10 | N/O |
| 20 | Shield | R2-7 | N/O | 105 | Shield | R33-4 | N/O |
| 21 | Sel & Rdy, Mod IV | R16-12 | N/O | 106 | Sel TU 6 | R30-10 | N/O |
| 22 | Shield | R2-11 | N/O | 107 | Shield | R30-11 | N/O |
| 23 | Sel & TI On | R2-10 | N/O | 108 | Sel TU 7 | R30-12 | N/O |
| 24 | Shield | R2-11 | N/O | 109 | Shield | R30-11 | N/O |
| 25 | Sel & TI Off | R2-12 | N/O | 112 | Shield | R33-11 | N/O |
| 26 | Shield | R19-2 | N/O | 113 | Read Bus C | R33-4 | N/O |
| 27 | Sel & At Ld Pt | R19-1 | N/O | 116 | Shield | R33-3 | N/O |
| 28 | Shield | R19-2 | N/O | 117 | Sel TU 8 | R33-1 | N/O |
| 29 | Sel & Not At Ld Pt | R19-3 | N/O | 118 | Shield | R33-3 | N/O |
| 31 | Sel & Rdy Mod II | R19-4 | N/O | 119 | Sel TU 9 | R33-2 | N/O |
| 32 | Shield | R19-5 | N/O | 171 | Shield | R5-5 | N/O |
| 33 | Sel Rdy & Read | R19-6 | N/O | 172 | Write Bus 1 | R5-4 | N/O |
| 34 | Shield | R19-5 | N/O | 173 | Shield | R5-5 | N/O |
| 35 | Sel Rdy & Write | R19-7 | N/O | 174 | Write Bus 2 | R5-6 | N/O |
| 36 | Shield | R19-8 | N/O | 175 | Shield | R5-8 | N/O |
| 37 | Sel & Rewind | R5-1 | N/O | 176 | Write Bus 4 | R5-7 | N/O |
| 38 | Shield | R5-2 | N/O | 177 | Shield | R5-8 | N/O |
| 39 | Rewind & Unload | R19- | N/O | 178 | Write Bus 8 | R5-9 | N/O |
| 40 | Shield | R19- | N/O | 179 | Shield | R5-11 | N/O |
| 41 | Set Hi-Density | R19-10 | N/O | 180 | Write Bus A | R5-10 | N/O |
| 42 | Shield | R19-11 | N/O | 181 | Shield | R5-11 | N/O |
| 43 | Set Lo-Density | R5-3 | N/O | 182 | Write Bus B | R5-12 | N/O |
| 44 | Shield | R5-2 | N/O | 183 | Shield | R16-2 | N/O |
| 46 | Shield | R19- | N/O | 184 | Write Bus C | R16-1 | N/O |
| 47 | Hi-Density Lo-Dens | R19- | N/O | 192 | Write Echo Pulse | R16-3 | N/O |
| 76 | Shield | R30-2 | N/O | 193 | Shield | R16-2 | N/O |
| 77 | Sel TU 0 | R30-1 | N/O | 194 | Write Check Chor | R16-4 | N/O |
| 78 | Shield | R30-2 | N/O | 195 | Shield | R16-6 | N/O |
| 79 | Sel TU 1 | R30-3 | N/O | 196 | Write Pulse | R16-5 | N/O |
| 82 | Read Bus 1 | R33-5 | N/O | 197 | Shield | R16-6 | N/O |

Figure 55. Tape Switching Logic

COMMENT SHEET

IBM 729 II, III, IV, MAGNETIC TAPE UNITS

CUSTOMER ENGINEERING REFERENCE MANUAL, FORM 223-6868-3

FROM

NAME _____

OFFICE NO. _____

TYPE OF USING SYSTEM _____

CHECK ONE OF THE COMMENTS AND EXPLAIN IN THE SPACE PROVIDED

FOLD

- SUGGESTED ADDITION (PAGE _____, TIMING CHART, DRAWING, PROCEDURE, ETC.)
- SUGGESTED DELETION (PAGE _____)
- ERROR (PAGE _____)

FOLD

EXPLANATION

CUT ALONG LINE

FOLD

FOLD

STAPLE

STAPLE

FOLD

FIRST CLASS
PERMIT NO. 81
POUGHKEEPSIE, N. Y.

BUSINESS REPLY MAIL
NO POSTAGE STAMP NECESSARY IF MAILED IN U. S. A.

POSTAGE WILL BE PAID BY
IBM CORPORATION
P. O. BOX 390
POUGHKEEPSIE, N. Y.



CUT ALONG LINE

ATTN: CE MANUALS, DEPARTMENT 296

FOLD

9/61:5M-AG-72

STAPLE

STAPLE

IBM

International Business Machines Corporation
Data Processing Division
12 East Post Road, White Plains, New York

Printed in U. S. A. 223-6868-3