RECORDER AND PAPER TRANSPORT

FOR "DATASPEED"* PRINTER

DESCRIPTION AND PRINCIPLES OF OPERATION

CONTENTS PAGE

1. GENERAL

1.01 This section provides the description and principles of operation for the recorder and paper transport of the "DATASPEED" Printer. It is being reissued to incorporate recent engineering changes and technical comments not previously included. Since Issue 1 was presented in limited quantity, this is the first general distribution of this section.

1.02 References to right or left, up or down, front or rear, apply to the machine as viewed when facing it from the front or tank side.

1.03 The "DATASPEED" system forms characters from a series of nozzles (jets) located in a horizontal plane in front of the paper. An ink supply cavity, common to 40 ink nozzles and maintained at a selected pressure and temperature, enables large quantities of uniform copy to be recorded on conventional teletypewriter paper. A high potential charge on the platen, located directly behind the paper, attracts a stream of ink at high velocity from the selected nozzle. In transit, the stream breaks up into tiny droplets which are individually guided (electrostatically) in a vertical and a horizontal plane to form each character – one character every eight milliseconds at 1200 words per minute. The nozzles are selected sequentially to print an 80 character line.

1.04 A two section cover, consisting of a shallow base pan and a close-fitting upper enclosure, protects the recorder mechanism (ink manifold) and high speed paper transport mechanism (platen, line feed, and paper supply puller) from damage and contamination. In addition, it shields the operator from the printer elements with the high potential charge. With the front lid and/or the rear lid of the cover raised for inspection of the printer, the high voltage power supply is de-energized by the magnet operated reed type interlock switches. Also, power is shut off when the upper cover is lifted from the base pan. Because of the high potential in these areas, only qualified personnel should service the set. Allow a 15 minute warm-up time before initiating the printing cycle. However, if the set is shut down only momentarily, a 30 second warm-up time is required.

CAUTION: (A) BE SURE THAT THE SET IS DISCONNECTED FROM ALL POWER PRIOR TO SERVICING. (B) EXERCISE EXTREME CARE TO AVOID SPILLING INK WHEN REPLENISHING SUPPLY OR HANDLING MANIFOLD ASSEMBLY AS THE INK HAS VERY POWERFUL STAINING PROPERTIES.

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Prepared for American Telephone and Telegraph Company by Teletype Corporation

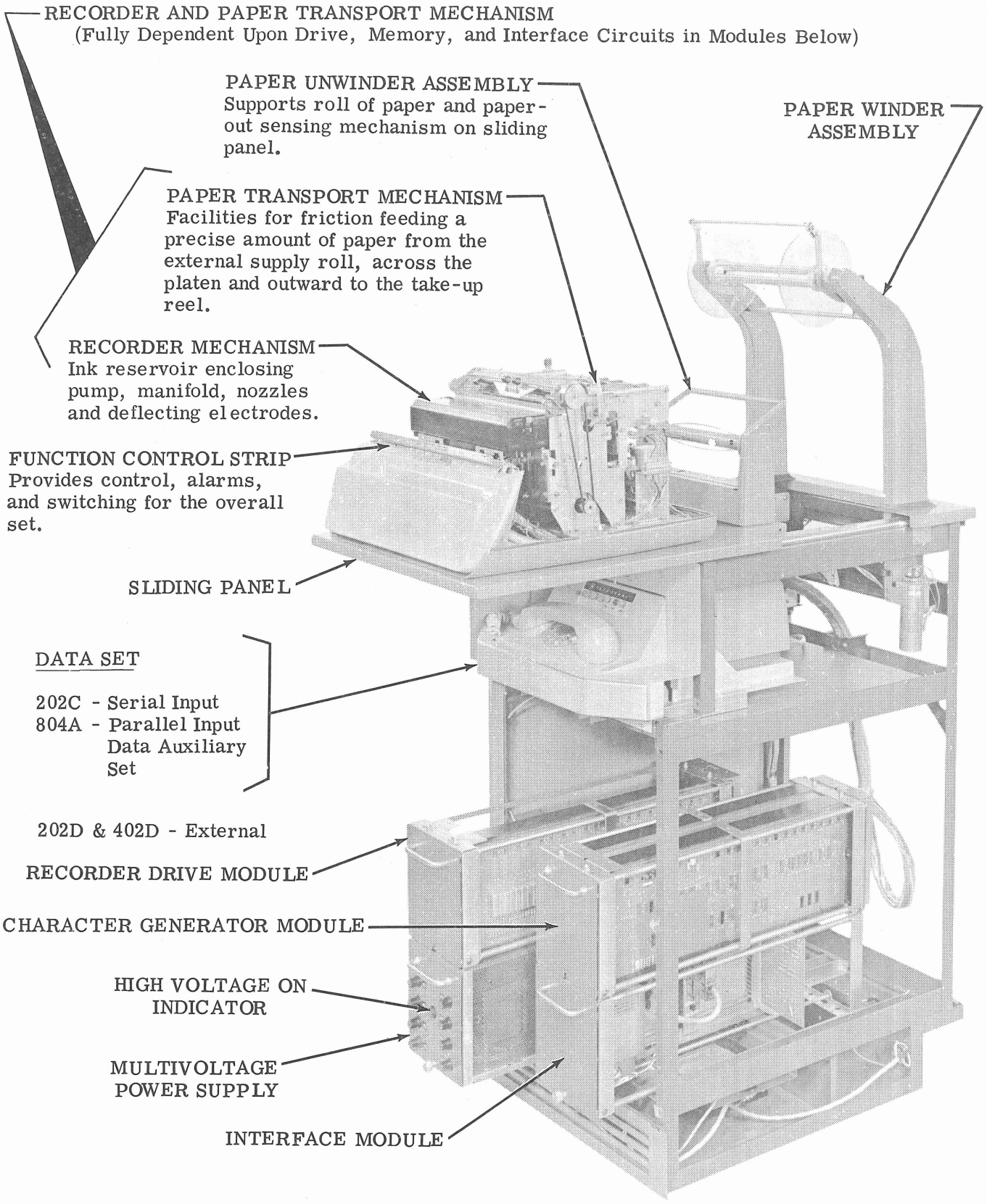


Figure 1 - Recorder and Paper Transport Mechanism With Associated Modules

AVOID TOUCHING THE ELECTRODE AREA AND TRANSFERRING INK RESIDUE TO SKIN, CLOTHING, OR OTHER MATERIALS.

1.05 The cabinet supports the nonimpact recording unit and its cover on an extendable panel (Figure 1). A shelf directly below the panel is provided for certain data or auxiliary sets. A blank panel (except for a recessed control switch) replaces the data set when an alternate signal input such as "DATASPEED" is used. All horizontal and vertical drive pulses, directing the excursion of each stream of ink, are generated by one of four modules housed in the lower section of the cabinet. A self-contained multivoltage power supply furnishes the operating potential for the various logic circuits of the system and initiates the high potential fields for the respective elements of the printer. The memory logic is contained in the character generator module with facilities for changing from Baudot to ASCII code or vice versa. The interface module houses the terminal control logic, etc. The hinged front door has a detented latch. Refer to Section 592-820-100 for cabinet variations and other printer applications. Interlock switches are attached to the front door and the rear panel to de-energize the system when the modules are to be inspected. Allow a 30 second warm-up time after the doors have been closed before the printing cycle is initiated. Refer to the appropriate sections for further description. The source of current for the ink heater, also, the drive pulses for each line feed escapement magnet are furnished by the components assembled on the chassis near the data set.

1.06 Facilities for supplying a large volume of teletypewriter paper to the recorder and transport at high speed and a motor driven take-up reel or paper winder to retrieve the printed copy from the unit are provided by the external paper handling devices at the rear of the cabinet. The paper supply reel moves forward with the cover and cabinet top panel to facilitate the installation of a new supply of paper. The paper winder is secured to the rear cabinet frame. It remains stationary as the recorder and transport, cover and paper supply are moved forward. For further information, refer to Section 592-820-112.

2. DESCRIPTION

2.01 The high speed page recorder and transport (Figure 1) is capable of printing copy at any rate of speed up to 1200 words per minute. The first application of the low noise level recording unit is designed for receive-only service. Unlike most telegraphic printing devices, this unit utilizes high potential fields to transfer ink to the paper and, with the exception of paper feeding, line feeding, and ink circulating (pump) mechanisms, it has no moving parts.

2.02 The nonimpact printing function is dependent not only upon the initiation of a high velocity stream of ink from the selected nozzle, but also upon the direction of this trace to form a character. The characters are formed on the paper at the platen. A series of 40 ink nozzles, located on a manifold in front of the platen, emit a stream of small droplets of ink which are attracted to the platen by the potential difference between the nozzles, or the emitted ink droplets, and the platen. Printing takes place from left to right across the page under control of the recorder drive circuits. The recorder drive circuits control the flow of ink with the valving electrode as well as the forming of characters with the horizontal and vertical deflection electrodes. The maximum length of line is 80 characters.

2.03 Paper for the recorder and transport is fed from a 4-1/2 inch diameter roll, through the paper transport mechanism, to the line feed mechanism which controls the paper as it passes the ink nozzles. The paper tensioner assembly pulls the printed paper from the platen and also keeps it tightly against the platen during printing.

2.04 The recorder and paper transport mechanism is approximately 12 inches wide, 9-1/2 inches high, 12 inches deep, and weighs approximately 33 pounds. It consists of the paper transport mechanism with three driving motors, an ink tank with an electrically driven 26-volt pump, 40 nozzles, and three sets of electrodes (Figure 1) aligned with each nozzle.

PAPER TRANSPORT (Pre-Paper Puller, Line Feed, and Post Paper Puller)

2.05 As the teletypewriter paper is pulled from the external supply roll to replenish the paper processed after each printing cycle, a controlled length or loop of paper is maintained within a recessed area of the transport mechanism. This loop is maintained in order to free the line feed mechanism of any jerks or drag being placed upon the flow of paper as it is stepped through the printing station. When the paper loop diminishes to a certain level, a sensing switch turns the pre-paper puller motor on to strip more paper from the roll. The loop forming switch forms the loop on initial threading of the paper over the recessed area. Closing the pressure roller bail brings the paper loop forming mechanism into action. A one-way clutch in the pre-paper puller roller assembly restricts the paper from moving in the opposite direction. The control logic is located at the right rear corner of the base.

2.06 A line feed motor and its associated control logic is used in conjunction with the magnet operated escapement assembly to move a measured amount of paper (0.167 inch) over the platen in time for the next printing cycle. The line feed assembly includes a one-way (antiback-up) clutch with a torsion rod, a friction feed roller, interconnecting tie tube, and a timing belt drive arrangement. Some manual adjustment of the line feed motor torque is provided by the rheostat on the right side frame. The line

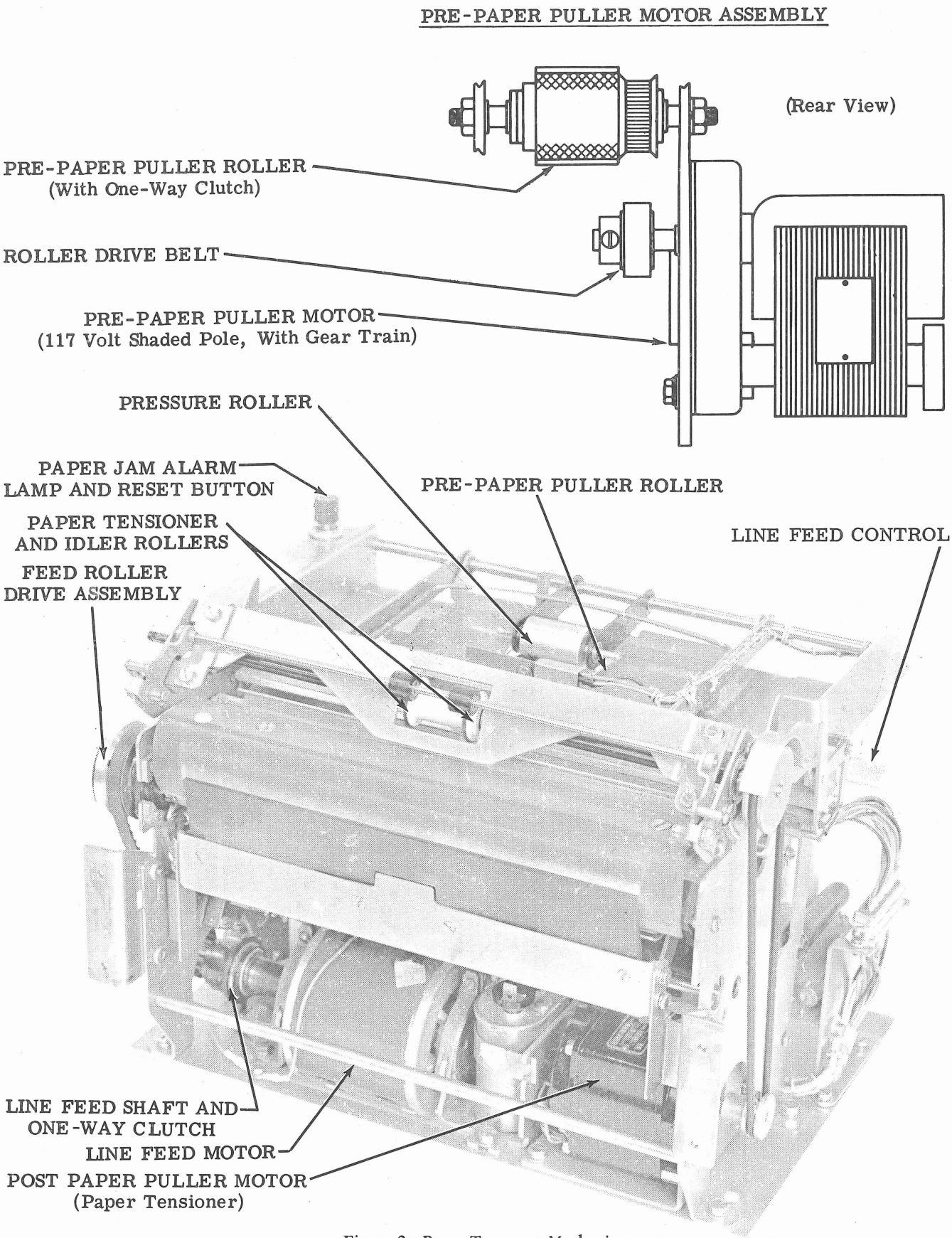


Figure 2 - Paper Transport Mechanism

feed escapement magnets control the indexing of the escapement wheel which allows the friction type feed roller to advance the paper.

2.07 A third motor, a post paper puller motor, is coupled to the paper tensioner roller and idler shaft by a round drive belt. This assembly moves the paper out of the printing station through the cabinet and toward the paper take-up reel. The motor (117 volt ac capacitor start/capacitor run) is regulated by the logic at the rear of the base.

2.08 However, it will be noted that the three paper drive motors described above are powered from three separate sources by individual control circuitry located at the right rear corner of the unit. A manual adjustment of the line feed motor torque is provided by the rheostat located on the printer right side frame. Refer to the circuit card description at the end of this section for further identification of the pre-paper puller, post paper puller, and the paper out/paper jam alarm logic.

2.09 Illumination of the printing station is provided by the flourescent lamp assembly attached toward the front of the cover. The plastic lens directs the light over the full width of the copy to be viewed.

PRINTING SYSTEM – RECORDING HEAD

2.10 The printing portion of the nonimpact page recorder consists of an ink tank with a means of maintaining consistent pressure on 40 ink nozzles, and a series of (four-element) electrodes to initiate and control the ink stream. The platen, which attracts the ink from the respective nozzles, is located on the paper transport unit. Electrical connectors enable the recording head to be removed for service. Exercise extreme care in handling to avoid stains by the ink or its residue. The ink tank, enclosing the electrodes and ink handling components, extends across the entire width of the unit and forms the front side of the paper transport mechanism.

2.11 The supply tank at the front of the unit has a liquid ink capacity of about one bottle of "INKTRONIC"® ink TP301168 (12 ounces per bottle). The manifold, with its 40 nozzles and attached character forming electrodes, is located near the top of the tank and aligns with the platen. A continuous flow of ink is lifted into the manifold reservoir by the diaphram type pump. The pump is suspended from the manifold and submerged into the ink supply. The reservoir spillway maintains a certain ink level and enables the excess ink to be returned to the tank. Individual ducts connect the common reservoir with the respective nozzle. An electric heating element, embedded in the manifold below the nozzles, warms the liguid to facilitate an even flow of ink and the printing of a legible copy.

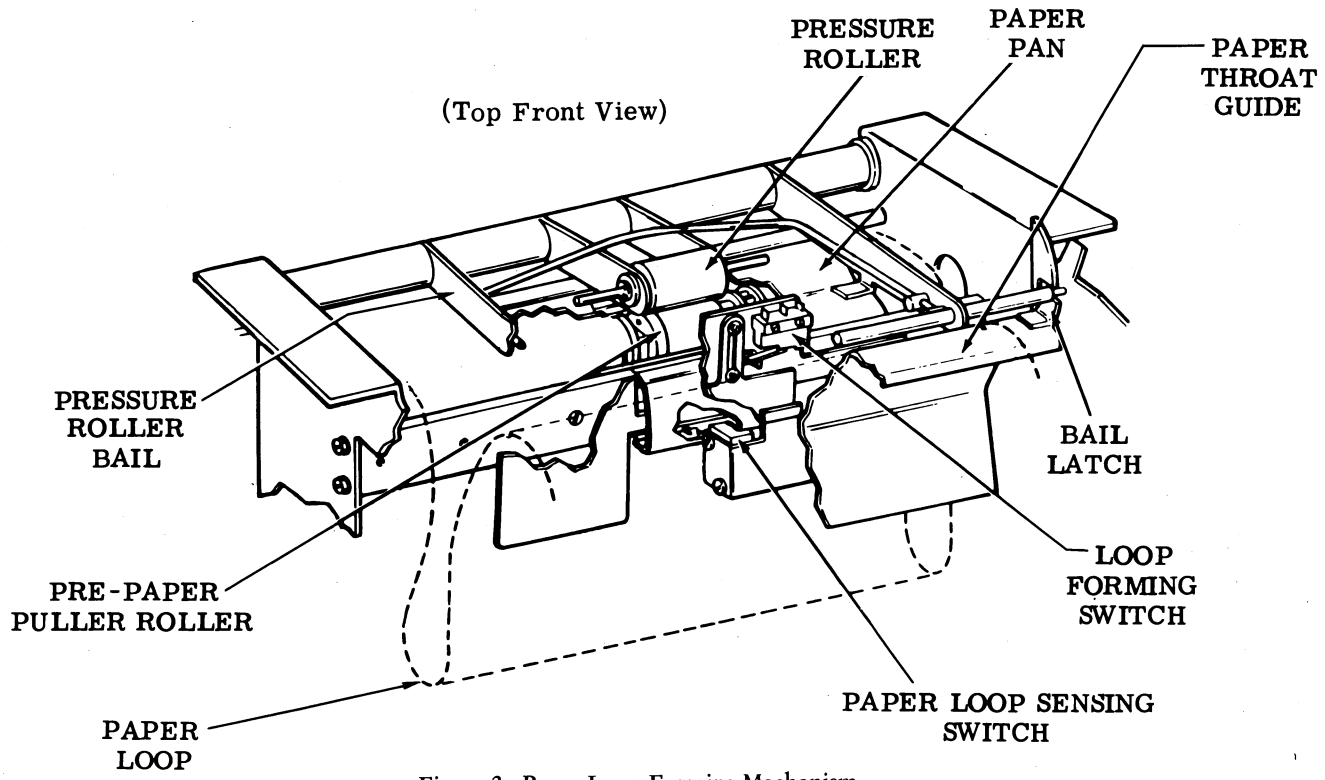


Figure 3 - Paper Loop Forming Mechanism

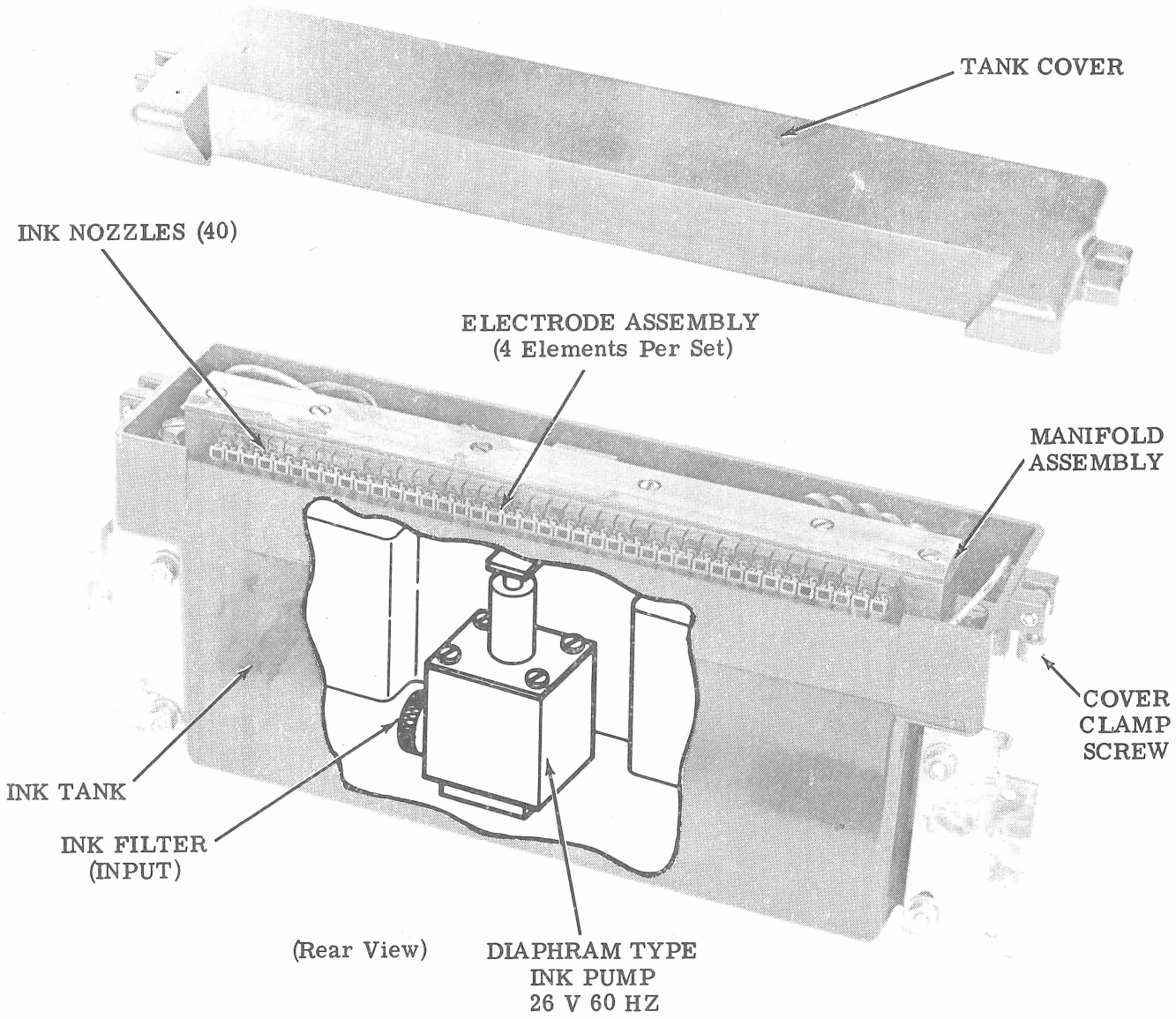


Figure 4 - Recording Head (Less Platen)

2.12 The recorder contains forty sets of electrodes in a vertical plane across the back of the manifold. Each set consists of a nozzle and one each of the following electrodes: (a) a valving element (next to nozzle with hole for ink stream), (b) vertical deflection elements (an upper and lower electrode), (c) horizontal deflection elements (left and right element separately charged with gap for ink stream), and (d) a common mask (40 openings small enough to block undesired traces of the ink stream). The respective electrodes are electrically connected to the recorder drive module (Figure 1).

3. PRINCIPLES OF OPERATION

GENERAL

3.01 The paper is pulled from a supply roll by means of a motor driven pre-paper puller roller and formed into a loop for ready feeding over the platen by the line feed mechanism. At the platen, printing takes place by means of electrostatic attraction of deflected ink droplets from the nozzles on the manifold.

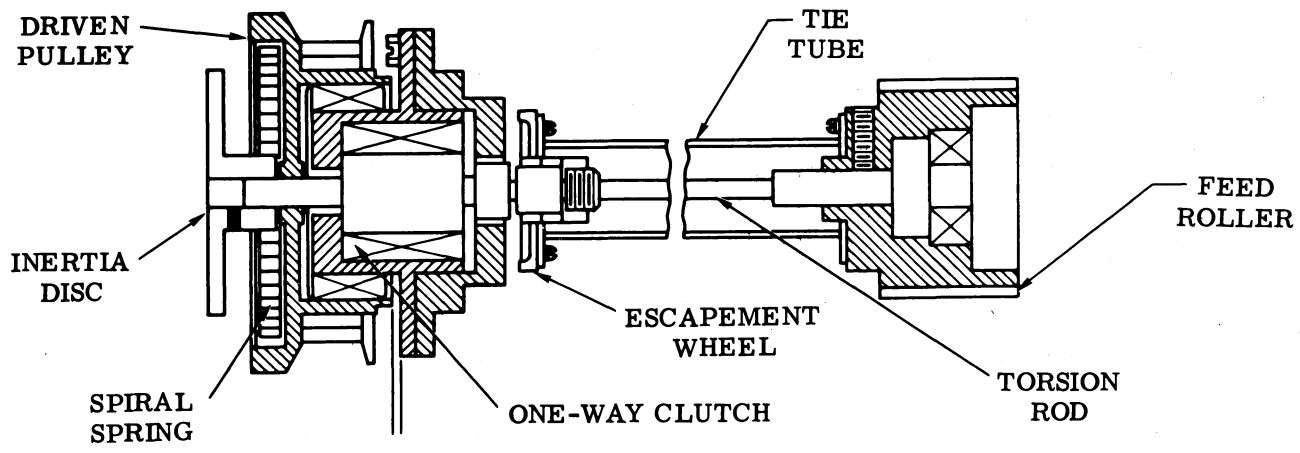


Figure 5 - Line Feed Assembly

3.02 Since the recorder is capable of printing at speeds up to 1200 words per minute, a large amount of paper must be processed. To feed paper accurately at this rate of speed and to line feed within 8.3 milliseconds requires a precise and efficient paper handling mechanism. For this reason, a separate motor (Figure 2) – controlled by a sensitive switch (loop forming) – is used to pull the paper from the roll and form it into a loop ready for instant response to the line feeding mechanism. A second switch (loop sensing) is used to turn off the flow of paper into the loop. Moving the loop sensing switch from the ON to the OFF position will activate the dynamic break feature found on the drive motor.

PAPER SUPPLY AND PAPER UNWINDER ASSEMBLY

3.03 The 450-foot roll of paper that supplies the recorder and transport mechanism is held in its unwinder assembly on a nylon bearing spindle. This assembly is a part of the cabinet, therefore, refer to the appropriate section for further description. To install a roll of paper, insert the spindle into a roll of 8-1/2 inch wide paper, 4-1/2 inches in diameter. Push the slack arm and the low paper alarm lever aside and set the spindle on its supports. Then thread the paper through the back of the cover, transport mechanism, and outward through the upper slot in the cover to the winder.

PAPER HANDLING

3.04 The paper passes across a paper guide pan, between the pre-paper puller roller and its pressure roller, into the loop forming area, through the paper guide and line feed roller assembly, across the platen and between the paper tensioner drive roller and its idler rollers. (Refer to the diagram located on the top, inside surface of the printer cover.)

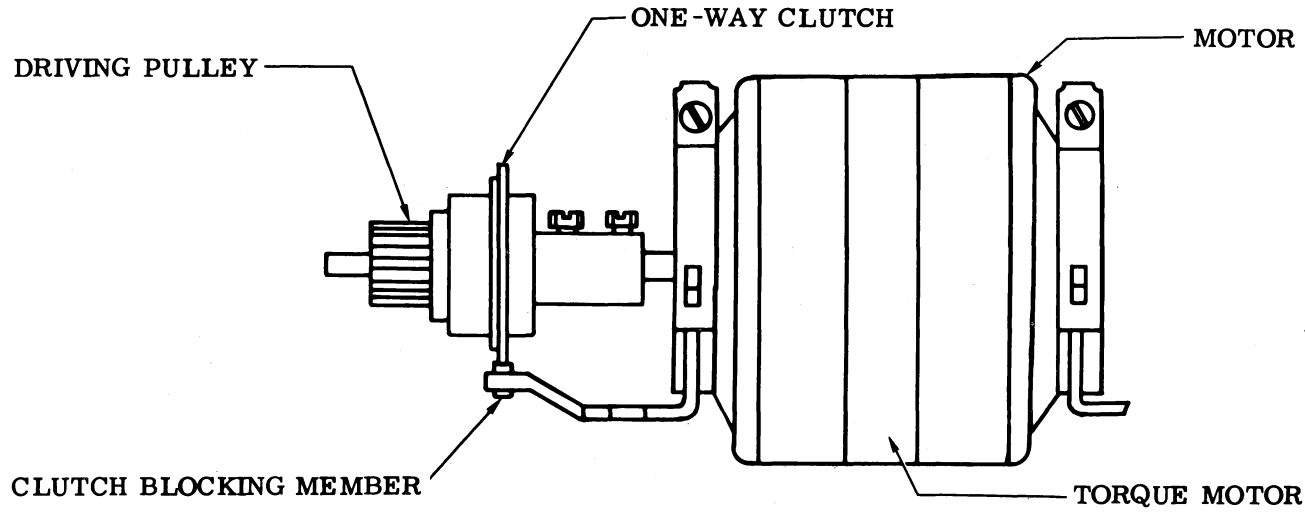


Figure 6 - Line Feed Torque Motor

3.05 The components of the pre-paper puller mechanism consist of a shaded pole motor (117 v ac) with a gear train, pulley and a timing belt to drive the pre-paper puller roller. An internal one-way clutch restricts any tendency for the feed roller to move backwards. A dual function circuit card provides the ac input and the dynamic braking control of the shaded pole motor.

3.06 Assuming that little or no paper has been moved into the paper loop storage area, the loop forming slide will be elevated. Since the slide is linked to the upper switch, the normally open contacts of this switch will be closed to turn the motor on. Note that the control of pre-paper puller motor is obtained by two small switches wired in parallel to select the required input to the circuit card (Figure 3). The upper switch is a loop forming switch that energizes the motor as the loop forming slide starts its downward travel. With the motor on, paper is fed downward to form a loop. When the loop reaches a certain level, the operating arm of the loop sensitive switch causes the second switch to take over and continue operation. Further travel of the loop forming slide deactivates the ac connection to the card and activates the dc circuit. When the loop is formed below the lower switch arm, pressure on the arm is removed and the switch opens the alternate input to the circuit board. This loop is formed to provide a ready supply of paper for the line feed mechanism. When the loop moves upward, due to line feeding, the wider diameter applies sufficient pressure to the lower switch arm to close the circuit to the drive motor. As a result of this operation, the paper is fed again. The loop is then pushed downward until the switch opens again. Should the lower switch fail to start the motor, the upper switch will. A pressure roller on top of the paper holds the paper tightly against the feed roller.

3.07 In a similar manner, the post paper puller motor retrieves the paper that is stepped across the platen by the line feed mechanism. This arrangement provides a constant tension, as far as is possible, upon the paper leaving the platen and assures that the paper is moved out of the cover for storage. Refer to the circuit board description at the rear of this section for further description of the circuit logic.

LINE FEEDING

A. General

3.08 The line feed mechanism moves the paper, from the loop previously described, over the platen on a line-by-line basis (six lines to the inch) with a maximum line feed rate of 120 operations per second. Line feeding is the most critical operation in the paper handling system. The ultimate goal is to perform a line feed operation in approximately 8.3 milliseconds. The principal components of the line feed assembly are the torsion rod, the inertia disc, an escapement pawl, the feed roller assembly, which includes the feed roller, the tie tube and escapement wheel, and the motor which provides the power necessary for operation (Figures 5 and 6). The combined forces of these components are placed in readiness by the torque derived from the motor through the one-way clutch and the regulating circuit. The escapement is modified to slow the escapement wheel prior to stopping.

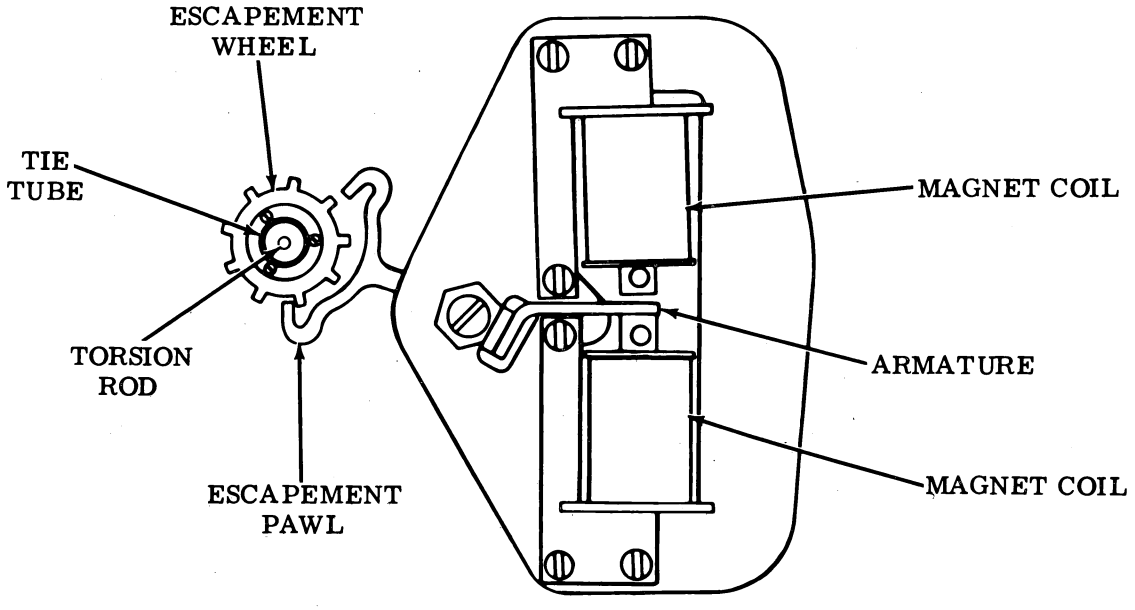


Figure 7 - Escapement Magnet Assembly

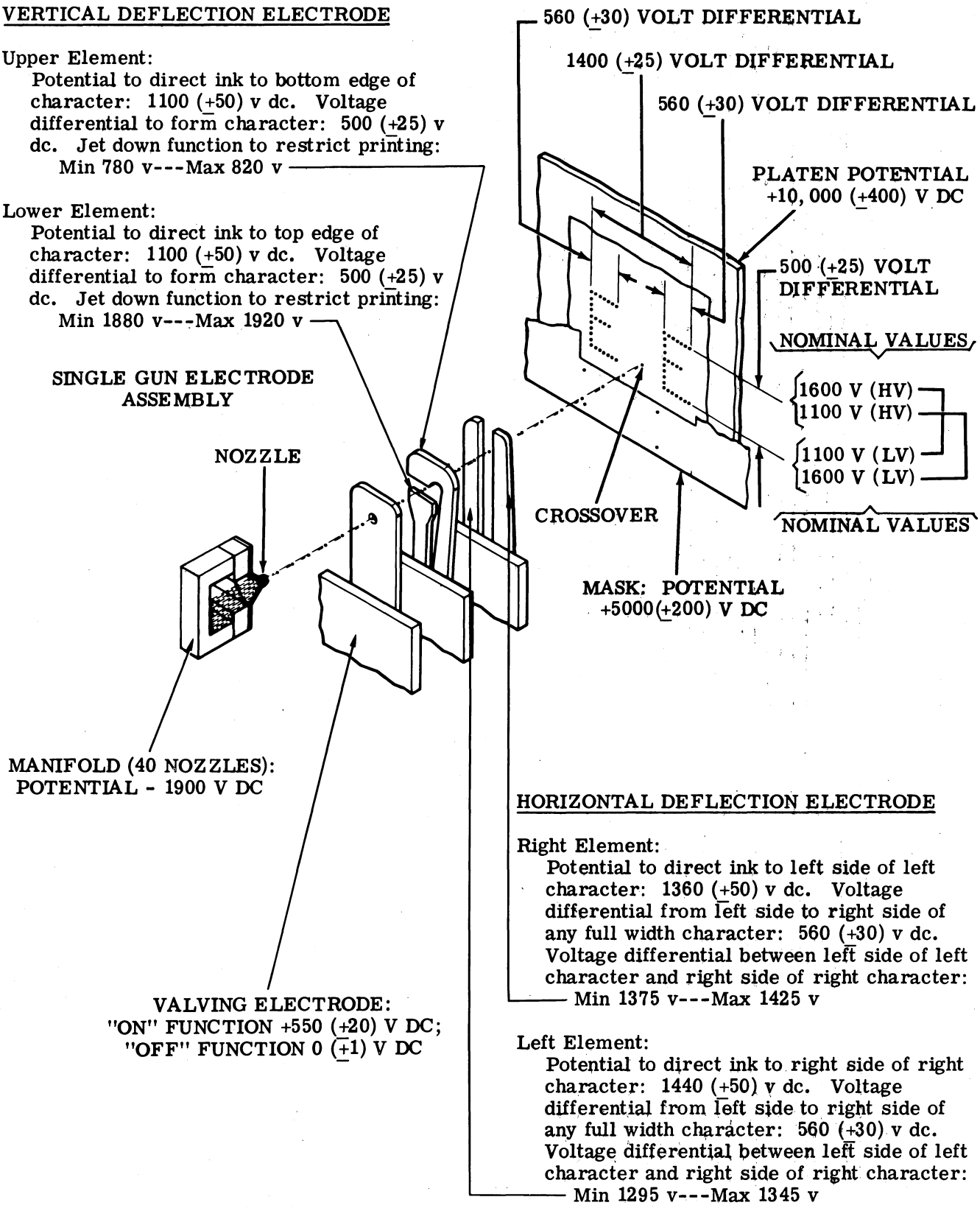


Figure 8 - Nominal Electrode Voltages

B. Components

3.09 A one-way clutch and a driving pulley are attached to the line feed motor located in the left front corner of the recorder base plate. Manual adjustment of the motor torque is furnished by the rheostat located on right side frame. This control is in series with one winding of the motor, a current limiting resistor and the line feed control logic at the rear of the transport. With this arrangement for intermittent and controlled operation of the drive motor, the torque used by the line feed assembly may be replenished as it is needed. The driving pulley is connected to a driven pulley on the line feed torsion rod through a spring and a timing belt. The torsion rod is attached to the line feed roller and the tie tube at the right end with a set screw. An escapement wheel is attached to the left end of the tie tube (Figure 5) and is held in a blocked position by an escapement pawl of the escapement magnet assembly (Figure 7).

3.10 The circuit board assembly mounted at the rear of the transport senses a line feed signal and turns on the line feed motor (Figure 6). This circuit regulates the voltage applied to the torque motor. The purpose of this motor is to apply a controlled torque to the torsion rod. The torsion rod as well as the motor shaft assembly, contains a one-way clutch (Figures 5 and 6) which prevents the spiral spring in the line feed assembly from turning backwards. The spiral spring stores enough torque in it to drive the line feed assembly until the line feed motor is able to come up to operational speed.

3.11 Note that the torque is applied to the spiral spring in the line feed assembly and the spiral spring transfers the torque to the torsion rod. The torque is then passed on to the escapement wheel through the paper feed roller and the tie tube (Figures 5 and 7). In this condition, the reactive inertia elements are approximately one-half step ahead of the escapement wheel.

3.12 The line feed cycle is initiated by a current pulse from the line feed driver of an associated unit which energizes the unoperated magnet coil, and de-energizes the other (Figure 7). The release of one coil and the energization of the other, switches the armature escapement pawl to its alternate position. As the escapement pawl reaches its alternate position, it unblocks the escapement wheel. Due to the potential energy stored in the torsion rod, the line feed operation is completed in approximately 8.3 milliseconds. To avoid excess wear on the escapement wheel, this assembly is designed so that the end result of additions and subtractions of torques developed within the assembly starts the escapement wheel rotation with an accelerated velocity, but ends its travel with a retarded velocity.

PRINTING

3.13 Forty equally spaced assemblies each containing a single ink nozzle and a set of three electrodes are in horizontal alignment with the platen. When the proper printing conditions exist, a maximum 80-character line of copy at 1200 words per minute is available. A manifold assembly supports the nozzles and contains the ducts that link each nozzle with the common ink reservoir. A continuous flow of ink (in excess of printing needs) is pumped from the supply tank into the reservoir. When the reservoir is filled to its operational level, the surplus ink drains back into the tank (Figure 4). By maintaining a constant ink level, a uniform hydrostatic pressure exists at each nozzle to assure good droplet formation. Also, a heating element located under the ink nozzles maintains the temperature of the ink above room temperature so that good density of the copy is assured. With this preparation, the ink in extracted from the nozzles in the form of small negatively charged droplets which are electrostatically deflected to form the characters on the page.

3.14 The recorder assembly consists of forty sets of printing units. Each printing unit consists of a nozzle, a valving electrode, a pair of vertical deflection electrodes, and a pair of horizontal deflection electrodes. Across the front of the print head assembly is the mask. There is a rectangular hole in the mask in front of each printing unit. Each printing unit prints two characters, one in a left matrix and one in a right matrix. A maximum of 32 points in the matrix are available for forming one character. However, one of these points must be used to end the character. Therefore, 31 points in the matrix are the maximum area available for the actual printing of one character (Figure 9).

3.15 The manifold supports the nozzles and provides a supply of ink to each of the forty nozzles. The manifold and nozzles are held at a constant negative voltage of -1900 v dc.

3.16 The valving electrode, in front of each nozzle, controls the flow of ink from that nozzle. The valving electrode derives its potential of +550 v dc (Figure 8) from the spacing drive power supply contained in cabinet. The spacing drive power supply uses the input signals, received from the character generator, to select the appropriate valving electrodes which will turn on the appropriate nozzles for printing. When the valving electrode is at the off voltage (0 v dc), no ink issues from the nozzle. When it is at the on voltage (+550 v dc), ink is extracted from the nozzle in the form of a droplet stream. The droplets, approximately 0.001 inches in diameter, pass through the hole in the valving electrode and proceed with increasing velocity to the region of the deflection electrodes.

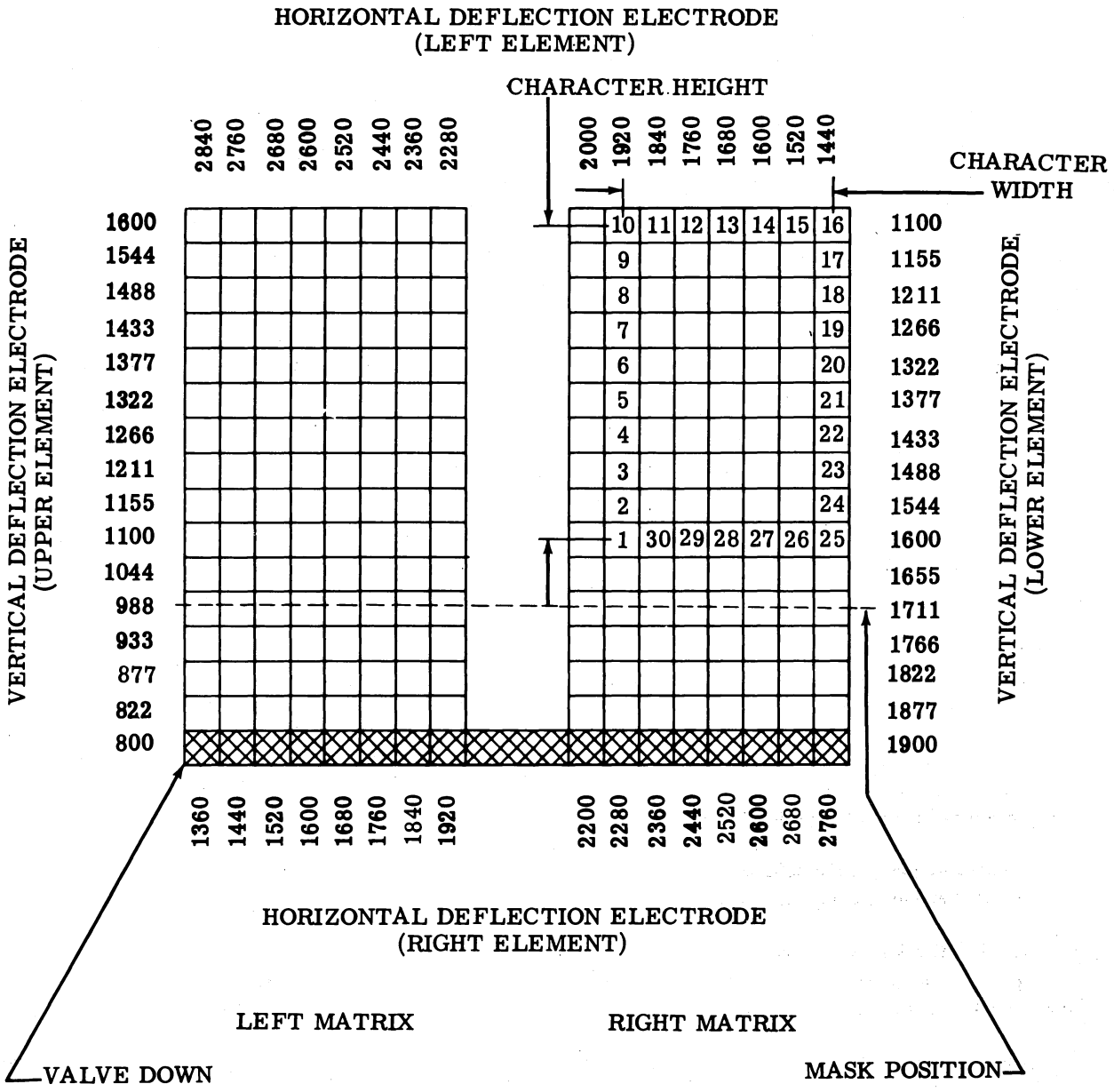


Figure 9 - Character Matrices and Deflection Voltages

3.17 The first pair of deflection electrodes which influence the path of the ink droplets are the vertical deflection electrodes. These electrodes are supplied with their deflection voltage (Figure 8) by the high voltage power supply which is modulated by the digital-to-analog converter for vertical printing contained in lower cabinet. The vertical deflection electrodes, one above and one below the jet, are arranged to form a horizontal slot. If the upper electrode is at a higher voltage than the lower, the ink droplets will be deflected upward; or conversely, if the lower electrode is at a higher voltage than the upper, the path of the droplets will be deflected downward. The average voltage of these two electrodes is higher than that of the valving electrode; therefore, the droplets are accelerated.

3.18 The next set of electrodes, the horizontal deflection electrodes, are arranged to form a vertical slot. These electrodes are supplied with their deflection voltage (Figure 8) by the high voltage power supply which is modulated by the digital-to-analog converter for horizontal printing contained in lower cabinet. Similar to the above description, the droplets can be deflected horizontally by varying the electrode voltage. The average voltage of this electrode set is higher than the previous set; so, again the ink droplets are accelerated.

3.19 In their flight toward the paper, the ink droplets encounter one more electrode, the mask. The mask derives its constant +5000 v dc (Figures 8 and 15) from the

power supply located at the rear of the paper handler. When a nonprinting condition exists, the mask acts as a shield. That is, the voltage at the deflection electrodes is such that the stream of ink droplets are deflected downward striking the lower portion of the mask. The ink droplets are therefore prevented from continuing their journey to the paper and drain down the mask to be returned to the ink supply in the manifold. When a printing condition exists, the voltage is selected to hold the mask voltage at the same average voltage established by the electric field between the previous electrode set and the platen. As far as the ink droplets are concerned, the mask is invisible. Also, the mask provides some protection for the deflecting electrodes.

3.20 Summarizing the function of each electrode, the sequence of events leading to the formation of a character can be explained as follows:

(a) The valving voltage is raised at the selected position until the ink begins to flow from the nozzle. At the same time the vertical deflection voltages are such that the ink is directed toward the lower edge of the mask until it is desired to start forming the character. Deflection voltages are applied to each of the electrode sets which will cause the droplets to hit the starting position in the given character.

(b) Then the deflecting voltages are stepped up by the stored information for the respective character so that the droplets hit the next position in the character.

(c) Continued stepping of the deflecting voltages occur until the character is completely formed.

(d) Vertical deflection is stepped so as to cause the droplets to hit the cover edge of the mask. In this manner, the ink flow to the paper is stopped.

(e) Valving voltage is reduced until the jet is turned off.

3.21 Since there are only half as many nozzles as possible characters in a line, it is necessary for each nozzle to print two characters. This is accomplished by having a bistable voltage condition in the last (horizontal deflection) electrode set. In effect, this results in two home positions for the droplets (Figure 9).

3.22 The stepping, or turning on, of the appropriate nozzle is accomplished electronically as described in Section 592-820-111. Note that 20 upper elements of the vertical deflecting electrodes receive the same stepping charge. Likewise, the 20 lower elements of the vertical deflecting electrodes simultaneously receive a different value of the stepping voltage. A second signal path supplies the upper and lower elements of the remaining 20 vertical electrodes. In a similar manner, all the horizontal electrodes are charged simultaneously. However, the ink nozzles are conditioned separately and only the selected nozzle will initiate the printing with the adjacent nozzle made ready for the next two characters. The respective valving electrode that is brought up to +550 volts will cause the ink, which is negatively charged at -1900 volts, to flow from its nozzle. The platen on the transport assembly, supported by the positive charge on the various electrodes, attracts the droplets toward the paper.

3.23 Referring to the block diagram (Figure 10), it will be noted that the nonimpact printing mechanisms (recorder and paper transport) are dependent upon various drive, control and interlock circuits which are ultimately linked with the interface circuitry. Also the paper supply and winding mechanisms are external to the actual printing mechanism.

3.24 To reduce the complexity of the electronics required to produce such control signals, a basic dot matrix pattern is used to build up all printed characters. Figure 8 shows how this dot pattern is used to build up the letter E using a dot pattern of seven dots wide and 10 dots high. In printing, the ink jet is directed to a given pattern dot position, remains there for a specific time interval (250 microseconds), and is then directed to each succeeding dot position for a similar length of time until the complete letter has been printed. The total time required to print a character is, therefore, 250 microseconds times the number of dots needed to make up the letter. A maximum of 31 dots for each character is possible in the printing system.

3.25 If each nozzle and set of electrode assemblies were to print one character, a total of 80 nozzles and electrode assemblies would be required to print a line of 80 characters across the page. However, each nozzle and set of electrode assemblies is called upon to print two adjacent characters so that only 40 sets are necessary to print a single line. This is why the matrix pattern, shown in Figure 8 shows two adjacent E s and the spacing relationship between them.

3.26 A fixed amount of time is available for printing each character. At 1200 words per minute this is 8 milliseconds. However, characters built up from relatively few dots in the matrix pattern, such as the letter I, will be finished printing early and a wait period occurs when, even though the ink jet is turned on, it must not print. This is accomplished by deflecting the ink jet downward to a considerable distance below the printing area where it strikes the mask shown in Figures 8, 11, and 12. Ink that hits the mask cannot reach the paper, so deflecting the ink downward is equivalent, in effect, to turning off the ink jet. This down position is referred to as jet-down or on-the-mask. Whenever a jet is turned on by the valving electrode (ink flowing) but is not printing, it is directed toward the mask. This situation

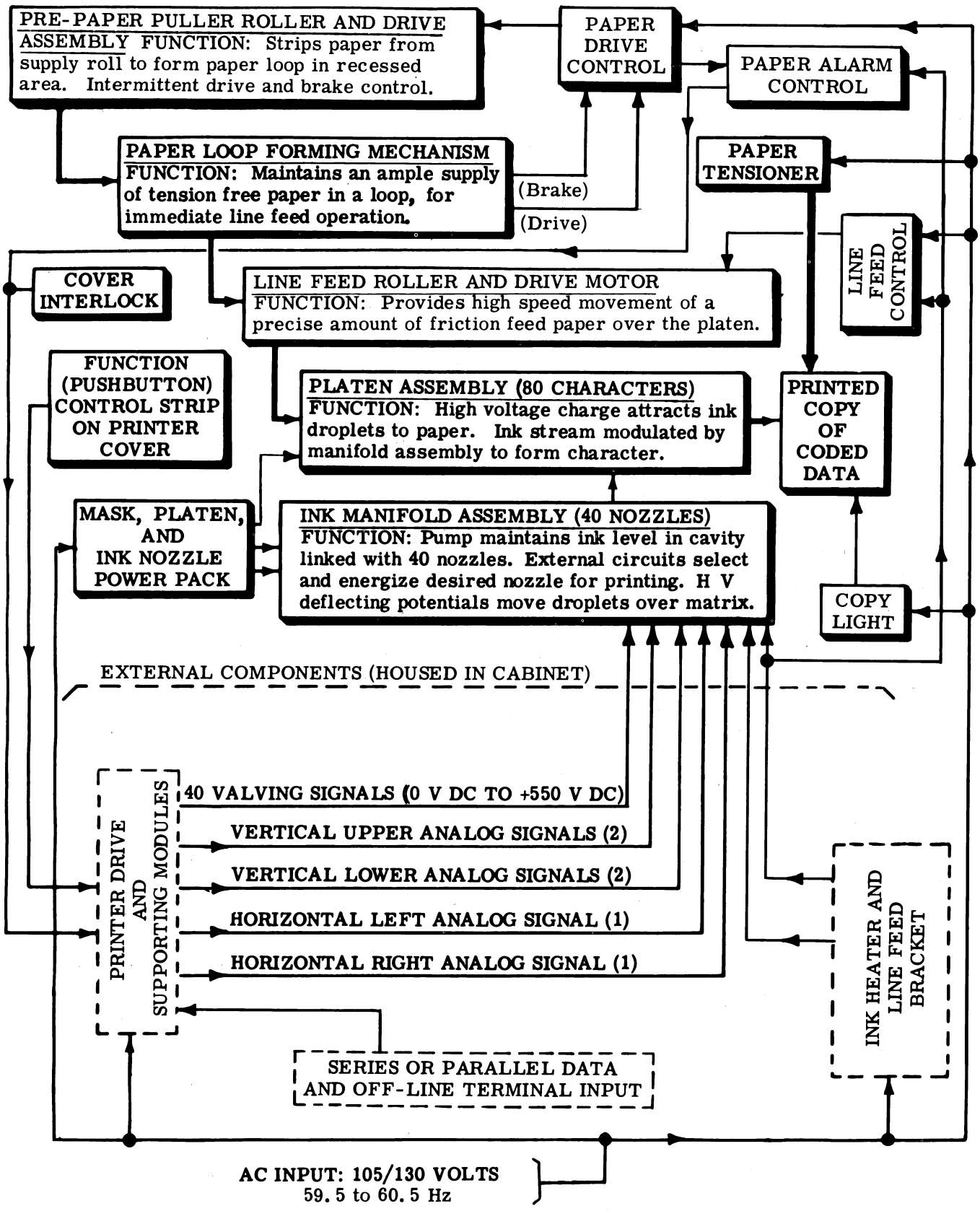


Figure 10 - Block Diagram of the Nonimpact Printing System for the Page Recorder and Paper Transport Mechanism

occurs at three different times in the printing process: First, during the time allowed for ink to start flowing, but before printing has begun; second, after a left character has been printed but before a right character has started; and third, after printing has been completed and during the time allowed to turn off the ink jet.

3.27 To print a line of characters from left to right, each of the 40 ink jets could be turned on in successive order. Thus, the first jet could be turned on, print two characters followed by the second jet to print the next two characters, and so forth. Each individual jet prints first a left and then a right character until the entire line is printed. The return to starting position for a new line is called reset and is initiated by a CARRIAGE RETURN (reset) signal.

3.28 To understand the character signals which must be supplied as input signals to the printer drive for providing the required vertical and horizontal deflection at the electrodes, refer again to Figure 11. This basic matrix pattern shows 12 possible positions above the zero position. These 12 vertical locations are conveniently represented by a 4-bit binary code, as shown to the left of the matrix pattern. Such a code can give a maximum of 15 combinations. The seven horizontal positions are represented by a 3-bit binary code, as shown above the matrix pattern. Any position in the matrix pattern may be located by specifying four vertical bits and three horizontal bits.

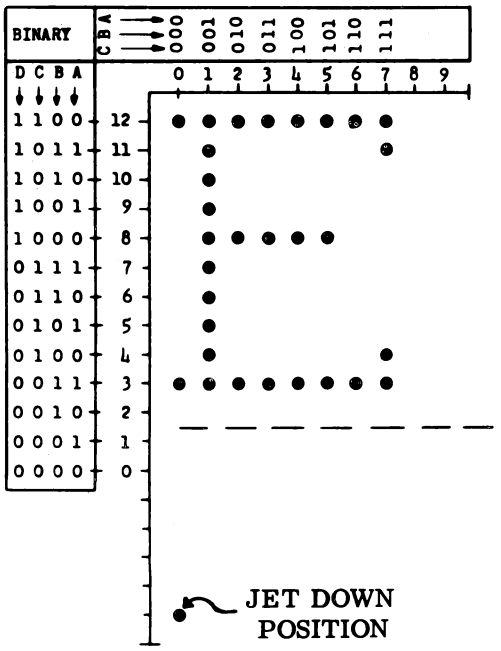


Figure 11 - Matrix Pattern

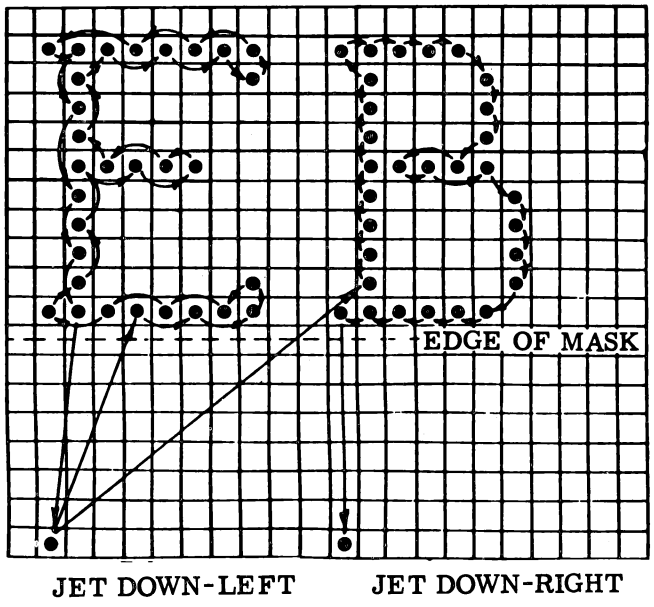


Figure 12 - Basic Tracing Pattern of Typical Electrode Assembly

3.29 A separate signal is provided to control printing the left or the right character from a single jet. This signal is called LEFT/RIGHT SHIFT signal. Also a separate signal must be provided to control the jet-down (on-the-mask) or the jet-up (printing) positions. Refer to Section 592-820-111 for a description of the circuits and timing requirements for the recorder drive signals.

3.30 The teletypewriter paper, which is held taut against the platen by the paper tensioner mechanism, represents the ultimate goal for the negatively charged ink droplets. The platen derives its +10,000 v dc from the power supply located at the rear of the paper transport mechanism (Figures 2 and 8).

3.31 The recorder enclosure houses the ink supply, the (vibrating-diaphram) pump and the ink manifold. The (26 v) pump, operating in the ink reservoir, raises the ink to the manifold where it is drawn through a nozzle jet when valving potential appears at a valving electrode. Correct viscosity of the ink is maintained by a thermostatically controlled heater located in the ink container. This heater-thermostat arrangement maintains the temperature of the ink at a constant 130 degrees fahrenheit.

3.32 The ink pump is a magnetic actuated vibrating diaphram type which operates at a rate of 60 hertz (Figure 4). This rate is achieved by half-wave rectification of the 26 volt ac input to the pump magnet. The pulsating dc potential improves the mechanical cycling time of the pump. The self-contained pump assembly consists of a housing, a coil, a moving plunger (armature) and a vibrating diaphram.

The housing is the enclosure for the assembly and supports for the core. The coil is connected in series with the half-wave rectified 26 volt ac input to provide the pulsating electromagnetic field. This field will actuate the armature, which is coupled to the diaphram to provide the pump action.

3.33 For filtering purposes, the ink inlet to the pump is covered with a screen which is secured by the filter retainer. The retainer is used as a reference point to gauge the ink level. When the filter retainer is not completely covered add more ink. The capacity of the tank is one bottle of ink – do not replenish the ink supply with more than 1/2 bottle unless the tank is drained, cleaned and refilled.

3.34 When the manifold temperature falls below 130 degrees F, the contacts of the thermostat close to forward bias the gate circuit of the triac. With the triac turned on, 26 volts ac is directed to the ink heating element until the ink temperature reaches 130 degrees F. Then the thermostat contacts are opened and the triac becomes nonconducting. A second thermostat, with a manual reset button, is placed in one leg of the 26 volt ac input to the heater and the pump. Should a malfunction occur in the ink heater thermostat which might cause the ink temperature to reach 160° F, then the second thermostat would open to protect the ink supply.

3.35 The ink used in the nonimpact printing process contains a violet toner and organic liquids. Exercise extreme care in handling to avoid any possibility of the ink or its residue coming into contact with clothing, skin, or most plastics. The violet toner has powerful staining characteristics, therefore, the ink tank cover and the doors of the cover over the unit should be well seated in the recessed area provided to seal the components.

PAPER TENSIONER MECHANISM

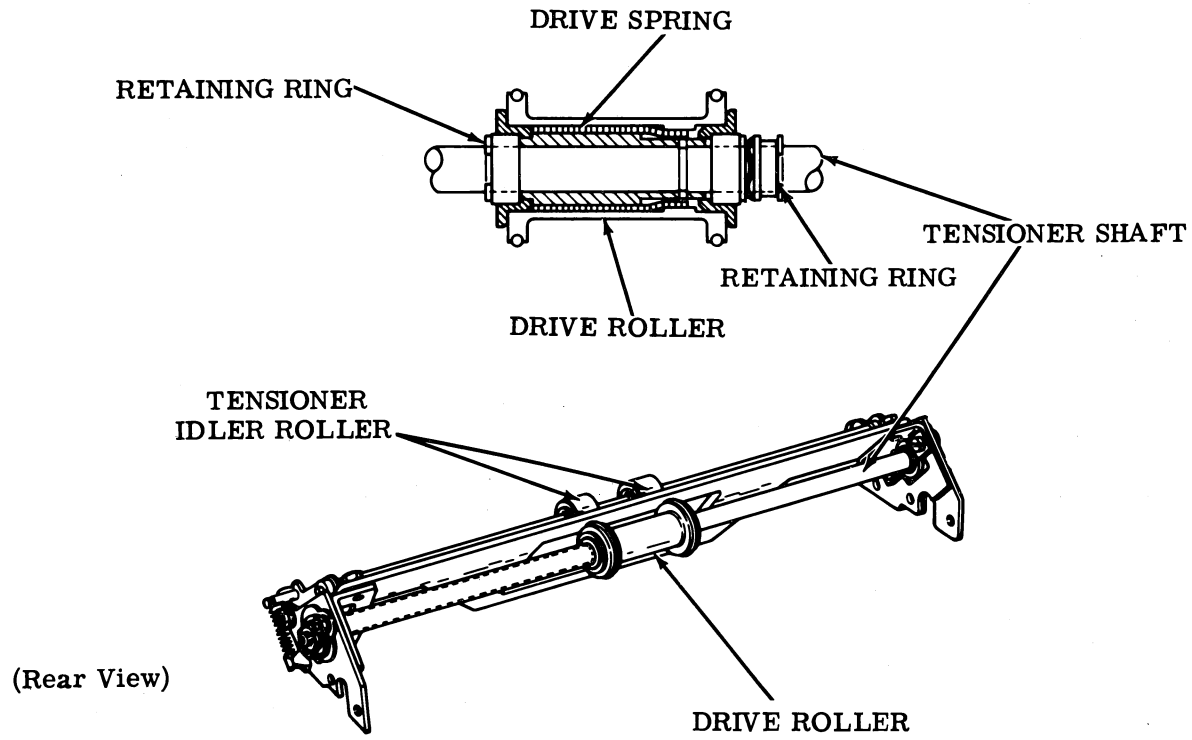
3.36 The paper tensioner mechanism (Figure 13) consists of a drive roller and a pressure roller. The drive roller derives a constant torque through an internal overrunning spring clutch. The spring clutch is secured to a continuously rotating shaft. The tensioner provides for the instant take-up of the printed copy. In addition, it provides a positive drive to move the paper outward through the slot in the cover. The rapid take-up feature of the tensioner tends to maintain a taut paper condition in the printing area during most of the feeding cycle. The drive roller is confined to the center of the tensioner shaft by two retaining rings, one at either end of the drive roller. Because the drive roller is not directly fastened to the shaft, which continually rotates, it is allowed to slip around its drive spring keeping the paper taut during the printing cycle. During the line feed cycle, the torque in the drive spring rotates the roller with a power take-off effect. This power take-off keeps the paper taut throughout most of the line feed cycle.

3.37 Continuous rotation of the tensioner shaft is maintained by the direct connection of the driving belt to the shaft driven pulley from the drive pulley. The torque for the paper tensioner is derived from the separately excited motor (Figure 13). The capacitor start-capacitor run motor (1550 RPM) is located at the lower right corner of the transport mechanism. This motor is independent and not regulated by separate or accumulated line feed drive pulses.

3.38 A paper damper, consisting of two rollers (near each edge) engage the paper after it leaves the printing area. The damper integrates the stepping motion of the line feed mechanism into a smooth continuous motion thereby restricting the noise to the area within the cabinet.

MULTIVOLTAGE – HIGH POTENTIAL POWER SUPPLY

3.39 The high voltage electrostatic charges used on three elements of the manifold assembly are obtained from the self-contained (high-potted) power supply located at the left rear corner of the printer. The "snap-on" high voltage regulator assembly distributes the proper output by means of a well insulated divider and current limiter. The power supply consists of a potted transformer (167 peak v ac primary/2500 peak v ac secondary), rectifier, and filter circuits centered around a common output terminal. With respect to this terminal, a half-wave rectifier (lower section Figure 15) and associated filter provides a -2500 v dc output for connection to the high voltage regulator assembly linked to the manifold nozzles (Figure 14). In a similar manner, a voltage doubler and filter has its negative lead attached to the common terminal to provide a +5000 v dc output for the mask element. A second voltage doubler configuration draws upon the 5000 v ac peak potential from the previous doubler input for its +10,000 v dc output to the platen.



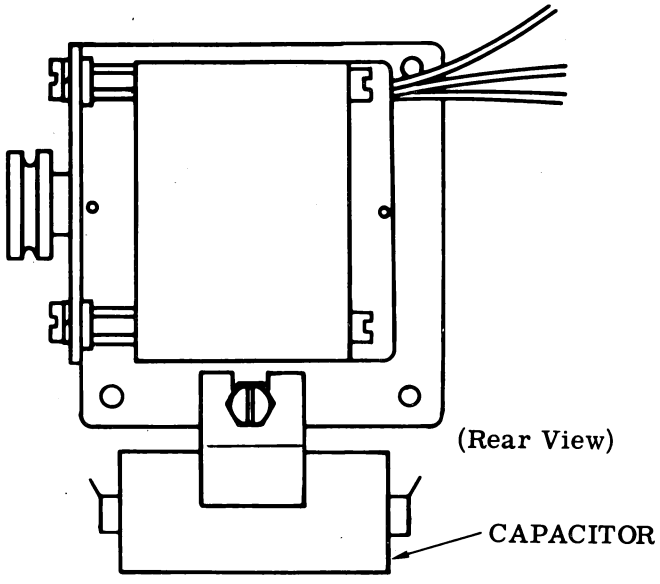


Figure 13 - Paper Tensioner Drive Motor

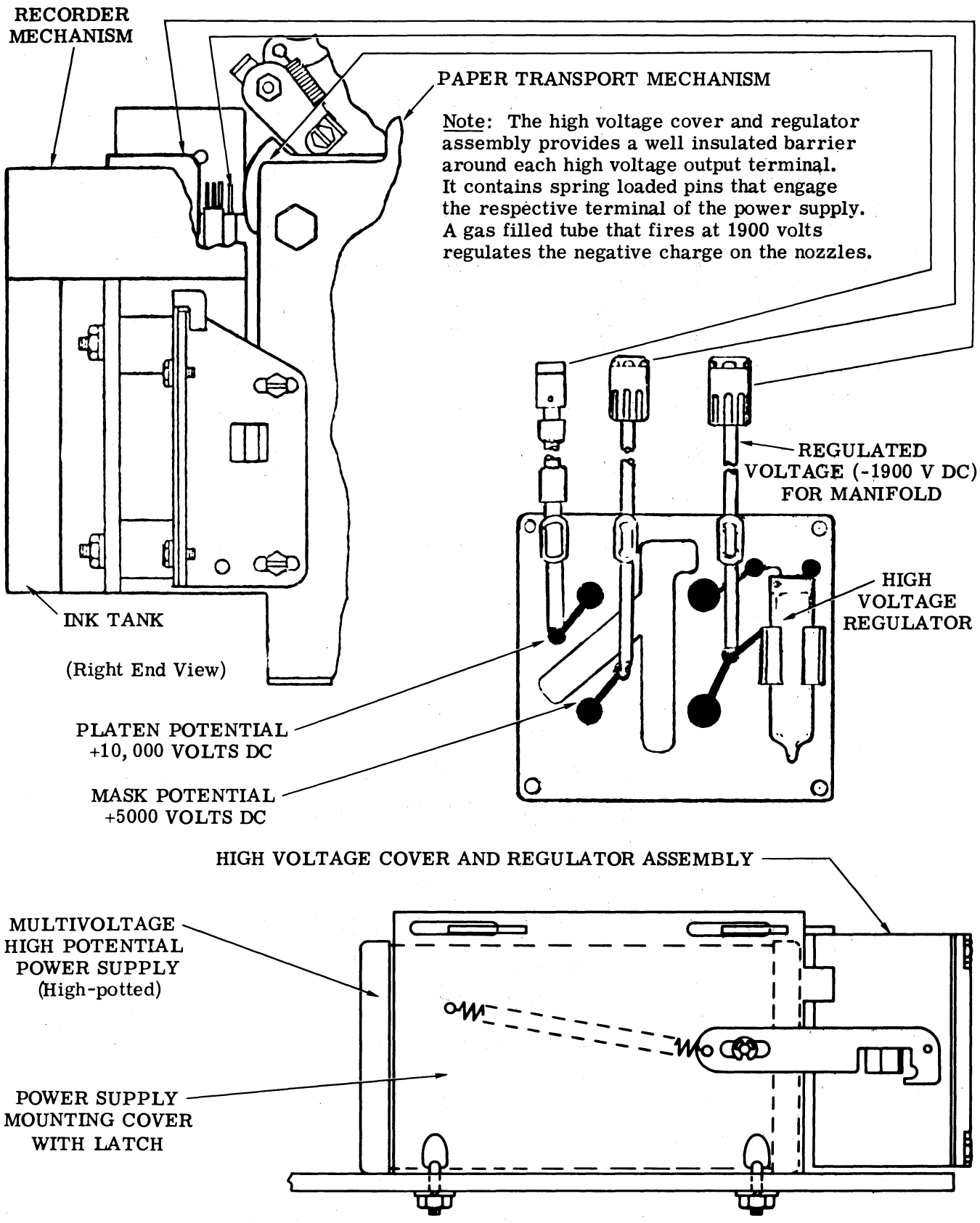
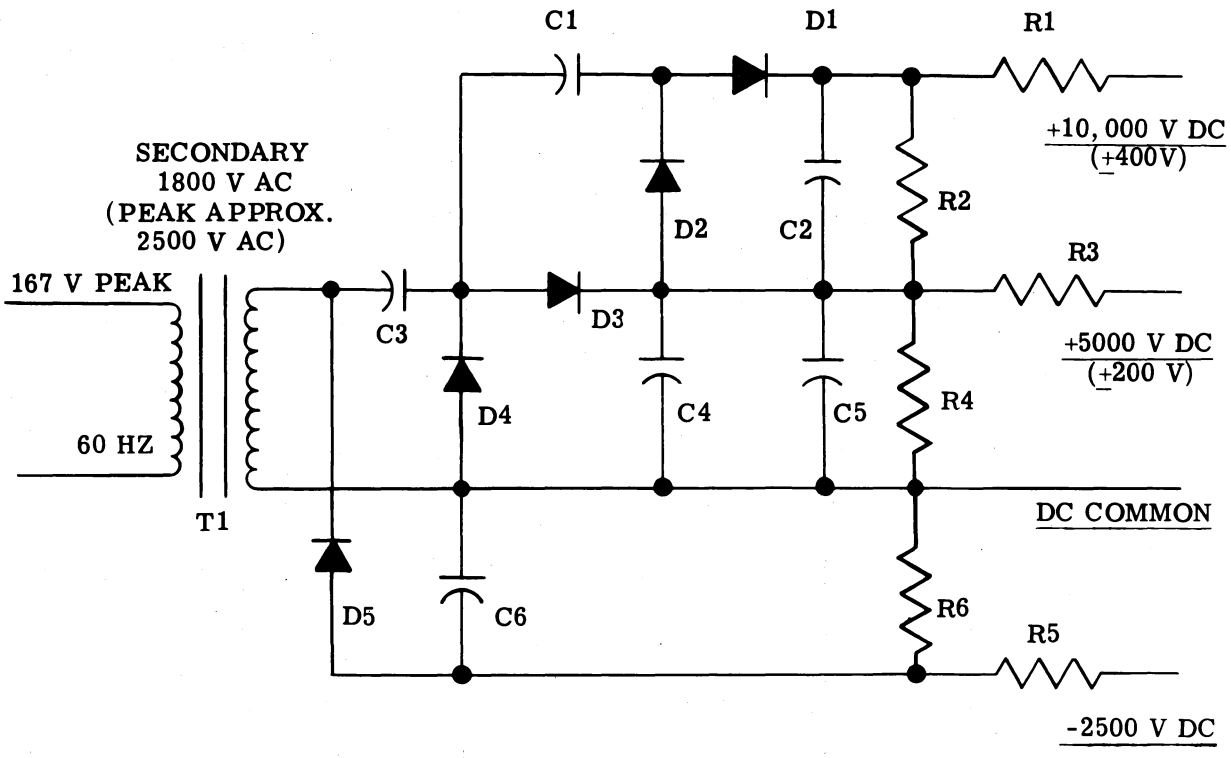
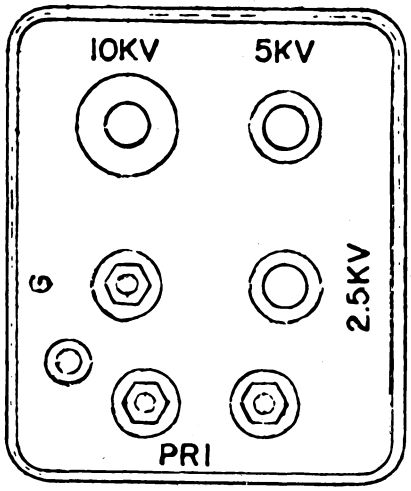


Figure 14 - Distribution of Electrostatic Charges to the Platen, Mask, and Nozzles





(Top View)

Figure 15 - Platen, Mask, and Ink Nozzle Multivoltage High Potential Power Supply

PRE-PAPER PULLER MOTOR CONTROL AND DYNAMIC BRAKE – CIRCUIT BOARD TP330433

Purpose

Circuit board TP330433 is used in conjunction with the pre-paper pulling mechanism that strips the paper from the external supply roll and places a limited quantity of the paper in storage for the line feed mechanism. This storage loop serves to isolate the line feed (step-by-step) mechanism from the inertia of the paper roll. Loop size is regulated by a sensing switch which activates the circuit board as follows: (a) With one input of the board energized, the shaded-pole motor is turned on until a total of approximately 20 line feed steps are stored in the paper loop, and (b) with the second input energized in place of the first, a dc potential is impressed across the motor to provide the dynamic braking function. A rectifier, charging a large capacitor during a portion of the feed cycle, provides the source of dc voltage that restrains the rotor travel when the power is off.

Description

This circuit board plugs into the receptacle assembly (top level) located in the lower right corner of the transport base. The board is energized by a 117 volt ac, 60 Hz power input with its control inputs at terminals E and M. As the paper loop diminishes in size input E is energized by the loop sensing switch to forward bias triac TR-2 and start the motor. In a similar manner, triac TR-1 is energized when the paper loop is depleted below a certain level and capacitor C1 discharges through TR-1 to stall the motor.

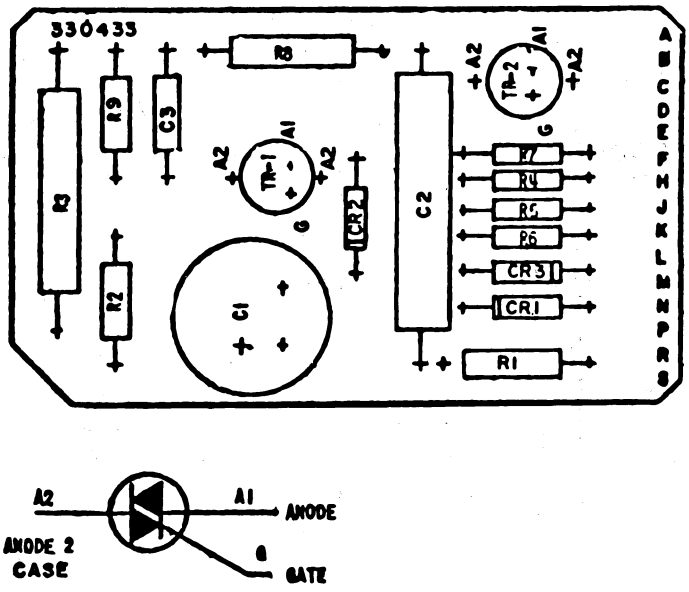


Figure 16 - Pre-Paper Puller Motor Control and Dynamic Brake Circuit – Actual

PRE-PAPER PULLER MOTOR CONTROL AND DYNAMIC BRAKE (continued)

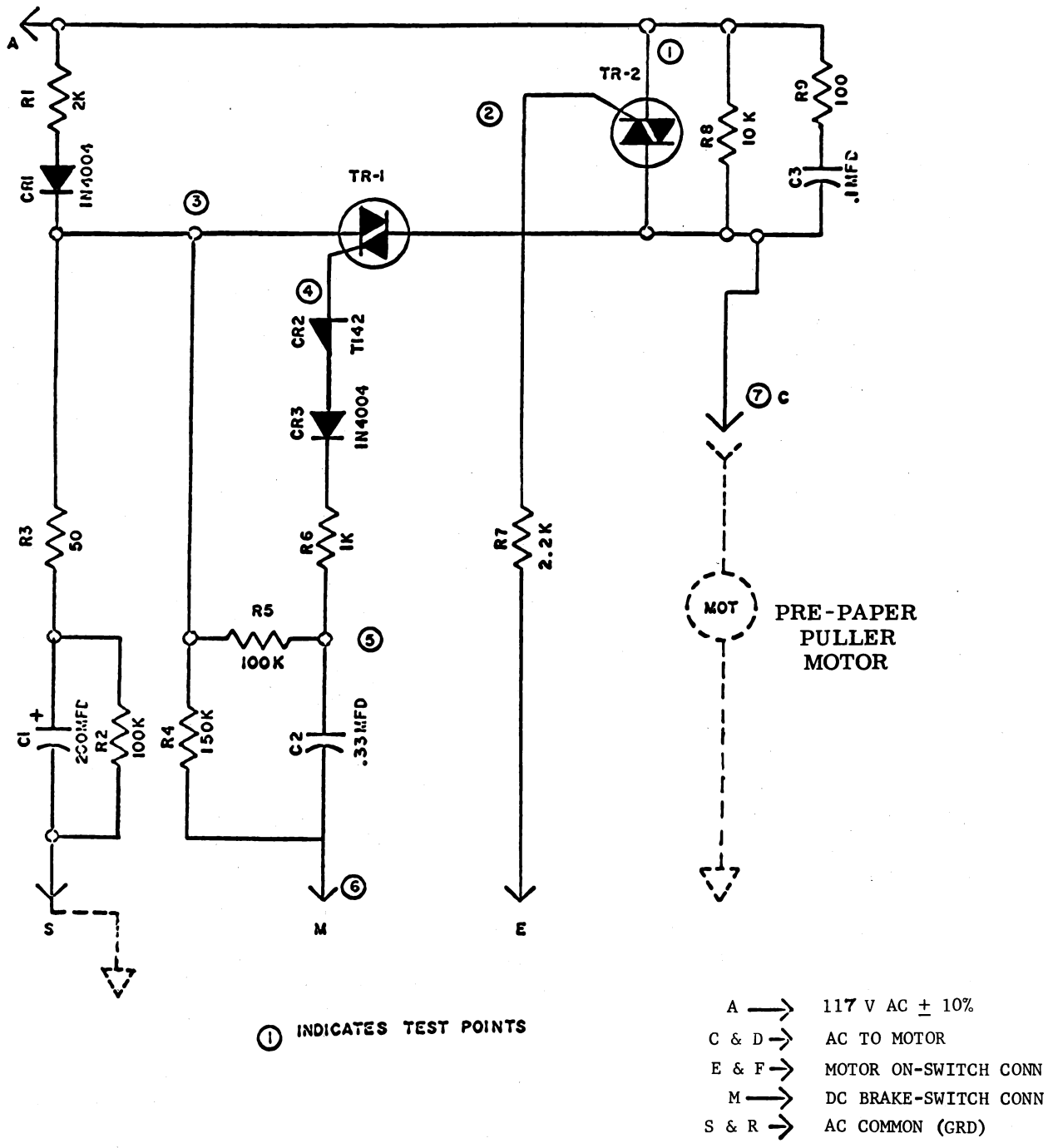


Figure 17 - Pre-Paper Puller Motor Control and Dynamic Brake – Schematic

LINE FEED MOTOR REGULATOR – CIRCUIT BOARD TP330173

Purpose

Circuit board TP330173 is used to control the capacitor start/capacitor run line feed motor. The motor is arranged for intermittent operation in order to replenish the energy released by the spiral spring and torque rod assembly during a series of line feed operations. The paper is moved in the time interval between the end of the recording of the last character in the line and the beginning of the first character of the succeeding line. The line feed drive signal precedes the start of paper motion by the length of time required for the mechanical parts of the line feed assembly to respond. The escapement type stepping mechanism moves the paper by increments of 0.167 inch. Repetitive line feed functions should not exceed a quantity of eight per second.

To insure that the motor provides a constant torque output for the line feed function, a manual control in series with the circuit board logic limits the voltage impressed across the running winding of the motor. Thus, a vernier torque adjustment is arranged in conjunction with the automatic regulator to furnish constant torque output.

Description

This circuit board plugs into the receptacle assembly (center location) mounted in the lower right corner of the transport base.

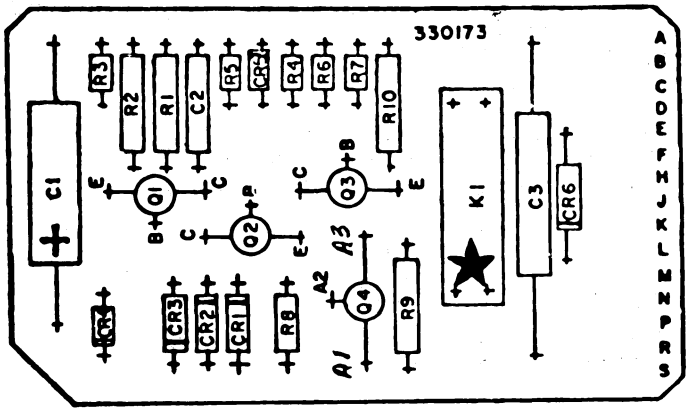


Figure 18 - Line Feed Motor Regulator – Actual

LINE FEED MOTOR REGULATOR - CIRCUIT BOARD TP330173 (continued)

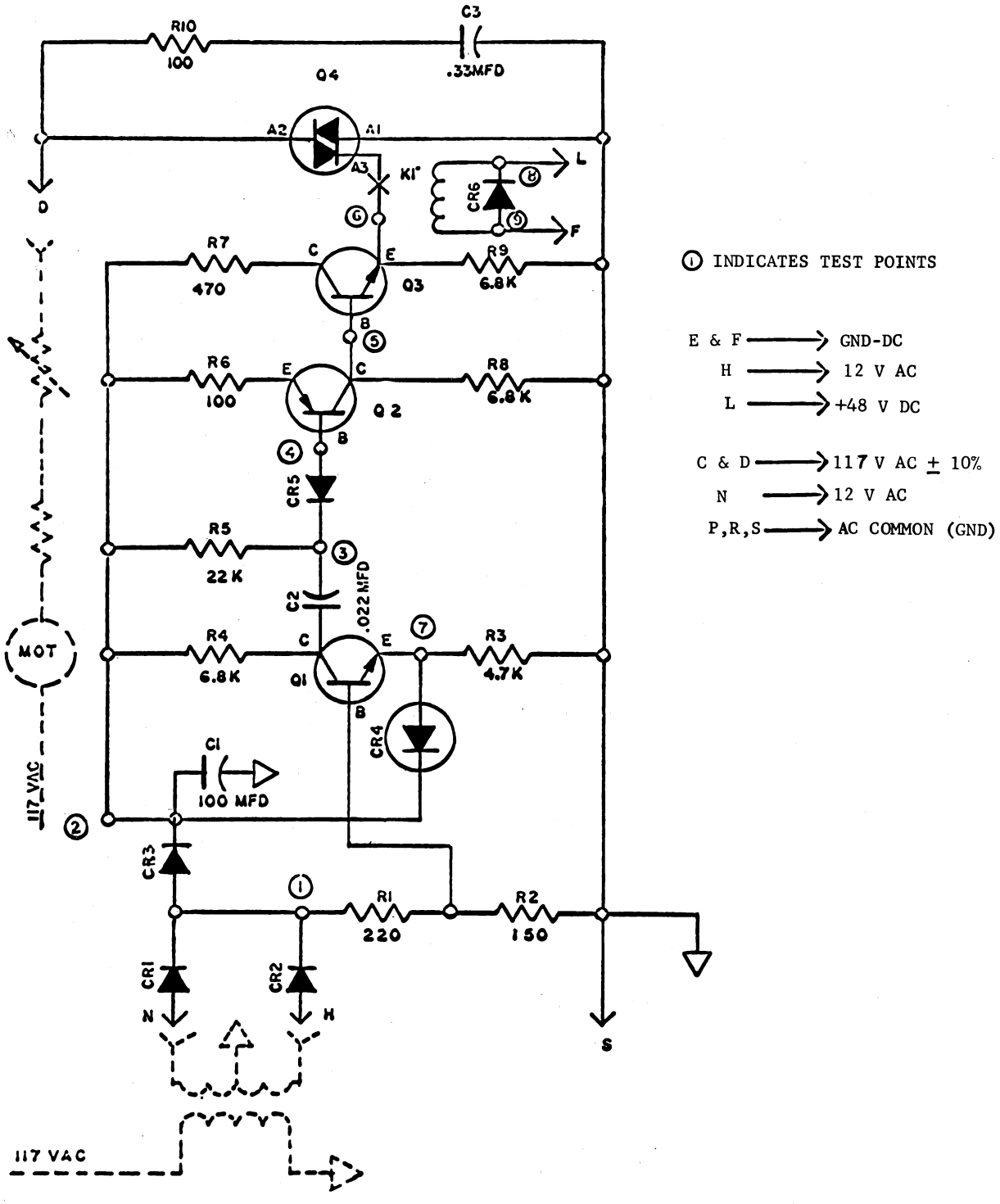


Figure 19 - Line Feed Motor Regulator – Schematic

PAPER JAM AND/OR PAPER-OUT ALARM – CIRCUIT BOARD TP330152

Purpose

The paper-feed failure alarm, circuit board TP330152, is arranged to turn off the printer, should the paper storage loop fail to be replenished within 28 line feed steps. Note that the pre-paper puller motor must be actuated at least every 28 line feed steps. If the paper feed failure alarm is actuated, the unit will automatically turn off the ready light on the front panel of the cover and the unit will become inoperative. A red indicator lamp on the left side frame will be illuminated. In order to reset the paper feed failure alarm, depress the red button (illuminated) on the left side frame.

Description

The circuit board plugs into the receptacle assembly (bottom level) located on the lower right corner of the recorder. Basically, circuit board TP330152 is a binary ripple counter (frequency divider) which, on a count of 28 or 29 (depending upon which line feed magnet is energized), will energize relay K1 to open a set of contacts which are used to interrupt the series circuit of the interlock string. The counter is normally reset by the pre-paper puller motor, after a count of 18 line feed operations, or may be reset manually by a pushbutton on the side frame.

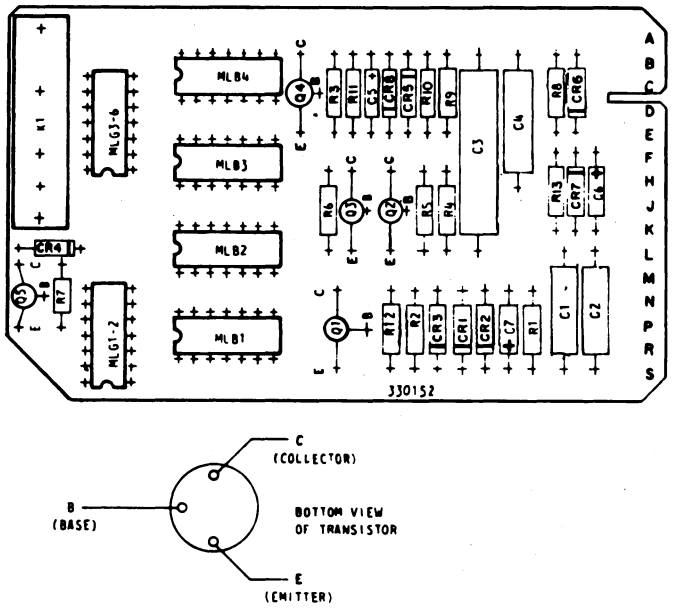


Figure 20 - Paper Jam/Paper-Out Alarm

PAPER JAM AND/OR PAPER-OUT ALARM — CIRCUIT BOARD TP330152 (continued)

A,C — RELAY CONTACT ○ INDICATES TEST POINTS

B — LAMP OUTPUT

D — 117 V AC FROM PRE-PAPER PULLER MOTION

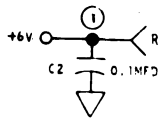
E — AC COMMON

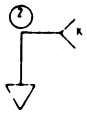
F — RESET

K — DC COMMON

N — LINE FEED SIGNAL

R — +6 V DC INPUT





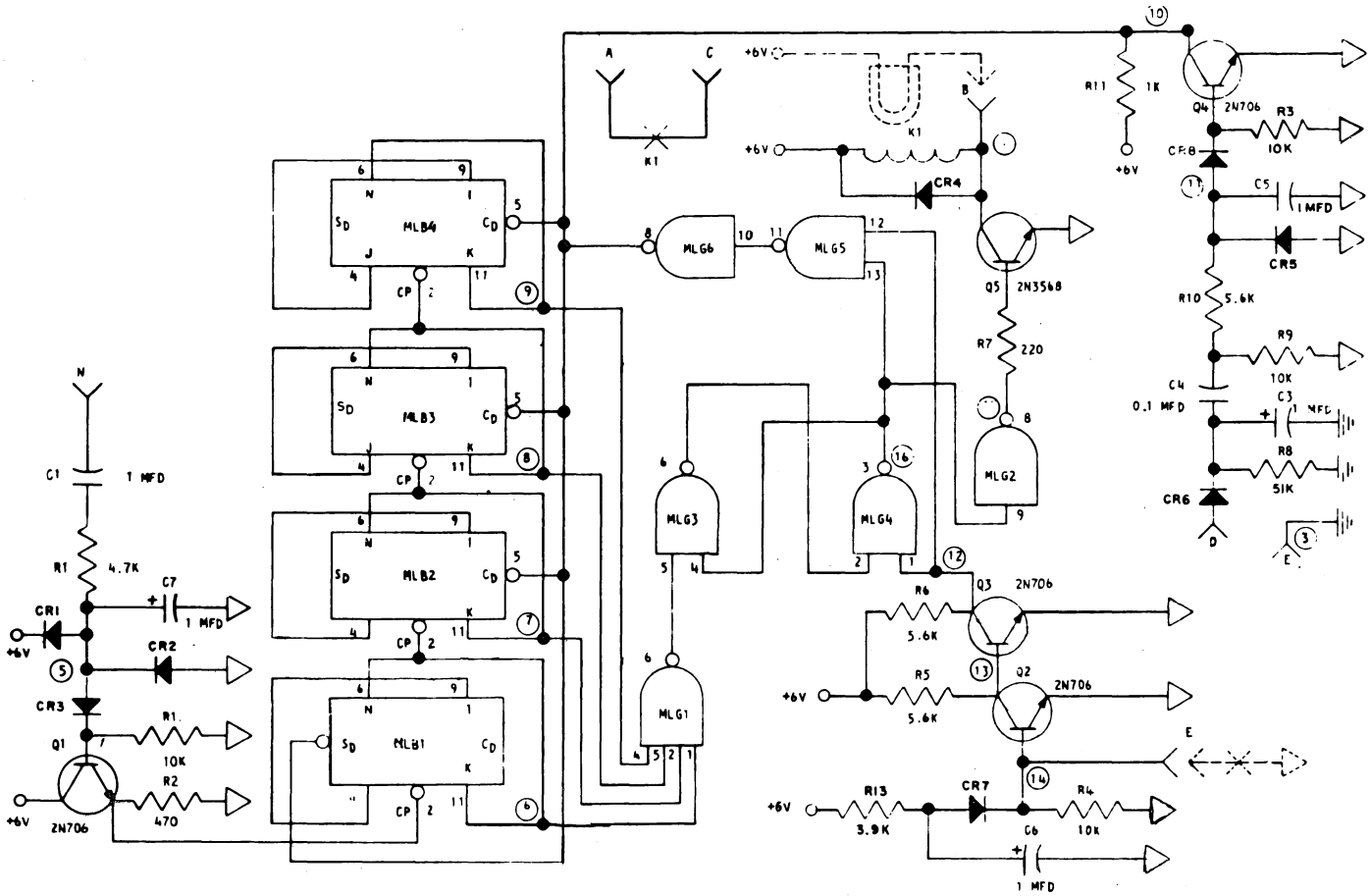


Figure 21 - Paper Jam/Paper-Out Alarm Circuit – Schematic