MTR-90II Transport Servo Alignment Procedure

Nothing has a greater effect on the proper functioning of the MTR-90 than the alignment of the servo system. Even if you have gone through this procedure before, please read from beginning to end before proceeding with any adjustment. Before we start, it will be helpful to review the basic principles underlying the operation of the transport.

The MTR-90 transport is a bi-directional, closed-loop servo. When a transport command is initiated, the capstan roller (that's the brown roller on the right) starts to turn. When the capstan is turning, speed and direction information are sent from the capstan motor to the CPU card. In addition, pulses from the tacho roller (the brown roller on the left) are also sent to the CPU card. The computer uses this information to calculate and generate voltages for the swing-arm solenoids. For this discussion, we will refer to these solenoids as linear motors to distinguish them from the tape-arming solenoids. The swing-arms are moved by these linear motors through the associated linkages. As the swing-arm position is changed, a potentiometer mounted under the arm's mounting shaft turns with the arm and generates a voltage proportional to the amount of movement. This voltage is used by the Reel Control Card to drive the reel motors, which then turn to control the slip between the two brown rollers and to make the tape keep up with what the capstan is doing. This process happens almost instantaneously and continues as long as tape is in motion.

This procedure requires the following tools: a small inside snap-ring pliers; a number 2 and a number 0 or 00 Vessel screwdriver (a small and a standard Phillips will do if the Vessels aren't available); 2.5mM and 3mM Allen or hex-key drivers; a spring scale capable of reading 500 grams with reasonable resolution; a voltmeter, preferably digital; a frequency counter; and two blocks to hold the swing arm assembly in the center of its travel.

PLEASE NOTE: This procedure covers the MTR 90II from "A" lot through "P" lot. For MTR-90II lots "Q" and "R" and MTR-90III, a seperate procedure has been written. Also note that this procedure does not cover adjustment of the capstan motor quadrature. Setting the quadrature is not a routine adjustment.

Parts of this procedure should be done regularly, while a few of the steps need only be done once. These will be noted. This procedure also assumes that everything in the

tape path is correctly aligned for height, azimuth, and zenith. This means that the swing arms aren't bent and the head assembly has been properly referenced on a granite block. Any errors in the tape path should be corrected before aligning the servo. References will be made to steps and diagrams in the MTR-90II manual, and the assumption is made that the manual has been read by the technician performing this procedure.

Following the instructions in section 5 of the manual, remove the transport cover plate and flip up the deck plate. CAUTION: Make sure the meter panel is folded down before lifting the deck plate or damage to the shield motor will result. Also note that one or both of the swing arm rollers may require removal to facilitate removing the cover plate. To remove the roller, use the 3mM hex key to remove the screw holding the roller assembly to the swing arm. This screw is accessible through a hole under the deck plate when the arms are at the bottom of their travel. Take care not to drop the screw or lose any shims which may be under the roller assembly. After the cover plate is off, replace the swing arm roller and proceed.

Refer to diagrams 1 and 2. Before making any adjustments, make sure all the linkages and screws are secure. CAUTION: Note that the deck plate and some of the linkage parts are cast aluminum. Be careful not to overtighten or cross-thread screws associated with these parts. Also note that the hex-head black screws are case-hardened and will break off if overtightened. Referring to the diagrams, tighten the screws at all positions A. Do this for both swing-arm assemblies. If your machine is being used with a synchronizer, these screws should be checked at 30 day intervals; otherwise, once every 90 days is sufficient.

Once these screws are secure, adjust the swing-arm spring tension. Loop one end of a string around the swing-arm roller and attach the other end to the spring scale. Pull straight towards the back of the machine until the centering marks on the swing-arm and deck plate are aligned and note the reading on the spring scale. Do this more than once and average the readings. The tension should be 460 grams for a 2" machine. If adjustment is required, loosen the double nut by holding one section and turning the other section. When the nut is loose, adjust the tension as required and tighten the nut. A pair of ignition wrenches work well for making this adjustment. Adjust the springs for identical tension measurements on both sides, +/- 10 grams. After the initial adjustment, only periodic checking at 6 month intervals should be necessary.

The next few steps require a machined bracket or block to hold the swing-arms in the center of their travel. In other words, the centering marks on the arm and the deck-plate

will be aligned. A bracket cut to fit between the inside edge of the front of the deck plate and the side of the swing-arm (2.999 inches on each side) will work. Using two brackets (one for each side) will make the adjustments go quicker.

Turn off the power to the machine and, using the extender card, extend the REEL CONTROL card (Board #1). Turn on the machine. Using the L-brackets, secure the swing-arms in the center of their travel. Refer to the diagram and find the black potentiometer located below the swing-arm assembly under the deck plate.

On the REEL CONTROL card, use the voltmeter to monitor test point 3 and ground (G). The reading should be 0 volts +/- 0.03 volts. If the reading is off, the position of the black potentiometer under the takeup swing-arm will have to be adjusted. Locate the two brackets securing the potentiometer to the frame and loosen the small screws no more than one turn. This will allow the potentiometer to be turned. Turn the pot until the voltmeter reads 0 volts. Re-tighten the screws until the pot is secure, but do not overtighten or the threads will strip. Now move the positive lead of the voltmeter to test point 1 and adjust the takeup POSition control for 0 volts.

Repeat these steps for the supply side using test point 4 for the first part and test point 6 for the second. Remove the L-brackets.

The next step adjusts the maximum and minimum swing-arm travel. Refer to the diagram and locate the limit-stop adjustment screws marked "B". These screws secure the position of the limit-stop brackets. At the limits of swing-arm travel, the tabs on these brackets contact a rubber-covered post mounted on the deckplate. To make this adjustment, monitor test point 3 (for the takeup side) or test point 4 (for the supply side. Loosen the adjustment screws for the brackets; slide the brackets toward the center as far as they will go and tighten the screws finger-tight. Watching the voltmeter, pull the swing arm down against the limit stop. As you pull the arm down, the brackets will move and the voltage will change. When the voltmeter reads 600 mV (0.6 V), stop pulling and tighten the bracket. Now do the same thing in the other direction to set the upper limit stop. Push the arm up until the voltmeter reads 600mV (0.6V) - note that the polarity will be opposite - and tighten the bracket.

Move the voltmeter to test point 1 (for the takeup side) or test point 6 (for the supply side, noting that the polarity will be opposite). With the swing arms at the bottom of their travel, adjust the appropriate GAIN pot on the front of the Reel Control card for 3.8 volts. With the swing arms

still resting at the bottom, adjust the LOWER limit pot on the front of the Reel Control card until the yellow LED indicator just turns on and continue turning in a clockwise direction for another eighth (1/8) of a turn. Holding the swing-arms at the top of their travel, adjust the UPPER limit pot until the green LED indicator just turns on and continue turning in a clockwise direction for another quarter (1/4) of a turn. This completes the adjustments on the REEL CONTROL card.

Push the swing-arms up until they lock. Both green LED indicators on the Reel Control card should be on and the amount of play in the take-up and supply arm linkages should be the same. If they are not the same, the position of the Tape Arming Solenoid should be adjusted. This is not an essential adjustment, but the play in the linkages when the arms are locked can be used as a reference for checking the integrity of the screws holding the swing-arm assembly together. To make this adjustment, loosen the screws holding the tape arming solenoid to the deck plate (these screws are marked "C" on the diagram). Move the solenoid forward or back until the amount of play in the arms is the same on both sides and tighten the screws.

Turn off the power to the MTR-90. Re-insert the Reel Control card and extend the Transport Control card. Turn on the power to the machine. Load a full 10-1/2" reel of tape on the machine and wind until the pack is equal on both sides. CAUTION: Make sure the grey ribbon cable from the tape counter is not blocking the two reel-size detectors at the rear of the deck plate. Disconnect any synchronizers being used. If an EC-101 is installed in position 9 of the lower card cage, turn off the power and remove it from the machine during the next set of adjustments. Raise the head shield. Just behind the head shield under the deck plate is a two-pin plug which comes from the bottom of the capstan motor. Carefully unplug this plug by squeezing the sides together and pulling straight out.

The next adjustment determines how quickly the reel motors follow the capstan motion by setting the voltage range fed to the linear motors which drive the swing-arms. PLEASE NOTE: If you are using 14" reels to any extent, then this adjustment should be performed with 14" reels on the machine. Locate VR1 and VR2 (or RV1 and RV2 - the screening may differ on your circuit card.) on the Transport Control card. Turn these controls full anti-clockwise and then clockwise about one-third of a turn. Press Rewind and give the capstan a good spin in the rewind direction with your hand. The tape should gradually slow down almost to a stop and keep crawling very slowly in the rewind direction. If the tape keeps moving quickly or fails to slow down after ten to fifteen seconds, press Stop and stop the capstan with your hand. Turn VR1 slightly anti-clockwise and try again.

Repeat this until the tape gradually slows to a crawl. Now similarly adjust VR2, but in Fast Forward mode.

A few comments about this adjustment are in order. The information for this adjustment comes from digital-to-analog converters fed from the data busses on the CPU card. The data is developed from capstan motor speed and direction information. During normal operation this data is used, dumped, and refreshed continuously. With the capstan motor not being driven, erroneous data could be developed by the CPU, causing this adjustment to be wrong. For that reason, the time that the capstan can turn in rewind or fast forward is limited to fifteen seconds. After that time the adjustment data are no longer valid. This is a "feel" adjustment to an extent, and where it is set depends on several factors. For example, if the MTR-90 is being used with a synchronizer, coupling the reel motors tightly to capstan motion will allow faster park and lock-up times. The price for this is faster glazing and more frequent replacement of the brown rollers. Turning VR1 and VR2 anti-clockwise makes the adjustment tighter; clockwise makes it less tight. Setting them so that the tape creeps at approximately five ips after the intial slow-down is a good starting point and should be suitable for most applications. As the rollers begin to glaze, VR1 and VR2 should be adjusted slightly clockwise to compensate. Be aware that a very small change in the position of these trimmers has a large effect.

When the adjustments of VR1 and VR2 are completed, turn off the MTR90, reinstall the Transport Control card, reconnect the capstan motor, and extend the Capstan Control card. Turn on the power and wind off the reel of tape. Remove the tape and the empty reel from the machine.

The next set of adjustments optimize performance of the capstan motor control circuits. These adjustments only need to be done once to any machine and will not change unless a component in the capstan control circuit fails. They are included because experience has shown most machines require them. Some of the adjustments presented in the MTR-90II manual are only necessary after repairs are done. They are not included in this procedure but are discussed in a seperate section on repairs. To begin, arm the servo system by pushing the swing-arms up to the lock position. Use the L-brackets to hold the swing-arms in the center of their travel. Press the STOP button. The arms will fall and rest against the L-brackets. If everything is adjusted correctly, the reel motors will not be turning.

The first adjustment is the OFFSET NULL. N.B.: This trimmer does not appear on earlier Capstan Control cards. Monitor TP 10 with the voltmeter. Press PLAY. The capstan motor should be turning at play speed. Press STOP. When the

capstan motor stops turning, verify that the voltage at TP 10 is 0V +/- 50mV. If adjustment is needed, adjust VR6.

Using the frequency counter, monitor TP 1. Verify that the FAST DAMP control (VR4) is in the center of its travel. Turn the FAST GAIN control (VR3) fully clockwise. Press FAST FORWARD. The capstan motor will spin and a reading should appear on the frequency counter. After the speed stabilizes, this reading should be approximately 51KHz +/- 1KHz. If the frequency is not in this range, adjust the FAST SPEED control on the I/O CONTROL card for the correct reading. If you are unable to adjust the speed to 51KHz using the FAST SPEED control, proceed to the I/O card adjustments below. Note the frequency; turn the FAST GAIN control (on the CAPSTAN CONTROL card) counterclockwise until the frequency counter reads 2.5KHz less. Note this frequency and then press REWIND. When the capstan motor has reached maximum speed, compare the frequency reading with that taken in FAST FORWARD. They should be the same +/- 100Hz. If required, adjust VR5. VR5 adjusts the FAST FORWARD/REWIND balance and affects the wind speed in both directions equally. If the difference is, for example, 200Hz, using VR5 to slow down the speed in the faster direction by 100Hz will subtract 100Hz from one direction and add it to the other direction, thus equalizing the wind speeds. After adjustment of VR5, use the FAST SPEED control on the I/O card to set the wind speed to 48KHz measured at TP 1 on the CAPSTAN CONTROL card.

The next step adjusts the play gain and damping. A tape with a steady 1KHz tone recorded on it is required. Before proceeding, turn off the machine and remove the transport control card. Locate switch 1-4 and switch it ON. Reinstall the TRANSPORT CONTROL card and the CAPSTAN CONTROL card. Turn on the machine and thread the tape. Monitor the output of any track (preferably a track with a steady 1KHz tone on it.) Press PLAY. The machine should come up to speed quickly and smoothly without overshooting. Press STOP. Turn the PLAY GAIN control clockwise a few turns and press PLAY again. You will reach a point where the overshoot is quite audible. Turn the PLAY GAIN control counterclockwise until the capstan just stops overshooting in PLAY.

Adjust the PLAY DAMPING control with the machine in PLAY mode. Turn the control counterclockwise until the swing-arms start to oscillate. Then turn the control clockwise until the oscillation just stops. Continue turning in the clockwise direction two full turns past the point where the oscillation stops. This completes the CAPSTAN CONTROL alignment. Turn off the machine, reinstall the CAPSTAN CONTROL card and extend the I/O CONTROL card. Turn on the machine and wind off the tape. Remove the tape and take-up reel from the machine.

The I/O CONTROL card extends the data and programs from the CPU card and converts them for use by external control devices (such as an autolocator); the I/O card also converts data and programs for use by other control cards in the machine. NOTE: Adjuustments on this card are necessary only if FAST SPEED cannot be properly adjusted, or if cueing action is erratic. The only adjustments required on this card all concern the FAST REFERENCE line. This line determines the maximum fast-wind speed and the minimum cueing speed. Adjustments to this card are described in Section 5 of the MTR 90II manual. What follows is an alternate adjustment method. When adjustments are completed, some readjustment of fast-wind speed and fast forward - rewind balance will be necessary.

Arm the servos as before by using the test jig to hold the swing arms in mid-position. Monitor TP4 and ground (TP1) with a voltmeter. Turn VR1 (Fast Speed) to maximum clockwise. Press FAST FORWARD. When the capstan speed stabilizes, adjust VR3 for 9.0 volts. Now turn VR1 counterclockwise until TP4 reads 8.3 volts. Press STOP. Press CUE. Turn the CUE WHEEL to the right or left until the yellow LED above it just starts to flash and the capstan just starts turning. Monitor TP3 with the voltmeter and adjust VR2 for 145 milliVolts (0.145 Volts). This completes adjustments on the I/O CONTROL card. Turn off the power and reinstall the card. Extend the CAPSTAN CONTROL card and verify 48 kHz at TP1 with the transport in FAST FORWARD. If adjustment is required, adjust the FAST SPEED control on the I/O card. Turn off the power and reinstall the card.

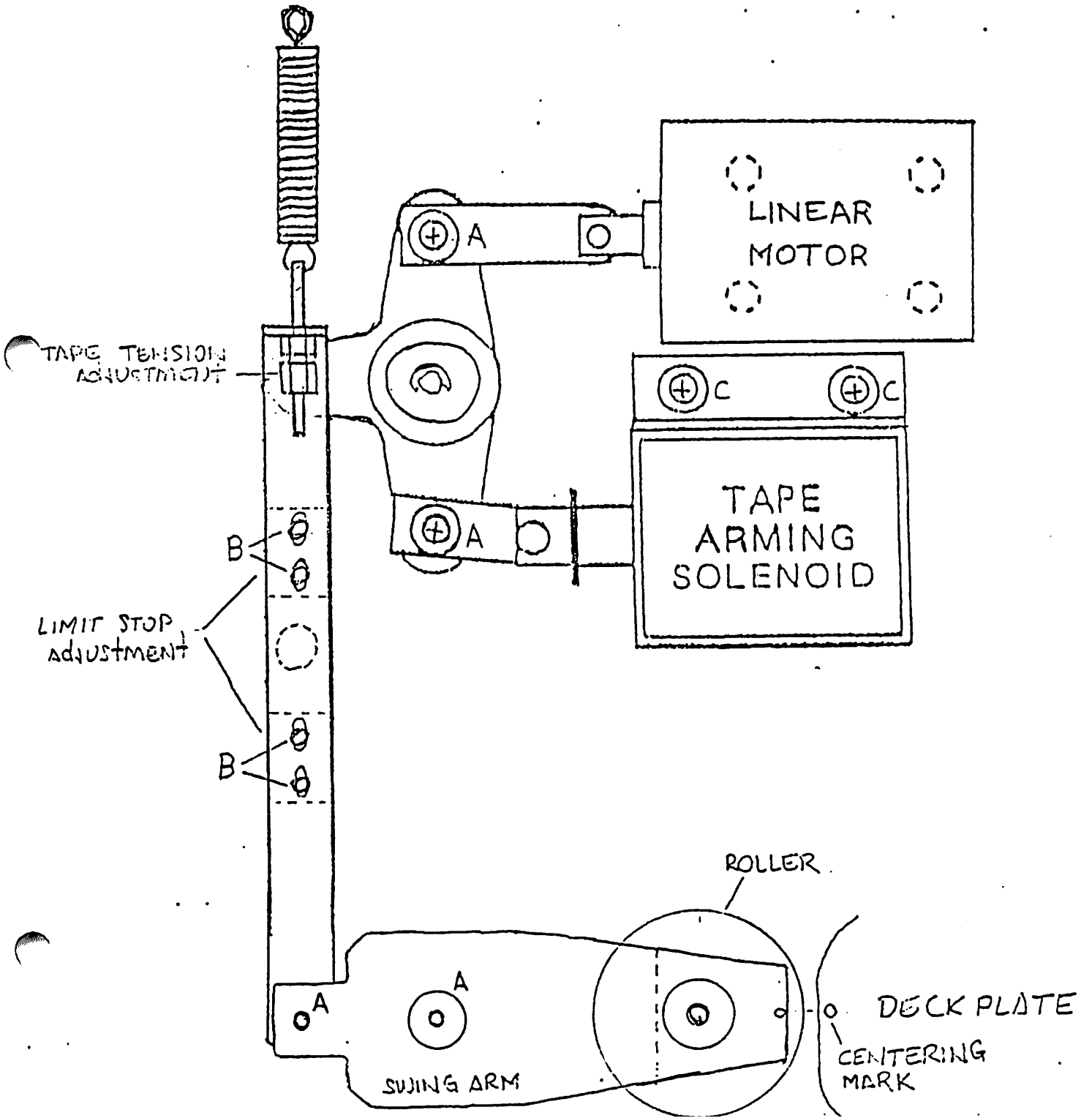
Check to make sure you haven't left any tools inside the machine. Reassemble the top covers, being careful not to cross-thread or overtighten any screws.

If you have successfully completed this procedure your MTR-90II should handle the tape smoothly and quietly.

SERVO ALIGNMENT SUMMARY OF ADJUSTMENTS

CARD		MODE	ADJUST	FOR	AT TP	COMMENTS
1	Reel	x	Swng arm pot	0 V	3,4	Arms in center
2	Reel	x	POSition	0 V	1,6	Arms in center
3	Reel	x	Swng arm limit stop	600mV	3,4	Arms at bottom
4	Reel	x	As in 3	600mV	3,4	Arms at top
5	Reel	x	GAIN	3.8 V	1,6	Arms at bottom
6	Reel	x	UPPER	Until green LED just turns on with arms at top		
7	Reel	x	LOWER	Until yellow LED just turns on with arms at bottom		
8	Tmsp	I,<<	VR1	Slow crawl	Capstan mtr unplugged	
9	Tmsp	I,>>	VR2	Slow crawl	As in 6	
10	Capstn	xI,0	VR6	0 V	10	From STOP after PLAY
11	Capstn	xI,0	FASTDAMP	Center of travel		
12	Capstn	xI,>>	FASTGAIN	Max	1	Note value
13	Capstn	xI,>>	FASTGAIN	-2.5 kHz	1	From value in step 12
14	Capstn	xI,<<	VR5	Same value in step 11		
15	Capstn	xI,>>	VR5	Same value in step 12		
16	Capstn	xI,>>	FAST SPD on I/O	48KHz	1	
17	Capstn	x,I,>	PLAYGAIN	Minimum overshoot from STOP to PLAY		
18	Capstn	x,I,>	PLAYDAMP	Two full clockwise turns from min swng arm jitter		
19	I/O	xI,>>	FAST SPD	Max	4	
20	I/O	xI,>>	VR3	9.0 V	4	
21	I/O	xI,>>	FAST SPD	8.3 V	4	
22	I/O	xI,<>	VR2	145mV	3	Adj at min CUE speed

KEY to MODEs: x=no tape; I=tape loaded and servo armed; xI=no tape loaded and servo armed; >=PLAY; >>=FAST FORWARD; <<=REWIND; 0=STOP; <>=CUE.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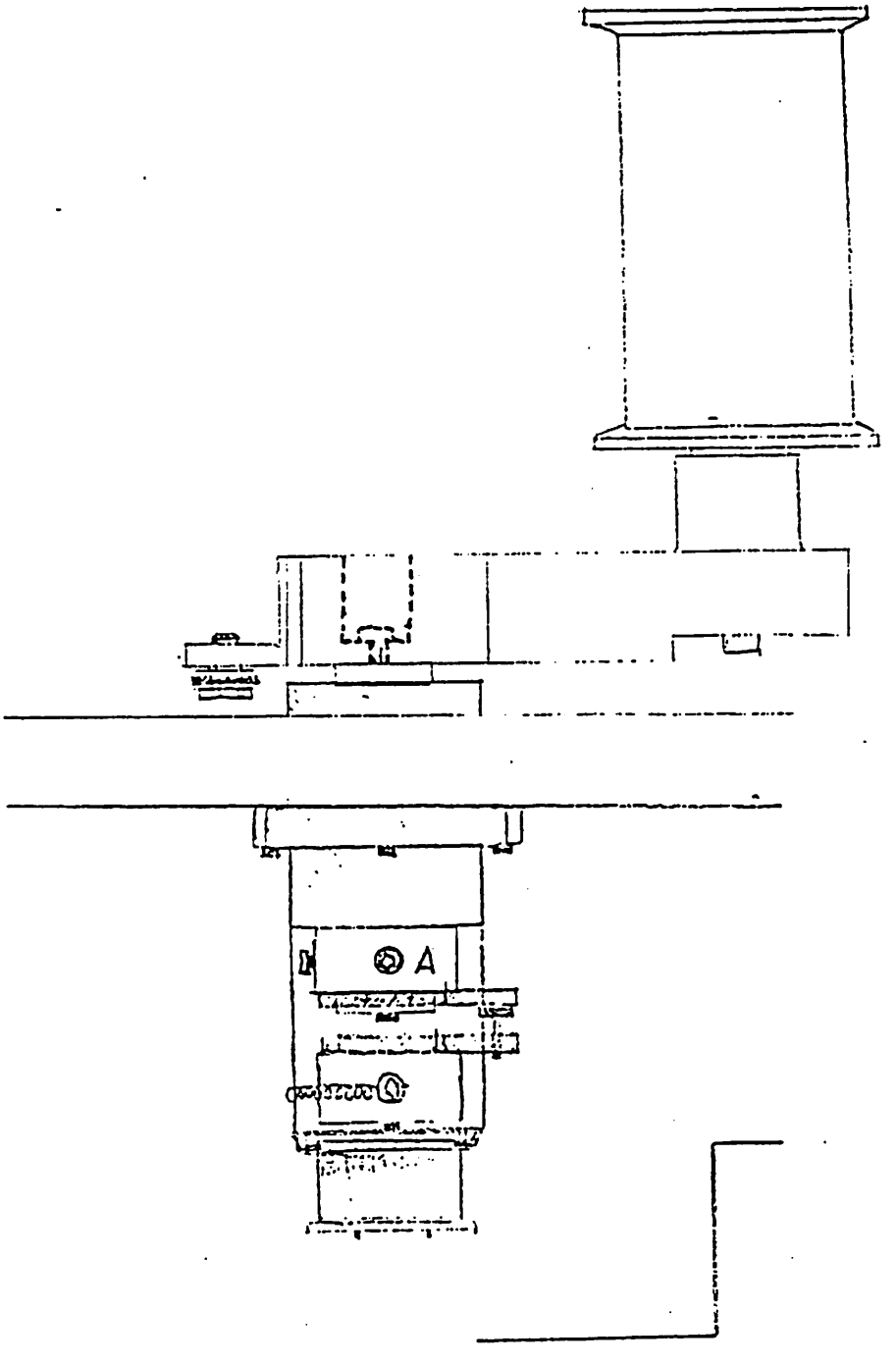
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