IBM

Customer Engineering Manual of Instruction

75 80 82 Card Sorting Machine

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75
80
82 Card Sorting Machine

MINOR REVISION (May 1957)

This edition, Form 225-8766-4, is a minor revision of the preceding edition but does not obsolete Form 22-8766-3. Principal changes in this edition are:

PAGE	SUBJECT
22 to end	Deletion of all material that is in the *82-80-75 C.E. Reference Manual*
76	Added instructions for the 978 Card Counting Unit

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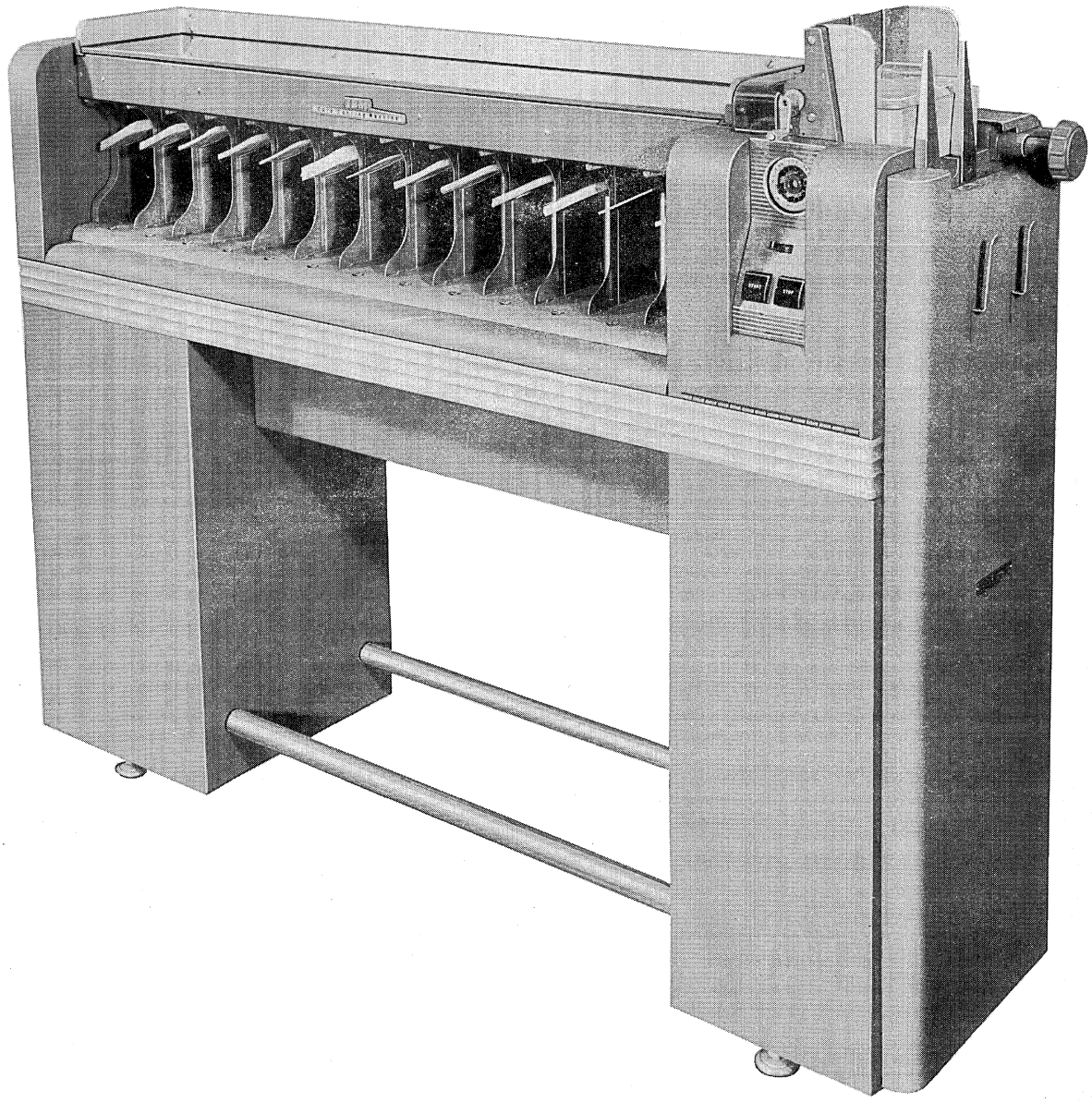


IBM 82 CARD SORTING MACHINE

IBM 82 CARD SORTING MACHINE

FUNCTIONAL PRINCIPLES

THE THREE machines necessary to perform the basic operations required in punched card accounting are the punch, the sorter, and the accounting machine. The punch establishes the records, the sorter arranges or classifies them, and the accounting machine produces the printed reports.

In punched card accounting systems, thousands of cards may be involved daily in the task of preparing final reports. In most cases, these cards must be classified properly prior to the preparation of each report on accounting machines. Classification of such a large number of cards manually would present an immense task which would consume many man hours of work and would be greatly subjected to human errors.

The Type 82 Card Sorting Machine affords a speedy and accurate method of arranging cards into any desired sequence. The operation of the Type 82 Sorter is

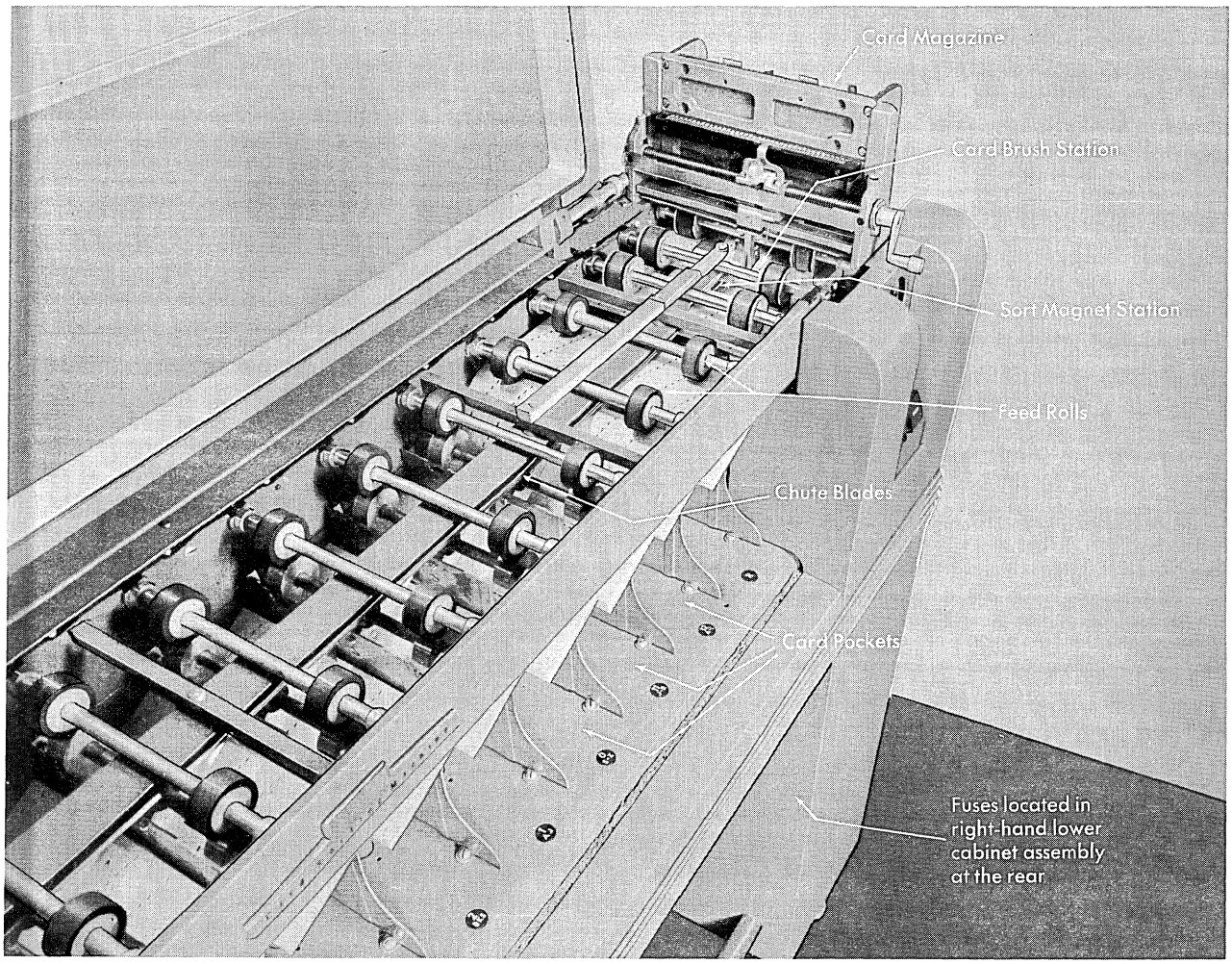


Figure 1. Card Transport Through the Machine

entirely automatic, except for the removal and replenishing of cards in the machine.

Sorting cards on the Type 82 machine consists of running the cards through the machine once for each column in the field being classified. This is comparable to scanning a series of printed figures with the human eye, except here an electric sensing brush becomes the eye. This brush can sort on only one column at a time. However, it is movable, so that the operator may position the brush to sort on any one of the 80 column positions on the IBM card. The machine is equipped with 13 pockets for dispersal of cards; one pocket for each digit value 0 through 12 and one reject pocket for cards unpunched in the column being sorted.

By means of feed knives, cards are fed one at a time from the bottom of the pack in the card magazine on the right end of the machine (Figure 1). After leaving the card magazine, they are gripped between sets of constantly revolving feed rolls and are fed from the right to the left of the machine. As the cards travel from right to left, they first pass the card brush station, located between the first and second sets of feed rolls. Here the punching in the card column being sorted is sensed by means of a brush projecting through the holes in the card and making contact on a common roll. Sensing of card punching at the card brush station sets up the proper combination of raised or lowered chute blades at the sort magnet station, located between the second and third sets of feed rolls. This setup is accomplished as the leading edge of the card is traveling under the chute blades. The chute blades, according to their setup, then direct the card to its proper pocket (the card is still being carried by the feed rolls).

If a 1 punch is sensed at the card brush station, the chute blade combination setup will be such that the card will be directed to the 1 pocket. If an 8 punch is sensed at the card brush station, the chute blade combination setup will be such that the card will be directed to the 8 pocket. If no punching is sensed at the card brush station, all chute blades will remain in a raised position, and the card will be directed to the reject pocket.

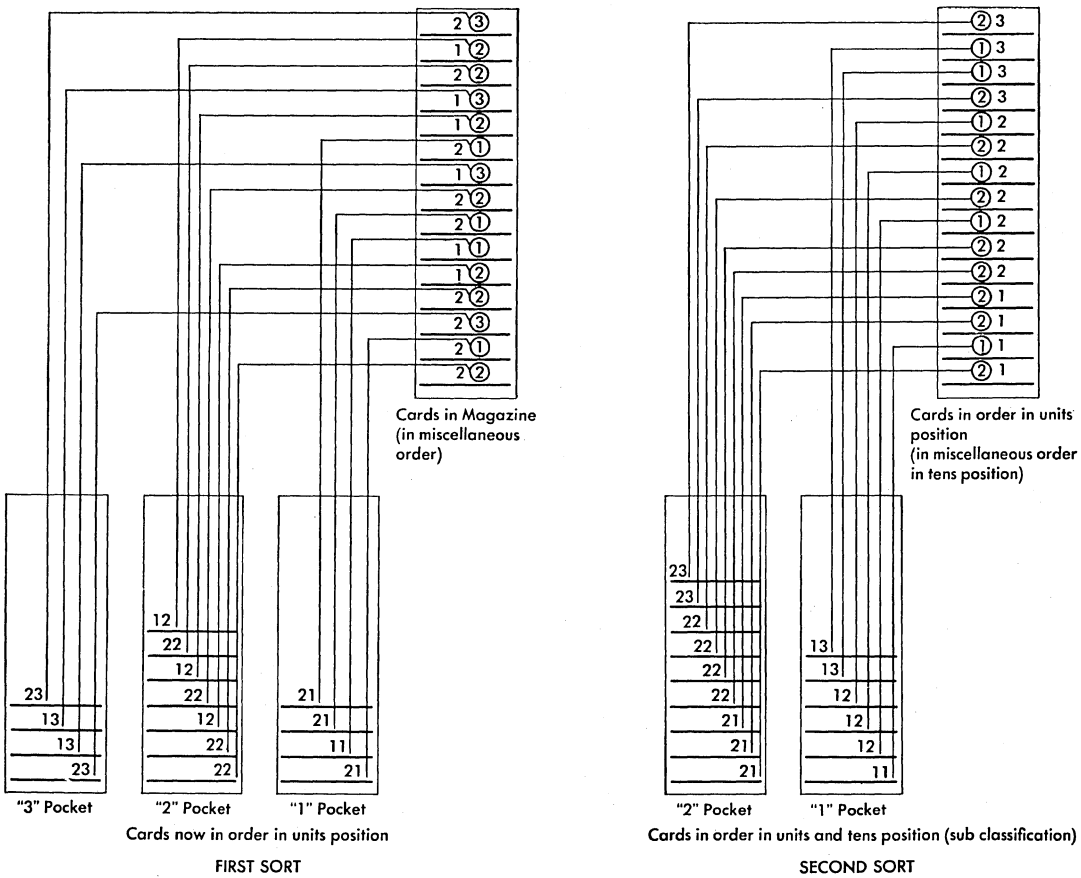


Figure 2. Principle of Sorting

During the time that the punching in the card is sensed and the proper chute blade combinations are set up, the card is continually moving from right to left under control of the constantly running feed rolls.

Speed and Capacity

The speed of the Type 82 machine is 650 to 660 cards per minute. The capacity of the card magazine is 550 cards.

PRINCIPLE OF SORTING

Numerical Sorting

Sorting multiple digit fields when only one column may be sorted at a time is illustrated in Figure 2. A group of cards, punched 11 through 23 in a two digit field, are arranged in miscellaneous order and placed in the card magazine of the sorter. The units position is sorted first by positioning the card brush on that column and running the cards through the machine. All cards punched with a 1 in the units column will fall into the 1 pocket, all cards punched with a 2 in the units column will fall into the 2 pocket, etc.

When all the cards have been run through the machine for sorting on the units position, the card brush is shifted to the tens column position and the cards removed from the pockets. To remove cards from the pockets in proper sequence, the 1's are removed first and placed face down in the card magazine, the 2's are removed next and placed face down on the 1's, the 3's face down on the 2's, etc. This is common practice but cards may be removed in descending order by starting with the 9's and keeping the cards face up in the palm of the hand instead of face down. The important item during removal is to keep the cards in sequence.

After all cards have been removed from the pockets and replaced in the card magazine, and the card brush has been located on the tens column position, the machine is restarted and sorting of the tens position takes place. Those cards punched with a 1 in the tens position fall into the 1 pocket, the 2's into the 2 pocket, etc. By removing the cards from the pockets in ascending order as was done on the first sort, (1's ahead of the 2's) the original group of miscellaneous cards will be found to be in numerical sequence from 11 to 23.

The sorting process could be illustrated further by the use of a larger field, but from the foregoing example it will be observed that, upon completion of the second sort, all cards will appear in groups arranged in correct numerical sequence.

The procedure for sorting cards to arrange them in proper sequence according to major and minor classifications follows the same general principle. If the above mentioned two-digit numbers were subclassifications and another one-column field were a major classification, the next sort for major classification would bring these groups together, and the subclassifications would be in order within each group as illustrated in Figure 3.

A general rule to be kept in mind is that the sorts for the minor or subclassifications are made first and the sorts for the major classifications are made last.

Alphabetic Sorting

Sorting cards containing alphabetic information into alphabetic sequence necessitates the double sorting of each column, since each letter is recorded by two holes in a single column, one of which is 12, 11 or 0 and the other a digit from 1 to 9. For example, the letter A is indicated by punched holes in the 12 and 1 positions of a given column.

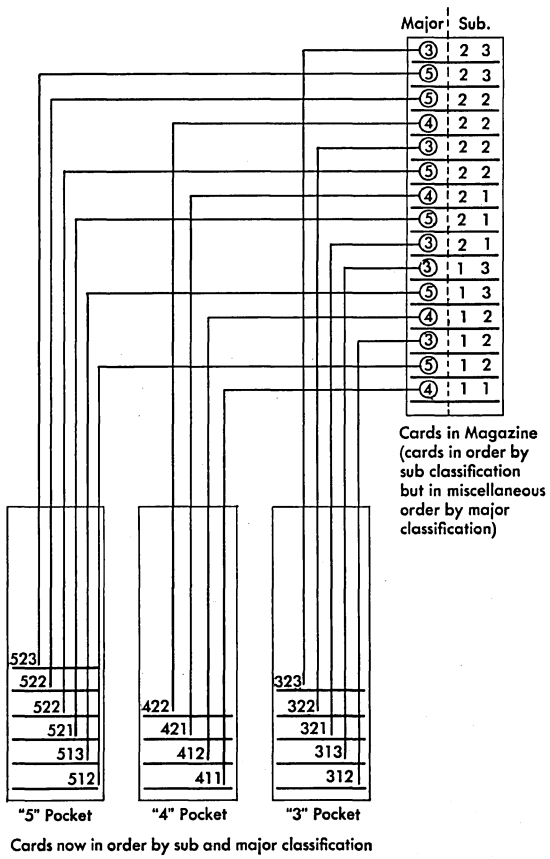


Figure 3. Principle of Sorting

The cards are sorted in the normal manner according to the digits 1 to 9 in the first column to be sorted. The zone contact bar on the commutator (Figure 4) is then moved to the center of the commutator and the complete sorting operation repeated on the same card column. Positioning the zone contact bar in this manner suspends sorting for all values of punching except 0, 11 and 12. Those cards which fall in the 12 pocket will contain the letters A to I in alphabetic sequence; those in the 11 pocket, the letters J to R; and those in the 0 pocket, the letters S to Z. Succeeding columns are each sorted in the same manner as above; the digits 1 to 9 first, followed by sorting of the zone punchings 0, 11 and 12. When cards are removed from the pockets following a zone sort, the 12 zone cards should be placed face down in the card magazine, the 11 zone cards next, and the 0 zone cards last in preparation for digit sorting on the next column.

In most cases, it is not necessary to sort on all columns of a name field to place the cards in alphabetic order. Usually sorting on the first three or four characters in a group of names will be sufficient.

OPERATING FEATURES

REFER to Figure 4 for the location of the major operating features.

Switches and Fuses

There are 3 operating switches located on the front right end of the machine. The main line switch, when turned on, furnishes power to the machine and com-

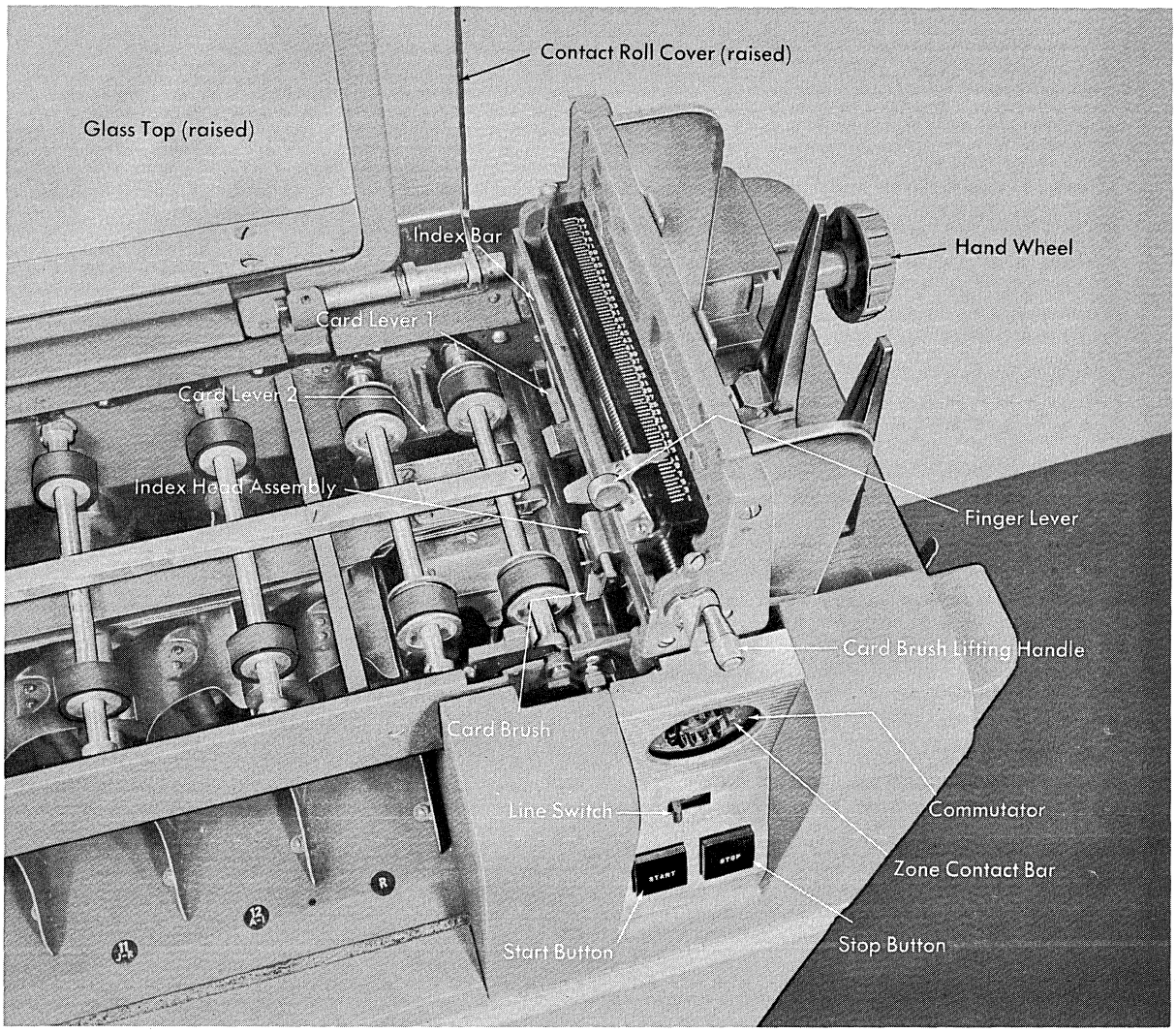


Figure 4. Operating Features

pletes a circuit to the filaments of the tubes. It also completes a circuit to the time delay relay.

The start button, when depressed, sets up circuits which energize the drive motor, and it causes the machine to operate. The start button is ineffective for approximately 50 seconds after turning on the main line switch because of the delay caused by the time delay relay. This delay is necessary to allow the electron tube filaments to reach proper operating temperature before the machine is started.

The stop button causes immediate stopping of the machine. When the stop button is depressed, the runout feature of the machine is rendered inoperative, and the machine stops as soon as its inertia is overcome by friction.

The fuses are located on the inner side of the right hand lower cabinet assembly in the position shown in Figure 1.

Card Brush

The card brush senses the punching in the card. It may be set on any column to be sorted by rotating the card brush lifting handle near the front of the card magazine. Each rotation of the handle moves the brush one column. The brush may be moved across several columns by rotating the handle to the upper position and sliding the brush holder to the desired column while pressing down the finger lever at the top of the brush assembly. A column indicator guide and pointer is located above the brush in a position readily visible to the operator for convenient setting of the brush on the column to be sorted.

Contact Roll Cover

The plastic cover over the contact roll must be down before the start key can become operative. This is a safety cover which operates two microswitches. Opening of these microswitches when the contact roll cover is raised interrupts the running and sorting circuits.

Commutator

On the front end of the first lower feed roll is a commutator on which 12 contact bars (one for each vertical position in the card) and an alphabetic zone bar are mounted. The contact bars on the commutator are accessible through the large hole in the switch plate. When all of the commutator contact bars are toward the outside of the commutator, all holes punched in the card column being sorted are sensed and cause the card to sort to its proper pocket. However, if the 4 and 0 contact bars, for example, were moved to the center of the commutator, sorting of 4's and 0's would be suspended. Any 4 or 0 punching in the card column being sorted would not be sensed and the card would feed to the reject pocket just as though it were unpunched. Sorting of all other digits would be normal.

If the zone contact bar (red bar) is moved to the center of the commutator, sorting will be suspended for all punching except 0, 11 and 12. That is, those cards that have no 0, 11 or 12 punching in the column being sorted, will be fed to the reject pocket as though they were unpunched.

Declutching Hand Wheel

A declutching hand wheel is provided for turning the machine over by hand to check adjustments and timings. This hand wheel is located on the right end of the machine and, when rotated in a clockwise direction, causes the main drive shaft and its gears to revolve. The handwheel must be pressed to the left while it is being revolved before the main worm shaft will rotate. When the machine is operating under power, the handwheel is automatically declutched to keep it from revolving and presenting a hazard.

Card Runout

When the card magazine becomes empty while the machine is in operation, a runout feature incorporated in the machine keeps the drive motor running for a long enough period of time to allow all cards to feed to their proper pockets. On older sorting machines this runout feature was not present, making it necessary in many cases to depress the start key long enough to feed the last few cards into their proper pockets.

Pocket Stop Device

Each pocket of the sorter is equipped with an automatic pocket stop. This is a safety device which automatically shuts off the current and stops the machine when any one of the thirteen pockets becomes filled to capacity with cards. Each pocket has a capacity of approximately 550 cards. Once the machine has been stopped by the activation of the pocket stop device, it can not be restarted by means of the start key until the full pocket or pockets have been emptied.

Machine Operation

The main line switch should be turned on first to allow time for the tubes to heat up while other preparations for starting are being completed.

Prior to placing cards in the card magazine, they should be carefully joggled against the glass top frame. Cards are then inserted in the magazine, face down with the 9 edge to the left. Do not drop or force the cards into the magazine. Check to see that the edges of the cards are even to assure free movement within the magazine. Place the card weight on top of the pack to insure proper feeding of the last few cards.

After the cards have been placed in the card magazine, the card brush should be positioned on the proper card column. The contact bars on the commutator should be checked to see that they are in the contacting or OUT position if desired, so that all holes punched in the card column will be sensed by the card brush. The contact roll cover must be down before the start key can become operative.

Assuming that all of the above conditions have been satisfied, the start key may be depressed to cause the machine to operate. This key must be held depressed until the cards have reached the third set of upper feed rolls, thus closing all card lever contacts. Once cards have reached this position in the machine, it will continue to operate automatically until the card magazine has been emptied of cards, one or more pockets become full, or the stop key is depressed. The contact roll cover must not be raised while the machine is in operation since this may cause mis-sorting as the machine comes to a stop.

Care should be exercised when adding cards to the card magazine while the machine is operating. Do not jar the pack of cards already present in the machine and do not add any cards if the pack of cards present in the machine is small; either procedure may cause the machine to jam.

Current, Weight and Dimensions

See the table below for the operating current, starting current and fuse rating of the Type 82 machine.

NOTE: Some Type 82 machines were produced using ½ HP motors equipped with fusetrons instead of fuses. In the case of these machines, the fusetron rating listed under the 1/3 HP heading may be used as these values give enough safety factor due to their time lag characteristic.

Weight unpacked - - - -	530 pounds
Weight packed - - - -	785 pounds
Length - - - - - - - -	61 inches
Width - - - - - - - -	16 inches
Height - - - - - - - -	46 inches

Voltage Group			Maximum Operating Current Amperes		Maximum Starting Current Amperes		Main Fuses Ampere Rating	
Volts	Cycles	Phases	1/2 HP	1/3 HP	1/2 HP	1/3 HP	1/2 HP	1/3 HP
							Fuse	Fusetron
115	DC		5.0	5.0	42.9	36.9	12	5.0
230	DC		3.0	3.0	21.9	18.9	6	3.2
115	25	1	6.5	6.0	38.9	26.7	12	8.0
115	50	1	7.0	6.5	37.9	25.6	12	8.0
115	60	1	6.5	6.1	39.9	26.9	12	8.0
230	25	1	3.7	3.5	18.6	13.5	6	4.0
230	50	1	4.0	3.9	19.1	13.0	6	4.0
230	60	1	3.7	3.5	20.1	15.0	6	4.0
208	60	1	4.0	3.8	18.2	16.6	6	4.0
230	25	3	2.1	2.0	12.7	8.4	6	2.5
230	50	3	2.3	2.2	14.6	9.9	6	2.5
230	60	3	2.1	2.0	13.2	9.1	6	2.5

THE REAR cover assembly and the covers on the right and left ends of the machine are each held in place by means of concealed latches. These latches may be released by pressing on the latch cover plate.

The cover over the switch plate is hinged at the bottom and held in place by a holding screw at the upper right hand corner. The right end cover must be removed before this holding screw is accessible.

Four adjustable levelers are furnished with each machine for the purpose of leveling the machine and to eliminate excessive vibration caused by an uneven floor surface.

Chute Blades and Sort Magnet

In Figure 5, a card is shown passing between the card brush and the contact roll just after it has been fed from the bottom of the pack in the card magazine. The leading edge of the card is passing under the tips of the chute blades and the card brush is wiping across the face of the card in search of punched holes in the column being sorted.

The chute blades are formed strips of tempered spring steel, varying in length, from the opening of each pocket to a position resting on the top of the sort magnet armature. There are two styles of chute blades in use. The old style blade is .008" thick and the new style blade is .009" thick. The .009" blade has better wearing qualities than the .008" blade. Each blade is numbered according to the pocket to which it guides the card. In guiding a card to the proper pocket, the card rides immediately over the chute blade for that pocket.

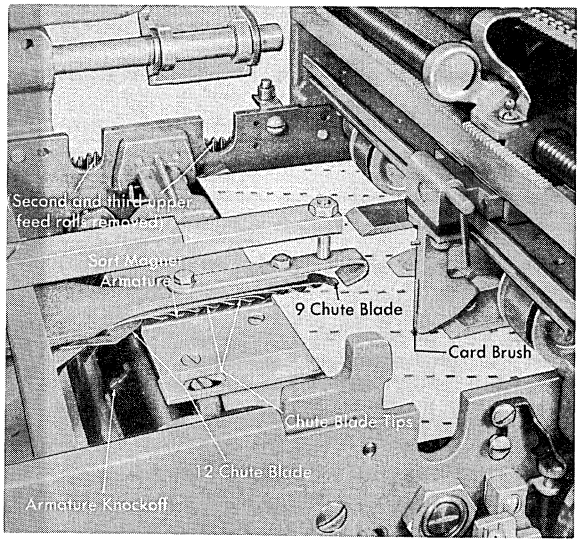


Figure 5. Sensing the Card

Assume that a 4 is punched in the column on which the card brush is set. The chute blades are so arranged that when the card has advanced to the position where the card brush makes contact with the contact roll through the 4 hole, the leading edge of the card will have passed under the 9, 8, 7, 6, and 5 chute blade tips as shown in Figure 6. In passing under the chute blades, the card separates them from the sort magnet armature.

As soon as contact to the contact roll is made by the card brush, circuits are completed which energize the sort magnet. Energization of the sort magnet attracts the sort magnet armature. This armature is normally held in a raised position away from the magnet cores (Figure 6) by means of a return spring.

As the armature is attracted, the 4, 3, 2, 1, 0, 11, and 12 chute blades follow it down because of the spring tension on the blades; but the 9, 8, 7, 6, and 5 chute blades are held up by the card, thereby creating an opening between the 5 and 4 blades (Figure 7). The feed rolls convey the card through this opening (over the 4 blade and under the 5) towards the 4 pocket. As the card nears the 4 pocket, travelling between the 4 and 5 chute blades, it strikes a formed ear on the under surface of the 5 blade which guides the card into the 4 pocket. As the card travels into the pocket, a deflector spring (Figure 8) is pushed upward by the card; then as the card leaves the feed rolls, the tension of this spring deflects the card downward. This action causes proper stacking of the card as it is free of any drive which might cause it to stand on edge.

An armature knockoff screw insures the return of the sort magnet armature to its normal position before the next card is read (Figure 7). The knockoff screw is rotated counterclockwise (as shown by the arrow)

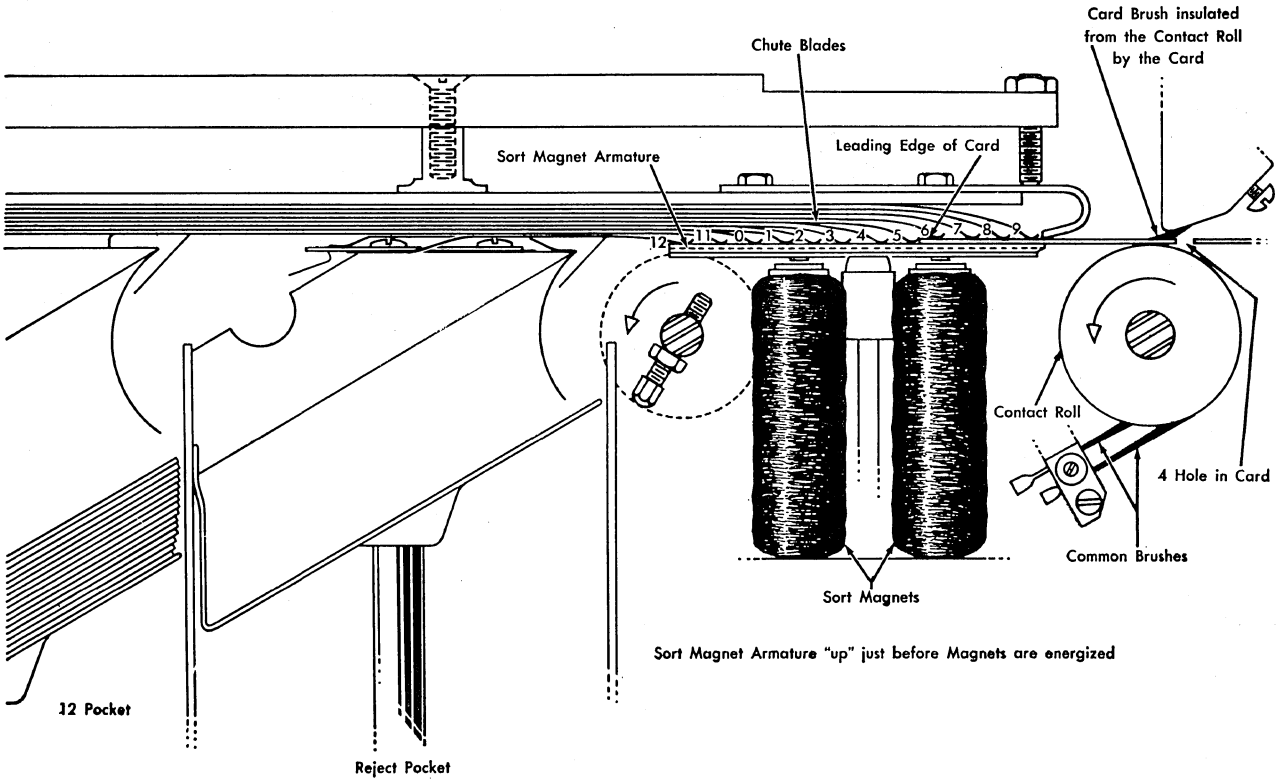


Figure 6. Position of Chute Blades Prior to Sort Magnet Energization

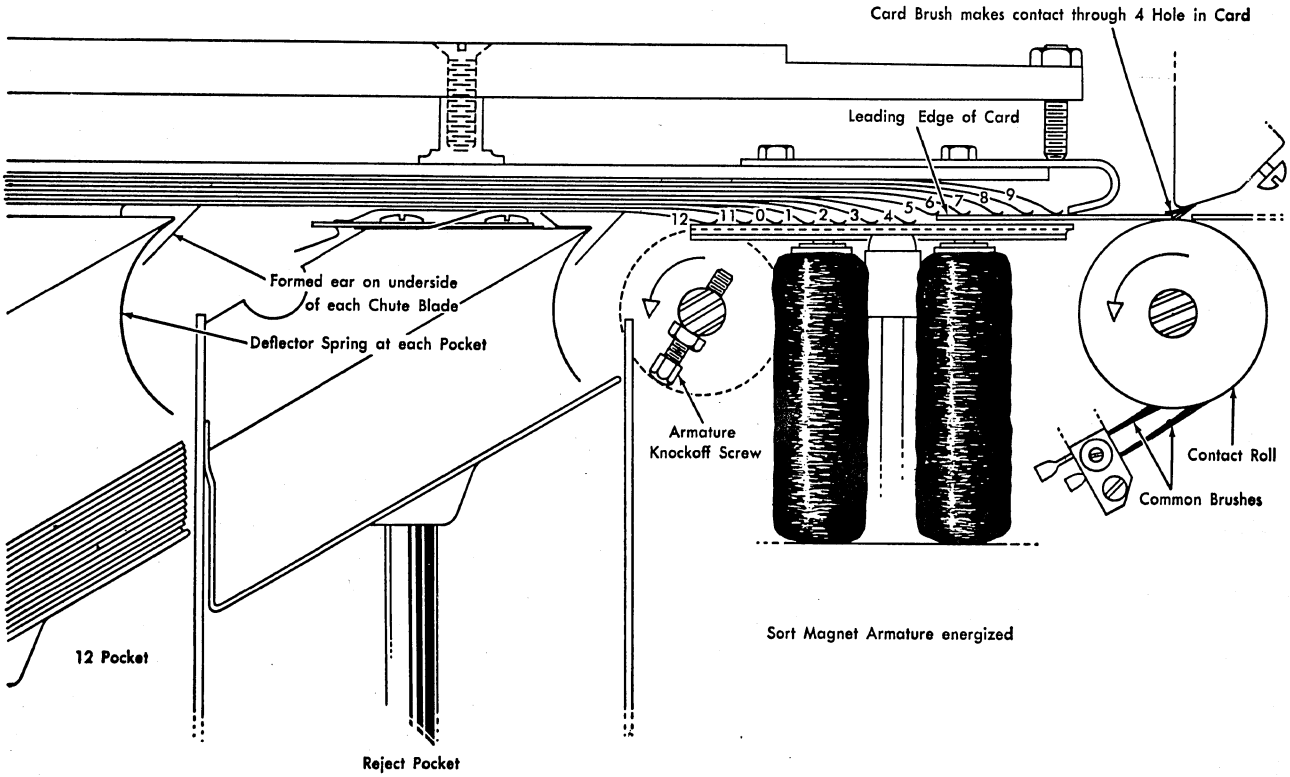


Figure 7. Position of Chute Blades After Sort Magnet Energization

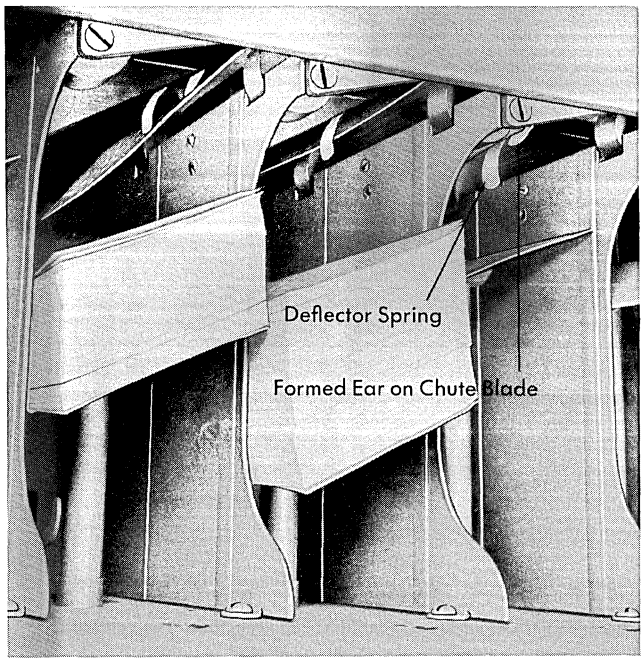


Figure 8. Cards Entering the Pockets

and is mounted on the third lower feed roll shaft, which is driven from the main worm shaft and makes one revolution per card cycle. It is timed to knock off the armature between the 12 position of one card and the 9 position of the following card. Although the return of the sort magnet armature is spring actuated, the knockoff screw is provided to overcome any residual magnetism present in the sort magnet.

If the card fed is unpunched in the column being sorted, the card brush fails to make contact with the contact roll; therefore, the sort magnet is not energized and its armature is not attracted. Consequently, the card is fed under all the chute blades and deflected into the R (reject) pocket.

Card Brush Assembly (Figure 9)

It will be noted by referring to Figures 6 and 7 that the card brush makes contact on the contact roll through the hole in the card. This sets up circuits which cause energization of the sort magnet.

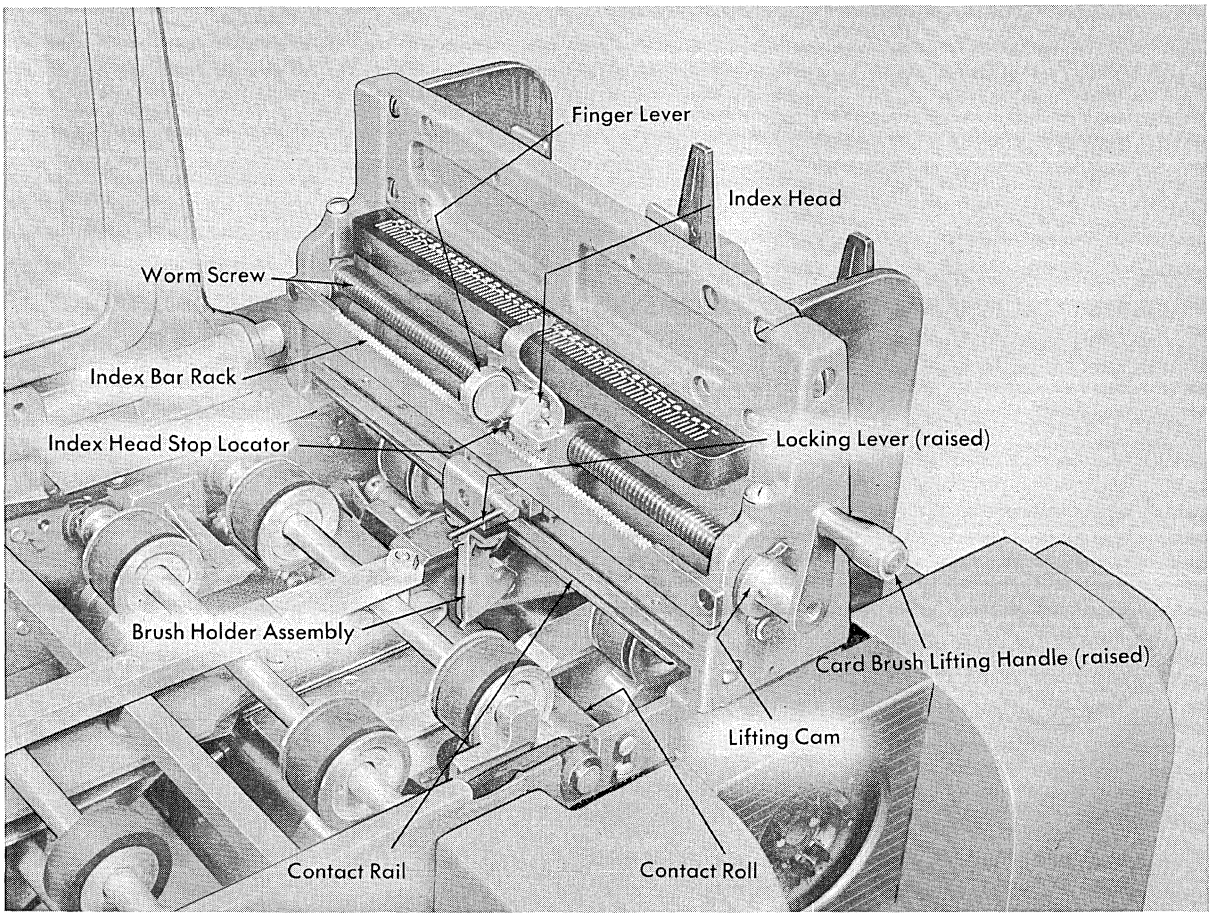


Figure 9. Removing the Card Brush Assembly

The card brush may be positioned at any column desired through manual operation of the card brush lifting handle and the finger lever on the index head rack holder (Figure 4). During a sorting operation, it is necessary that the card brush lifting handle be in a position with its handle downward, as this allows the card brush to rest on the contact roll for the purpose of reading the card.

When the card brush lifting handle is rotated one-half turn from its normal downward position, the card brush assembly is raised clear of the contact roll by means of a cam pinned on each end of the worm screw (Figure 9). These cams operate against rollers to raise the worm screw. The worm screw is normally held down by means of a compression spring on each end.

Rotation of the card brush lifting handle one-half turn not only raises the brush to clear the contact roll, but also disengages the index head stop locator from the index bar rack. This is necessary if the brush assembly is to be moved. For one column movement, one complete revolution of the lifting handle raises the brush, disengages the index head stop locator, moves the brush one column through the lead of the worm, and lowers the brush to the contact roll as the index head stop locator seats in the adjacent index bar rack tooth. Rotation of the card brush lifting handle in a clockwise direction moves the brush toward the rear of the machine. Rotation of the handle counterclockwise moves the brush toward the front of the machine.

To move the card brush assembly a distance of several columns or more, the lifting handle is rotated one-half turn to its raised position. As stated above, this raises the brush from the contact roll and disengages the index head stop locator from the rack. By depressing the finger lever on the index head rack holder, the index head locating nut is then disengaged from the worm screw. This is a half nut and is normally held engaged with the worm screw by means of a spring. Disengaging the index head locating nut from the worm screw allows free movement, in either direction, of the complete index head and brush holder assemblies as a unit. Releasing the finger lever after the desired movement has been completed again engages the locating nut with the worm screw, and returning the lifting handle to its downward position readies the brush for sensing the card.

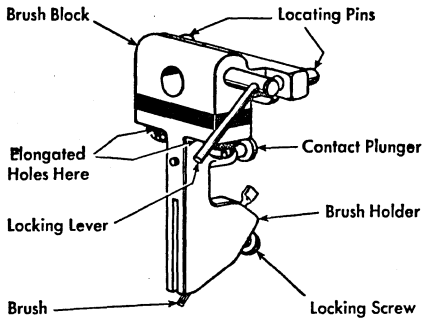


Figure 10. Card Brush Holder Assembly

A spring operated contact plunger (Figure 10) provides the means of electrical connection between the brush holder and an insulated contact rail. The contact rail extends from front to rear over the entire range of the card brush (Figure 9) furnishing a connection to the card brush regardless of the column being sorted. A square end brush (part number 202) is used and is held secure in the brush holder by means of a locking screw (Figure 10).

Figure 9 indicates the procedure for removing the card brush assembly. First, the lifting handle is turned one-half revolution to its upper position. The locking lever on the brush is then raised until it points directly towards the left end of the machine. This unlocks the brush assembly, allowing it to be removed by pulling it out to the left.

Commutator

The commutator assembly is mounted on the front end of the first lower feed roll shaft. The function of this assembly is to act as an electrical cam contact in the card brush circuit and, in conjunction with the card brush, to establish the timing of the impulses which energize the sort magnet.

The commutator makes one complete revolution for each card cycle; a card cycle being the distance from the leading edge of one card to the leading edge of the following card. As cards are fed from the magazine they are separated by a distance of ¾" (Figure 11). The width of a tabulating card is 3¼"; therefore, the distance from the leading edge of one card to the leading edge of the following card is 4". The distance between punching positions on a card is ¼", center to center of the holes. As this distance of ¼" is considered one point in the card cycle, the entire card cycle then becomes a 16 point cycle (4÷¼=16).

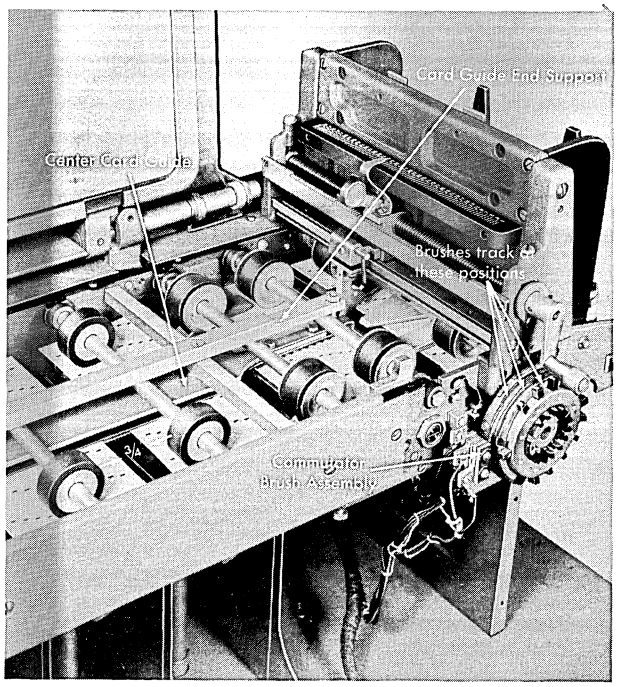


Figure 11. Card Spacing

However, the sort magnet can be energized only on 12 points of this cycle. These 12 cycle points correspond to the 12 punching positions on the card. The remaining four cycle points represent the distance from the 12 hole of one card to the 9 hole of the following card.

Figure 12 shows a commutator disassembled. Note the 13 contact spots near the center. Twelve of these spots, each adjacent to the other, are internally connected to the twelve segments on the inner (lower) ring. Nine of these spots, representing the digits 1 through 9, may be connected to the digit common on the extreme outer (upper) surface of the commutator by means of the individual contact bars, the operation of which is shown in Figure 12. The other three spots, representing the 0, 11 and 12 values, may be connected directly to the main common (outer) ring by means of their individual contact bars.

The thirteenth contact spot is internally connected to the digit common and, by means of its contact bar (zone contact bar), may be externally connected to

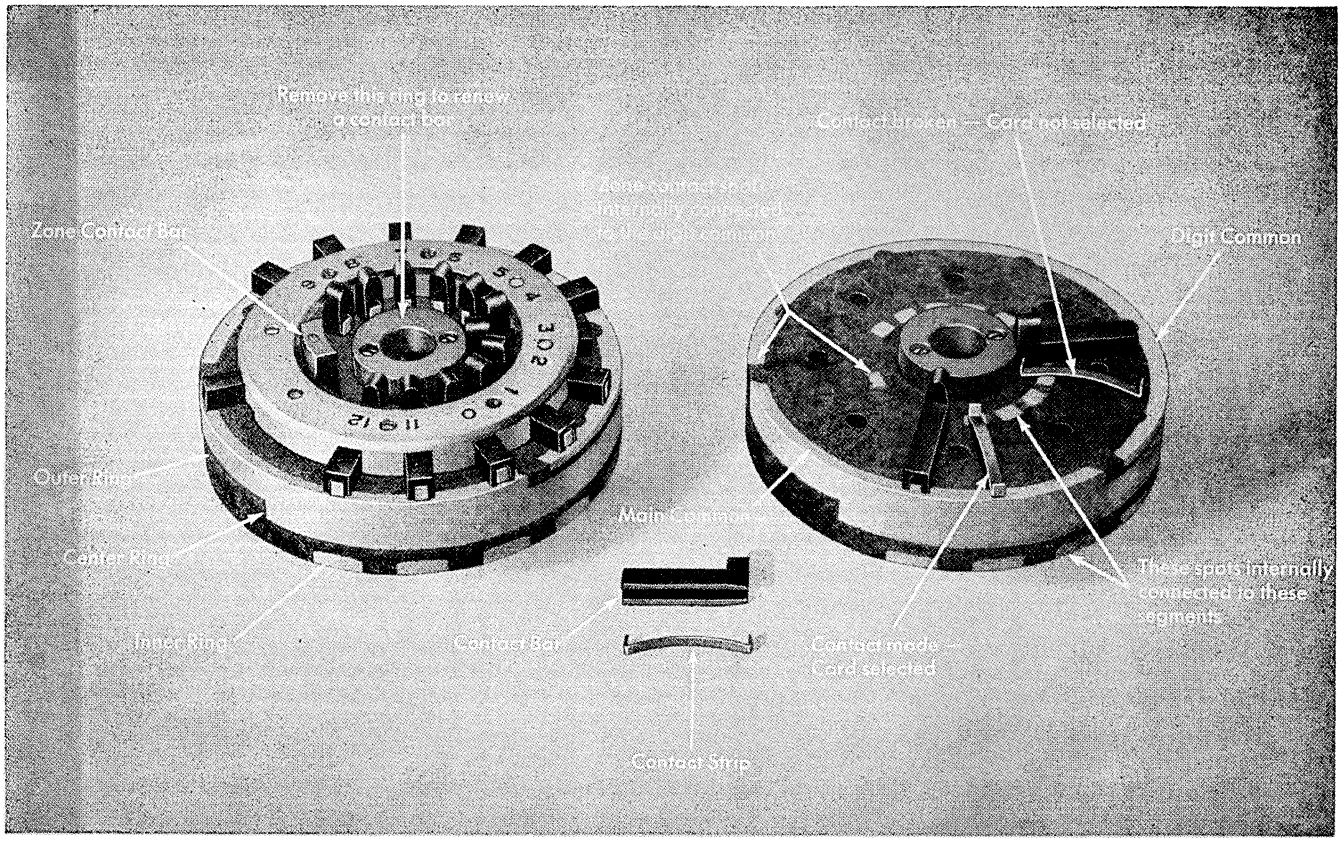


Figure 12. Commutator Assembly

the main (outer) common ring. Note that if the zone contact bar is in its retracted position, the digit common is not connected to the main common. By retracting the zone contact bar, sorting of all digit values 1 through 9 is suspended and only 0, 11, and 12 values are sorted.

There are three division points on the periphery of the commutator; the inner, center, and outer rings. Three contact brushes ride on this periphery, one to contact each ring (Figure 11). The inner ring consists of 12 insulated segments corresponding to each value in the card and internally connected to the 12 contact spots as mentioned above. The commutator is timed to the machine in such a manner that, when the card brush makes through the 4 hole in the card for example, the inner commutator brush will be making contact on the 4 segment. The center and outer rings are commoned together. The outer (common) ring extends around the complete circumference of the commutator. The center ring extends around approximately three fourths of the commutator circumference; the other one fourth is insulation.

When a hole is sensed in the card, a circuit to fire the OA4G trigger tube is first completed through the commutator from one of the 12 segments on the inner ring to the outer or common ring through the commutator contact brushes and the contact bar for that position. As soon as the trigger tube has been fired, a holding circuit to maintain conduction in the tube is completed from the center brush to the outer brush. Firing the trigger tube removes the negative bias on the sort magnet control tubes and allows them to energize the sort magnet. Furnishing a hold circuit to maintain conduction in the trigger tube keeps the sort magnet energized until the center brush breaks contact on the center ring. This occurs after the 12 position on the card has passed under the card brush, thus completing the sensing of any holes in that card column.

If two holes are present in a column being sensed, and no provisions are made by means of the contact bars on the commutator to suspend sorting of one value, the card will sort according to the first value sensed by the brush.

When the reading brush is resting on the bare contact roll between cards, no circuit is available to fire the trigger tube because both the inner and center commutator brushes are on insulated portions of the commutator.

Drive Shaft and Motor

Mounted on the rear of the machine is a horizontal drive shaft which transmits power from the motor to drive the card feed mechanism, the feed rolls, and the contact roll. The drive motor is located under the base on the left end of the machine and is connected

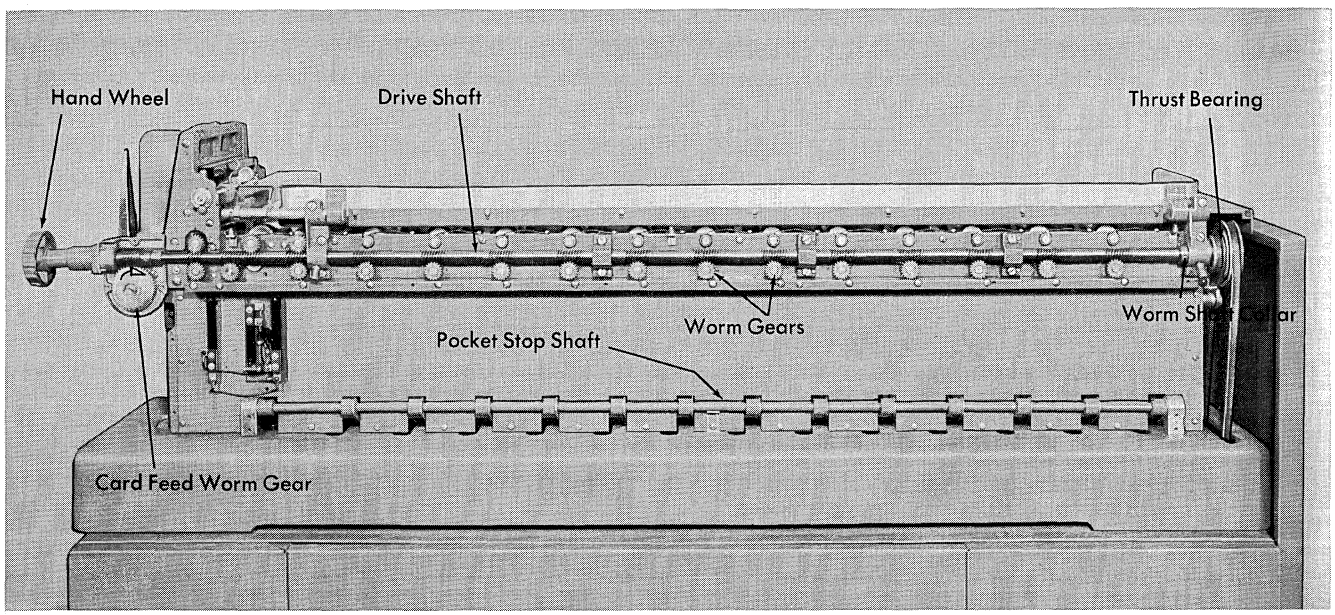


Figure 13. Main Drive Shaft and Pocket Stop Shaft

to the drive shaft by means of a V belt and pulleys. Variations in machine speed are obtained by adjusting the variable speed pulley on the drive motor. The motor mounting is adjustable vertically and can be pivoted in an arc for the purpose of regulating belt tension and alignment. The complete motor and mounting assembly is easily removed for repair or renewal.

The drive shaft extends over the length of the machine approximately on a level with the card line (Figure 13). Worms cut at intervals on the shaft are used for the purpose of gearing to the feed roll shafts, which run at right angles to the drive shaft. Except for the first 3 sets of feed rolls, only the lower feed rolls are gear driven; the upper rolls are friction driven from the lower rolls. Located at the right end of the drive shaft (rear view) is a thrust bearing which aids in absorbing the thrust developed in the shaft. This bearing must be kept well lubricated.

Declutching Hand Wheel (Figure 14)

Mounted on the left end (rear view) of the drive shaft is a hand wheel which is used to turn the drive shaft over manually when checking machine adjustments and timing. The hand wheel is normally disengaged from the drive shaft as it is cammed to the left (rear view) by the pin in the shaft striking the ratchet teeth on the handwheel as the shaft revolves. In this manner, the handwheel does not turn when the machine is in operation, thus eliminating a possible safety hazard. To revolve the shaft by hand, it is necessary to push the handwheel farther onto the shaft while turning it clockwise, causing the ratchet teeth to engage the pin.

A housing over the end of the horizontal shaft is held in place by four screws. The handwheel is retained in this housing by a ring type expansion spring around its shank. This spring expands into a shallow channel inside the housing when the shank of the hand wheel is inserted in it. A beveled edge on the housing aids in compressing the spring to facilitate inserting the shank of the handwheel. If it is desired to remove the hand wheel, a sharp rap to the left (rear view) with a mallet or hammer handle will cause compression of the retaining spring and allow it to slip through the smaller opening at the end of the housing. Figure 14 shows the housing removed and the handwheel inserted over the end of the shaft.

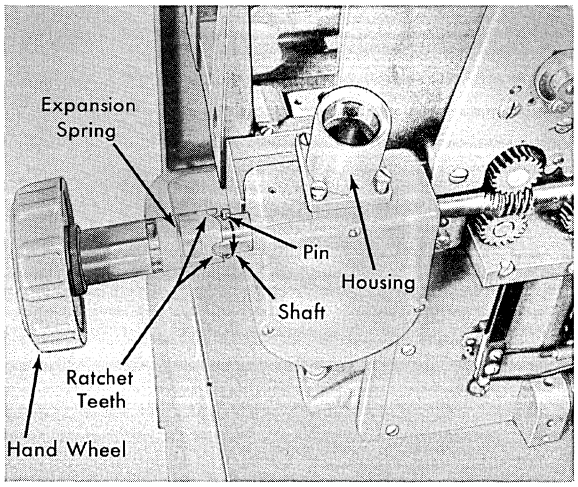


Figure 14. Declutching Hand Wheel

Reverse Lock (Figure 15)

Machines may be equipped with a reverse lock on the pulley end of the drive shaft which prevents the possibility of turning the drive shaft backwards and causing damage to the commutator and card brushes. This

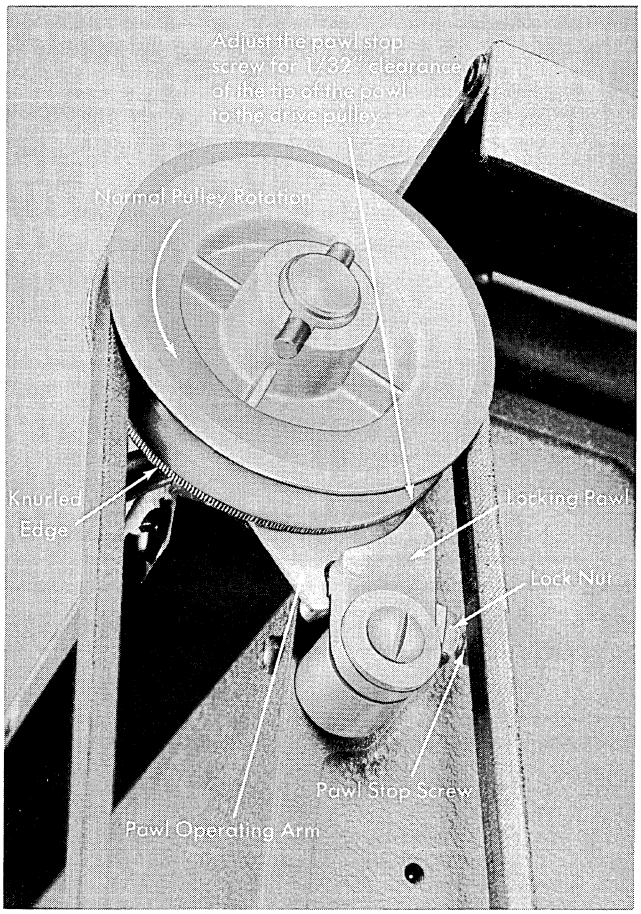


Figure 15. Reverse Lock

reverse lock is in the form of a ratchet knurl cut on the rim of the drive pulley. A locking pawl operates against the pulley when the force of motion is in a clockwise direction (viewed from the pulley end), thus preventing any actual rotation of the pulley. When the direction of rotation is counterclockwise (viewed from the pulley end), the locking pawl is held away from the knurled edge through the action of the pawl operating arm. The pawl operating arm is actuated by a friction contact with the drive pulley. The knurled teeth on the rim of the pulley are fine enough to prevent any appreciable motion when the reverse lock operates. Any older Type 80 machines which are not equipped with the declutching type of handwheel should have a reverse lock mechanism.

Feed Knives (Figures 16, 17, 17A)

The feed knives, in conjunction with the roller throat assembly, are designed to feed one card at a time from the card magazine. The roller throat assembly consists of a vertical knife whose lower edge is set parallel to a cylindrical steel roller. The throat assembly is adjusted to allow the passage of only one card at a time through an opening between the knife edge and the roller. The roller assembly is equipped with small oil wicks for continuous lubrication.

Power to operate the feed knives is obtained from the main drive shaft through the card feed worm gear

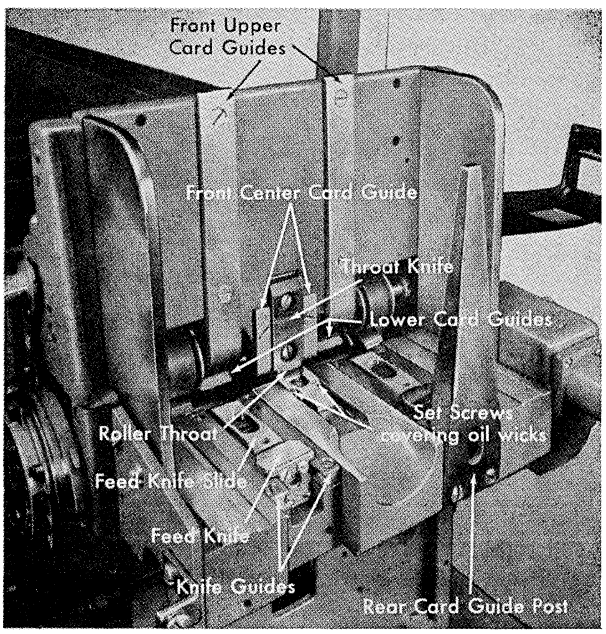


Figure 16. Card Magazine

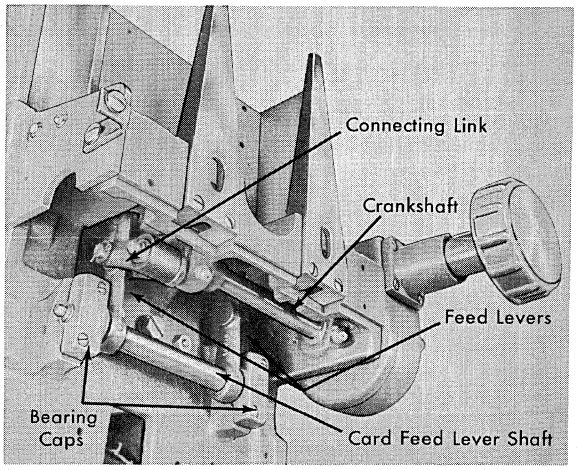


Figure 17A. Feed Knife Drive

located near the handwheel (Figure 13). This large gear drives a crank shaft which, by means of a connecting link, transforms the rotary motion of the crankshaft to reciprocating motion of two feed levers. One feed knife slide assembly is engaged with each feed lever and, as the feed levers reciprocate, the feed knife slide assemblies travel back and forth in porous bronze guides. Their speed of travel is 1300 strokes per minute, thus enabling them to feed 650 cards per minute, one with each stroke to the left.

The component parts of a feed knife slide assembly are shown in Figure 18. The knife holder is adjustable laterally in relation to the feed knife slide and the feed knife is adjustable vertically for the proper projection. (Carbolloy feed knives are not adjustable.) The knife slide pin furnishes the means of engagement with the feed levers. The knife slide pins are available in two sizes; a standard size and an oversize to compensate for wear.

Since there is no latching point in the drive of a sorter, the feed knives may come to rest at any stage of their feed or return stroke when the machine is stopped. Upon starting of the machine, however, that feed knife stroke which was interrupted will be completed and, as the feed knives make their first full length stroke to the left, one card will be picked up from the bottom of the pack in the card magazine. This card is fed through the roller throat and between the first set of feed rolls by the movement of the feed knives to the left (Figure 17). As soon as the card is firmly gripped between the first set of feed rolls, the feed knives start their return stroke

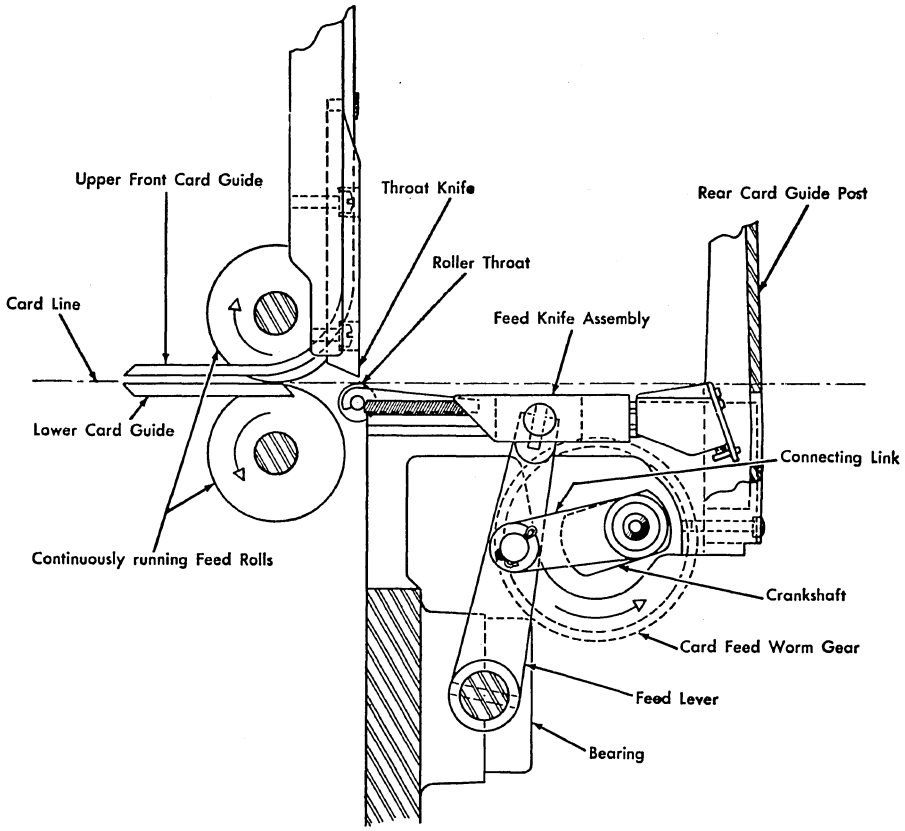


Figure 17. Feed Knife Operation

to pick another card from the bottom of the pack. While the knives are returning, the first card continues its travel to the left under control of the continuously running feed rolls. The stroke of the knives is so timed that, as the trailing edge of the first card leaves the magazine, the second card is picked up by the knives and is fed through the throat, following the first card by a distance of ¾". This process is repeated for the feeding of all cards.

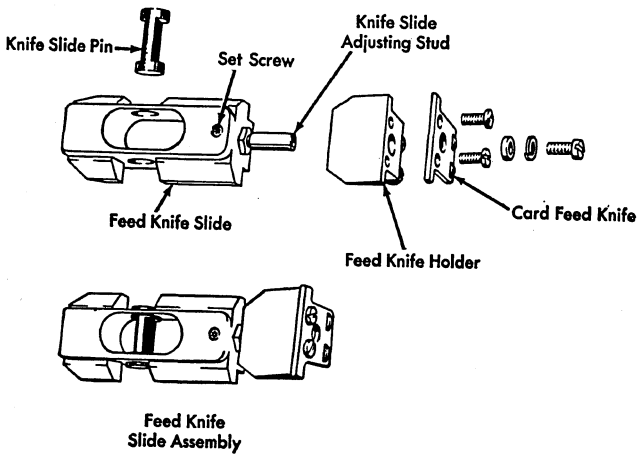


Figure 18. Feed Knife Slide Assembly

Feed Rolls (Figure 19)

The feed rolls furnish the means of receiving the cards from the feed knives and transporting them past the card brush and sort magnet stations and on to their proper pockets. There are fifteen sets of feed rolls in the machine. The first three sets nearest to the card magazine differ somewhat from the other twelve.

All the upper feed rolls consist of two rubber rolls pressed on a steel shaft. The first 3 upper rolls are driven by 19-tooth worm gears meshed with the drive shaft. The remaining 12 upper rolls are not direct driven, but are driven by friction from their matching lower rolls. Except for the second position, each lower feed roll consists of two steel rolls pressed on a steel shaft. At the second position, the lower feed rolls consist of two small auxiliary rolls mounted on separate shafts and bolted to the side frame. These auxiliary rolls

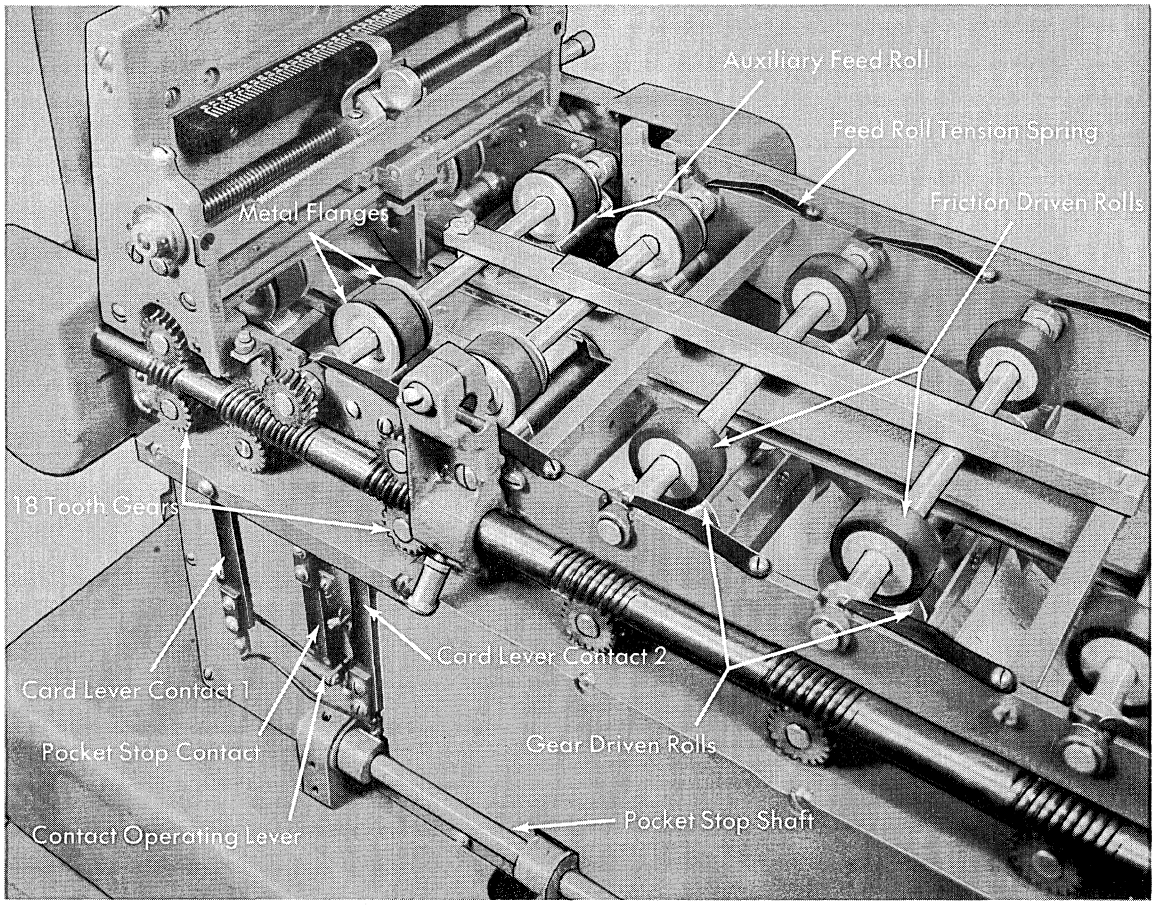


Figure 19. Feed Rolls

are friction driven from the rubber rolls above them. This arrangement is necessary at the second lower position because the size and location of the contact roll prohibits the use of a regular size lower feed roll. The first and third lower feed rolls are driven by 18-tooth worm gears meshed with the drive shaft. All other lower feed rolls, with the exception of the auxiliary feed rolls, are driven by 19-tooth gears.

Downward pressure is applied to each upper feed roll by means of flat tension springs on each feed roll shaft bearing. One exception to this, however, is the first upper feed roll which employs 2 small spring loaded plungers to furnish the downward tension necessary for gripping the card firmly. These small plungers are recessed upwards into the front and rear magazine frames. Note that the flat tension springs for the second upper feed roll are shorter than those for the other feed rolls. All feed rolls, with the exception of the auxiliary rolls, run in removable porous bronze bearings set in the side frames of the machine.

As stated above, some feed rolls are driven from 18-tooth gears while others are driven from 19-tooth gears. From this, it will be apparent that the shafts with 18-tooth gears will turn faster than those with 19-tooth gears. Therefore, it is necessary that those feed rolls having 19-tooth gears be enough larger in diameter than the two having 18-tooth gears to make the peripheral speeds of all rolls the same.

The first and third lower feed rolls, which are driven by 18-tooth gears, make one complete revolution per card cycle. It is necessary that these two shafts make one revolution per cycle because the commutator is mounted on the first shaft and the armature knock-off screw is mounted on the third shaft. The commutator and the armature knockoff must stay in synchronism with the movement of the card at all times.

All other geared rolls are driven by 19-tooth gears and make 18/19 of one revolution per card cycle. This distributes the cutting effect of the cards on the feed rolls since the leading edge of the card does not strike the same spot on the feed rolls each cycle. The contact roll is also driven by a 19-tooth gear. This aids

in the reduction of any possible arcing by changing the point of contact between the card brush and the contact roll each card cycle.

The cutting effect of the card is more pronounced at the first three feed roll stations than at any others. For this reason, the rubber feed rolls at these stations are equipped with metal flanges on either side of the rubber rolls. These flanges serve to further prevent knicking of the rubber rolls by deflecting the card as it strikes the roll. At the same time, because of the position and diameter of the flanges, the rubber portions of the rolls are permitted to exert pressure on the card for feeding even though some wear has taken place on the rubber rolls.

All feed roll gears are fastened to their feed roll shafts by means of two setscrews through each gear hub. On recent machines, a hole is provided in the rear magazine frame, permitting the entry of a setscrew wrench to reach the setscrews in the first upper feed roll gear.

Card Levers and Contacts (Figures 4, 19)

There are two card levers which operate contacts to govern machine circuits. Card lever 1 is located near the rear of the machine between the upper and lower first feed rolls and is operated to close its contact just as the leading edge of the card enters the first feed rolls. Closing of card lever contact 1 allows the sorting circuits to function if a hole is sensed in the card when it passes under the card brush.

Card lever 2 is located near the rear of the machine between the second and third upper feed rolls and is operated to close its contacts as the leading edge of the card leaves the second feed roll. Closing of card lever contact 2 governs two machine functions; one of which is to complete the circuits necessary for automatic machine operation after the operator removes his finger from the start key. The second function is to maintain the sorting circuits during sorting of the last card in the machine.

Once closed, the card lever contacts remain closed during the time that cards are continuously feeding through the machine, opening only when the machine runs out of cards.

Pocket Stop Device

The pocket stop mechanism consists of a normally closed contact operated by a lever (Figure 19). This lever is connected to the pocket stop shaft which extends behind all the pockets at a position below the main drive shaft (Figure 13). An arm is attached to the shaft at each pocket location (Figure 20) and extends under the stacker plate of the pocket in which it is positioned.

As cards collect in a pocket, their weight causes the stacker plate on which they rest to lower against the tension of the stacker spring inside the stacker tube. When a sufficient number of cards (450 to 550) accumulate in a pocket, the stacker plate is lowered far enough to operate against its pocket stop arm. This pivots the pocket stop shaft, causing the contact operating lever to open the pocket stop contact. Because the pocket stop contact is in the circuit to the motor control relay, opening of this contact causes the machine to stop. When the machine is stopped because of the operation of the pocket stop device, the runout feature of the machine is rendered inoperative and the machine stops as soon as its inertia is overcome by friction. Once the machine has been stopped by the operation of the pocket stop device, it can not be re-started by means of the start key until the full pocket or pockets have been emptied.

It is important that the stacker plates and pocket stop arms operate freely. Binding conditions in operation of the pocket stop arms may be corrected by adjustment of the end bearings on the pocket stop shaft. Do not lubricate the stacker tubes as this causes sluggish action because of the collection of dust particles on the tubes.

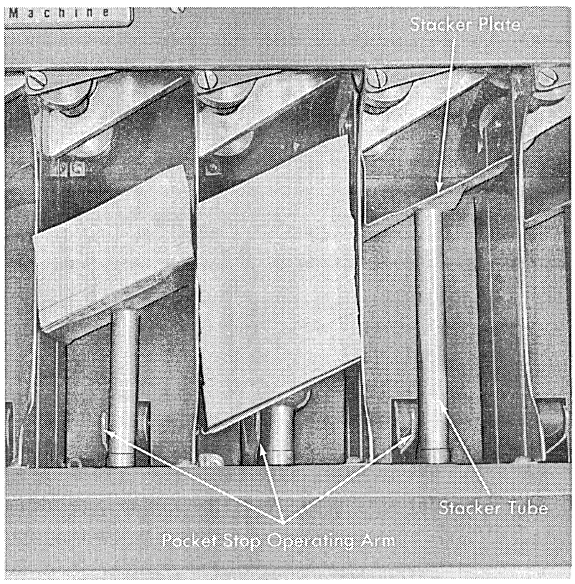


Figure 20. Pocket Stop Levers

CIRCUIT DESCRIPTION

ALL CIRCUITS described in the electrical principles of the Type 82 Card Sorting Machine will refer to wiring diagram 301701-D (Figure 55). Those circuits explained will be the circuits incorporated in a 115 volt AC, single phase machine since this is the type of machine most prominently in use in the field. Circuits for machines using a power supply other than 115 volt AC, single phase will be found to be very similar in layout except for the addition or subtraction of various resistors, filter capacitors, or a transformer in the machine power supply. These discrepancies in machine wiring are noted in sections 3, 4, 5 and 6 of the wiring diagram.

Direct current is required for the operation of all machine circuits with the exception of the motor circuits and the tube heater circuits. Where the source voltage is DC, there is no problem except for the use of extra resistors where the DC rating is 230 volts. Where the source voltage is AC however, selenium rectifiers are employed to convert the AC to DC.

NOTE: The machine frame should be grounded. It may be ungrounded at the customer's option; however, except for 230 volt DC machines, which must have the frame grounded at all times. No point which can be touched by operating personnel can be hot when the switch is on and the frame grounded.

Selenium Rectifiers

The selenium dry disc rectifier consists of an electrode made of a steel or aluminum disc, nickel plated or otherwise coated to prevent rust. On one side of the disc is deposited a thin coating of selenium, over which is sprayed a metallic conductive coating of low temperature alloy. Where the selenium and the low temperature alloy meet, a barrier layer is formed by a special process. It is this barrier layer which permits electron flow from the coated electrode to the steel electrode but restricts electron flow in the reverse direction.

There are two types of selenium discs in use by IBM at present. In one type, each disc will effectively block 18 volts in the reverse direction; in the other type, each disc will effectively block 26 volts in the reverse direction. There is no visual difference in the appearance of each type.

The connection of selenium rectifiers in an AC circuit permits current to flow in one direction only, even though the AC voltage reverses each half cycle; thus converting alternating current to pulsating direct current. However, because of the limitation in reverse voltage which each disc can effectively block, several discs must be connected in series with each other in order to properly rectify a normal source voltage of 115 volts AC which has a peak inverse voltage of approximately 150 volts. Full wave bridge rectifier circuits with filter capacitors and bleeder resistors are used most commonly in the power supplies of IBM machines.

The rectifier output voltage should be between 135 and 145 volts at the specified input voltage (115, 200, or 230 volts), with the machine stopped and the sort magnet continuously energized.

Duo Relays

Duo relays used in IBM machines are constructed with various arrangements of contact points in their makeup. For this reason, the contacts are given a definite nomenclature to differentiate between them on the relay and on the wiring diagram. Figure 21 shows

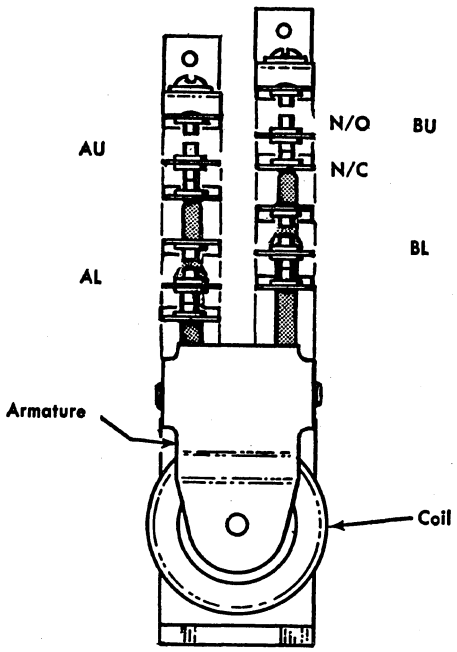


Figure 21. Duo Relay Nomenclature

an armature end view of a standard duo relay with the different contact points properly identified.

Glossary of Terms and Abbreviations

Listed below are some of the terms and abbreviations used in connection with the Type 82 wiring diagram.

N/C	Normally Closed Point
N/O	Normally Open Point
O/P	Operating Point
V1	Tube 1
V1-4	Tube 1, Pin 4
AC	Alternating Current
DC	Direct Current
R2	Resistor 2
TD	Time Delay
MC	Motor Control
MC-BL	Motor Control Relay BL Point
TD-BU	Time Delay Relay BU Point

Time Delay Relay

A time delay relay is employed in the machine to render the start key inoperative for 50 to 60 seconds after turning on the main line switch. This delay is necessary to allow the electron tube filaments to reach operating temperature before sorting begins. A contact strap, composed of two dissimilar metals, is heated by passing current through a coil of wire wrapped around the strap. Heating of this strap causes it to flex in a definite direction and, after having flexed a great enough distance, a contact point riveted to the strap makes contact with another adjustable contact point and completes a circuit to pick up the time delay relay. The duration of time required to cause the time delay relay to pick may be altered by increasing or decreasing the air gap between the A points by means of the adjusting screw on the outer contact strap.

Relay Gate and Electronic Chassis

The relay gate is located behind the cover on the right end of the machine and may be pivoted outward for ease of servicing (Figure 22). A latch mechanism keeps the gate locked in its closed position at all other times.

The electronic chassis is mechanically fastened to the relay gate by means of 4 screws. It is electrically connected to the rest of the machine circuits through an octal plug and tube socket.

NOTE: The following change should be made to the octal plug of machines wired prior to wiring diagram 301701-C, so that chassis 301639, which is wired to 301701-C, may be used: pins 6 and 8 must be jumpered in the octal plug to provide a circuit from the cathodes of the 25L6 sort magnet tubes to the negative side of the DC circuit. These cathodes are connected separately to pin 8 on chassis 301639, which is wired to 301701-C. This change should not be made on machines with special features without first checking the special feature wiring diagram as pin 8 is often used to separate these special circuits from the standard wiring on pin 6.

Figure 23 shows a bottom view of the electronic chassis.

Tube Filaments

Upon closing of the main line switch, a circuit is completed to the filaments of the vacuum tubes as follows: one side of the power outlet, through relay panel terminal 1, the main line switch, main line fuse or fusetron, 2 ampere fuse, octal plug terminal 7, the filaments of vacuum tubes 5, 6, 4, 3 and 2 in series, octal plug terminal 2, relay panel terminal 9, to the rectifier stack, through the 2 ampere fuse, main line fuse or fusetron, main line switch, relay panel terminal 2, to the other side of the power outlet.

DC Machine Circuit

The DC supply for operation of machine functional circuits is as follows: from one side of the power outlet, through relay panel terminal 1, the main line switch, main line fuse or fusetron, 2 ampere fuse, one leg of the selenium rectifier, the minus terminal of the rectifier, to DC circuit terminal 14 constituting the minus side of the line. A similar circuit can be seen through the plus side of the rectifier to DC circuit terminal 13 constituting the plus side of the line.

A filter capacitor is connected across the minus and plus terminals of the selenium rectifier to steady its output. A bleeder resistor is connected across the terminals of the capacitor to bleed out the charge on the condenser after the main line switch is turned off.

Since relay panel terminal 14 constitutes the minus side of the DC circuit supply and relay panel terminal 13 constitutes the plus side of the DC circuit supply, all subsequent functional circuits described herein will begin at terminal 14 and end at terminal 13.

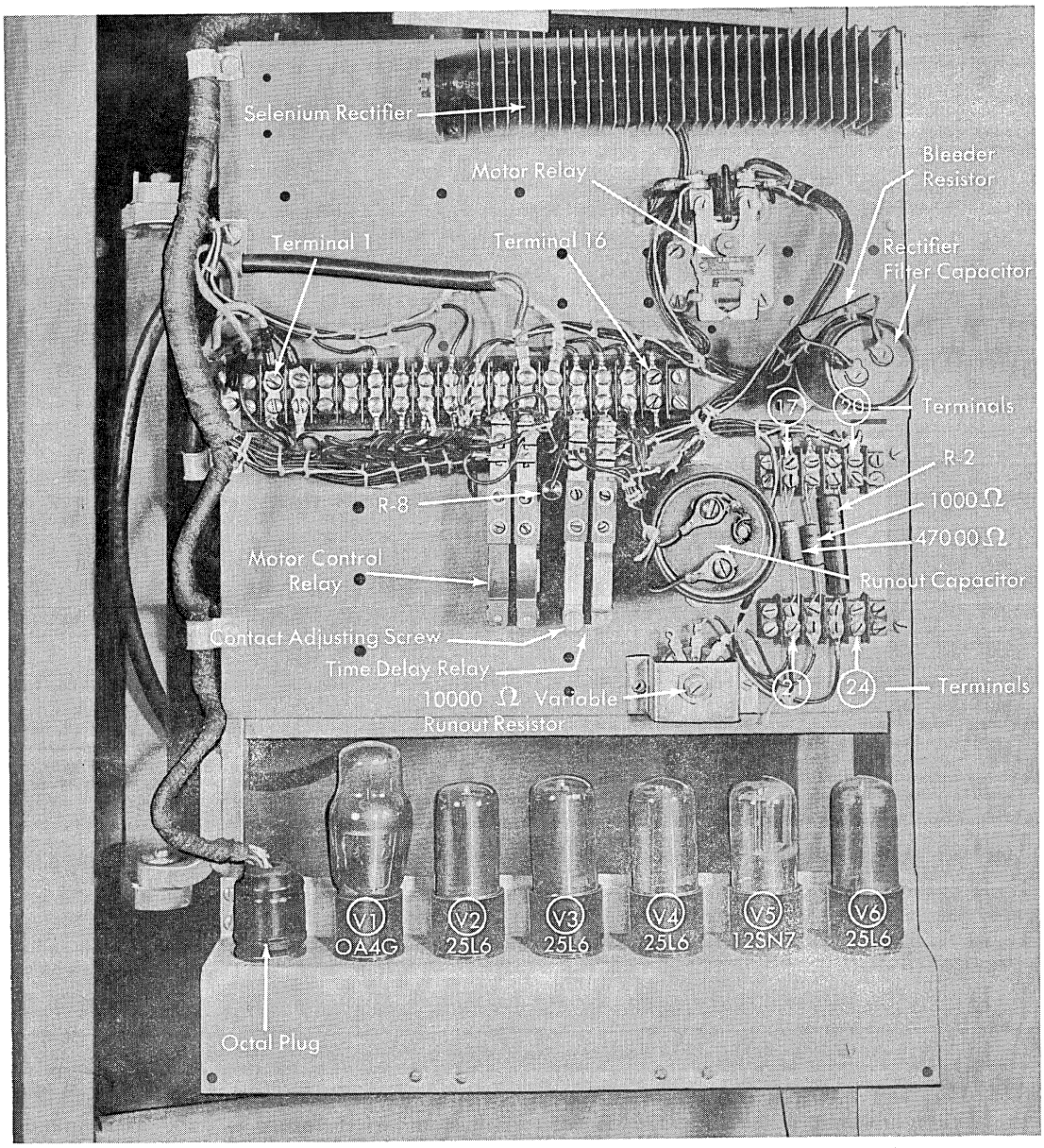


Figure 22. Relay Gate and Electronic Chassis

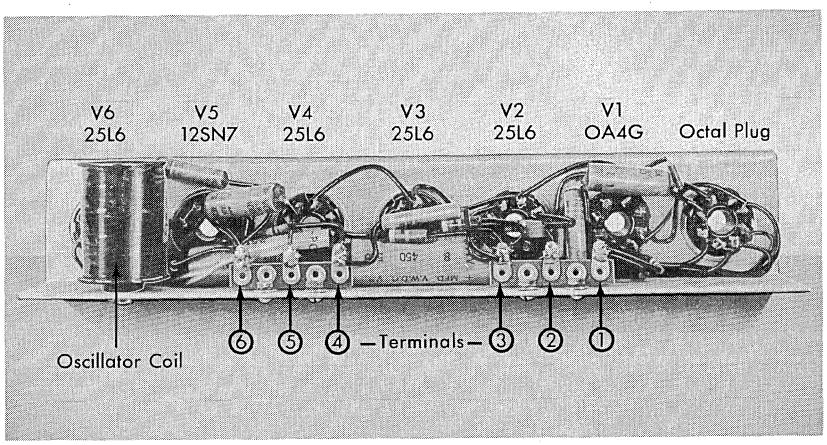


Figure 23. Bottom View of Electronic Chassis

STARTING AND RUNNING CIRCUITS

Time Delay Relay

As soon as the main line switch is turned on, a circuit is immediately completed to the filaments of the tubes and through the heating element on the TD-A strap of the time delay relay. The circuit through the heating element is as follows: from DC circuit terminal 14, through the jumper in place of R6, R8, TD heater, TD-BL point N/C, to the TD-A point, to DC circuit terminal 13. Current flowing through the heating element causes the TD-A strap to flex and close the TD-A point.

Closing of the TD-A point completes a circuit through the time delay relay coil, thus causing the relay to attract its armature and transfer its points. Opening of the TD-BL N/C point breaks the circuit to the heating element, thus allowing the TD-A point to return to its N/O position as soon as the TD-A strap cools. Closing of the TD-BL N/O point completes a holding circuit to the coil of the time delay relay. Once it is picked, the time delay relay remains energized until the main line switch is turned off.

Motor Control Relay

After cards have been inserted in the card magazine and the time delay relay has picked, depression of the start key completes a circuit to pick the motor control relay as follows: from DC terminal 14, through relay panel terminal 8, contact roll cover switch 2 (closed when the contact roll cover is down), terminal 7, jumper across R5, TD-BU, stop key, pocket stop contact, motor control relay, start key, contact roll cover switch 1, to TD-A, terminal 13.

The start key must be held depressed until the cards reach a position to close card lever contact 2. When card lever contact 2 closes, a hold circuit is completed to the motor control relay as follows: from terminal 14, through terminal 8, contact roll cover switch 2, terminal 7, jumper across R5, TD-BU, stop key, pocket stop contact, motor control relay, MC-AL, outer card lever contact 2, to the start key, through contact roll cover switch 1, to TD-A, terminal 13. Once the motor control relay has been picked and its hold circuit established, it remains energized until the stop key is depressed, the pocket stop device is activated, the contact roll cover is raised, or the machine runs out of cards and the runout capacitor discharges.

Motor Relay and Drive Motor

As soon as the motor control relay is picked by depression of the start key, the MC-BL point closes and a circuit is completed to pick and hold the motor relay as follows: from terminal 14, through terminal 8, contact roll cover switch 2, motor relay, MC-BL, to terminal 6, card lever contact 2, start key, through contact roll cover switch 1, to TD-A, terminal 13.

Pick of the motor relay closes its points and completes a circuit to the drive motor as follows: from one side of the power outlet, through terminal 1, the main line switch, main line fuse or fusetron, terminal 12, drive motor, terminal 11, motor relay points, main line fuse or fusetron, main line switch, terminal 2, to the other side of the power outlet.

As long as the motor relay remains energized, the drive motor will continue to run. The motor relay will be de-energized, however, when the stop key is depressed, the pocket stop contact opens, the machine runs out of cards, or the contact roll cover is raised.

The motor relay is a heavy duty relay with two large contact point surfaces which can withstand the arc occurring when the circuit to the drive motor is made or broken.

The later type 82 machines are equipped with a ⅓ HP motor, while the earlier machines are equipped with a ½ HP motor. The ½ HP motor draws a larger starting current than does the ⅓ HP motor.

Runout Capacitor

Upon the pickup of the motor control relay and subsequent closing of card lever contact 2, the runout capacitor is charged in the following manner: electrons flow from the minus DC terminal 14, to terminal 8, through MC-AU, terminal 17, to one plate of the capacitor, thus depositing on that plate an excess of electrons. From the opposite plate of the capacitor, electrons are repelled through terminal 21, the 10,000 ohm variable resistor, terminal 22, the 1000 ohm resistor, to MC-AL, through card lever contact 2, contact roll cover switch 1, to terminal 13, thus creating a deficiency of electrons on the latter plate.

Once charged, the capacitor retains this charge, approximately equal in amount to the potential present across terminals 13 and 14, until card lever contact 2 opens. Opening of card lever contact 2 removes the potential impressed on the runout capacitor, allowing it to discharge through the motor control relay in the following manner: electrons leave the minus plate of

the capacitor, travel through terminal 17, MC-AU, terminal 8, contact roll cover switch 2, terminal 7, jumper in place of R5, TD-BU, stop key, pocket stop contact, motor control relay, MC-AL, terminal 18, 1000 ohm resistor, terminal 22, 10,000 ohm variable resistor, terminal 21, to the positive plate.

This discharge keeps the motor control relay picked until the current flow from the capacitor falls below the value required to hold the relay energized. As long as the motor control relay remains picked, the MC-BL point maintains a circuit through the motor relay, and the motor relay points, in turn, maintain a circuit to the drive motor. Prolongation of the circuit to the drive motor in this manner allows the last card in the machine to be fed to its proper pocket before the machine stops.

The 10,000 ohm variable resistor in series with the runout capacitor should be adjusted so that the drive motor will keep running for .5 to 1 second after the last card drops in the 9 pocket. Decreasing the effective value of the variable resistor will prolong the runout time; increasing the effective value of the variable resistor will shorten the runout time.

The runout circuit is rendered inoperative in the event that the machine is stopped through opening of the pocket stop contact, raising of the contact roll cover, or depression of the stop key. Under any one of these conditions, the machine will coast to a stop as soon as its inertia is overcome by friction.

The 47,000 ohm resistor which shunts the terminals of the runout capacitor serves to bleed off the charge after the machine has been stopped through operation of the pocket stop device, raising of the contact roll cover, or depression of the stop key.

SORTING CIRCUITS

BECAUSE the Type 82 sorter operates at a speed of 650 cards per minute, the sort magnet armature must be attracted very quickly (.005 seconds or less) so that the cards will sort properly without being nicked by the tips of the chute blades. Relay operation, as in the Type 80 sorter, is not dependable at this speed; therefore, an electronic circuit is used. Not only does the electronic circuit provide the necessary speed of operation, but it also eliminates burning at the contact roll and the selector commutator because of the small amount of current used to control the energization of the sort magnet.

Before proceeding with the study of the sorting circuits, it may be well to review some of the basic principles of electronics as an aid to the better understanding of these circuits.

1. In this presentation, current flow shall be established synonymous with electron flow and shall be considered as flowing from negative to positive.

2. When current flows through a resistance, the voltage is negative on the end of the resistor where the current enters and positive on the end where the current leaves.

3. When there is no current flowing in a resistor network there will be no voltage drops across any given resistors in that network.

4. The term "ground" refers to a zero potential value. Usually the negative power input lead is considered to be at ground potential. Voltages measured from this reference may be positive (above ground) or negative (below ground).

5. Current or electron flow in a vacuum tube or a gas tube is always from the cathode to the anode (plate) and can take place only when the anode is positive in respect to the cathode.

6. The control grid of a vacuum tube is physically located between the cathode and the anode and acts as a valve in regulating the flow of electrons from the cathode to the anode. This control is accomplished by varying the amount of negative voltage applied to the grid. Increasing the negative voltage on the grid can slow down or completely cut off electron flow from cathode to anode, even though the anode (and screen grid) are positive in respect to the cathode. Decreasing the negative voltage on the grid can start or speed up electron flow from cathode to anode as long as the anode is positive in respect to the cathode.

7. The constant DC voltage applied between the control grid and the cathode of a tube is called the bias voltage. When such a voltage is applied to the control grid, it is negative with respect to the cathode potential and is called grid bias. When such a voltage is applied to the cathode, it is positive with respect to the voltage on the control grid and is called cathode bias. Regardless of whether grid bias or cathode bias is used, the purpose of both is to make the control grid negative with respect to the cathode.

8. The screen grid of a vacuum tube, physically located between the control grid and the anode, may have a positive voltage applied to it, thus aiding the anode in attracting electrons away from the cathode.

In performing this function, not all the electrons pass through this grid and on to the anode but some strike the screen grid wires and pass on into the screen circuit to cause the flow of screen current. There are other important uses of the screen grid. However, they do not apply in the Type 82 circuits.

9. Gas tubes, such as the OA4G, have the unique characteristic of not starting conduction until the starting anode receives the required positive voltage. Once ionization or conduction begins, however, the starting anode loses all control, and current flow in the tube can be cut off only by opening the main anode circuit or by decreasing the positive voltage on the main anode to a value insufficient to maintain ionization (approximately 65 to 70 volts for an OA4G tube).

General Operation

The flow of current to the sort magnet is furnished by three 25L6 beam power tetrodes connected in parallel. This flow of current is under control of an OA4G cold cathode gas triode which serves the same purpose as does the card brush relay in the Type 80 sorter. The OA4G, or trigger tube, is fired by the action of the card brush sensing a punched hole and, being a gas tube, it remains in conduction until the anode circuit is broken by the center brush of the commutator at the end of the card cycle (principle 9).

Oscillator and Rectifier Tube

Approximately –40 to –45 volts bias (principle 7) for the 25L6 power tubes and the OA4G trigger tube is supplied by a diode connected 12SN7, which rectifies a high audio frequency voltage (approximately 4.3KC) supplied by a Hartley type oscillator using a triode connected 25L6. Since a transformer and rectifier bias supply is not feasible for DC machines, an oscillator-rectifier setup is used so that machine circuits will be applicable on both AC and DC. The bias rectifier and oscillator operate continuously when the machine is turned on and the contact roll cover is down, so that –40 to –45 volts is always available as required.

The oscillator and rectifier are shown schematically in Figure 24. The rectified machine supply voltage is shown as 150 volts DC because the power supply capacitors tend to charge to peak line voltage under a light load. As the 25L6 oscillates, there is a constant rising and falling of the plate current through the tube. The speed at which this rising and falling of plate current occurs is dependent on the resonant frequency as determined by the tank circuit made up of the .05 mfd. capacitor and sections A and B of the oscillator coil. Because the B section of the coil is in series with the tube, variations in plate current cause variations in the current flowing through the B section of the coil. Rising and falling values of current in the B section of the coil induce voltages in sections A and C of the coil. These induced voltages are alternating voltages which change polarity with each rise and fall of the current through the B section. The voltage induced in the A section of the coil is applied to the grid of the tube to keep the tube oscillating. The voltage induced in the C section of the coil is applied across terminal 5 and the cathodes of the 12SN7. Since this voltage changes polarity each half cycle, the 12SN7 conducts only on those half cycles during which its anode is positive in respect to its cathode (principle 5). Because of this action, the 12SN7 rectifies the output from section C of the coil to provide approximately –40 to –45 volts DC with respect to the negative or zero side of the power supply.

When the oscillator first starts to operate, the 4 mfd. capacitor tends to charge through the circuit shown dotted in Figure 24 on each half cycle that the 12SN7 conducts. Because of its comparatively large size, several oscillator cycles are required before the capacitor becomes fully charged. As the condenser becomes charged to the value of the voltage drop across section C of the coil (approximately 40 to 45 volts), current flow in the 12SN7 diminishes greatly because of the lack of a difference in potential between its anode and its cathode. Once charged, the 4 mfd. capacitor remains charged except for a slight leakage through the 1 megohm resistor on those half cycles during which the 12SN7 does not conduct. Any loss of charge across the capacitor due to leakage is replaced by conduction through the 12SN7. Except for the small amount of current required to replace the charge that leaks from the 4 mfd. capacitor, current flow through the 12SN7 is practically zero after the capacitor is initially charged and before a hole is sensed in the card. Once the 4 mfd. capacitor becomes charged with the polarity as shown in Figure 24, a constant negative bias of –40 to –45 volts is supplied, even though the induced voltage in section C of the coil reverses polarity each half cycle. Without this capacitor, negative bias would be lost each half cycle that the 12SN7 did not conduct.

The 1 megohm resistor connected between the plate

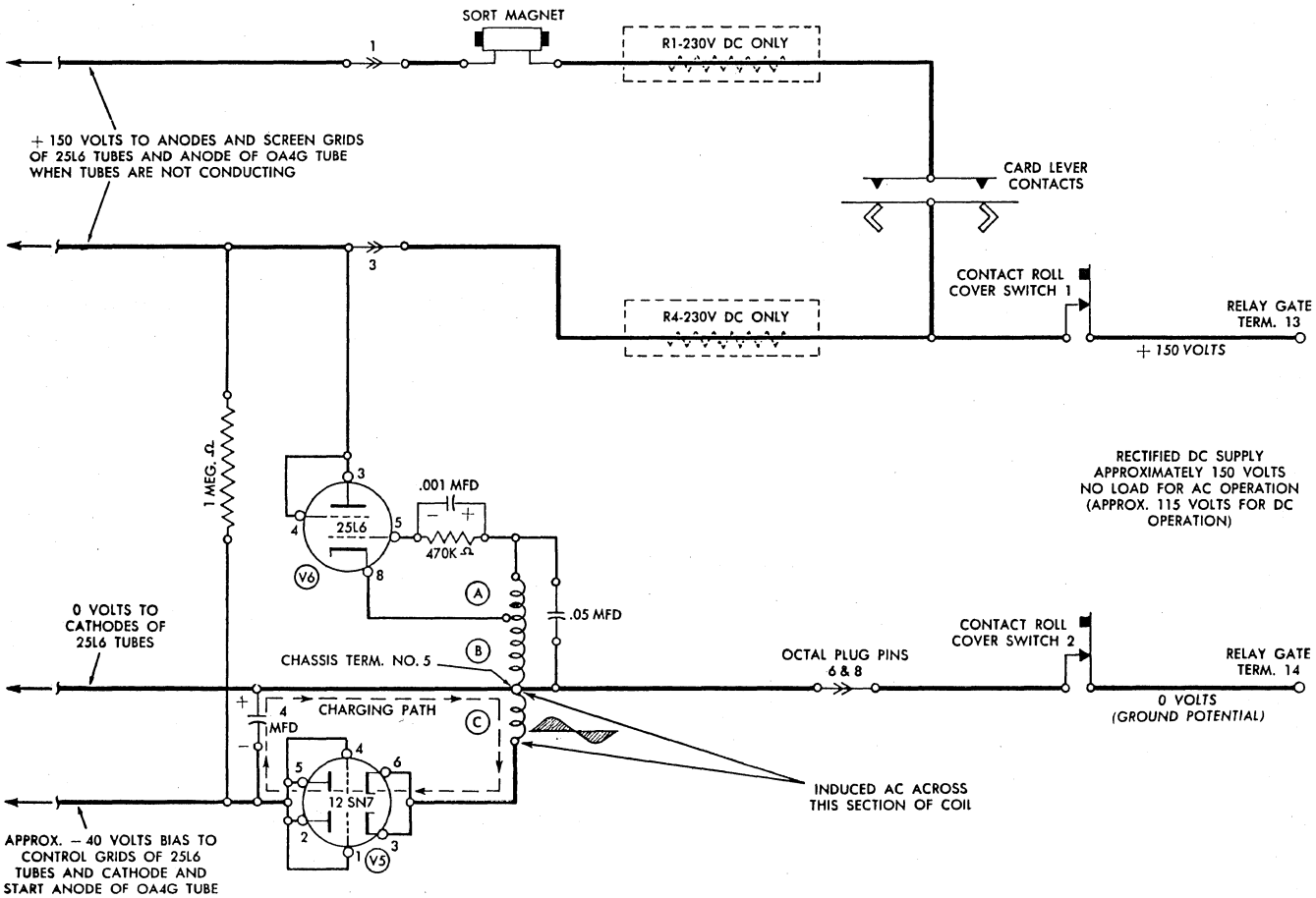


Figure 24. Schematic of Oscillator and Rectifier

of the 12SN7 and the plus side of the DC supply serves to stabilize the bias circuit.

The 470,000 ohm resistor and .001 mfd. capacitor in the oscillator circuit provide signal grid bias for the tube.

The condition of the 25L6 oscillator tube should be checked occasionally by placing a voltmeter across the 4 mfd. condenser. If this reading is below 25 volts in a static condition, the 25L6 tube may be faulty. (See the voltage chart and notes on wiring diagram 301701 - D.)

Static Circuit Conditions (Figure 25)

Prior to the time that a hole is sensed by the card brush, both ends of the 10,000 ohm resistor will be at –40 to –45 volts, as will the control grids of the 25L6 power tubes and the cathode of the OA4G tube (principle 3). The starter anode of the OA4G will also be at –40 to –45 volts through the 47,000 ohm and the 470,000 ohm resistors connected to one end of the 10,000 ohm resistor and the bias supply. This is a static condition and no current will be flowing in the bias network. Neither will any current be flowing through the 25L6 power tubes to the sort magnet as these tubes are biased beyond cutoff at this time (principles 6 and 7). The rectified supply voltage will be approximately 150 volts DC because the power supply capacitor tends to charge to peak line voltage under light loads.

Because no current is flowing through the 25L6 power tubes, both the anodes and the screen grids of these tubes will be at the maximum positive potential of 150 volts (card lever contacts closed). The anode of the OA4G tube will also be at 150 volts positive brushes on the commutator are electrically connected, potential through R2 when the center and outer but before a hole is sensed in the card.

Firing the Trigger Tube

As soon as the card brush makes contact with the contact roll through a hole in the card, +150 volts is applied to the starting anode of the OA4G and more than cancels the –40 volts applied from the bias network. This causes the tube to fire. The 47,000 ohm resistor limits the starting anode current when the tube fires.

Firing of the OA4G tube allows current to flow from the negative side of the line, through contact roll cover switch 2, octal plug pin 6, the lower section of the oscillator coil, 12SN7, 10,000 ohm resistor, cathode to main anode of the OA4G, octal plug pin 4, center to outer commutator brushes, R2, card lever contacts, contact roll cover switch 1, to the positive side of the line. Current flow through this circuit causes a voltage drop of approximately 60 volts across the 10,000 ohm resistor with the polarity as shown in Figure 25 (principle 2), This polarity opposes the polarity of the 40 volt negative bias on the grids of the 25L6 power tubes and tends to swing these grids to a value of approximately 20 volts positive with respect to their cathodes which are at zero potential. However, as soon as the grids become positive, current flows in the grid circuit of each tube and causes a voltage drop across the 47,000 ohm grid resistors with the polarity is shown in Figure 25. This lowers the positive potential on the grids to a value only slightly greater than the cathodes.

The 4 mfd. capacitor partially discharges through the OA4G tube each half cycle that the alternating voltage across the lower section of the oscillator coil opposes the main DC voltage. The capacitor tends to charge when the alternating voltage across the lower section of the oscillator coil aids the main DC voltage. In this respect, the capacitor acts as a half wave filter and tends to keep the bias supply steady when the OA4G tube is conducting. Although the 4 mfd. capacitor steadies the bias supply when the OA4G is conducting, the bias supply decreases in value at this time from –40 volts to –30 volts or less. When the OA4G ceases to conduct at the time the center commutator brush opens the circuit, the 4 mfd. capacitor fully charges as before, and –40 to –45 volts bias is again placed on the power tubes and the cathode and starting anode of the OA4G tube.

Energizing the Sort Magnet

With the negative bias removed from the grids of the 25L6 power tubes, they immediately conduct (principle 6) from the negative side of the line, through contact roll cover switch 2, octal plug pin 8, 25L6 cathodes, 25L6 anodes, octal plug 1, sort magnet, card lever contacts, contact roll cover switch 1, to the positive side of the line; thus energizing the sort magnet. The initial surge of current through the 25L6 tubes is of a comparatively large value due to the action of the 8 mfd. capacitor in the screen grid circuit of the 25L6 power tubes. This capacitor charges up to the line potential of 150 volts as soon as the main line switch is turned on. When the grid bias is removed from the control grids of the 25L6 tubes, causing them to go into conduction, the charge on the 8 mfd. capacitor maintains a high positive potential on the screen grids; thus producing a peak plate current flow through the tubes (principle 8). This initial heavy current surge through the three 25L6 tubes lasts only a short time. As the capacitor discharges through the screen grid circuits, the positive potential on the screen grids decreases, finally reaching a steady state value of approximately 65 volts because of the voltage drop across the 4,700 ohm resistor. Lowering the screen grid voltage in this manner causes the plate current to decrease to its normal steady state value. The foregoing action described gives a large initial impulse to the sort magnet, causing fast attraction of the sort magnet armature; after which the current through the sort magnet tapers off, remaining in sufficient magnitude, however, to keep the armature attracted.

Steady state current flow through the sort magnet on a 115 volt AC machine should be approximately 220 MA, measured when a punched card is fed through the machine by hand. On a 115 volt DC machine, current flow measured in this manner should be approximately 165 MA. If a meter with the proper current scale is not available, the voltage drop across the sort magnet can be measured, and should be approximately 13 volts for AC machines and 10 volts for 115 volt DC machines. Steady state current flow through the sort magnet should never fall below 140 MA on either AC or DC operated machines. This value of 140 MA through the sort magnet is comparable to a drop of 8.4 volts across it. If the current through the sort magnet falls below 140 MA when the line voltage is correct, it may be an indication that one or more of the 25L6 power tubes are weak.

The action of the 8 mfd. capacitor and the 4,700

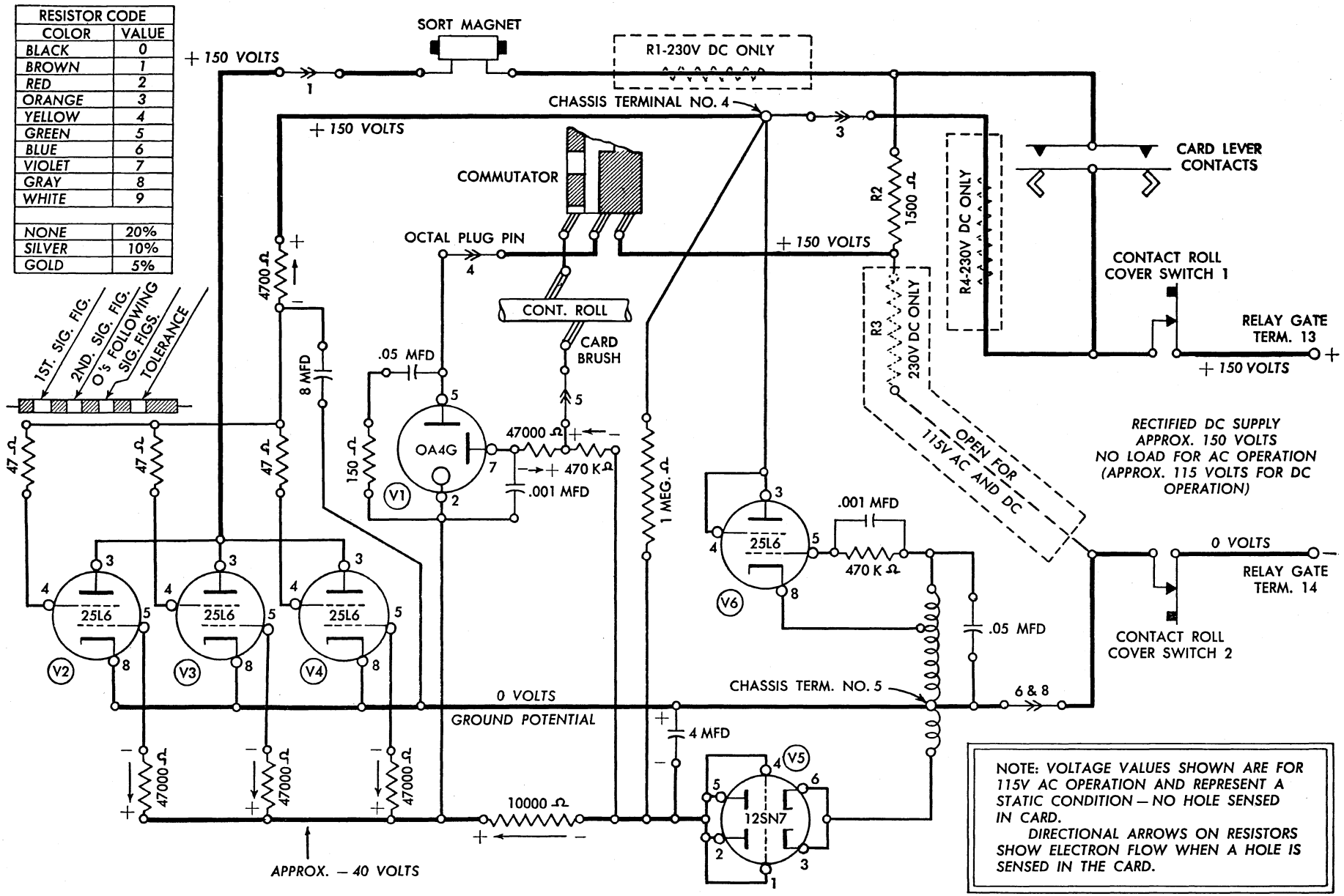


Figure 25. Schematic of Type 82 Sorting Circuits

ohm resistor also serves as a protective device for the 25L6 power tubes by reducing the initial high surge of current through these tubes to a value below their safe maximum continuous rating. Thus, if the machine were stopped at a time in the card cycle when the power tubes were conducting, the continuous flow of current through the tubes would not be great enough to cause damage.

Restoring Bias

When the hole in the card passes from under the card brush, thus insulating the brush from the contact roll, the positive voltage is removed from the OA4G starter anode. This does not cause the OA4G tube to stop conducting, however, since the starter anode loses control of conduction in a gas tube after the tube fires (principle 9). The OA4G continues to conduct until the center brush on the commutator opens the anode circuit. When this occurs, the OA4G is extinguished and current ceases to flow through the 10,000 ohm resistor. The voltage drop across this resistor is then lost (principle 3), and the control grids of the 25L6 tubes and the cathode and starting anode of the OA4G are returned to 40 to 45 volts negative bias by the oscillator and rectifier circuit. Restoring bias to the grids of the 25L6 tubes causes these tubes to cease conducting, thus de-energizing the sort magnet.

Between the 12 position of the leading card and the 9 position of the following card, the armature return spring and the armature knockoff come into play to restore the armature to its normal raised position in preparation for sorting the following card.

Miscellaneous Components

The 47 ohm resistors in the screen grid circuits of the 25L6 power tubes suppress parasitic oscillation which may appear as a result of operating tubes in parallel.

The 47,000 ohm resistors in the 25L6 control grid circuits serve to limit the positive grid swing on conduction which would otherwise allow excessive grid current to damage the tube. These resistors also act as isolating resistors to prevent the development of parasitic oscillations in these tubes.

The .001 mfd. capacitor between the cathode and the starting anode of the OA4G serves to by-pass transient impulses which may be introduced into the card brush circuit and cause firing of the tube even though no hole has been sensed in the card.

The .05 mfd. and the 150 ohm resistor in series between the cathode and the anode of the OA4G also serve to by-pass transient impulses and prevent them from firing the tube prematurely.

The 470K ohm resistor in the OA4G circuit connects the starting anode to its cathode through the 10,000 ohm resistor, thus keeping the starter anode at its own cathode potential whenever the card insulates the card brush from the contact roll.

E Suffix Changes

Machines wired to 301701-E are similar in circuit operation to machines which are wired to 301701-C or D. On the E suffix wiring diagram, the 12SN7 rectifier tube is replaced with a selenium rectifier. An additional power tube is added in the circuit to the sort magnet. This added power tube furnishes more current to the sort magnet, thus increasing the safety factor of operation. This was considered especially desirable for DC-operated machines.

The E suffix electronic chassis consists of a flat plate instead of the L-shaped chassis shown in Figures 22 and 23. The flat chassis is *electrically* interchangeable with the L-shaped chassis if the machine is wired to 301701-D or 301701-C, or if the machine has been altered in accordance with CEM 1213.

F Suffix Changes

Machines wired to 301701-F are similar in circuit operation to those wired to 301701-C, D, or E. The electronic chassis is physically and electrically the same as that used for 301701-E. A running light is incorporated in the circuit to indicate to the operator that the machine is ready for operation. This light comes on after the time delay relay picks up.

Machines wired to 301701-F are Vinyl-covered machines and have several redesigned external features which modernize the machine.

G Suffix Change

Machines wired to 301701-G that operate on 115, 208, 230 volts AC, 50 or 60 cycle, obtain tube bias voltage from a transformer which replaces the 25L6 oscillator bias circuit.

PURPOSE OF RELAYS, CONTACTS AND SWITCHES

Motor Control Relay

The primary function of this relay is to prevent starting of the machine by any means other than by depression of the start key. This relay is picked up when the start key is depressed and remains energized as long as the machine is running. When the machine runs out of cards, the runout capacitor discharges through this relay, holding it energized long enough for the MC-BL point to keep the motor relay energized and the drive motor running until the last card in the machine is fed to its proper pocket.

The MC-AL point, in conjunction with card lever contact 2, completes a hold circuit to the motor control relay. In its N/O condition, this relay point prevents the energization of the above relay except by means of the start key in the event the machine was stopped with cards in the feed.

The MC-AU point prevents a back circuit which would make the contact roll hot if the machine was stopped with cards in the feed and the contact roll cover was raised.

The MC-BL point completes a circuit to pick the motor relay and hold it energized during automatic machine operation.

Motor Relay

This relay is a heavy duty relay. Its purpose is to complete a circuit to the drive motor. It is picked and held energized under control of the motor control relay. As long as the motor relay remains energized, its points complete a circuit to the drive motor.

Time Delay Relay

The purpose of the time delay relay is to prevent starting of the machine until the tubes have reached their proper operating temperature. Upon closing of the main line switch, current flowing in the TD heater coils causes the TD-A contact strap to flex, close its contact point, and pick the time delay relay. The time required to close the TD-A point is 50 to 60 seeconds.

The TD-BL N/C point allows a circuit through the TD heater when the main line switch is turned on. After the time delay relay has picked, opening of this point breaks the circuit to the heater coil.

The TD-BL N/O point provides a hold circuit for the time delay relay once it has been picked.

The TD-BU point renders the start key inoperative until the time delay relay picks.

Card Lever Contact 1

This contact closes as the leading edge of the card enters the first feed rolls. Closing of this contact allows sorting of the first card. Once closed, it remains closed during the time that cards are continuously feeding through the machine and, in conjunction with card lever contact 2, furnishes circuits to the commutator and the sort magnet for sorting.

Card Lever Contact 2

This contact closes as the leading edge of the card leaves the second feed roll. Once closed, it remains closed during the time that cards are continuously feeding through the machine, and furnishes circuits to the commutator and sort magnet for sorting and to the motor control relay for automatic operation. This contact maintains the necessary circuits for sorting the last card.

Pocket Stop Contact

This contact is normally closed. Opening of this contact when one or more card pockets become full renders the runout circuit inoperative and causes immediate dropout of the motor control relay. Dropout of this relay opens the MC-BL point, de-energizing the motor relay and stopping the machine as soon as its inertia is overcome by friction.

Contact Roll Cover Switches 1 and 2

These two switches are held in a closed position when the contact roll cover is lowered. Raising of the contact roll cover opens both switches, breaking all machine circuits and removing the potential from the contact roll. These switches are installed as a safety measure for operating personnel, and their operation must not be crippled in any way.

IBM 80 CARD SORTING MACHINE

FUNCTIONAL PRINCIPLES

THE TYPE 80 Card Sorting Machine (Figure 26) is a forerunner of the Type 82 machine and performs the same functions as does the Type 82. The speed of the Type 80, Model 1, is 450 cards per minute; the speed of the Type 80, Model 2, is 250 cards per minute. Because of this reduced speed, the operation of high speed relays is fast enough to control the energization of the sort magnet, and an electronic circuit is not necessary. The capacity of the card magazine is the same as that on the Type 82 machine; 550 cards.

OPERATING FEATURES

THE OPERATING features on the Type 80 machine are the same as those on the Type 82, except for the main line switch and the start and stop keys.

The main line switch and the start and stop keys are located as shown in Figure 26. Turning on the main line switch immediately furnishes power to the machine and makes the start key effective. The start key is protected by a metal hood which prevents inadvertent starting of the machine due to accidental depression

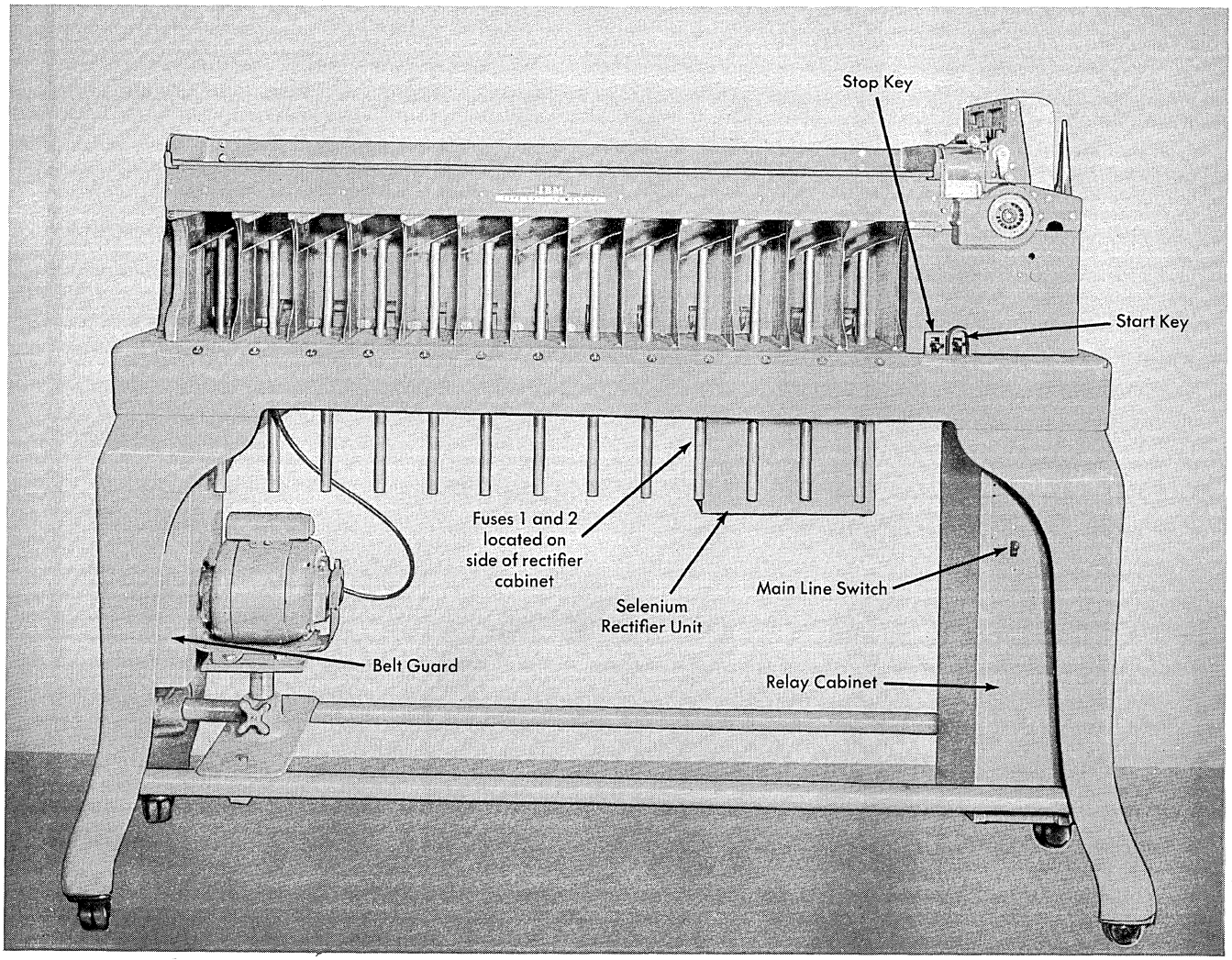


Figure 26. Type 80 Card Sorting Machine

of this key. The stop key, when depressed, renders the runout feature of the machine inoperative and causes immediate stopping of the machine.

Current, Weight, and Dimensions

The maximum operating current, starting current, and fuse rating of the Type 80 machine equipped with a ⅓ HP motor should be:

Voltage Group			Operating Current	Starting Current	Main Fuses
Volts	Cycles	Phases	Amperes	Amperes	Amperes
115	DC		4.1	31.5	12
230	DC		2.3	16.0	6
115	25	1	5.2	26.3	12
115	50	1	5.5	28.0	12
115	60	1	5.3	29.2	12
127	50	1	5.0	20.5	12
150	60	1	4.3	17.5	12
208	50	1	3.8	12.5	6
208	50	2	2.8	6.5	6
208	50	3	2.4	8.2	6
208	60	1	3.6	12.5	6
230	25	1	2.9	13.4	6
230	50	1	3.0	14.2	6
230	60	1	2.9	14.8	6
230	50	3	2.1	9.5	6

Weight unpacked - - - - -	445 pounds
Weight packed - - - - -	735 pounds
Length - - - - - - - - -	63 inches
Width - - - - - - - - -	16 inches
Height - - - - - - - - -	45 inches

MECHANICAL AND ELECTRICAL PRINCIPLES

THE MECHANICAL principles of the Type 80 Sorter are identical to those of the Type 82.

The electrical principles of the Type 80 machine differ somewhat from those employed in the Type 82. No tubes are present in the Type 80 machine; therefore, the use of a time delay relay to allow time for tubes to heat up is not necessary. A high speed slate base relay is employed in place of tubes to aid in controlling the energization of the sort magnet.

When a hole is sensed in the card, a circuit is completed to energize the sort magnet and cause pickup of a high speed slate base relay. This circuit is controlled through the card brush and the inner and outer brushes on the commutator. Pickup of the high speed relay closes its contact point and maintains a hold circuit to the sort magnet through the center and outer commutator brushes. This hold circuit continues until slightly after the 12 position on the card has passed under the reading brush, thus completing the sensing of any holes in that column. As on the Type 82 machine, if two holes are present in a column sensed, and no provisions are made by means of the contact bars on the commutator to suspend sorting of one value, the card will sort according to the first value sensed by the brush.

CIRCUIT DESCRIPTION

ALL CIRCUITS described in the electrical principles of the Type 80 Card Sorting machine will refer to wiring diagram 161847-N. A reproduction of this wiring diagram is shown in Figure 27. Those circuits explained will be the circuits incorporated in a 115 volt AC, single phase machine because this is the type most prominently in use in the field. Circuits for machines using a power supply other than 115 volt AC, single phase will be found to be very similar in layout except for the addition or subtraction of various resistors, filter capacitors, or a transformer in the machine power supply.

Direct current is required for the operation of all machine circuits with the exception of the motor circuits. Where the source voltage is DC, there is no problem except for the increase of resistor values where the DC rating is greater than 115 volts. Where the source voltage is AC, however, selenium rectifiers are employed to convert the AC to DC.

NOTE: The machine frame should be grounded. It may be ungrounded however, at the customer's option, except for 230 volt DC machines which must have the frame grounded at all times. No point which can be touched by operating personnel can be hot when the switch is on and the frame grounded.

Relay Cabinet

The relay cabinet, located on the right end of the machine, serves as a container for all fuses, relays, resistors, and capacitors. Figure 28 shows the relay cabinet with the cover removed.

DC Machine Circuit (Figure 27)

The DC supply for operation of machine functional circuits is as follows: from one side of the power outlet, through F3, the main line switch, F2, the minus side of the rectifier, to the minus DC circuit terminal. A similar circuit can be seen through the plus side of the rectifier to the plus DC circuit terminal.

A filter capacitor is connected across the plus and minus terminals of the rectifier to reduce ripple and steady its output. A bleeder resistor is connected across the terminals of the capacitor to bleed off its charge after the main line switch has been turned off.

Since the circuit to the plus and minus DC circuit terminals has been given, all subsequent circuits described herein will begin at the plus DC terminal and will terminate at the minus DC terminal.

STARTING AND RUNNING CIRCUITS

Motor Relay and Card Control Relay

After cards have been inserted in the card magazine and the contact roll cover has been lowered, depression of the start key completes a circuit to pick the card control relay and the motor relay as follows: from the plus DC circuit terminal, through contact roll cover switch 1, the start key, card control relay, pocket stop switch, stop key, motor relay, jumper in place of R-2, 2 ampere fuse, contact roll cover switch 2, to the minus DC circuit terminal.

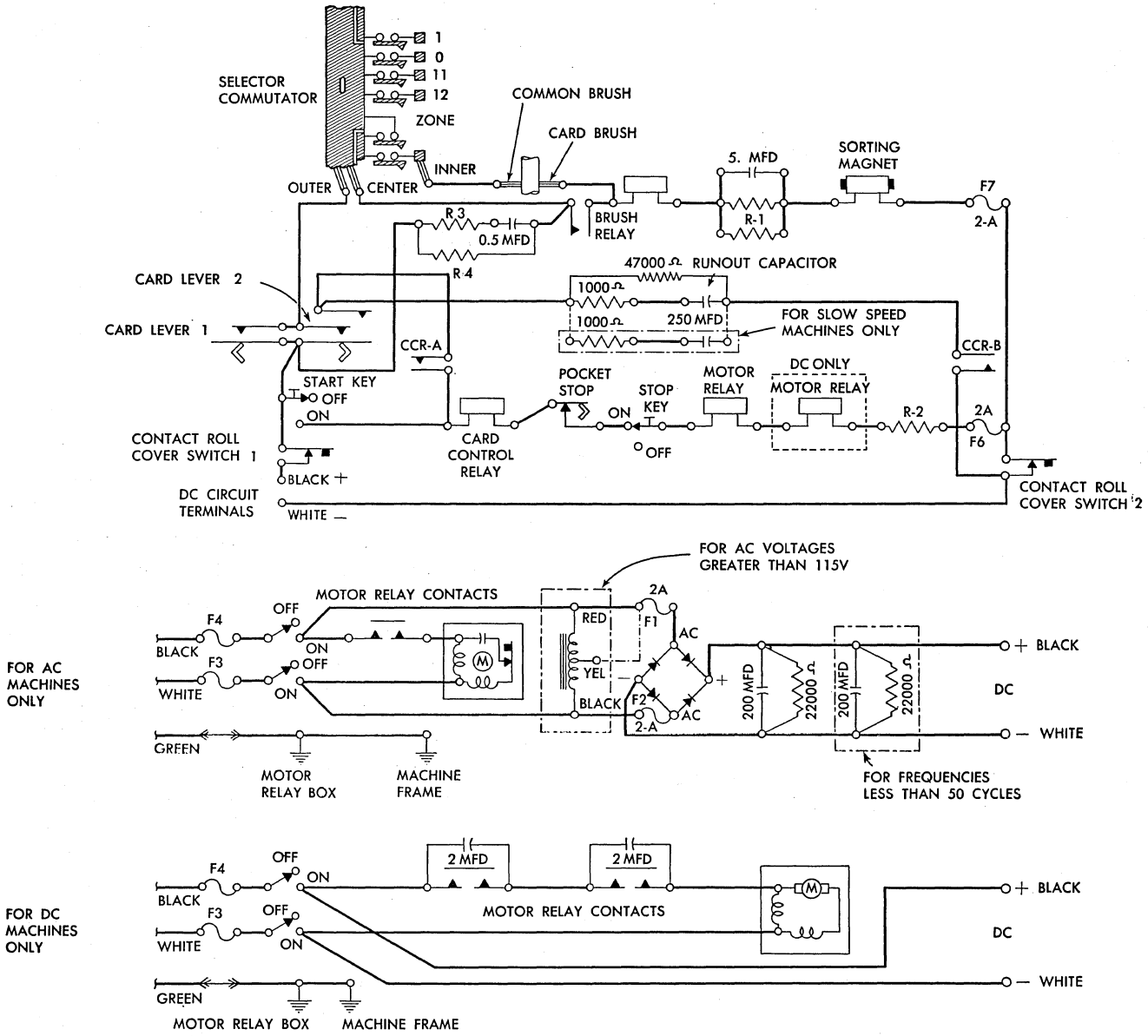
The start key must be held depressed until the cards reach a position to close card lever contact 2. When card lever contact 2 closes, a hold circuit is completed to the card control relay and the motor relay through the card lever 2 contact points and the CCR-A point. Once the card control relay and the motor relay are picked up and their hold circuits established, they remain energized until the stop key is depressed, the pocket stop device is actuated, the contact roll cover is raised, or the machine runs out of cards and the run-out capacitor discharges.

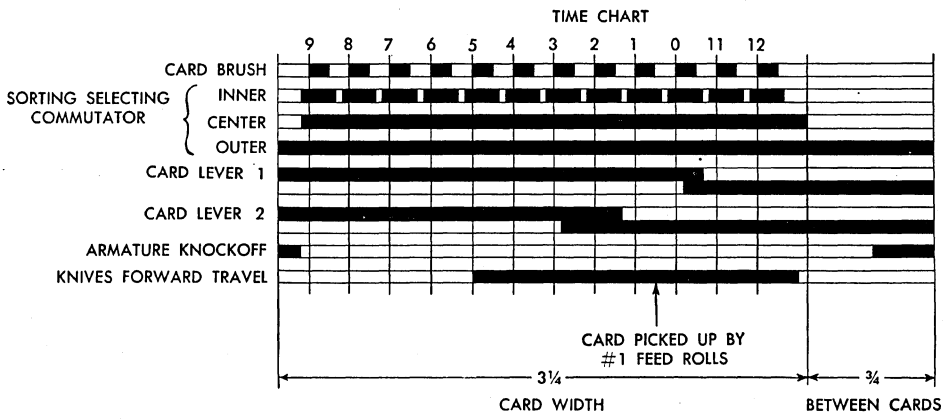
Drive Motor

As soon as the motor relay is picked, a circuit is completed to the drive motor as follows: from one side of the power outlet, through F3, the main line switch, drive motor, motor relay contact points, main line switch, F4, to the other side of the power outlet. As long as the motor relay remains energized, the drive motor will continue to run.

The motor relay is a heavy duty relay with two large contact point surfaces which can withstand the arc occurring when the circuit to the drive motor is made or broken.

The later Type 80 machines are equipped with a 1/3 HP motor, while the earlier machines are equipped with a 1/4 HP motor.





MAIN LINE FUSES

VOLTAGE	AC OR DC
115	12 A
230	6 A

RES	115V DC	230V DC	ALL AC
R-1	2-650 Ω	2-1500 Ω	2-650 Ω
R-2	JUMPER	3000 Ω	JUMPER
R-3	160 Ω	300 Ω	160 Ω
R-4	47000 Ω	82000 Ω	47000 Ω

R3 IS IN CONDENSER UNIT

Figure 27. Type 80 Wiring Diagram

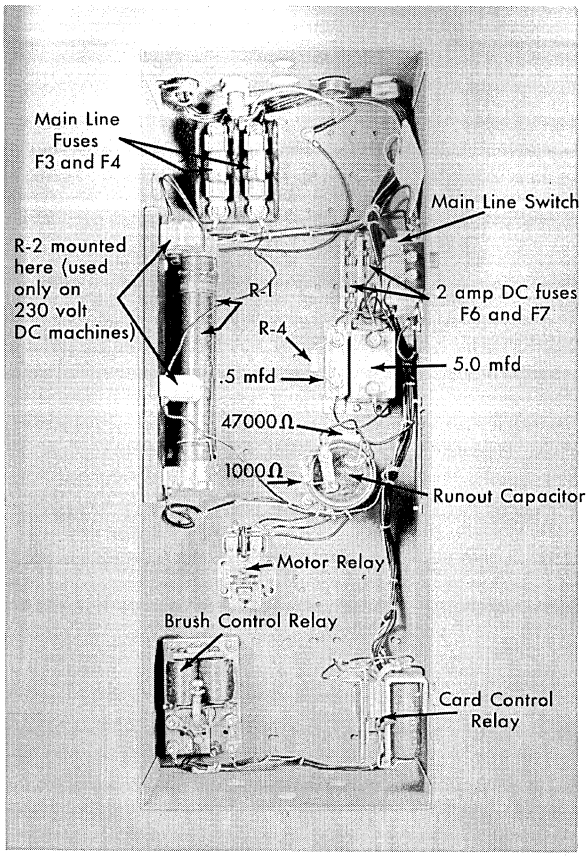


Figure 28. Type 80 Relay Cabinet

Runout Capacitor

Upon starting of the machine and the subsequent closing of card lever contact 2, the runout capacitor is charged to the DC circuit potential by means of a circuit through contact roll cover switch 1, card lever contact 2, the 1,000 ohm resistor and capacitor in series, and the CCR-B point.

Once charged, the capacitor retains its charge until card lever contact 2 opens. Opening of card lever contact 2 removes the potential impressed on the runout capacitor, allowing it to discharge through the CCR-A point, the card control relay, the motor relay, contact roll cover switch 2, and the CCR-B point. This discharge current keeps the card control relay and the motor relay picked until the current flow from the capacitor falls below the value required to hold the relay energized. As long as the motor relay remains picked, the motor relay points maintain a circuit to the drive motor. This allows the last card in the machine to be fed to its proper pocket before the machine stops.

The runout circuit is rendered inoperative when the machine is stopped by opening of the pocket stop contact, raising the contact roll cover, or depressing the stop key.

The 47,000 ohm resistor which shunts the terminals of the runout capacitor serves to bleed off the charge after the machine has been stopped by operation of the pocket stop device, raising the contact roll cover, or depression of the stop key.

SORTING CIRCUITS

As SOON as the card brush makes contact with the contact roll through a hole in the card, a circuit is completed to energize the sort magnet and the brush relay as follows: from the plus DC circuit terminal, through contact roll cover switch 1, card lever contacts 1 and 2 in parallel, outer to inner commutator brushes, common brush, contact roll, card brush, brush relay, R-1, sort magnet, F7, contact roll cover switch 2, to the minus DC circuit terminal. Energizing the sort magnet causes the attraction of its armature and the setup of the proper combination of raised and lowered chute blades to direct the card to the desired pocket.

Once it is energized, the sort magnet is held energized through the outer and center commutator brushes and the brush relay contact point. This circuit holds the sort magnet energized until the center brush breaks contact on the commutator common shortly after the 12 position on the card passes the card brush. Between the 12 position ot the leading card and the 9 position of the following card, the armature return spring and the armature knockoff come into play to restore the armature to its normal raised position in preparation for sorting the following card.

PURPOSE OF RELAYS AND CONTACTS

Motor Relay

The motor relay is a heavy duty relay. Its purpose is to complete a circuit to the drive motor. It is picked when the start key is depressed and is held energized primarily under control of the card lever contacts. When the machine runs out of cards, the runout capacitor discharges through this relay, holding it energized while the last card is fed to its proper pocket. As long as the motor relay is energized, its points complete a circuit to the drive motor.

Card Control Relay

On machines built since February, 1951, this relay is a duo relay. On machines built prior to the above date,

this relay is a high speed slate base relay. Its primary function is to prevent starting of the machine by any means other than the start key. This relay is picked when the start key is depressed and remains energized as long as the machine is running.

THE CCR-A point, in conjunction with card lever contact 2, completes a hold circuit to the card control relay and the motor relay. In its N/O condition, it prevents the energization of either of the above relays except by means of the start key in the event the machine is stopped with cards in the feed.

THE CCR-B point prevents a back circuit which would make the contact roll hot if the machine was stopped with cards in the feed and the contact roll cover was raised.

Brush Relay

This relay is a high speed slate base relay. Its purpose is to provide a holding circuit for the sort magnet from the time an impulse is sensed through a hole in the card until the end of the card cycle when the circuit is broken by means of the commutator center ring and brush.

Card Lever Contact 1

This contact closes as the leading edge of the card enters the first feed rolls. Closing of this contact allows sorting of the first card. Once closed, it remains closed during the time that cards are feeding continuously through the machine and, in conjunction with card lever contact 2, furnishes circuits to the commutator for sorting.

Card Lever Contact 2

This contact closes as the leading edge of the card leaves the second feed roll. Once closed, it remains closed during the time that cards are feeding continuously through the machine, and furnishes circuits to the commutator for sorting and to the card control relay and the motor relay for automatic operation. This contact maintains the circuit to the commutator and contact roll for sorting the last card.

Pocket Stop Contact

This contact is normally closed. Opening of this contact, when one or more card pockets become full, renders the runout circuit inoperative and causes immediate dropout of the card control relay and the motor relay. Dropout of these relays stops the machine as soon as its inertia is overcome by friction.

Contact Roll Cover Switches 1 and 2

These two switches are held in a closed position when the contact roll cover is lowered. Raising of the contact roll cover opens both switches, breaking all machine circuits and removing the potential from the contact roll. These switches are installed as a safety measure for operating personnel, and their operation must not be crippled in any way.

5.0 Mfd Condenser

The action of the 5 mfd capacitor in series with the sort magnet gives a large initial impulse to the sort magnet when the card brush makes contact through a hole in the card. This causes fast attraction of the armature, after which the current tapers off to hold the sort magnet energized until the center brush on the commutator breaks.

IBM 75 CARD SORTING MACHINE

FUNCTIONAL PRINCIPLES

THE TYPE 75 Card Counting Sorter (Figure 29) is designed to count and/or sort cards according to the perforations in a single column. It is not possible to count on one column and sort on another column at the same time. It is possible, by means of switch controls, to count without sorting, sort without counting, or count and sort at the same time. Cards that are multi-punched in a single column will sort on the figure of the highest order only (all commutator selection switches out) but all punchings will be counted. If, however, there should be more than two punched holes in a single column of a card, possibly only two holes will be counted when sorting and counting are taking place together. When counting is taking place without sorting, a maximum of four holes in a single column may be counted without the possibility of error.

There are fifteen Veeder counters of five wheel capacity. In addition to the twelve counters which accommodate the pockets, 12 through 9 inclusive, there is a reject counter and two total counters. The reject counter counts all cards which are unpunched in the column being sensed by the card brush. The two total counters consist of a subtotal counter and a grand total counter. These total counters count all cards, regardless of whether or not they are punched. The subtotal counter is reset during the operation in which all

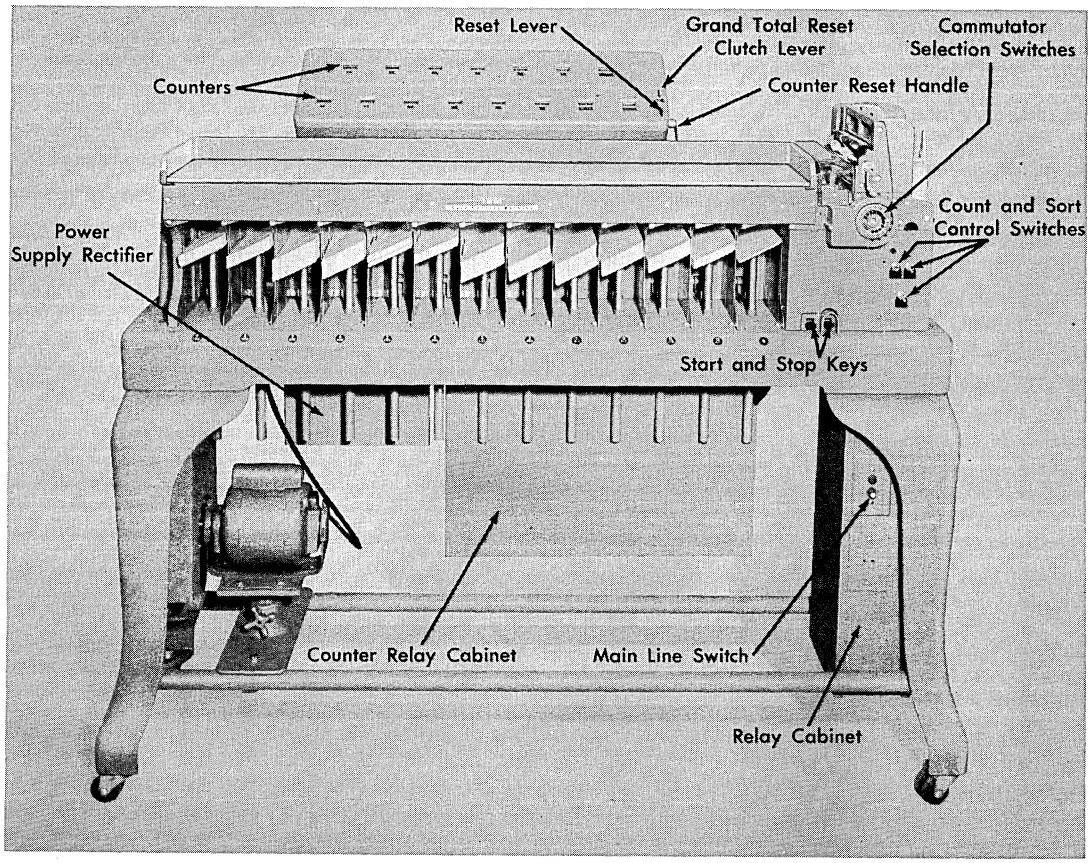


Figure 29. Type 75 Card Counting Sorter

other counters are reset. The reset of the grand total counter is selected by the operator under control of an additional operating lever.

A standard Type 80 Sorter is used in the construction of the Type 75 machine and all of the Type 80 sorting features have been retained. The mechanical principles, removal procedures, and adjustments of the sorting mechanism on the Type 75 machine are the same as those on the Type 80 machine.

Speed and Capacity

The speed of the Type 75 Sorter is 400 cards per minute for Model 1 and 250 cards per minute for Model 2.

The capacity of the card magazine is 550 cards. The capacity of each of the fifteen counters used is 99999.

OPERATING FEATURES

WITH THE exception of those items pertaining to the operation of the card counters, the operating features of the Type 75 machine are the same as those for the Type 80.

Switches (Figure 29)

Three switches marked sort, card count, and total card count are located on the front of the machine below the card magazine. When the sort and card count switches are on, counting takes place in all counters and all cards are sorted according to the punching in the column passing under the card brush. When only the sort switch is on, sorting takes place but counting does not. When only the count switch is on, counting takes place in all counters but the cards are passed to the reject pocket.

When the total card count switch is in the off position, the grand total counter will not count unless the card count switch is on. When the total card count switch is on, it permits counting in the grand total counter regardless of the setting of the count switch. Thus, with the card count switch off, and the total card count switch on, the grand total counter will count all cards passing through the machine but no other counters will operate.

Counter Reset (Figure 29)

A reset handle is located on the right end of the counting unit assembly. This handle is held in the zero position by means of a detent mechanism. To clear the counters, the reset lever must be pushed to the rear and the reset handle rotated one full turn clockwise until the detent reseats to hold the reset handle in its zero position. When only the reset lever is engaged, the grand total counter will not clear during a reset operation. To clear the grand total counter, the grand total reset clutch lever must also be pushed to the rear. It is possible to clear all counters except the grand total counter during a reset operation but it is not possible to clear the grand total counter without clearing the rest of the counters also.

When counters are being cleared, all machine circuits are broken by the opening of the reset interlock contact.

Current, Weight, and Dimensions

The maximum operating current, starting current, and fuse rating of the Type 75 machine equipped with a ⅓ HP motor should be:

Voltage Group			Operating Current	Starting Current	Main Line Fuses
Volts	Cycles	Phases	Amperes	Amperes	Amperes
115	DC		4.6	32.0	12
230	DC		2.8	16.5	6
115	25	1	5.7	26.8	12
115	50	1	6.0	28.5	12
115	60	1	5.8	29.7	12
150	50	1	5.0	17.2	12
150	60	1	4.8	18.0	12
208	50	1	4.3	13.0	6
208	50	3	2.9	8.7	6
230	25	1	3.4	13.9	6
230	50	1	3.5	14.7	6
230	60	1	3.4	15.3	6
230	50	3	2.5	10.0	6

Weight Unpacked	575	pounds
Weight Packed	830	pounds
Length	63	inches
Width	22	inches
Height	48	inches

MECHANICAL AND ELECTRICAL PRINCIPLES

THE MECHANICAL and electrical sorting principles of the Type 75 Card Counting Sorter are identical to those of the Type 80 machine. The mechanical and electrical principles of card counting are explained below.

Card Counters

The type of card counter assembly used in the counting unit of the Type 75 sorter is shown in Figure 30. Fifteen such counters are employed in the machine. They are numbered according to the number plates on the counting unit cover.

An impulse to the counter magnets, from the card brush sensing a hole in the card, effects sufficient rotation of the rotor to cause the counter to add one unit. The levers necessary to transmit the armature motion to the adding wheels are incorporated within the Veeder counter unit, including a mechanical carry. Addition of one occurs directly in the units position of the counter only. Each remaining position is advanced by a carry operation effected when the counter wheel to its right moves from 9 to 0.

The spring loaded counter shaft restores the rotor to its home position as soon as the magnets are de-energized. Adjustable rubber stops limit the travel of the rotor in both directions and aid in obtaining quiet operation.

Counter reset to zero is obtained manually through a train of gears in the counting unit which mesh with each individual counter reset gear. All counters are reset simultaneously with one rotation of the reset handle. Reset of the grand total counter in conjunction with the other counters may, however, be selected at the discretion of the operator.

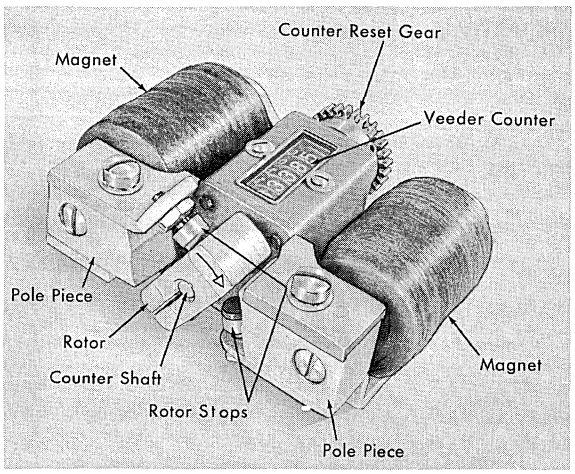


Figure 30. Type 75 Card Counter Assembly

Reset Interlock Contact

The reset interlock contact is located adjacent to the counter reset lever. When the counter reset lever is operated during resetting of the counters, it causes opening of the reset interlock contact. Opening of this contact breaks all machine circuits.

Counting Commutators

In addition to the sorting commutator, there is a series of 17 additional commutators and an impulse distributor in the Type 75 machine. These additional units make one complete revolution for each card cycle and furnish timed electrical impulses which aid in the control of the counting and sorting circuits. They are housed in a cover behind the card feed magazine and are gear driven directly from the main drive shaft worm which also drives the feed knife mechanism. Figure 31 shows the counter commutators with the cover removed.

The lower twelve commutators and their common strip are assembled and keyed to a steel cylinder as one unit. The contact segment of each commutator in the unit is spaced 22½° apart, or one cycle point. This assembly is, in turn, inserted over an insulating sleeve on the vertical shaft of the commutator unit and is held in place by a friction lock nut. The assembly is adjustable as a unit only; each commutator is not adjustable individually. However, after removing the assembly from the vertical shaft and then removing the large lock nut inside the common ring, each commutator and the common strip are replaceable individually.

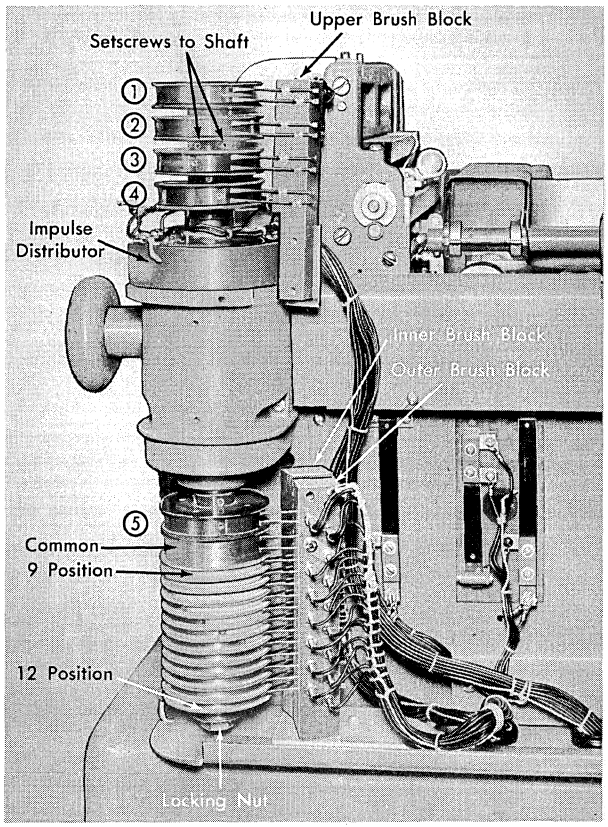


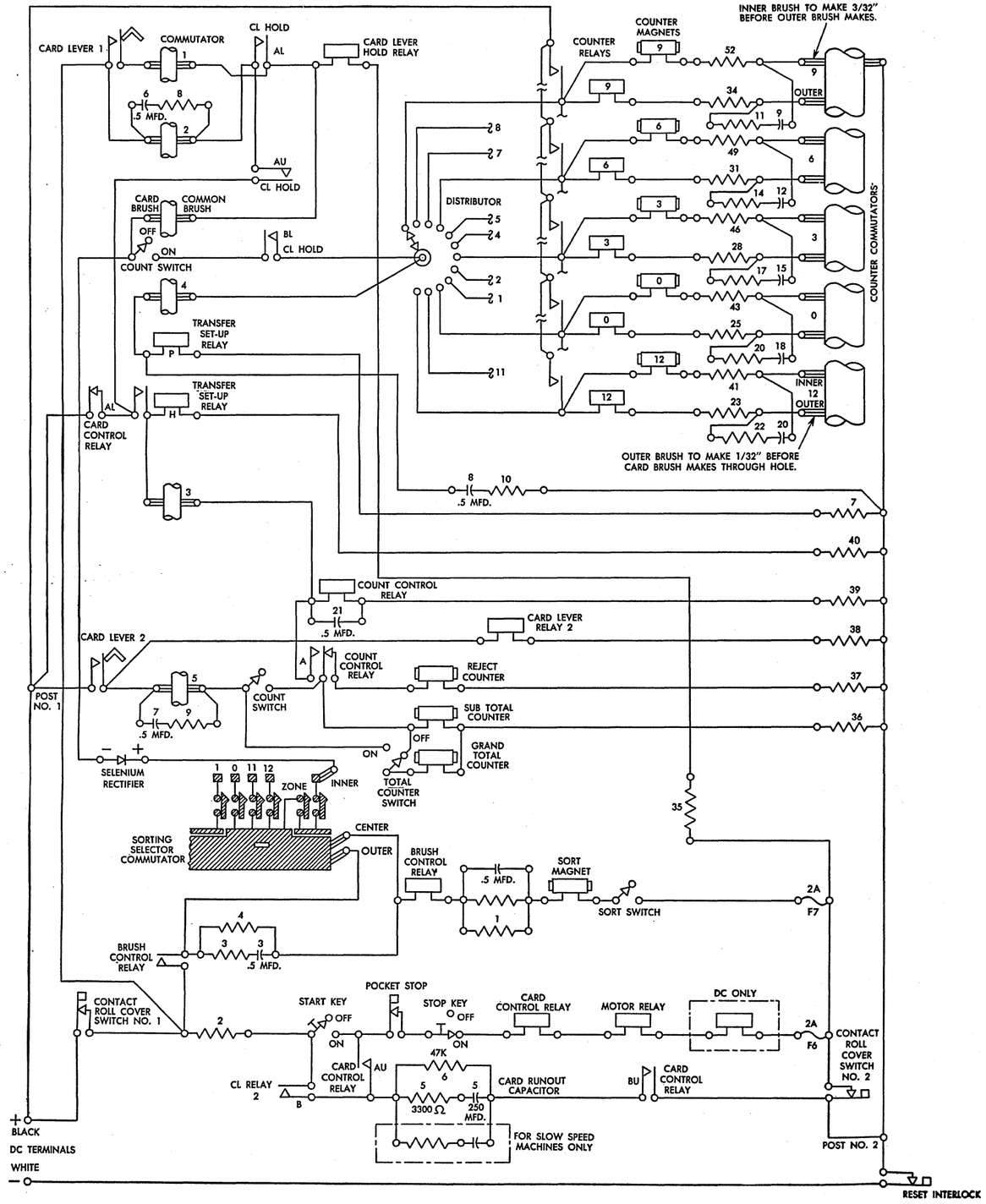
Figure 31. Counter Commutators and Impulse Distributor

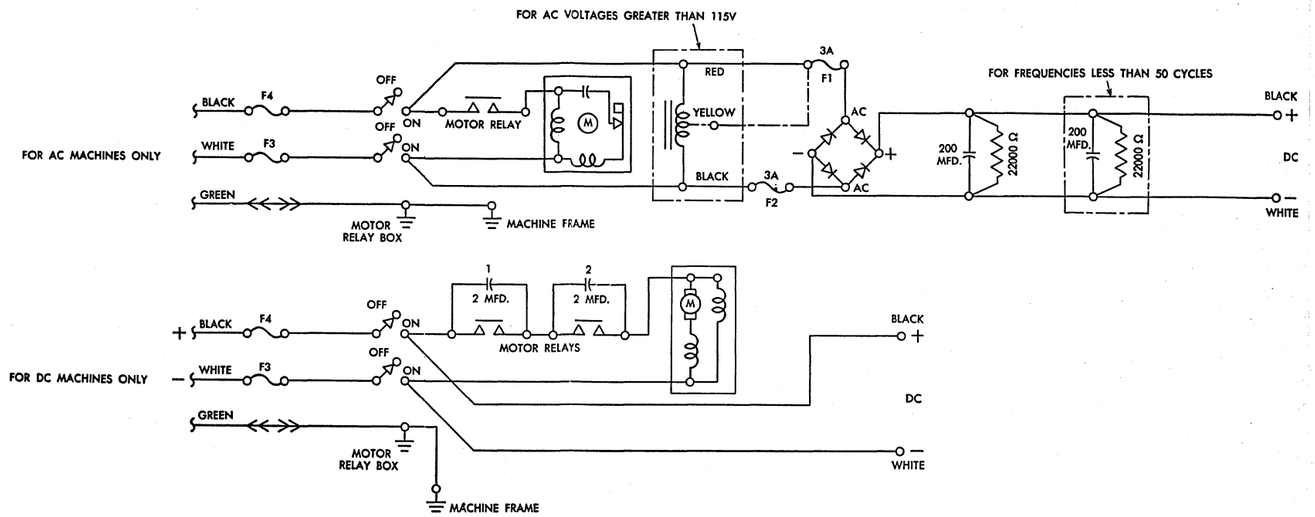
Each of the upper five commutators are individually adjustable since each one is fastened to the shaft by means of set screws. Two brushes ride on each of the 17 commutator surfaces to make and break contact at timed intervals.

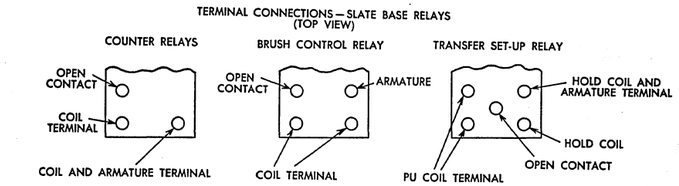
The impulse distributor consists of two rotating brushes which follow the inside surface of a circular emitter strip. This circular strip has twelve contact spots, one for each punching position in the card, and a common ring. The common brush rides the common ring while a selecting brush makes and breaks contact on each of the twelve contact spots in synchronism with the timing of the card as it passes the card brush. When the card brush is reading a 9 hole for example, the selecting brush of the distributor is made on the 9 contact spot; when the card brush is reading a 5 hole, the selecting brush is made on the 5 contact spot. As the selecting brush makes on a contact spot, it electrically connects that contact spot to the common ring. The impulse distributor, in conjunction with the card brush, is used to provide timed impulses to the digit counter magnets.

Slate Base Relays

High speed slate base relays are used extensively in the Type 75 machine in both the sorting and the counting circuits. Their application in the sorting circuits is the same as that in the Type 80 machine. In the counting circuits, they are used predominantly as high speed hold relays for the card counters.







LINE FUSES

VOLTAGE	AC & DC
115 V	12 A
150 V	12 A
208 V	6 A
230 V	6 A

RESISTOR CHART

RES. NO.	115V DC	230V DC	AC
1	2 (650 Ω)	2 (1500 Ω)	2 (650 Ω)
2	JUMPER	1500 Ω	JUMPER
3	160 Ω	300 Ω	160 Ω
4	47000 Ω	82000 Ω	47000 Ω
5	3300 Ω	3300 Ω	3300 Ω
6	47000 Ω	47000 Ω	47000 Ω
7	1300 Ω	3000 Ω	1300 Ω
8	300 Ω	300 Ω	300 Ω
9	300 Ω	300 Ω	300 Ω
10	2700 Ω	2700 Ω	2700 Ω
11 - 22	300 Ω	300 Ω	300 Ω
23 - 34	1300 Ω	3000 Ω	1300 Ω
35	1000 Ω	2000 Ω	1000 Ω
36	JUMPER	500 Ω	75 Ω
37	JUMPER	1000 Ω	100 Ω
38	1500 Ω	3000 Ω	1500 Ω
39	1000 Ω	2000 Ω	1000 Ω
40	1500 Ω	3000 Ω	1500 Ω
41 - 52	JUMPER	1000 Ω	100 Ω

RESISTORS 3 AND 8 - 32 ARE LOCATED WITHIN THEIR ASSOCIATED CAPACITOR UNITS

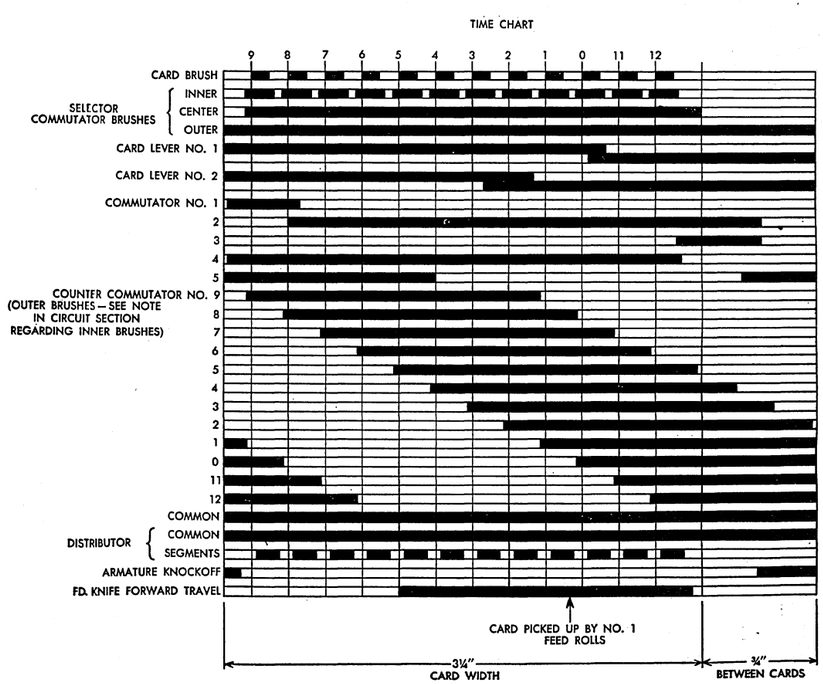


Figure 32. IBM 75 Wiring Diagram

ALL CIRCUITS described in the electrical principles of the Type 75 Card Counting Sorter will refer to wiring diagram 153129-S. A reproduction of this wiring diagram is shown in Figure 32. Since the starting and running circuits in the Type 75 machine are very similar to those employed in the Type 80 machine, they will not be discussed in detail in this section of the manual. Only the counting and sorting circuits will be covered.

The rectifier output voltage should be between 120 volts and 135 volts at the specified input voltage (115, 200 or 230) with the machine stopped, and the sort magnet and a count magnet energized.

NOTE: The machine frame should be grounded. However, it may be ungrounded at the customer's option, except for 230 volt DC machines which must be grounded at all times. No point which can be touched by operating personnel can be hot when the switch is on and the frame is grounded.

Relay Cabinets and Power Supply Rectifier

There are two relay cabinets in the Type 75 Sorter; a sorter relay cabinet and a counter relay cabinet. The sorter relay cabinet is located on the right end of the machine and is shown in Figure 33 with the cover removed. It contains the necessary relays, resistors and capacitors which are used in the sorting, starting, and running circuits. This cabinet also contains all the machine fuses. The motor relays are heavy duty relays, the brush control relay is a high speed slate base relay, and the card control relay is a duo relay. (On older machines, the card control relay is a high speed slate base relay.)

The counter relay cabinet is accessible from the rear of the machine and is shown in Figure 34 with the door open. It contains all relays, resistors, capacitors and the selenium rectifier used in the counting circuits. The counter relays and the transfer setup relay are high speed slate base relays. The card lever hold relay, card lever 2 relay, and the count control relay are duo relays.

Resistors 3, and 8 through 22 inclusive are built into their respective capacitors with which they are used.

Type 75 machines are equipped with a larger power supply rectifier than are the Type 80 machines.

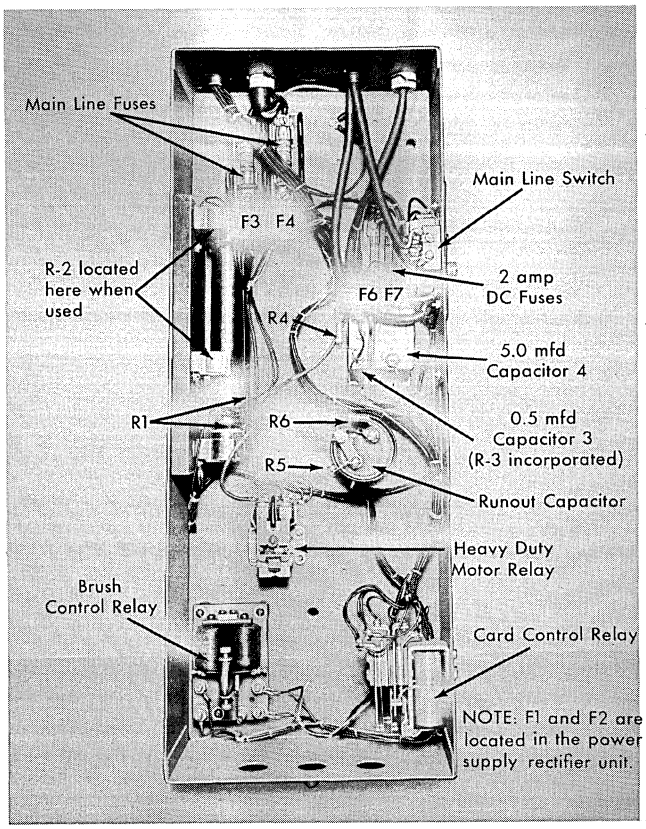


Figure 33. Type 75 Sorting Relay Cabinet

COUNTING CIRCUITS

Card Lever Hold Relay

Once card lever contact 1 has closed, the card lever hold relay is picked each card cycle when commutator 1 makes. The circuit is as follows: from the plus DC terminal, through contact roll cover switch 1, to R-2, through card lever contact 1, commutator 1, card lever hold relay, R-35, contact roll cover switch 2, reset interlock contact, to the minus DC terminal.

Following the pickup of the card lever hold relay, it is held energized through its own AL point and commutator 2. This hold circuit lasts until after 12 time, following which the card lever hold relay is dropped and then picked again through commutator 1 in the next card cycle. The AL point of the card lever hold relay prevents any impulses through commutator 2 to the digit counters until after the first card in the

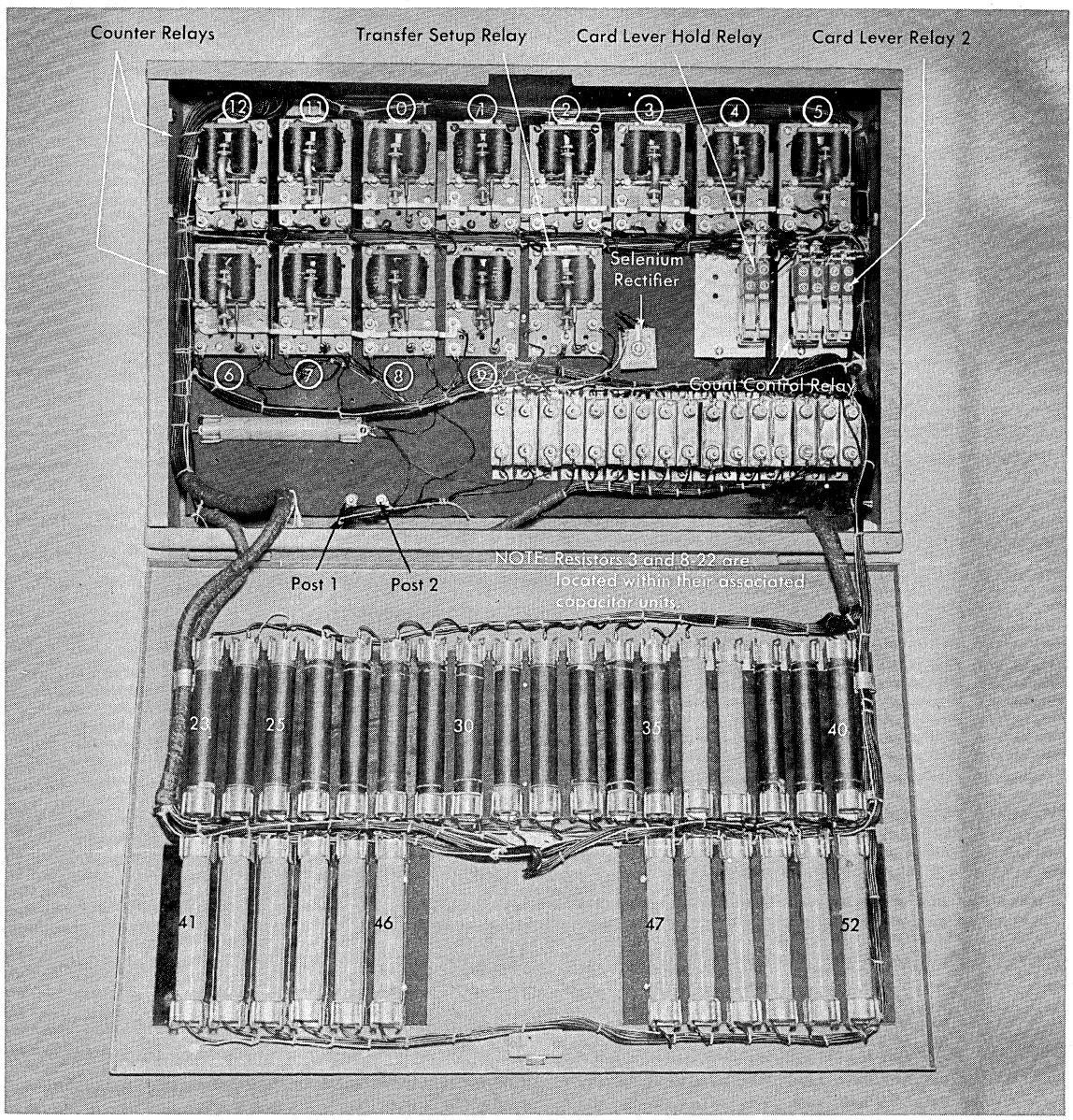


Figure 34. Type 75 Counting Relay Cabinet

machine has insulated the card brush from the contact roll. The AU and the BL points serve to keep the contact roll from being hot in the event the machine is stopped with cards in the feed and the contact roll cover is raised.

Counter Magnets and Relays

In order to count into the digit counters, the card count switch must be on. Counting in the digit counters is initiated at the time the hole in the card is sensed by the card brush. The circuit to impulse a counter magnet and its relay is as follows: from the plus DC terminal, through contact roll cover switch 1, card lever contact 1, commutator 2, (commutator 1 for a 9), CL hold AL point, common brush, contact roll, hole in the card, card brush, card count switch ON, CL hold BL point, counting distributor common, spot on distributor, counter magnet and counter relay in parallel, commutator inner and outer brushes, commutator, common brush, reset interlock contact, to the minus DC terminal.

The counter relays are high speed slate base relays; therefore, once energized, they quickly complete a hold circuit directly from the plus side of the DC line to their respective counter magnets for the duration of

their counter commutator segment. The duration of each counter commutator is 8 cycle points.

It can be seen by analyzing the above circuits that each hole sensed by the card brush will be counted when the card count switch is on.

Transfer Set Up Relay

When the card count switch is on, a circuit is completed each time the card brush makes contact through a hole in the card to pick the transfer setup relay as follows: from the plus DC terminal, through contact roll cover switch 1, card lever 1, commutator 2, (commutator 1 for a 9), CL hold AL point, common brush, contact roll, hole in card, card brush, card count switch ON, CL hold BL point, commutator 4, transfer setup relay pickup coil, R-7, reset interlock contact, to the minus DC terminal.

Once it is picked, the transfer setup relay is held energized through its own point and commutator 2. When counting 9's, a parallel hold circuit is available through commutator 1 and the card lever hold AL point. This latter hold circuit is necessary when counting 9's because commutator 2 does not make until 8 time.

Count Control Relay and Reject Counter

Pickup and hold of the transfer setup relay allows a circuit through commutators 2 and 3 to energize the count control relay. This transfers the count control relay A points, thus establishing a hold circuit to the count control relay through commutator 5 and, at the same time, preventing a circuit to the reject counter.

If no hole is sensed by the card brush, neither the transfer setup relay nor the count control relay will be energized. Therefore, when commutator 5 makes, a circuit will be completed to the reject counter to count one unit.

Total Counters

In conjunction with card lever contact 2, commutator 5 furnishes the electrical impulse to the sub total and grand total counters. Under their proper switch settings, these two counters count the cards passing through the machine. They do not count punched holes. As long as card lever contact 2 is closed, signifying that cards are passing through the reading station, the total counters will count one each time commutator 5 makes.

SORTING CIRCUITS

SORTING of cards on the Type 75 machine occurs only when the sort switch is on. If the sort switch is off, all cards passing through the machine are directed to the reject pocket. Even though all cards are passed to the reject pocket when the sort switch is off, normal counting of the cards and the digit values in the cards can take place if the card count switch is on and the card brush is lowered on the contact roll.

The circuit to energize the sort magnet and the brush control relay when a hole is sensed in the card is as follows: from the plus DC terminal, through contact roll cover switch 1, card lever contact 1, commutator 2 (commutator 1 if sorting a 9) card lever hold AL point, common brush, contact roll, hole in card, card brush, selenium rectifier, inner to center sorting commutator brushes, brush control relay, R-1, sort magnet, sort switch, F7, contact roll cover switch 2, reset interlock contact, to the minus DC terminal.

Once it is energized, the sort magnet is held energized through the outer and center sorting commutator brushes and the brush control relay contact point. This circuit holds the sort magnet energized until the center brush breaks contact on the commutator common shortly after the 12 position on the card passes the card brush. Between the 12 position of the leading card and the 9 position of the following card, the armature is restored to its normal raised position by means of the armature return spring and the armature knock-off.

PURPOSE OF RELAYS, COMMUTATORS, AND CONTACTS

Motor Relay

The motor relay is a heavy duty relay. Its purpose is to complete a circuit to the drive motor. It is picked up on depression of the start key and is held energized primarily under control of the card lever 2 relay B point. When the machine runs out of cards, the run-out capacitor discharges through the motor relay, holding it energized while the last card is fed to its proper pocket. As long as the motor relay is energized, its points complete a circuit to the drive motor.

Card Lever Relay 2

This relay is a duo relay. The purpose of this relay and its B point is to furnish an isolated hold circuit to the card control relay and the motor relay under

control of card lever contact 2. This permits automatic operation of the machine as soon as the cards have reached a position to close card lever contact 2.

Card Control Relay

This relay is a duo relay. (On older machines, this relay is a high speed slate base relay.) Its primary function is to prevent starting of the machine by any means other than the start key. This relay is picked when the start key is depressed and remains energized as long as cards are feeding through the machine.

The AU card control relay point, in conjunction with the B point of card lever relay 2, completes a hold circuit to the card control relay and the motor relay. In its N/O condition, it prevents the energization of either of the above relays except by means of the start key in the event the machine is stopped with cards in the feed.

The AL card control relay point maintains a hold circuit to the transfer setup relay in the event the machine is stopped when a card or cards are at the reading station and the contact roll cover is raised. Dropout of the transfer setup relay under the above conditions could cause the reject counter to over count one in error when the machine was restarted.

The BU card control relay point, in its N/O condition, prevents back circuits which would make the contact roll hot if the machine was stopped with cards in the feed and the contact roll cover was raised.

Brush Control Relay

This relay is a high speed slate base relay. Its purpose is to provide a holding circuit through its contact point for the sort magnet from the time an impulse is sensed through a hole in the card until the end of the card cycle when the circuit is broken by means of the commutator center ring and brush.

Card Lever Hold Relay

This relay is a duo relay. Its purpose is to control the sorting and counting circuits in conjunction with commutators 1 and 2. This relay is picked and dropped each card cycle under control of commutators 1 and 2.

The AL card lever hold point, in its N/O condition, prevents a circuit to the contact roll before the first card in the machine has insulated the card brush from the contact roll. In its closed position, this point allows completion of circuits to the contact roll through commutator 2.

The AU card lever hold relay point prevents a back circuit which would allow the contact roll to be hot if the machine were stopped with cards in the feed and the contact roll cover were raised.

The BL card lever hold relay point prevents back circuits which would allow the contact roll to be hot when the contact roll cover was raised (card count switch on).

Counter Relays 12 through 9

These relays are high speed slate base relays. There is one relay for each digit counter magnet, 12 through 9. The purpose of each of these relays is to provide a holding circuit for its particular counter magnet from the time an impulse is sensed in the card until the counting commutator for that position breaks the circuit.

Transfer Set Up Relay

This relay is a high speed slate base relay. Its purpose is to determine whether or not any punching is present in the card column being sensed. If punching is present, this relay is picked and, in turn, sets up circuits which prevent impulsing the reject counter. If no punching is present in the card, the transfer setup relay is not picked, and the reject counter magnet is impulsed to add one.

Count Control Relay

This relay is a duo relay. Its A point controls the circuit to impulse the reject counter magnets. If punching is present in the column being sensed, the count control relay is picked under control of the transfer setup relay and commutator 3, thus interrupting the circuit to the reject counter. If no punching is present in the column being sensed, the count control relay is not picked and a circuit is completed through its N/C A point to permit energization of the reject counter magnet.

Commutator 1

Upon starting of the machine, this commutator prevents completion of a circuit to the contact roll until the first card has insulated the card brush from the roll. Commutator 1 also furnishes the timed impulse to pick the card lever hold relay at the beginning of each card cycle and, when necessary, furnishes a hold circuit for the transfer set up relay until commutator 2 makes.

Commutator 2

This commutator continues the circuit to the contact roll for the duration of the card after commutator

1 has broken. It also provides hold circuits for the card lever hold relay and the transfer setup relay and, in conjunction with commutator 3 and the transfer setup relay point, provides a pickup circuit for the count control relay.

Commutator 3

This commutator times the impulse to pick the count control relay immediately after the 12 punching position of the card has passed under the card brush. This impulse is delayed until after 12 time to allow for the pick of the transfer setup relay from a 12 hole in the card. Pickup of the transfer setup relay sets up the circuit to the count control relay, which is timed through commutator 3.

Commutator 4

This commutator, in conjunction with the card brush and commutators 1 and 2, sets up a circuit to pick the transfer setup relay when a hole is sensed in the card and the card count switch is on.

Commutator 5

This commutator, in conjunction with card lever contact 2, times the impulse to the total counters and the reject counter. The make time of this commutator is late in the card cycle after the card brush has had the opportunity to read all 12 positions of the card.

Counter Commutators 12 through 9

In conjunction with the card brush and the distributor, these twelve commutators time the impulses to the counter magnets. There is one commutator for each counter position. Each of these commutators has a duration time of 8 cycle points and, together with the counter relay for that position, serves to furnish an 8 cycle point hold circuit for its counter magnet once the counter magnet has been impulsed.

Impulse Distributor

The distributor causes energization of the proper counter magnets by successively conditioning each of the counter relays to respond to the proper hole in the card only.

Card Lever Contact 1

This contact closes as the leading edge of the card enters the first feed rolls.

Once closed, this contact remains closed as long as cards are feeding continuously through the machine and, with commutators 1 and 2, furnishes circuits for sorting and counting all cards.

Card Lever Contact 2

This contact closes as the leading edge of the card leaves the second feed roll. Once closed, it remains closed as long as cards are feeding continuously through the machine and furnishes a circuit to pick and hold card lever relay 2. Card lever relay 2, in turn, completes hold circuits to the card control relay and the motor relay for automatic operation of the machine. Card lever contact 2 also sets up the circuit to commutator 5 for impulsing the reject counter and the total counters and for furnishing a hold circuit to the count control relay.

Pocket Stop Contact

This contact is normally closed. Opening of this contact when one or more card pockets become full renders the runout circuit inoperative and causes immediate dropout of the card control relay and the motor relay. Dropout of these relays stops the machine as soon as its inertia is overcome by friction.

Contact Roll Cover Switches 1 and 2

These two switches are held in a closed position when the contact roll cover is lowered. Raising of the contact roll cover opens both switches, breaking all circuits to the contact roll and making the start circuits inoperative. These switches are installed as a safety measure for operating personnel, and their operation must not be crippled in any way.

Reset Interlock Contact

This N/C contact is automatically opened during manual resetting of the counters. Opening of this contact breaks all machine circuits so that accidental starting of the machine is not possible.

Selenium Rectifier

The selenium rectifier in the circuit to the inner commutator brush prevents back circuits to the counter magnets after the brush control relay has been energized. These back circuits would add a false count in the corresponding counter when the inner brush made on each segment of the selector commutator. This rectifier replaces the sort control relay on older machines.

5.0 Mfd. Condenser

The action of the 5.0 mfd. capacitor in series with the sort magnet gives a large initial impulse to the sort magnet when the card brush makes contact through a hole in the card. This causes fast attraction of the armature, after which the current tapers off to hold the sort magnet energized until the center brush on the commutator breaks.

SPECIAL DEVICES

AUXILIARY CARD COUNTING DEVICE

THE AUXILIARY card counting device on the Type 80 or Type 82 Sorter is a device for counting all cards which pass through the machine. The counter on the Type 82 operates at 650 cards per minute and the counter on the Type 80 operates at 450 cards per minute. They are not interchangeable. The principles of operation and the circuits described in the following paragraphs apply primarily to the high speed auxiliary card counter which is available on the Type 82 Sorter. The circuits for the card counter on the Type 80 are very similar to those on the Type 82. The mechanical principles for the counter on the Type 80 are described under *Card Counters,* in the Type 75 section of this manual. When used as an auxiliary card counter on a Type 80 machine, the counter shown in Figure 30 has a manual reset knob in place of the reset gear shown.

The auxiliary card counter does not affect machine speed and all normal functions may be performed, regardless of the position of the card count switch. The capacity of the counter is 99,999, and it may be reset to 00,000 by turning the knurled handwheel. The counter assembly and the card count ON-OFF switch are located on the front of the Type 82 sorter in an easily seen position, as shown in Figure 35. On a Type 80 Sorter, these units are located on the front of the machine below the card magazine.

Type 82 machines equipped with an auxiliary card counting device have larger power supply rectifiers than do the standard Type 82 machines. Type 80 machines employ the same size rectifier whether or not they are equipped with an auxiliary card counting device.

The actual counting and accumulating is done mechanically by a Veeder type counter. Each time the shaft of the Veeder counter is rotated sufficiently far, a 1 is added into the units position of the counter. The mechanical carry from one position of the counter to another, is done internally in the Veeder unit.

The operation of the card counting device begins with the card count commutator which is located on

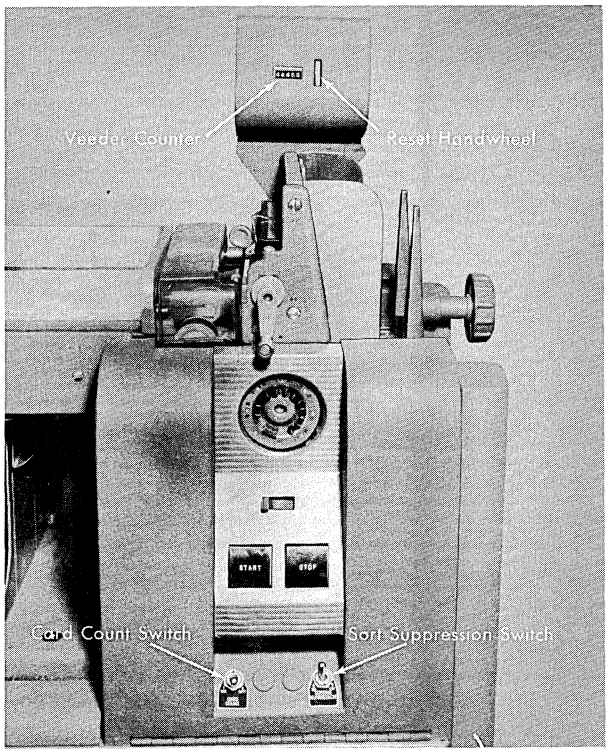


Figure 35. Auxiliary Card Counting Device

the feed knife crankshaft (Figure 36). The commutator consists of a two-section cam which is setscrewed to the shaft.

For each revolution of the crankshaft, the card count cam completes a circuit between the two brushes which ride on the cam surface. When cards are passing through the machine, i. e. when the card lever contacts are closed, a circuit is completed through the card count cam and the card levers to energize the card count magnets once each card cycle.

When the card count magnets are energized (Figure 37) they cause rotation of the rotor because of its tendency to line up with the opposite pole pieces. The total movement of the rotor is limited by rubber stops which also help to insure silent operation. As the rotor rotates, it drives the rotor shaft, which in turn transmits motion through a 3 piece linkage assembly to the shaft of the Veeder counter.

Rotation of the Veeder shaft causes a 1 to be added to the units position as mentioned previously. When the card count magnets are de-energized, the rotor shaft and drive linkage are returned to their normal positions by means of the rotor return spring located on one end of the rotor shaft (Figure 37).

CIRCUIT DESCRIPTION

FIGURE 38 is a reproduction of wiring diagram 260276B and shows the circuit required for the operation of the auxiliary card counting device. Wiring diagram 260276C, which features the new cam-type counter, is not shown but is similar in operation to 260276B. The major differences between the B and C suffixes is that on B suffix diagrams the card count magnets are wired in series, while on C suffix diagrams they are wired in parallel.

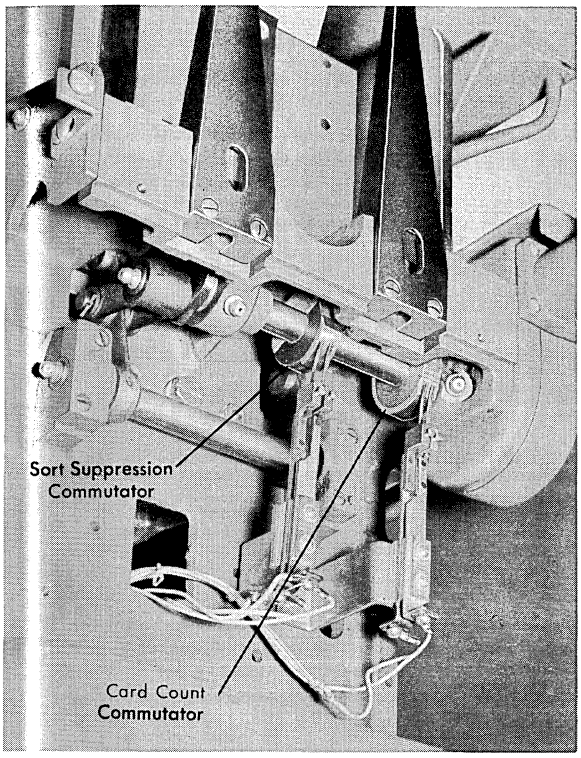


Figure 36. Auxiliary Card Count and Sort Suppression Commutators

When the card count switch is on and cards are passing through the machine, a circuit is completed near the end of the card cycle to impulse the card count magnets as follows: from DC terminal 14, through contact roll cover switch 2, R1, counter magnets, card counting commutator, card count switch, outer point of card lever contact 1, contact roll cover switch 1, to DC terminal 13.

The timing chart shows that the card count cam makes $\frac{1}{32}''$ after the center brush leaves the metal segment of the selector commutator, and breaks while the next card is passing under the card brush. When the card count cam breaks, the card count mechanism is restored to normal by means of the rotor return spring. Since the card feed crankshaft makes one revolution per card cycle, a circuit is completed to the card counter once for each card passing through the machine.

To insure the best operating characteristics of the rotor and the magnets, the proper value of R1 should be used. These values are shown in Figure 38 and on wiring diagram 260276B. Resistor 1 and the condenser-resistor coupling that shunts the card count commutator are both located on the rear of the relay gate.

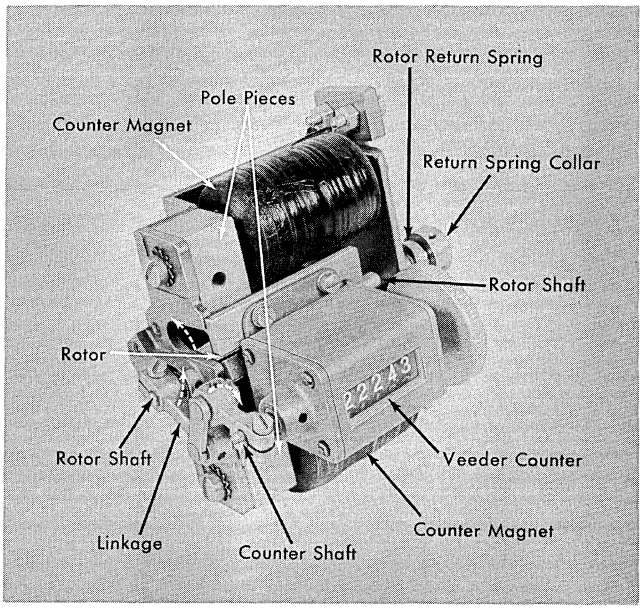
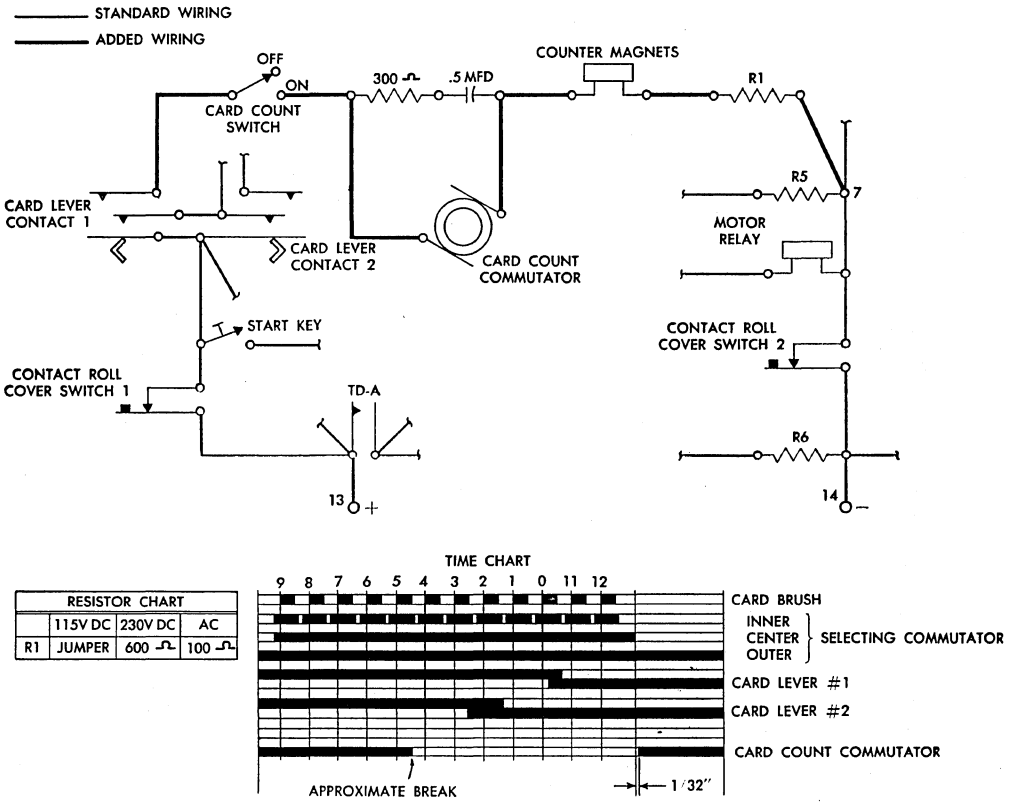


Figure 37. High Speed Card Counter Assembly



RESISTOR CHART			
	115V DC	230V DC	AC
R1	JUMPER	600	100

Figure 38. Wiring Diagram - Auxiliary Card Count Device, Type 82

SORT SUPPRESSION DEVICE

THE SORT suppression device may be installed on a Type 75, 80 or 82 Sorter. This device is controlled externally by means of a toggle switch which is mounted below the start and stop buttons in a recess in the upper right front cover assembly (Figure 35). When the sort suppression switch is off, regular sorting is accomplished in the normal manner.

This device permits the segregation of cards into either the reject pocket or the 12 pocket without disturbing the sequence of the cards within the two groups. It is useful in the segregation of unpunched cards because, when sorting is suppressed, blank cards are rejected while all other cards fall into the 12 pocket in their original sequence. It is also useful in conjunction with the contact bars on the selector commutator if cards containing one of two or more digits are to be separated without disturbing the sequence of either the selected or the unselected cards. For example, with sort suppression on, and the 1 and 3 contact bars on the selecting commutator retracted towards the center, all cards punched 1 or 3 will be rejected while all cards punched with other digits will fall into the 12 pocket. The sequence of the cards in both pockets will remain undisturbed. With the 12 contact bar on the selecting commutator in the out position, cards punched 12 will always sort into the 12 pocket, regardless of the setting of the sort suppression switch.

CIRCUIT DESCRIPTION

THE FOLLOWING circuit description applies to a Type 82 sorter equipped with a sort suppression device. Figure 39 is a reproduction of the sorting suppression wiring diagram 270093-A. All circuit description pertaining to sort suppression will refer to this figure.

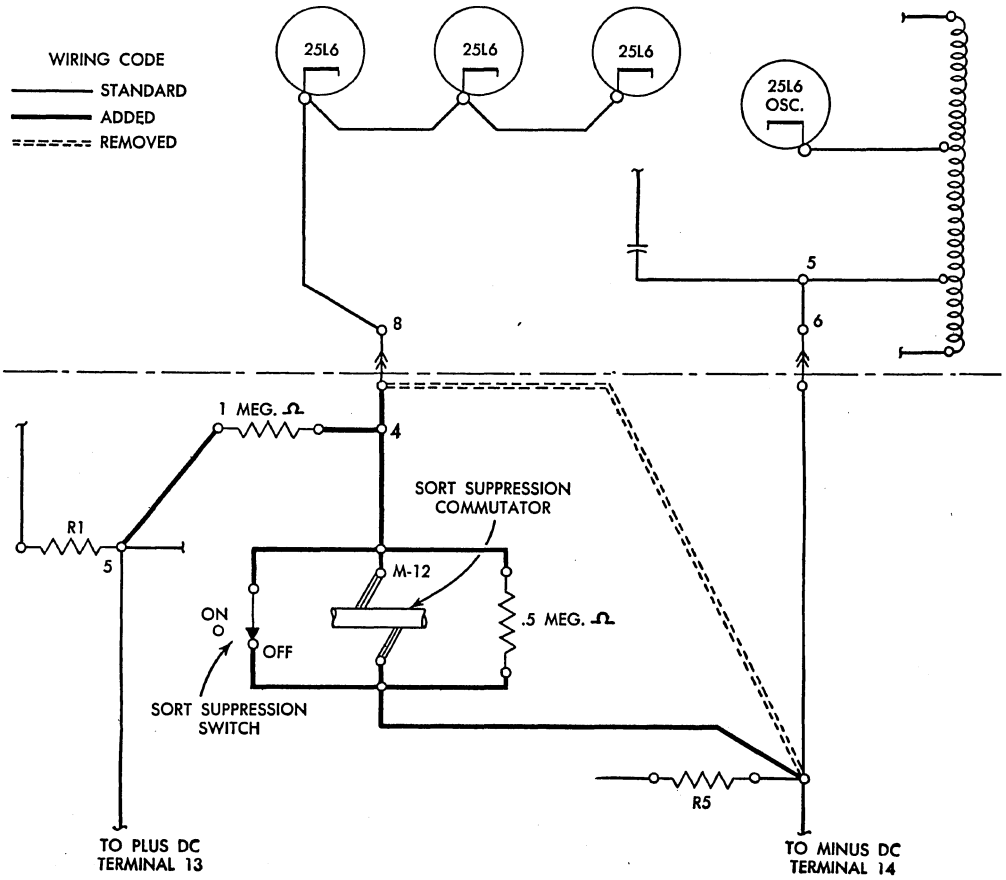


Figure 39. Wiring Diagram - Sort Suppression Device, Type 82

Sort Suppression Commutator

In addition to the sort suppression switch, there is a sort suppression commutator which is mounted on the card feed crankshaft (Figure 36). This is a split commutator which can be fastened to the shaft without having to remove any basic parts. Two brushes, mounted in a holder fastened to the right end frame assembly, ride the surface of the commutator and are electrically connected each time the metal segment on the cam passes under the brushes. This commutator completes one revolution per card cycle. It is timed to make contact when the card is $\frac{1}{64}''$ to $\frac{1}{32}''$ under the 11 chute blade (12 time).

Energizing the Sort Magnet

During sort suppression, sensing of any value of punching in the card fires the OA4G trigger tube in the normal manner. Once fired, the OA4G remains ignited until the center brush on the selector commutator breaks near the end of the card cycle. Although firing of the OA4G immediately removes the normal negative grid bias from the 25L6 power tubes, the sort magnet is not energized until 12 time when the sort suppression commutator makes. When the commutator makes, it shunts around the .5 megohm resistor connected between the cathodes of the 25L6 tubes and the negative side of the line. This .5 megohm resistor is connected across the DC circuit in series with a 1 megohm resistor to form a voltage divider and provide additional bias for delaying the firing of the 25L6 tubes.

The voltage drop across the .5 megohm resistor is applied to the cathodes of the 25L6 power tubes through octal pin 8. This voltage is of a positive value in respect to the zero or negative side of the DC circuit and, as such, drives the cathodes of the 25L6 power tubes positive in respect to the negative side of the DC circuit. When the cathodes are driven positive in this manner, they become more positive than their control grids. This, in effect, means that the control grids are then negative with respect to their cathodes; therefore, the 25L6 tubes fail to go into conduction even though the normal negative grid bias is removed when the OA4G fires. When the sort suppression commutator makes to shunt around the .5 megohm resistor, the additional bias is removed, thus allowing the 25L6 tubes to energize the sort magnet for sorting the card into the 12 pocket.

If the card brush does not sense a value in the card because that column is blank or because the selecting commutator contact bar for that value is retracted, the OA4G will not fire and the card will pass to the reject pocket.

CARD MATCHING DEVICE

A TYPE 75, 80 or 82 Sorter may be equipped with a card matching device and may be used for regular sorting as well as for card matching. When it is desired to do card matching, it is necessary to turn the two card matching switches at the front of the machine to the ON position. When regular sorting is desired, these switches must be OFF.

The card matching device is primarily used to sense a previously filed pack of master and detail cards and to reject those master cards which are not preceded by one or more detail cards. In the following discussion of card matching, detail cards will be considered as those cards whose file may be incomplete in quantity, while master cards will be considered as those cards which constitute a complete file.

Each detail card or group of detail cards precede their master card or cards in the sorter. These cards are sensed by a special demountable rail brush which can be mounted on the front or rear rail of the machine (Figure 40). This brush should be timed in the same manner as the card brush. The rail brush is used to sense corner cuts or a 12 or 9 punch in columns 1 or 80 of the detail cards.

Detail cards may be fed into the machine 12 or 9 edge first, face up or face down, depending upon whether the detail cards are filed in their storage cabinet in front of or behind the master cards. The method of feeding used should be that method which will allow the detail cards to be fed ahead of the master cards and which will place the hole or corner cut at the leading edge of the detail card.

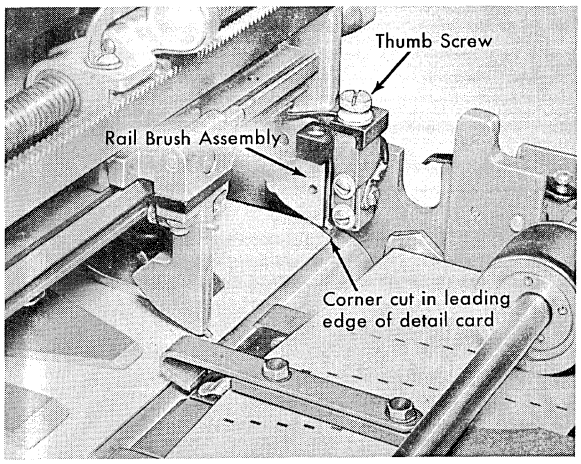


Figure 40. Card Matching Rail Brush

The 9 contact bar and the zone contact bar on the selector commutator must be in the out (contacting) position. All other contact bars should be retracted towards the center. The master cards are identified by means of a significant punch in a specified column or a corner cut on the opposite end of the card from which the corner cuts occur in detail cards. Significant punching in a master card is sensed by the regular card brush. This punching, however, must not occur in either of the two columns next to the rail brush. A special offset brush holder for the card brush is provided if it is desired to use a contrasting corner cut to identify master cards.

If the identifying punch in the master card is other than a 9 punch or a 12 punch, the corresponding commutator contact bar must be in the out position in addition to the 9 and zone contact bars. All other contact bars should be retracted.

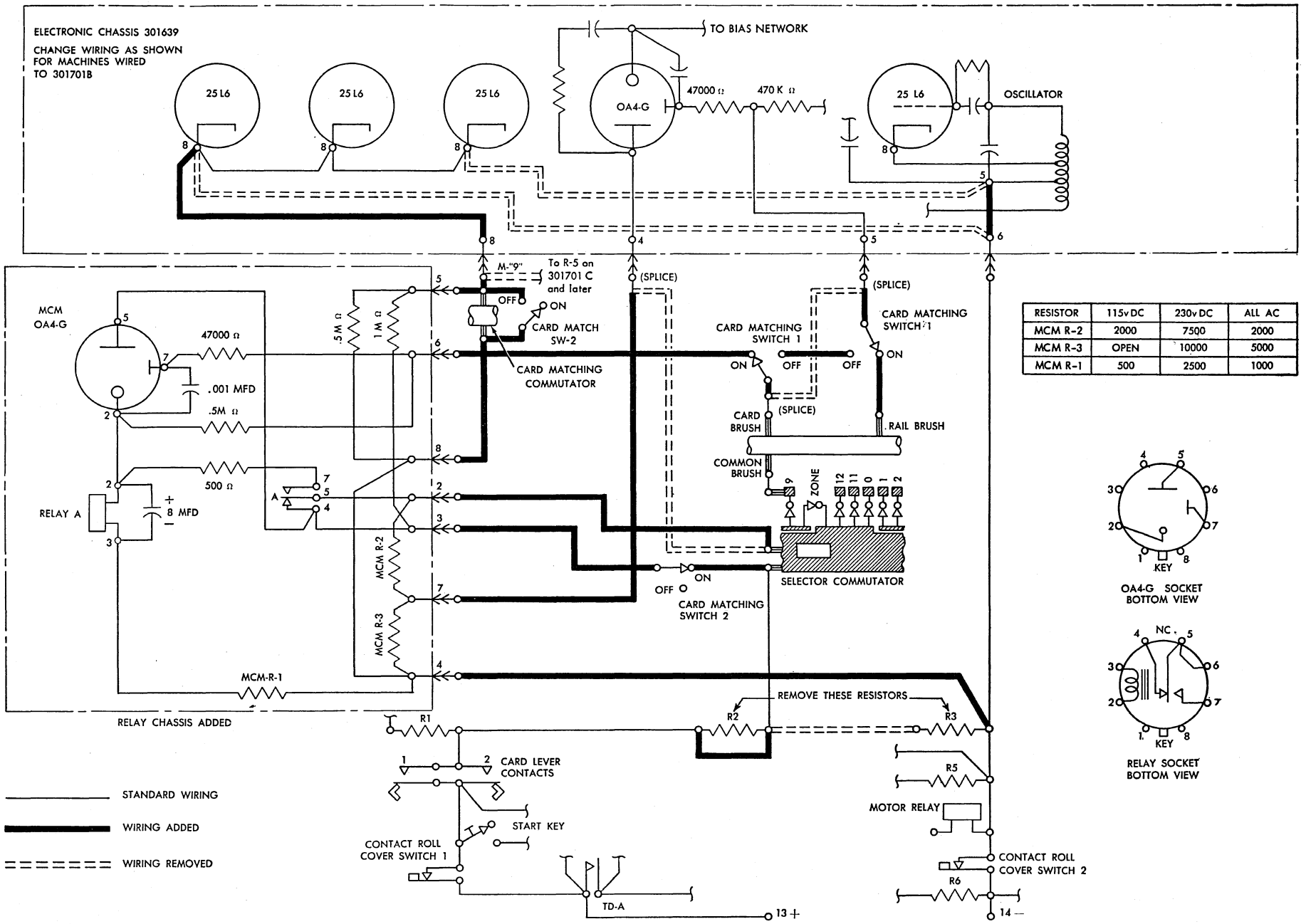
If master cards are being fed 12 edge first, the proper commutator contact bar for sensing significant punching must be selected in reverse order, i. e., an eight contact bar for 11 punching, a seven contact bar for 0 punching, etc.

Operation

Although it is possible to match detail cards with groups of master cards, the operation described below deals with only one master card for each group of detail cards.

The first detail card with a punched hole or corner cut which is read by the rail brush is sorted into the 9 pocket. This sets up an automatic holding circuit to sort successive detail cards into the 9 pocket also. Those detail cards following the first detail card may or may not have the detail identification punching or corner cut in them. As soon as a master card is sensed by the card brush, it is automatically sorted into the 9 pocket and the holding circuit to sort 9's is interrupted before the next card is sensed. This master card is identified by means of a significant punch or a corner cut which contrasts those on the detail cards.

Once the holding circuit for sorting 9's has been interrupted by sensing a master card, any succeeding master cards are passed into the reject pocket until



RESISTOR	115v DC	230v DC	ALL AC
MCM R-2	2000	7500	2000
MCM R-3	OPEN	10000	5000
MCM R-1	500	2500	1000

Figure 41. Wiring Diagram - Card Matching, Type 82

the advent of a detail card which again causes sorting into the 9 pocket. Thus, it can be seen that if two master cards occur in direct succession, the first master card will follow its group of detail cards into the 9 pocket while the second master card will be rejected. As long as each master card is preceded by one or more detail cards, both the detail cards and their master card will sort into the 9 pocket.

If it is desired to match a group of detail cards with more than one master card, the master card identification must occur only in the last master card of each group. If the identifying punch or corner cut were to occur in all master cards, the first master card of each group would follow its detail cards into the 9 pocket but the latter master cards of the group would be rejected.

Cards which have no punching or no corner cut which can be read by either the card brush or the rail brush will sort into the same pocket as the preceding card. If such a card is the first card fed into the machine, it will reject.

Those cards having a corner cut or significant punching which is read by the card brush will reject, unless they are preceded by a detail card.

The arrangement of the cards as well as the identifying punching or corner cuts in the cards is a factor that governs matching. However, it should be remembered that matching with this device should be done only with a master deck that is known to be complete.

CIRCUIT DESCRIPTION

THE FOLLOWING circuit description for card matching covers the operation of a Type 82 Sorter with a card matching device. The circuits described refer to wiring diagram 270094. A reproduction of this wiring diagram is shown in Figure 41.

An additional relay chassis, which accommodates the circuit components necessary for card matching, is mounted on the inner side of the main relay gate at the top (Figure 42). The two card matching switches are located directly below the start and stop keys in a special recess in the right upper front cover assembly.

A commutator is mounted on the card feed crankshaft and is timed to make at 9 time and break after 12 time of each card cycle. This commutator consists of a split cam which can be setscrewed to the shaft without removing any basic machine parts. A pair of brushes, mounted in a holder which is attached to the

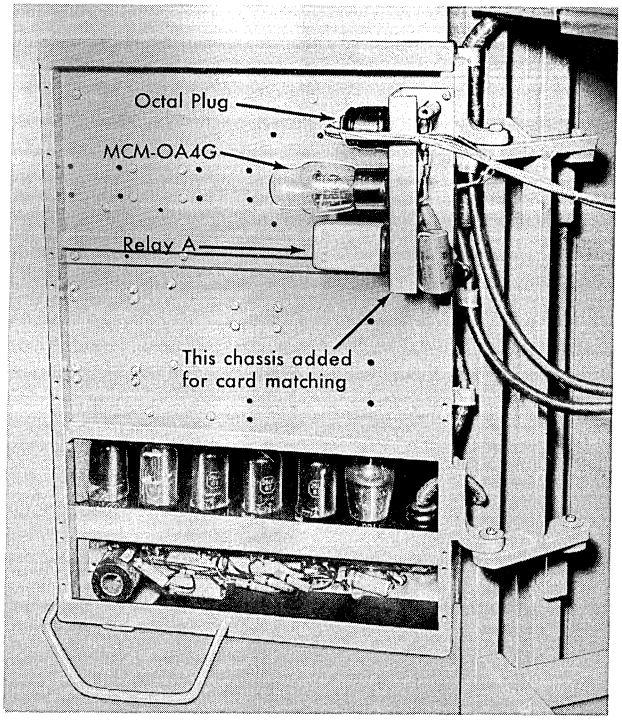


Figure 42. Card Matching Tube Chassis

right end frame assembly, ride on the surface of the cam and are electrically connected once each card cycle when the metal section of the cam passes under the brushes.

As previously stated, the rail brush is timed to make at the same time as the card brush. By means of the thumb screw on the rail brush assembly (Figure 40), the rail brush may be positioned properly for tracking.

Sorting Detail Cards (Figure 41)

When the corner cut or 12 or 9 punching in the first detail card of a group is sensed by the rail brush at 9 time, a circuit is completed as follows to apply +150 volts to the starting anode of the OA4G trigger tube: from the plus DC circuit terminal 13, to the TD-A point, through contact roll cover switch 1, card lever contact 1, to R-1, through the outer selector commutator brush, the inner commutator brush on the 9 spot, the contact roll common brush, contact roll, the hole in the card (or corner cut), rail brush, card matching switch 1 ON, octal plug terminal 5, 47,000 ohm resistor, to the starting anode of the OA4G trigger tube. Applying this voltage to the starting anode causes the OA4G trigger tube to fire, thus removing the grid bias from the 25L6 power tubes and energizing

the sort magnet at 9 time through the card matching commutator. This sorts the detail card into the 9 pocket.

Under regular sorting conditions, the OA4G trigger tube ceases to conduct when the center brush on the selector commutator opens its main anode circuit after 12 time each cycle. In this instance, however, the N/C A point of the card matching relay A shunts around the outer and center commutator brushes via MCM-R2, thus keeping the OA4G trigger tube continuously ignited. This automatically sorts all successive detail cards into the 9 pocket along with the first detail card.

Although the OA4G trigger tube remains continuously ignited while successive detail cards are passing through the machine, the sort magnet is de-energized between 12 and 9 time on each cycle so that there will be no conflict with the mechanical armature knockoff. This de-energization is accomplished by introducing an additional bias voltage in the cathode circuit of the 25L6 power tubes which control the circuit to the sort magnet.

This voltage is obtained from a voltage divider consisting of a 1 megohm resistor and a .5 megohm resistor connected in series across the DC machine circuit. By referring to Figure 41, it can be seen that any voltage drop across the .5 megohm resistor is applied to the cathodes of the 25L6 power tubes through octal plug pin 8. This voltage is of a positive value in respect to the zero or negative side of the DC circuit and, as such, drives the cathodes of the 25L6 power tubes positive with respect to the negative side of the DC circuit. When these cathodes are driven positive in this manner, they become more positive than their control grids. This in effect means that the control grids are then negative with respect to their cathodes; therefore, the tubes cease to conduct and the sort magnet is de-energized. (See principle 7 in the Type 82 Circuit *Description.*)

The .5 megohm resistor is shorted by the card matching commutator between 9 and 12 time, thus removing the bias from the cathodes by connecting them directly to the negative side of the circuit. This allows the 25L6 power tubes to conduct and energize the sort magnet at 9 time of each cycle as long as the OA4G trigger tube remains ignited.

Sorting Master Cards

When a master card is sensed by the card brush, the starting anode of the MCM OA4G tube is driven positive, thus firing the tube and picking up the card matching relay A (Figure 41). This relay then holds, through the 500 ohm resistor, the N/O relay A points, and the center and outer brushes on the selector commutator. The starting anode circuit of the MCM OA4G tube is interrupted when the hole in the card passes from under the card brush. Transfer of the A relay points shunts the main anode circuit of the MCM OA4G tube, lowering the potential across it greatly and causing it to go out. (See principle 9 in the Type 82 *Circuit Description.*)

Transfer of the A relay points places the sort trigger OA4G tube under control of the center and outer selector commutator brushes via MCM-R2. When the center brush on the selector commutator breaks after 12 time, the hold circuit for relay A is interrupted and the main anode circuit of the OA4G sort trigger tube is opened. Opening of the main anode circuit of the OA4G trigger tube causes it to go out, thus de-energizing the sort magnet and restoring the sorting circuits to normal by placing the normal negative grid bias on the 25L6 power tubes.

Once the sorting circuits have been restored to normal in the foregoing manner, any succeeding master cards are rejected until the advent of a detail card which is read by the rail brush. When a detail card is sensed, this card and all successive detail cards are sorted into the 9 pocket as previously described, until a master card is encountered.

Purpose of Miscellaneous Circuit Components

The 8 mfd. capacitor across the A relay coil increases the dropout time of this relay sufficiently to insure that the MCM OA4G tube will go out before anode voltage is again applied.

The 47,000 ohm resistor in the starter anode circuit of the MCM OA4G limits the starter anode current when the tube fires.

The .001 mfd. capacitor between the starter anode and cathode of the MCM OA4G serves to bypass high frequency transient pulses which might otherwise fire the tube at the wrong time.

The .5 megohm resistor in the cathode circuit of the MCM OA4G connects the starting anode to its cathode, thus keeping the starter anode at its own cathode potential as long as the card insulates the card brush from the contact roll.

MULTIPLE COLUMN SELECTION DEVICE

THE MULTIPLE column selection device may be installed on a Type 75, 80 or 82 Sorter and can be used for either multiple column selection or zero elimination. This device has no effect upon machine speed.

Externally the device consists of a demountable ten-position brush which permits reading from any ten adjacent card columns in one pass of the card through the reading station. In addition, the machine is externally equipped with a small control panel, ten switches for the selection of brushes for sorting, and the necessary operational control switches. On a Type 82 machine there are three operational control switches; two zero-eliminate switches which are connected by a common bar and operate together, and one multiple column selection switch. On Type 75 and 80 machines there are two operational control switches; one zero-eliminate switch and one select switch.

On a Type 82 machine, the operational control switches are mounted directly below the start and stop keys in a special recess in the right upper front cover assembly. The control panel and brush selection switches are mounted on a special cover plate on the right end of the machine as shown in Figure 43. A holder is provided on this cover plate to accommodate the ten-position brush holder and cable assembly when it is not in use. The plastic cover over the control panel and brush assembly operates a microswitch to open the main machine circuit when this cover is raised. In addition, there is a contact in the brush holder assembly which is open at any time the brush holder is not mounted in its reading position or is not properly mounted on its holder near the control panel. This brush holder contact also opens the main machine circuit, thus protecting the operator from shock while handling the brush assembly.

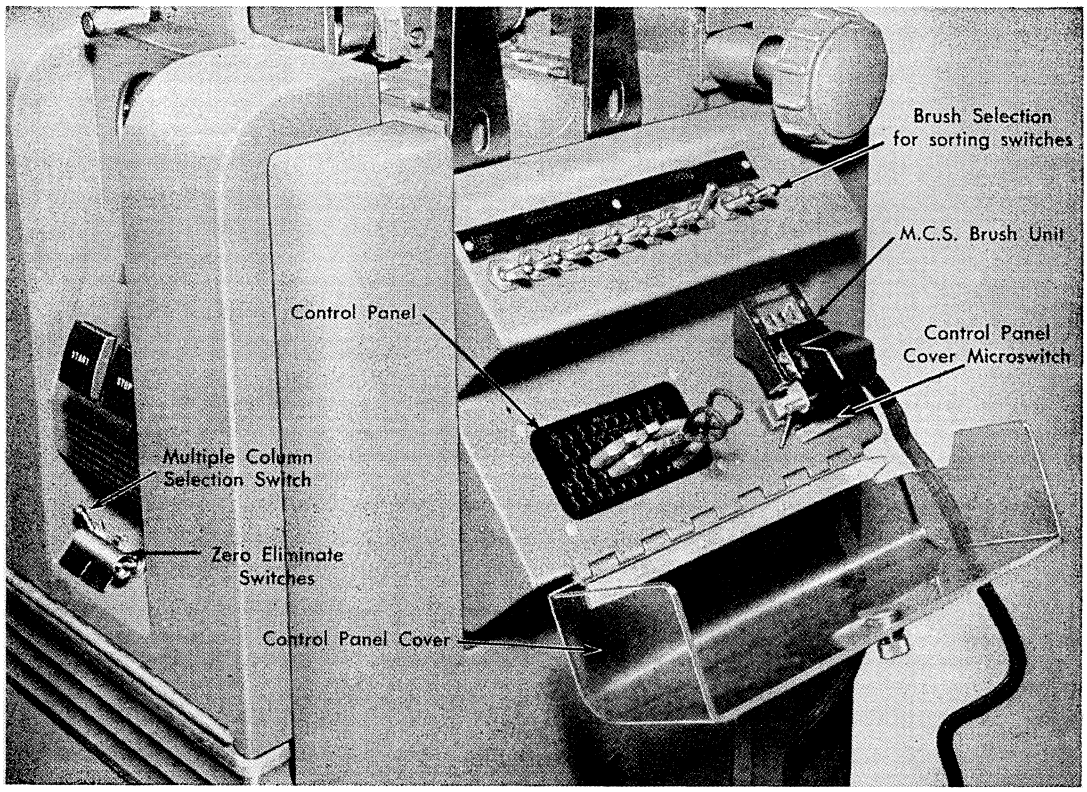


Figure 43. Multiple Column Selection Device, Type 82

On a Type 75 or 80 machine, the control panel, the brush selection switches, and the operational control switches are all mounted on a special inclined cover plate on the right end of the machine.

Operation of all multiple column selection external controls, including the layout and wiring of the control panel, is similar for the Type 75, 80 and 82 machines.

Control Panel

A diagram of the control panel is shown in Figure 44. The brush positions, 1 through 10, are labelled on the top row of hubs. Brush position 1 denotes the rear brush on the brush unit.

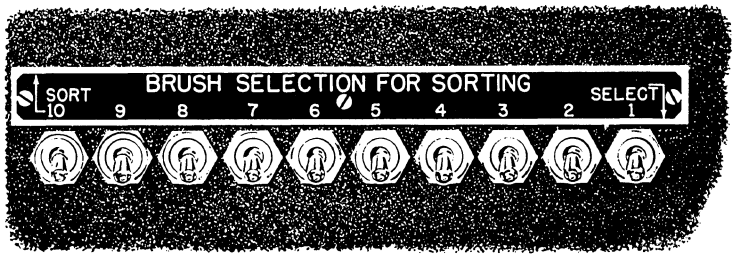
The two upper rows of hubs, which are commoned together vertically at each position and are labelled ZONE PUNCHING, emit impulses for their respective brush position when a 0, 11 or 12 punch in the card is sensed by that brush position. The third and fourth rows of hubs, which are commoned together at each position and are labelled LOWER PUNCHING, emit impulses for their respective brush positions when a digit punch in the card, 1 through 9, is sensed by that brush position.

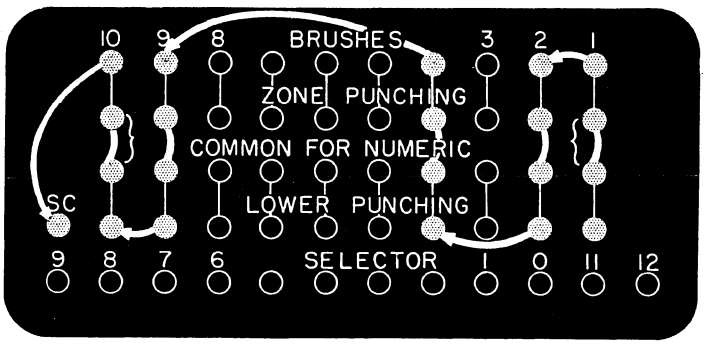
The lower row of selector hubs, 9 through 12, are entry hubs for the reception of impulses emitted from the brush hubs. These selector hubs are internally wired to a selecting commutator which acts as a rotary switch to direct impulses to perform the proper function within the machine, depending upon the timing of the impulse received.

The SC hub is an entry hub for the reception of impulses emitted from the brush hubs. It is usually used to permit selection of a common digit or digits from one or a multiple number of columns within the span of the ten position brush.

Common Digit Selection

It may be desired to sort out all cards which have one or more common digit punches in any one of a multiple number of columns. Figure 44 shows the control panel wiring necessary to accomplish this. When the SC hub is used, the brush selection for sorting switches should be set to SELECT and all contact bars on the sorting selector commutator should be retracted towards the center, except for those necessary to select the common digit or digits. Both the zero-eliminate and multiple column selection control





Selection of a predetermined digit occurring in any one or more of brush positions, 1, 2, 4, 9, or 10. Selecting commutator contact bar OUT for digit value desired. All others IN. All brush selection for sorting switches set to SELECT. Zero-eliminate and MCS control switches — OFF.

Figure 44. Control Panel Wiring - Common Digit Selection

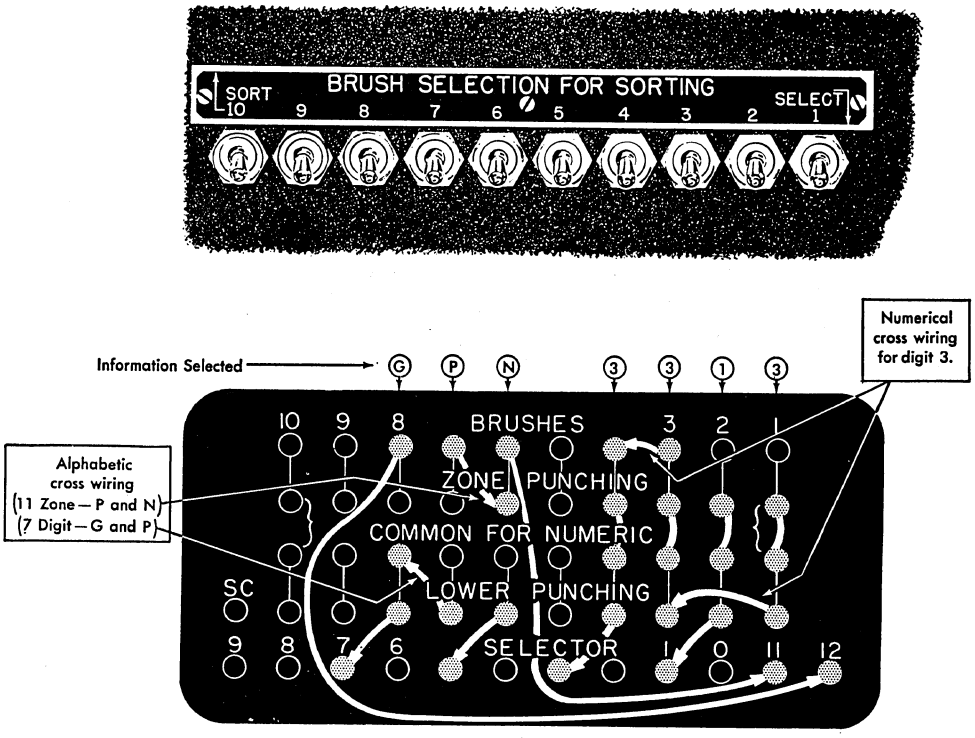
switches should be off. All cards with a selected digit in any of the selected columns will sort into the pocket corresponding to the digit. All cards with no selected punching in selected columns will pass into the reject pocket.

Multiple Column Selection

This operation selects automatically from a field of cards, those cards which are punched with a predetermined alphabetic, numerical, or combination indication within any ten adjacent columns. In a single run, selected cards of the desired classification are made to fall in the reject pocket while the remaining cards are deposited in the 12 pocket of the sorter. The sequence of the unselected cards is not disturbed. By means of this device, it is possible to select all the cards for a specified branch, agent, product, date, part number, man number, or other classification.

The control panel diagram illustrated in Figure 45 is wired for a combination alphabetic-numerical selection problem in which the indication is punched within a range of ten columns, but not in adjacent columns. Ordinarily, the brushes would be wired consecutively for information punched in adjacent columns. The digits representing a number, or the combinations of digits and zones representing letters to be selected, are wired from the selector hubs to the brushes which read the indication from the card. Cross wiring is used as illustrated whenever a digit or a zone is repeated. For numerical multiple column selection, the zone punching and lower punching hubs are wired together as in dicated. The zero-eliminate switches are turned off, the multiple column selection switch is turned on, and the series of brush selection switches are set to select. All selected cards are deposited in the reject pocket, while the remaining cards fall in the 12 pocket.

NOTE: The multiple column selection device does not recognize blank columns. If any one or several of the selected columns are unpunched, the multiple column selection device will not analyze these blank columns as unselected information. In the event that all the selected columns are blank, however, the card will sort into the 12 pocket.



Combination Alphabetic-Numerical Selection.

Zero eliminate control switches OFF
Multiple column selection switch ON
All brush selection switches set to SELECT

Figure 45. Control Panel Wiring - Multiple Column Selection

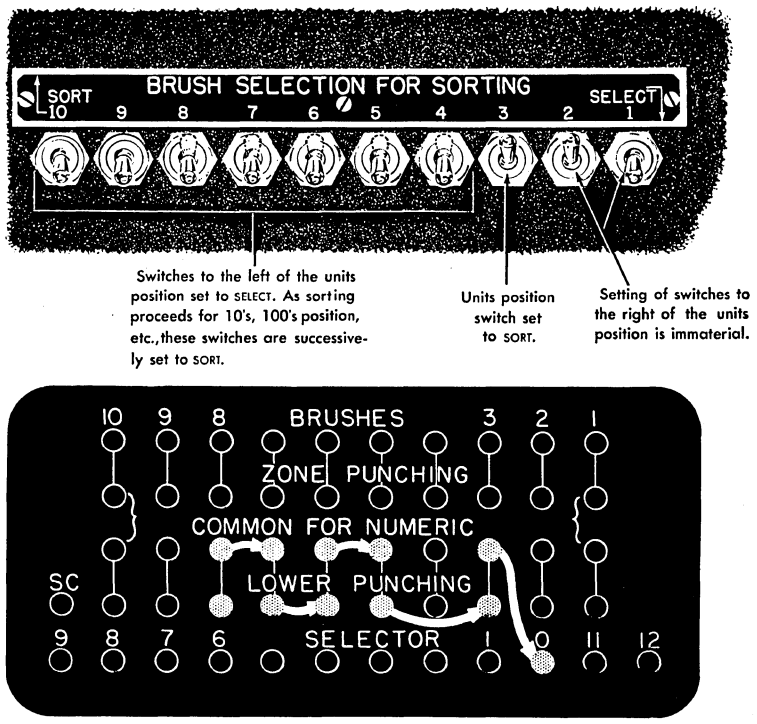
Zero-Elimination

The multiple column selection device permits greater speed in the completion of either alphabetic or numerical sorting operations through the automatic rejection of cards which require a reduced amount of sorting.

Cards can be rejected during a numerical sorting operation whenever the columns wired at the left and the column being sorted all contain only 0's, 11's, 12's or are blank. These rejected cards do not require further sorting because they contain sorting codes lower than those in the remaining cards and, therefore, are available for immediate report preparation or other machine operations. If the column being sorted is blank, punching from 1 to 9 in any column wired to the left of the sorting position will cause the card to sort into the 12 pocket. If 0, 11, or 12 punching occurs in the column being sorted, and a value of 1 to 9 punching occurs in any column wired to the left of the sorting position, the card will sort into the corresponding 0, 11, or 12 pocket. If punching from 1 to 9 occurs in the column being sorted, the card will sort into the corresponding pocket, regardless of what punching may or may not be sensed in those positions wired to the left of the sorting position.

The zero-elimination operation requires the use of the multiple brush in place of the standard card brush. To avoid unnecessary wear on both the brush and the cards, the multiple brush should be used only when zero-elimination is of value.

Zero-elimination is made operative for numerical sorting by cross wiring the lower punching hubs of the field or fields and, in turn, connecting them to the zero selector hub as shown in Figure 46. Columns may be skipped in the right to left sequence by leaving them unwired as shown. At the start of the operation, the brush selection switch in the units position of the columns being sorted is set to SORT. All other brush selection switches to the left of the units position are set to SELECT, even though some columns are skipped in the right to left sequence. As sorting proceeds for the 10's, 100's position etc., the brush selection switches for those positions are successively turned to SORT in order to advance the units reference point for determining which cards need no further sorting. Each switch to the left, set to the sort position, takes precedence over those to the right. The zero elimination operational control switches are turned on, while the multiple column selection switch is turned off.



Zero-Eliminate Control Switches ON

Multiple Column Selection Switch OFF.

Figure 46. Control Panel Wiring - Zero Elimination

Alphabetic sorting can be accelerated considerably by the zero-elimination operation. Cards with long names or descriptions can be segregated from cards with short names or descriptions. In the example below, card 1 may be sorted on all 12 columns, while card 2 requires sorting on only 5 columns.

Card Col.	1	2	3	4	5	6	7	8	9	10	11	12
Card 1	C	H	R	I	S	T	I	A	N	S	O	N
Card 2	J	O	N	E	S							

If columns 6 through 12 are wired for zero elimination, all cards with names as short or shorter than JONES will be rejected on the first sort and need not be sorted further until the regular sort on column 5 is made. The operator's knowledge of the data punched in the sorting field will determine the best number of columns to wire for zero-elimination on the first sort, as well as whether or not smaller portions of the field should be wired for elimination on successive sorts. The wiring and switch settings are the same as for zero-elimination in numerical sorting.

Normal Sorting

With the zero-eliminate and the multiple column selection switches turned off, all sorting selector commutator contact bars pushed out, and the single sort brush replacing the multiple column brush, sorting can be accomplished in the normal manner.

INTERNAL CONTROLS

IN ADDITION to the external controls, several internal mechanical and electrical components must be added to a standard Type 75, 80 or 82 Sorter to equip it with a multiple column selection device. A selection commutator, several additional electrical timing commutators, and a set of mechanically operated transfer contacts are mounted inside the covers on the right end of each machine. Figure 47 shows the location of these units on a Type 82 machine. These units are located in a similar position on the Type 75 and 80 machines. All units are driven by gearing from a special card feed crankshaft.

On a Type 82 machine, the standard electronic chassis is replaced with a larger chassis to accommodate two type 2D21 thyratron tubes and the R-ZE pluggable relay. A circuit cutout duo relay, with several additional MCS resistors, is added on a panel on the rear of the relay gate as shown in Figure 48. Type

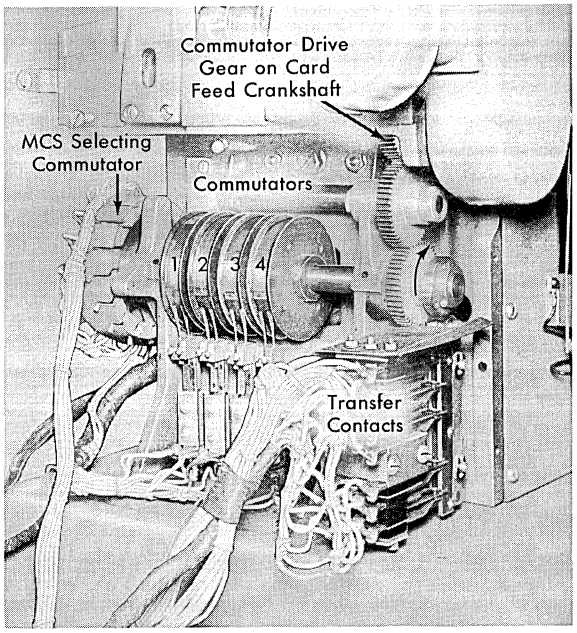


Figure 47. Internal Controls - MCS Device

82 machines equipped with the MCS device have larger power supply rectifiers than do the standard machines.

On Type 75 and 80 machines, slate base relays are used in place of tubes to complete the MCS circuits.

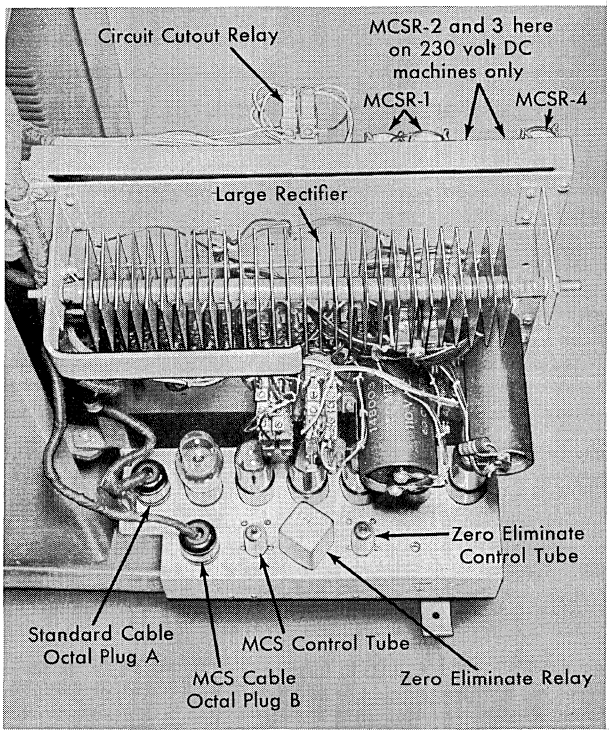


Figure 48. Type 82 MCS Relay Gate, 115 volt AC

These relays, with several necessary additional resistors, are mounted inside the standard relay cabinet. All Type 75 and 80 machines have a circuit cutout relay to open the machine circuit when the MCS brush is being handled by the operator. The location of these items inside the cabinet is schematically shown on the wiring diagram for each machine (Refer to the first paragraph in the *Circuit Description* section for these wiring diagram numbers.)

CIRCUIT DESCRIPTION

THE CIRCUITS described herein for multiple column selection and zero-elimination pertain to a Type 82 machine equipped with a multiple column selection device. Figure 49 is a reproduction of the multiple column selection wiring diagram 270096-A. All circuit description pertaining to multiple column selection and zero-elimination will refer to this figure. (The wiring diagram for a Type 80 machine with MCS is 181914-D; for a Type 75 machine it is 181916-E.)

Normal Sorting and Common Digit Selection

When the machine is set up for normal sorting or for selection of a common digit through the use of the SC hub, the sorting circuit operates in a similar manner to those circuits described in the Type 82 circuit description section of this manual.

MULTIPLE COLUMN SELECTION

Static Circuit Conditions

A type 2D21 thyratron tube (MCS control) is connected across the DC machine circuit with a 2000 ohm resistor in series with its anode. Negative bias for this tube is obtained from the standard bias oscillator and rectifier and is applied across a voltage divider consisting of a .5 megohm and 1 megohm resistor in series. A schematic diagram of this wiring is shown in Figure 50. The voltage across the 1 megohm resistor is applied between the control grid and the cathode of the tube through another .5 megohm resistor, making the grid approximately 25 volts negative with respect to the cathode. This negative grid bias prevents the tube from firing when anode voltage is applied through commutator 2 at the beginning of each card cycle.

The control grid circuit of the tube is also connected to the common brush on the A segment of the MCS selecting commutator through the number 2 zero-eliminate switch in the off position.

Sensing a Selected Value (Figure 49)

When a multiple column brush senses a value in the card which corresponds to the value of the selector hub to which the brush is wired, a positive voltage is applied to the grid of the 2D21 MCS control tube as follows: from the positive DC terminal 13, through the CCR-B point, contact roll cover switch 1, card lever contacts, commutator 2, zero-eliminate switch 1-L OFF, contact roll common brush, multiple column brush, brush selection switch set to SELECT, transfer contact, zone or lower punching hub, control panel wire, selector hub to which the brush is wired, selector brush on the A segment of the selecting commutator, A segment common brush, zero-eliminate switch 2-L OFF, pin 7 on octal plug B, two 500K ohm resistors in series, to the grid of the MCS control tube. This positive voltage cancels the negative grid bias, causing the 2D21 to fire and remain in conduction until its anode circuit is broken after 12 time in the cycle when commutator 2 opens.

When commutator 3 makes at $12+\frac{3}{64}$ of each cycle, a positive voltage is applied to the starting anode of the OA4G trigger tube through the following circuit: from the positive DC terminal 13, through the CCR-B point, contact roll cover switch 1, card lever contacts, commutator 2, zero-eliminate switch 1-L OFF, pin 4 on octal plug B, 2000 ohm resistor, to pin 6 on the MCS 2D21 tube, through the 47,000 ohm resistor, pin 6 on octal plug B, commutator 3, multiple column selection switch 1-R ON, to the outer brush of the sorting selector commutator, through pin 5 on octal plug A, the 47,000 ohm resistor, to the starting anode of the OA4G. If the MCS 2D21 has not been fired prior to the time that commutator 3 makes, the full positive DC voltage is applied to the starting anode of the OA4G, thus causing the tube to fire and sort that card into the 12 pocket. If the 2D21 tube has been fired prior to the time that commutator 3 makes, the positive voltage applied to the starting anode of the OA4G is not sufficient to fire the tube, thus causing that card to reject. Current flowing through the 2000 ohm resistance, because of the firing of the MCS 2D21, causes a voltage drop through this resistance, thus reducing the magnitude of the positive voltage available to the starting anode of the OA4G when commutator 3 makes.

Sensing an Unselected Value

When a multiple column brush senses a value in the card which does not correspond to the value of the

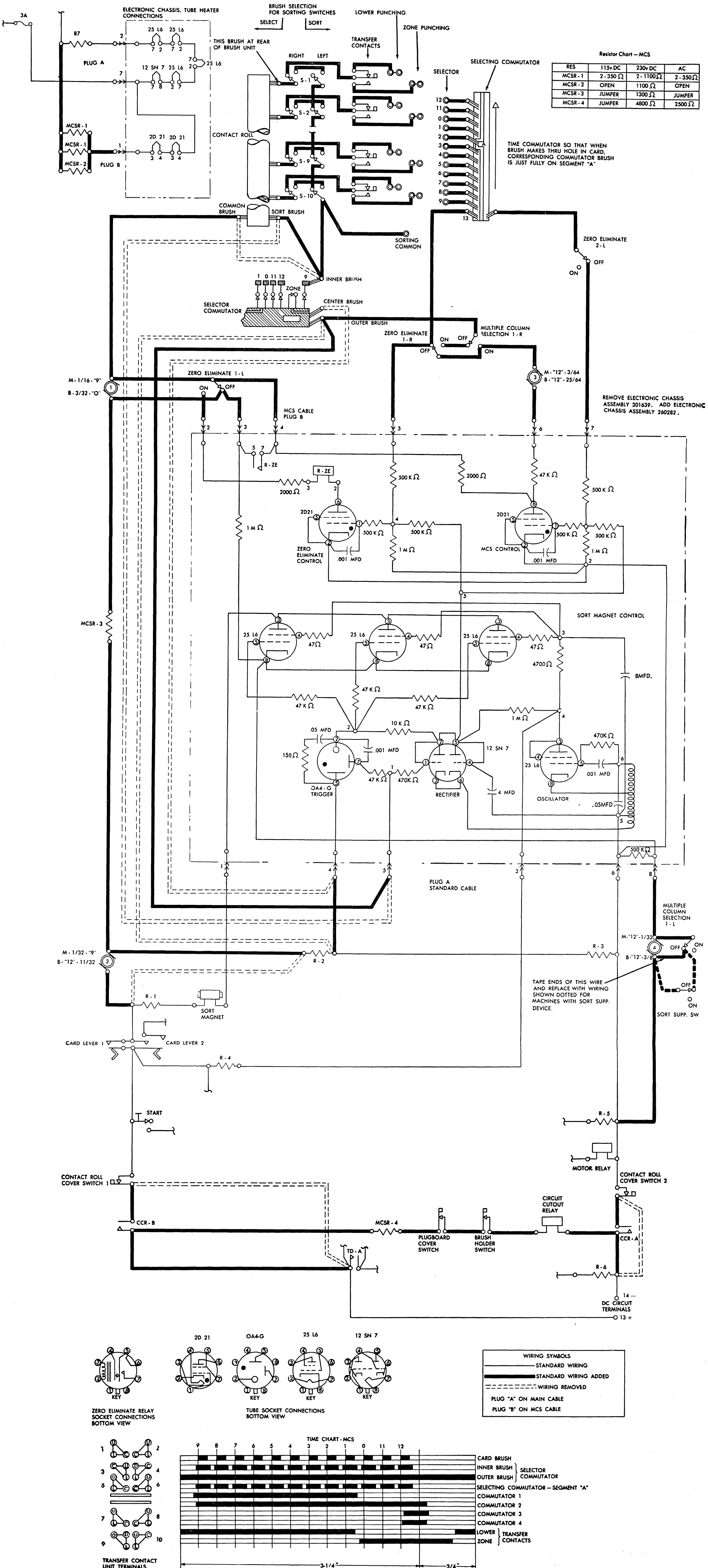


Figure 49. Wiring Diagram - 82 MCS Device

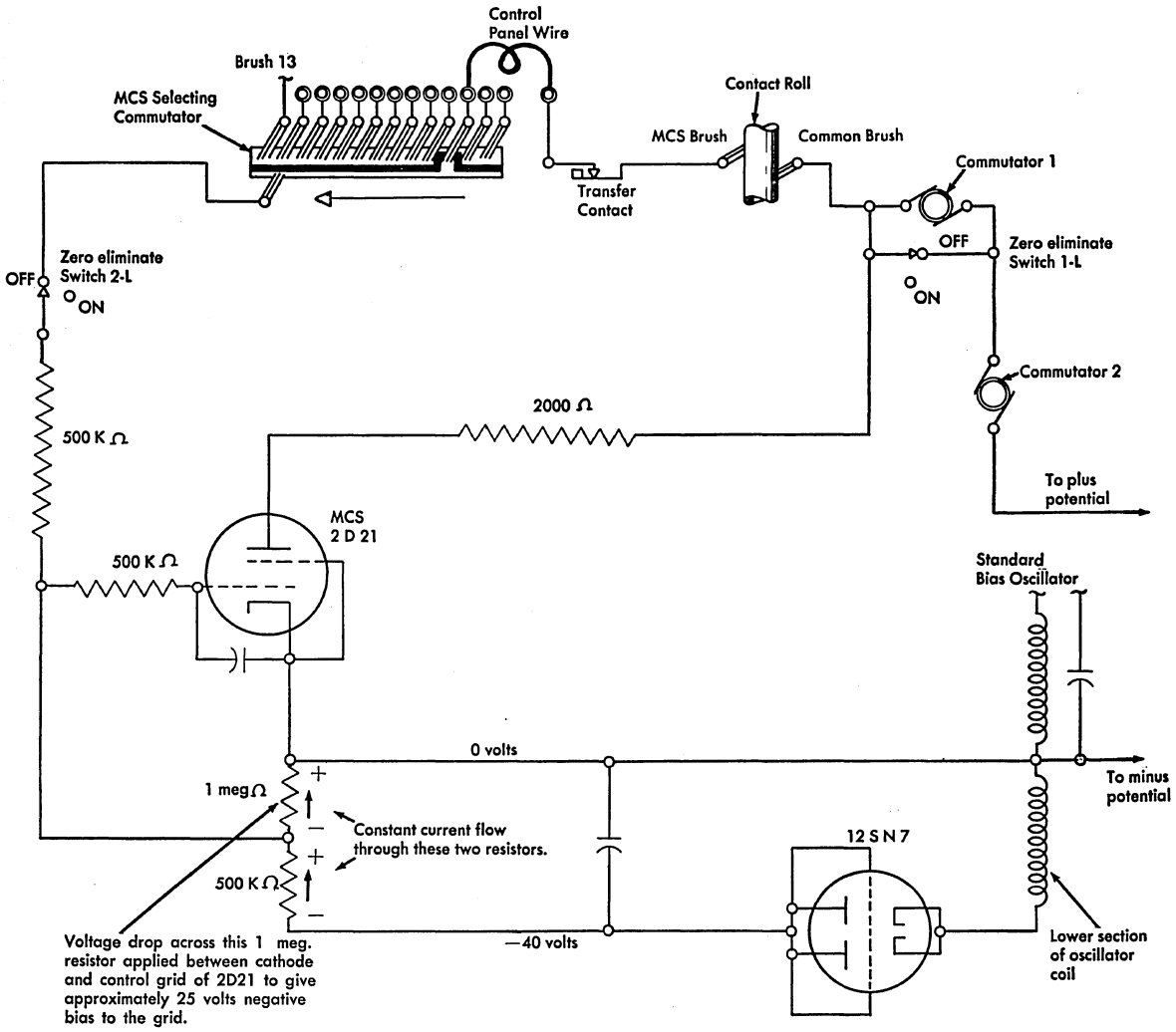


Figure 50. Schematic Wiring of MCS Control Tube

selector hub to which the brush is wired, a positive impulse is applied directly to the starting anode of the OA4G trigger tube. This occurs, because when the brush impulse is received in the selector hub, that selector brush is not on the A segment but rather is on the common of the MCS selecting commutator. The impulse is then directed through selector brush 13, the zero-eliminate switch 1-R OFF, multiple column selection switch 1-R ON, to the outer brush of the sorting selector commutator, through pin 5 on octal plug A, the 47K resistor, to the starting anode of the OA4G.

Application of this positive pulse fires the OA4G immediately and the tube remains in conduction until near the end of the cycle when commutator 2 breaks. Although firing of the OA4G immediately removes the normal negative grid bias from the 25L6 power tubes, the sort magnet is not energized until 12 + $\frac{1}{32}$ when commutator 4 makes to shunt around the 500K resistor connected between the cathodes of the 25L6 tubes and the negative side of the line. The 500K resistor is connected across the DC circuit in series with a 1 megohm resistor. This connection is between pin 6 on octal plug A and pin 3 on octal plug B. It serves to act as a voltage divider which provides sufficient additional bias to prevent the 25L6 tubes from energizing the sort magnet even though the normal negative grid bias is removed when the OA4G fires. When commutator 4 makes to shunt around the 500K resistor, the additional bias is removed, thus allowing the 25L6 power tubes to energize the sort magnet for sorting the card into the 12 pocket.

After analyzation of the foregoing circuits, it becomes possible to make the following statements:

1. If any one or more of the multiple column brushes sense a hole in the card which does not correspond to the value of the selector hub to which the

brush is wired, the card will sort into the 12 pocket.

2. If all the multiple column brushes read blank columns in the card, the card will sort into the 12 pocket. If, however, one or more brushes sense selected information, and one or more brushes sense blank columns, the blank columns will not be analyzed as unselected information and the card will pass into the reject pocket.

3. If only selected holes are sensed by the multiple column brushes, the card will pass to the reject pocket.

4. If one or more brush hubs are plugged to the sorting common, the impulse from the brush hubs will be applied directly to the starter anode through the regular sorting commutator. In order to sort to the value sensed by the brush, both the zero-eliminate and multiple column selection switches must be off.

5. If a brush selection switch is set to SORT, and that brush senses a hole in the card, the impulse will be applied directly to the OA4G starter anode. This impulse will pass through those switches directly below the switch set to SORT and through the regular sorting commutator. In order to sort to the value sensed by the brush, both the zero-eliminate and multiple column selection switches must be off.

ZERO ELIMINATION

Static Circuit Conditions

A 2D21 thyratron tube (zero-eliminate control) is connected across the DC machine circuit with a 2000 ohm resistor and the R-ZE relay in series with its anode. Negative grid bias for this tube is obtained in the same manner as for the MCS control tube. The control grid of the zero-eliminate tube is connected to the number 13 common brush on the MCS selecting commutator through two 500K resistors.

Operation of the Zero-Eliminate Control Tube

When any brush in the multiple column brush unit, with the exception of the units column brush, senses significant digit punching (1 through 9) in the card, a positive pulse is available at the lower punching hub for that position. When wired for zero-elimination, this impulse is directed into the zero selector hub and to the common of the selecting commutator. The zero brush contacts the A segment at zero time only. From the common of the selecting commutator, the pulse is applied to the grid of the zero eliminate 2D21 tube through common brush 13 and the two 500K resistors. This pulse cancels the negative bias on the grid of the 2D21, causing it to fire and pick up the R-ZE relay. The tube remains in conduction and the relay remains energized until the end of the card cycle when commutator 2 breaks. The N/O R-ZE relay points shunt commutator 1 to allow this condition.

At $\frac{3}{64}$" after 12 time, commutator 3 makes and applies the plus DC machine voltage to the starting anode of the OA4G through the following circuit: from the positive DC terminal 13, through the CCR-B point, contact roll cover switch 1, card lever contacts, commutator 2, pin 3 on octal plug B, the R-ZE point, the 2000 ohm resistor, to pin 6 on the MCS control tube, through the 47K resistor, pin 6 on octal plug B, commutator 3, zero-eliminate switch 1-R ON, multiple column selection switch 1-R OFF, to the outer brush of the regular sorting commutator, through pin 5 on octal plug A, the 47K resistor, to the starting anode of the OA4G. Application of this voltage fires the OA4G and causes sorting of the card into the 12 pocket.

Zero-eliminate switch 2-L prevents the MCS control tube from firing even though some brushes may have sensed a 0 punch in the card.

If none of the brushes to the left of the units position sense a significant digit in the card, the zero eliminate control tube is not fired and R-ZE is not picked up. When commutator 1 breaks at $\frac{3}{32}$ before 0, the voltage is removed from the contact roll and the anode circuits of both 2D21 tubes. This prevents any brush from reading a 0, 11 or 12 hole in the card. It also prevents the OA4G tube from firing when commutator 3 makes. If, under the above conditions, the units position brush senses a blank column or a 0, 11 or 12, punch, the card will pass to the reject pocket.

If the units position brush senses a 1 through 9 punch in the card, this impulse is applied directly to the starting anode of the OA4G. The circuit is through the brush selection switches to the left of the units position and the regular sorting selector commutator. Application of this impulse to the starting anode of the OA4G causes it to fire and sort the card into the pocket corresponding to the value of the punching sensed. Significant digit values, which are sensed by the units position brush as described above, are sorted to their corresponding pocket regardless of whether or not the zero eliminate tube has been fired.

If the zero eliminate control tube has been fired and the units brush senses a 0, 11 or 12 in the card, the card will sort into the pocket corresponding to the value of the punching sensed. If, however, the units column is blank and the zero-eliminate control tube has been fired, the card will sort into the 12 pocket under the control of commutator 3.

Circuit Cutout Relay

The circuit cutout relay is controlled by an interlock contact on the multiple column brush unit and a microswitch which is operated by the plastic cover over the control panel. This relay is de-energized when the control panel cover is raised or when the multiple brush assembly is not properly mounted in its reading position or on its holder near the control panel. De-energization of this relay opens the machine circuits to prevent the operator from receiving a shock when handling the multiple column brush unit or the control panel wires.

GROUP SORTING DEVICE

IBM 80 and 82 Sorters may be equipped with the group sorting device. This device permits sorting of entire groups of variously punched detail cards, according to the punching in a single master card which precedes each group. Operation of the device is externally controlled by two group selection switches. On a Type 82 machine, these switches are mounted below the start and stop buttons in a special recess in the right upper front cover assembly. On a Type 80 machine, these switches are mounted on the front of the cover over the card feed crankshaft mechanism.

When the group selection switches are on, the group sorting device is operative; when they are off, group sorting is rendered inoperative and regular sorting can be accomplished in the normal manner. On a Type 82 machine, when the group selection switches are first turned on, the machine is electrically interlocked under control of a time delay relay and can not be started for approximately one minute, until the group sort tube filaments reach their proper operating temperature.

The use of the group sorting device does not affect machine speed. This device can be furnished for operation in either one of two ways:

Single Master Card Method: The single master card method requires only that each group of detail cards be preceded by a master card. This master card determines the pocket into which its detail cards will sort, even though the detail cards may be punched differently in the column being sorted. Master cards are identified on their leading edge by a corner cut. This corner cut is sensed by a special rail brush at a separate sensing station located ahead of the contact roll on either the front or rear side rail of the machine. Figure 51 shows the location of this brush on a Type 82 machine. On a Type 80 machine, this brush is located on the front or rear card magazine side plate. On either type of machine, the master card corner cut may occur at the column 1 end or the column 80 end of the card, depending upon whether the special rail brush is mounted on the front or rear rail of the machine. Machines may be equipped with both a front and a rear rail brush. A front-rear switch controls the selection of these brushes and must be set to correspond with the position of the corner cut in the master cards. The detail cards need have no identification. They may have corner cuts in them but these corner cuts must not be in same postion as the corner cuts on the master cards.

Trailer Card Use: The double master card method requires both a leader card and a trailer card for each group. The master (leader) card controls the sorting as in the single master card method, but a trailer card is used to signify the end of each group. The master card is identified by a corner cut on its leading edge; the trailer card is identified by a corner cut on its trailing edge; the detail cards require no identification. Detail cards, however, must have no corner cuts which would identify them as master or trailer cards. Two rail brushes, one on the front rail and one on the rear rail, are required on a Type 82 machine when the double master card method is used. One rail brush is used to sense master cards while the other rail brush is used to sense trailer cards. On a Type 82 machine, once the rail brushes are installed, the use of these rail brushes is not flexible; that is, all master cards for all group sorting applications on a particular machine must have their corner cuts in the same position. All trailer cards must have their corner cuts on the opposite edge of the card.

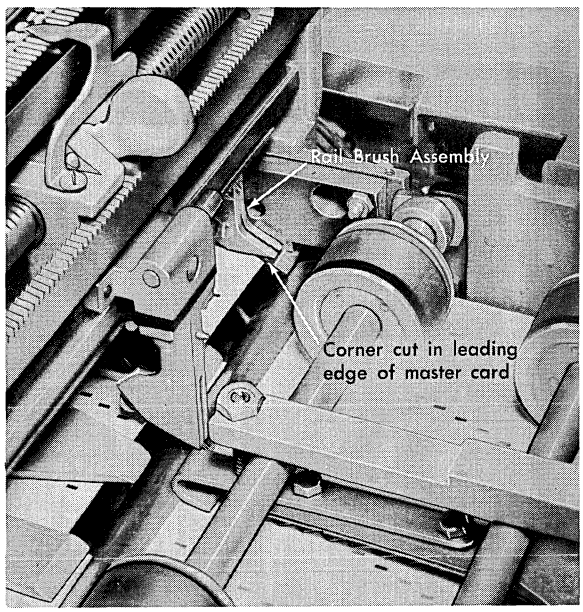


Figure 51. Group Sort Rail Brush

On a Type 80 machine, double master card operation may be accomplished by means of one or two rail brushes. When only one rail brush is used, the trailing corner cuts on trailer cards are placed on the same end of the card as the leading corner cuts on master cards. When two rail brushes are used, a special brush switch is furnished to permit sensing trailer cards with corner cuts on either end of the card. The special brush switch can not be installed on machines equipped with a front-rear switch.

INTERNAL CONTROLS

IN ADDITION to the external switch and rail brush controls, several internal mechanical and electrical components must be added to a standard Type 80 or 82 Sorter to equip it with a group sorting device. An impulse emitter and several electrical timing commutators are mounted inside the covers on the right end of each machine. Figure 52 shows the location of these units on a Type 82 machine. These units are located in a similar position on Type 80 machines. All units are driven by gearing from a special card feed crankshaft.

On a Type 82 machine, an additional electronic chassis, time delay relay, and several necessary resistors are mounted on the rear of the relay gate as shown in Figure 53. Type 82 machines equipped with the group sorting device have larger power supply rectifiers than do the standard machines.

On Type 80 machines, slate base relays are used in place of tubes for storing the necessary information. These relays, along with the necessary additional resistors, are mounted in a special cabinet on the rear of the machine. The location of these items inside the cabinet is schematically shown on the Type 80 group sort wiring diagram 292052-B. Type 80 machines equipped with the group sorting device employ larger power supply rectifiers than do the standard machines.

CIRCUIT DESCRIPTION

THE CIRCUITS described herein for group sorting pertain to a Type 82 machine equipped with the group sort device. Figure 54 is a reproduction of the Type 82 group sorting wiring diagram 270097-A. All circuit description pertaining to group sorting will refer to this figure. (The wiring diagram for a Type 80 machine equipped with group sorting is 292052-B.)

When the machine is set up for normal sorting, the sorting circuit operates in a similar manner to those

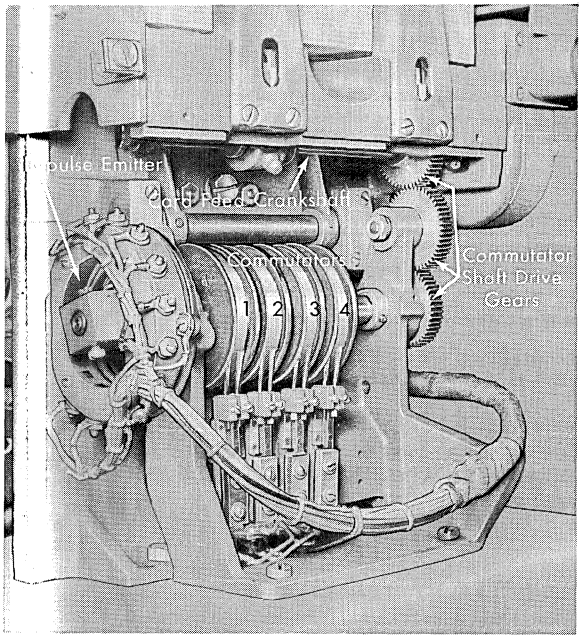


Figure 52. Internal Controls - Group Sorting Device

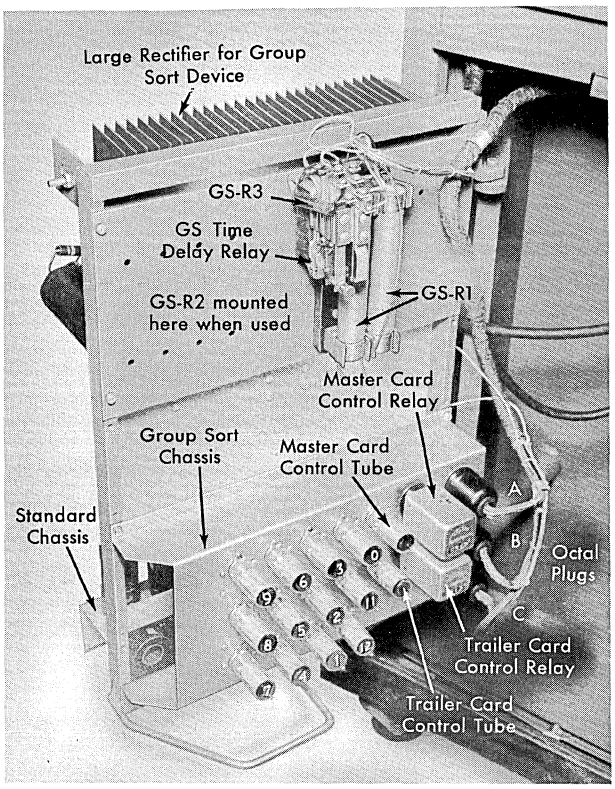


Figure 53. Type 82 Group Sort Relay Gate, 115 volt AC

circuits described in the Type 82 circuit description section of this manual.

Static Circuit Conditions

A 2D21 thyratron tube (master card control) is connected across the DC machine circuit with a 2000 ohm resistor in the cathode circuit and a high speed relay in the anode circuit. Negative bias voltage for this tube is obtained from the standard bias oscillator and rectifier and is applied to the grid in series with two 500K resistors, making the grid approximately 40 volts negative with respect to the cathode. This negative bias prevents the tube from firing when anode voltage is applied each cycle at the time commutator 2 makes.

The control grid of the tube is also connected to the master rail brush through a .05 mfd capacitor.

Firing the MCC Tube

Shortly before a master card reaches the card brush station, the rail brush senses a corner cut in the leading edge of the card (Figure 51). This applies a positive pulse to the control grid of the master card control tube through commutator 2, the master rail brush, the .05 mfd capacitor, and the 500K resistor. This positive voltage cancels the negative grid bias and causes the tube to fire since, at this time, anode voltage is also applied to the tube through commutator 2.

Firing of the MCC tube picks up the MC relay in the anode circuit, thus transferring the MCR points. Opening of the N/C MCR point allows removal of the anode voltage from all impulse storage tubes when commutator 3 breaks. This allows any storage tube (12 through 9) which has been previously fired to de-ionize, thus clearing the impulse storage section.

Closing of the N/O MCR point completes a circuit as follows: from the positive side of the line, through contact roll cover switch 1, the card lever contacts, group sort switch 1, to commutator 2, commutator 3, through A-3, MCR N/O, A-2, to the outer brush on the selecting commutator. This permits placing a positive potential on the contact roll when the inner brush sweeps across the segments, thus allowing the card brush to sense holes in the master card.

Just before 9 time at the start of the master card cycle, the center and outer selector commutator brushes make. This happens before commutator 2 breaks at $\frac{1}{64}$" before 9. In conjunction with the MCR N/O point, these brushes shunt around commutator 2, thus maintaining a positive potential on the anode of the MCC tube and keeping the MC relay energized until the end of the master card cycle when the center brush breaks.

Commutator 3 makes at $\frac{5}{32}$" before 9, shunting the N/C MCR point (now open) and applying anode voltage to the impulse storage tubes.

Sorting the Master Card

When the card brush senses a hole in the master card, the full DC machine circuit voltage is applied to the starting anode of the OA4G trigger tube. This causes immediate firing of the OA4G and sorting of the master card into the corresponding pocket. At the same time, this positive voltage is applied through the corresponding impulse emitter segment to a tube in the impulse storage section.

Each impulse storage tube (2D21 thyratron) is connected across the DC circuit with a 47K resistor in series with its cathode. Negative grid bias for these tubes is obtained in the same manner as for the MCC tube. The positive pulse from the impulse emitter segment is applied through a .05 mfd capacitor and a 500K resistor to the control grid of the storage tube connected to that emitter segment. This voltage cancels the negative grid bias on the tube, causing it to fire. Once fired by the action of a master card, the tube remains in conduction until the following master card (or a trailer card) is sensed. Since the voltage drop across a conducting 2D21 is approximately 8 volts, the voltage on the cathode of the storage tube during conduction rises almost to the full DC circuit potential. The majority of the potential drop appears across the 47K resistor in the cathode circuit.

At the end of the master card cycle, the center brush on the selecting commutator breaks, de-ionizing the MCC tube and dropping out the MC relay. The N/C MCR points close before commutator 3 breaks, thus maintaining anode voltage on the impulse storage tubes and keeping that tube in conduction that was previously fired by punching sensed in the master card. The N/O MCR point breaks the circuit to the selecting commutator and the contact roll to prevent sensing of detail card information by the card brush.

Sorting Detail Cards

If the card immediately following the master card is a detail card, it will not be read by the sort brush because of the condition of the N/O MCR point. However, when the impulse distributor makes on the segment corresponding to the value sensed in the previous master card, a positive potential is applied to the start-

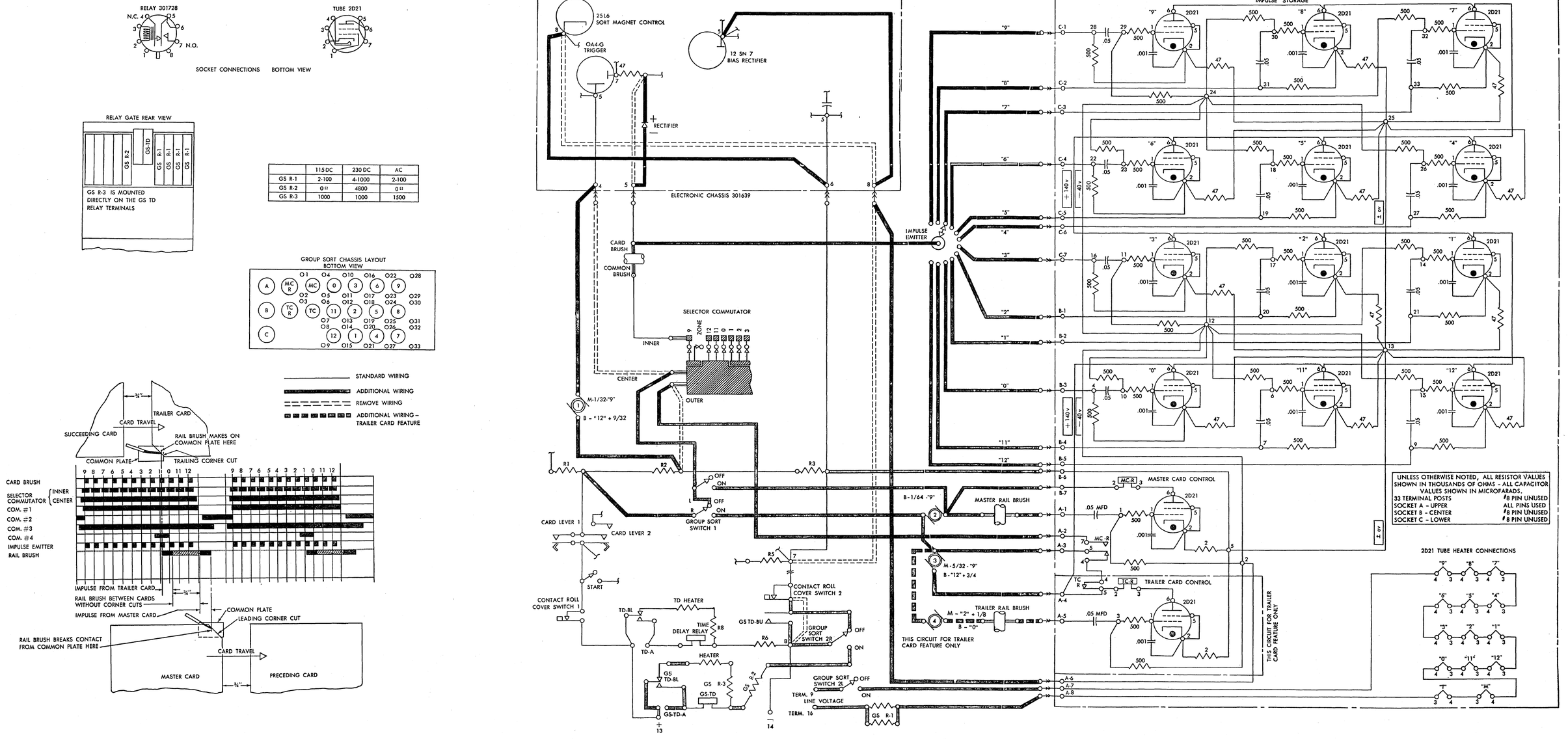


Figure 54. Wiring Diagram - 82 Group Sort Device

ing anode of the OA4G trigger tube. This positive potential is available from the cathode of the previously fired impulse storage tube and is applied through the 500K resistor, octal plug, emitter segment, and on to the starting anode of the OA4G. This immediately fires the OA4G and sorts the detail card into the same pocket as the preceding master card. In this manner, all successive detail cards are sorted into the same pocket as the master card which preceded them.

Trailer Card Operation

Trailer cards are sorted in the same manner as are the detail cards. Between 0 and 1 time in a trailer card cycle, however, the trailer rail brush senses the corner cut on the trailing edge of the card. This applies a positive pulse to the control grid of the trailer card control tube through commutator 4, the trailer rail brush, the .05 mfd capacitor and the 500K resistor. The trailer card control tube (2D21) is connected across the DC machine circuit in exactly the same manner as the master card control tube. It is also biased in the same manner.

Application of a positive pulse from the trailer card rail brush cancels the negative grid bias on the TCC tube, causing it to fire and pick up the TC relay. Pickup of the TC relay opens the TCR points which break the shunt circuit around commutator 3. This places the anode circuits of the impulse storage tubes directly under control of commutator 3. Therefore, when this commutator breaks at the end of the trailer card cycle, it de-ionizes any storage tubes which had been previously fired, thus clearing the impulse storage section. Breaking of commutator 3 also opens the trailer card control tube anode circuit and drops out the TC relay.

Any card which follows a trailer card in the machine will be rejected unless it is a master card; in which case, new master card circuits will be set up as described in the foregoing circuit description.

Single Master Card Operation

When detail cards are immediately followed by a master card instead of a trailer card, the master card is sensed by the master rail brush before it reaches the card brush station. Operation is identical to that described under the heading *Firing the MCC Tube.* The MC relay is picked up; all impulse storage tubes are de-energized to clear out previous information; the MCR point sets up a circuit to the selecting commutator and the contact roll for sorting the master card; and commutator 3 re-applies anode voltage to the impulse storage tubes in preparation for storing information sensed in the master card. The master card is sensed by the card brush and sorted to its proper pocket, and all detail cards following it sort into the same pocket until the advent of another master card.

Purpose of Miscellaneous Circuit Components

The .001 mfd capacitors connected between the control grid and the cathode of each 2D21 tube serve to by-pass transient impulses which may otherwise fire the tube at the wrong time.

The 500K resistor, attached to and in series with the control grid of each 2D21 tube, limits the grid current to the proper value.

The 47K resistor in the cathode circuit of each 2D21 storage tube serves to limit the anode current through the tube.

The 500K resistor between the cathode of each 2D21 storage tube and its impulse emitter segment is actually connected in series with the 47K resistor in the cathode circuit. These resistors are placed across the DC machine circuit together and act as a voltage divider when a hole is sensed in the master card, thus developing a difference in potential between the cathode and grid of the storage tube and causing it to fire.

The .05 mfd capacitor in the grid circuit of each 2D21 tube acts as a blocking capacitor which isolates the –40 volt bias supply from ground (zero volts)

The rectifier in the OA4G starting anode circuit prevents firing of additional lower value impulse storage tubes after the OA4G trigger tube has been fired from a value sensed in the master card. Without the rectifier, additional impulse storage tubes could fire from the inherent positive potential on the starting anode of the conducting OA4G as the emitter brushes sweep across their segments. Firing of excess tubes in this manner would place a strain on the power supply.

The 500K resistors connected between the –40 volt bias supply and the grid circuits of the 2D21 tubes serve to improve the voltage regulation of the bias source by preventing the bias source from rising to cathode potential when a tube fires.

The 2000 ohm resistors in the cathode circuit of the MCC tube and the TCC tube serve to limit the anode current through these tubes.

GS-R1 limits the filament current and voltage of the 2D21 tubes to the proper value.

IBM 978 CARD COUNTING UNIT

FUNCTIONAL PRINCIPLES

Introduction

The 978 is used with, and under the control of, the 82 Sorter for the purpose of counting cards. The counter unit performs a pocket distribution count for all cards with or without card sorting. For normal operation, a count is made of the cards entering each pocket with a total of all cards accumulated in the subtotal counter. If the cards have multiple punches, the counters count each hole present in the card column. The subtotal accumulates the total number of cards and not the number of holes read.

Two switches control the operation of the counting unit. The counter switch is positioned ON whenever cards are counted. When this switch is positioned ON, the counting unit must be connected to the sorter. The cable from the counting unit connects into an Elco receptacle. If the cable is not connected to the Sorter and the counter switch is positioned ON, the Sorter does not operate. The count-only switch is positioned ON to suppress sorting while cards are counted. Digit suppression is used to suppress sorting cards with specific punches without suppressing the count of the respective punches.

The counting unit consists of 14 separate counters: 12 counters to count the punches in the card, one counter to count rejected cards, and one counter to accumulate a total of all cards. The counters are mounted in two rows across the length of the counting unit. The counters are numbered to correspond with the particular hole counted. The counters in the top row consist of 0 through 5 and reject. The counters in the lower row consist of 6 through 12 and subtotal. Each counter has a capacity of 99,999.

Reset

The counters are reset manually by turning the crank at the right side of the counting unit. It is necessary to depress the detent lever located on the front of the unit before the crank may be operated. The detent lever serves as an interlock to prevent machine operation when the counters are not fully reset to zero. When the detent lever is depressed, it operates a switch that opens the machine start circuit.

The reset crank resets the counters by turning a shaft to which all the counters are geared. At the completion of the second crank revolution, a detent lever engages in the counter reset shaft. This prevents further movement of the reset mechanism until the detent lever is again depressed.

Counters

The actual counting and accumulating in the counters is done mechanically. Each hole is counted by impulsing the proper counter magnet. As the magnet armature is attracted, point A engages the counter ratchet and moves the unit counter wheel (Figure 55). This provides half of the ratchet movement necessary to add 1. The armature is spring-returned when the counter magnet is de-energized. As the armature returns, point B drives the counter ratchet, completing the action of counting 1 (Figure 56). The carry from one position of the counter to the next higher position is done internally. A carry wheel engages the counter wheel when passing from 9 to 0 and mechanically connects the motion to the next higher position.

Tube and Relay Storage

Actual counting of a hole in a card takes two machine cycles. On the first cycle when the hole is sensed by the card brush, a 2D21 tube is driven into conduction. Twelve tubes of this type are used, one for each punch in a card column. The tube that is driven into conduction serves as a memory device signifying that a hole has been read. Each hole drives a separate tube into conduction. When the reading of

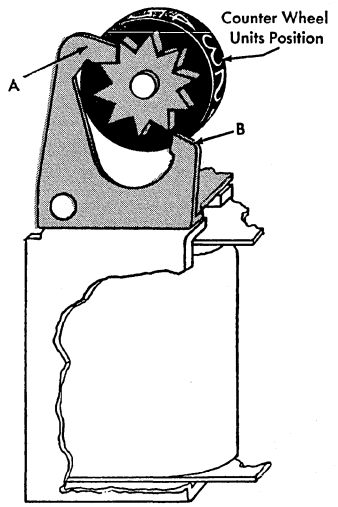


Figure 55. Counter Magnet Energized

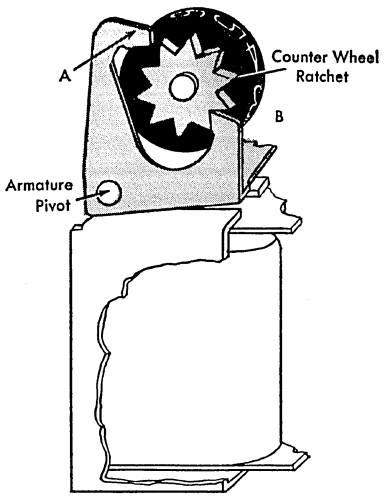


Figure 56. Counter Magnet Normal

holes 9 through 2 has been completed, the tube or tubes in conduction pick the memory relays. Having picked the memory relays, the tubes are extinguished to allow them to be conditioned by the next card on the following cycle. Memory of holes read in the card is thus transferred from a tube to a relay. Tube memory is not necessary when holes 1, 0, 11, and 12 are read in the card; in this case the tubes fire and immediately pick the memory relays. The tube and relay chassis is located under the stackers.

On the second cycle an impulse to the counter network through the transferred memory relay points energizes counter magnets, adding a 1 into the counter corresponding to the digit read.

CIRCUITS

Power Supply

The power supply is located in the motor compartment. Two transformers are used in the power supply to provide the necessary voltages for machine operation. The transformers may be wired for an input of 115, 208, or 230 volts AC. Both have two primary windings, wired in parallel for an input of 115 volts AC or wired in series for 230 volts (Figure 57).

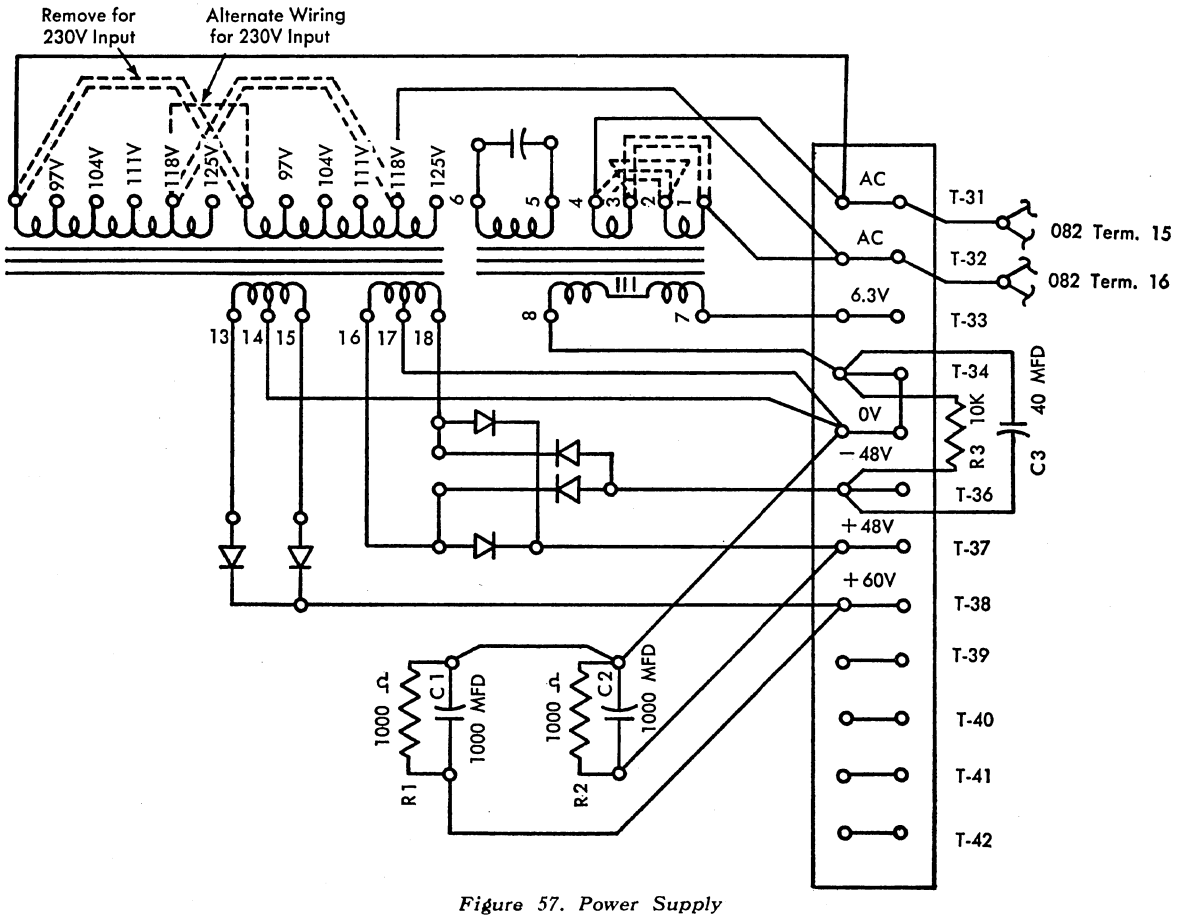


Figure 57. Power Supply

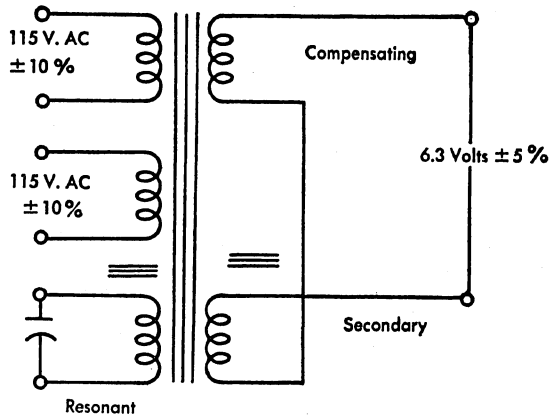


Figure 58. Filament Voltage Transformer (Schematic)

FILAMENT VOLTAGE TRANSFORMER

A regulating transformer is used in the power supply to provide voltage regulation for the 2D21 tube filaments (Figure 58). The regulating transformer is designed to deliver an output of 6.3 volts ± 5 percent over a ± 10 percent variation of rated line voltage on the primary. It is especially constructed with a compensating winding wound with the primary at one end of the core (Figure 59). At the other end of the core, a resonant winding and the secondary winding are wound. In the design of the transformer, a space is provided between the primary and secondary windings to change the reluctance of the transformer.

When the input voltage is applied to the primary windings, magnetic lines of flux set up in the transformer core. In the path of the flux linkages, the air space makes the normal magnetic path higher in reluctance (magnetic resistance) than that of a solid core arrangement. The result of this design causes the flux lines to travel around the core and up through the center instead of across the area with the air spaces.

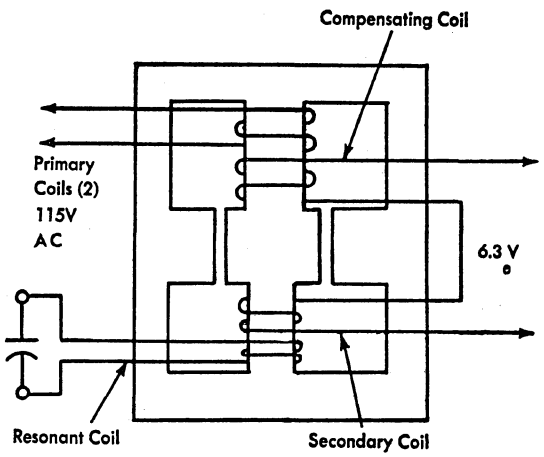


Figure 59. Schematic of Filament Voltage Transformer

The flux lines through the lower center part of the core induce a voltage into the resonant and secondary windings. Connected in series with one of these windings is a capacitor (matched in rated size to the inductance of the coil), that causes a high current to flow (resonant). Only the DC resistance of the circuit opposes the resonating current. The high current flow in the resonant winding causes a magnetic field that saturates the lower core area with magnetic lines of flux.

With the resonant winding saturating the lower core, more lines of flux are available than can pass through the lower part of the core. Consequently, not all of the primary flux linkages can go through the lower core area because it is saturated. Part of the flux crosses the air space as a path of less resistance.

Saturation is maintained at the lower core area by compensating for the resistive losses of the resonant coil. When the losses tend to cause the magnetic field to fall below saturation, more of the primary flux can enter through the lower core area. The additional primary flux induces voltage into the resonant winding which increases the magnetic field and maintains saturation of the lower core area.

By maintaining saturation, the secondary winding output is maintained because the flux changes at the secondary winding are not in proportion to variations in primary voltage. Because of inherent conditions in the transformer, however, there are small changes of output voltage when the input voltage varies. The slight changes are regulated by the compensating winding.

The compensating winding is designed to cancel the slight variations in secondary output voltage. It is wound (positioned) with the primary windings and wired in series with the secondary winding. The compensating winding is wound so that its induced voltage opposes that of the secondary winding (Figure 59). Within the range of regulation, if the primary input voltage rises, the induced secondary voltage rises slightly. Also the voltage induced into the compensating coil increases in proportion to the increase over normal output of the secondary winding. The two voltages oppose each other with the result that 6.3 volts remain impressed on the filament circuit (Figure 61). When the input voltage on the primary decreases, the induced voltage of the secondary is lower, with a

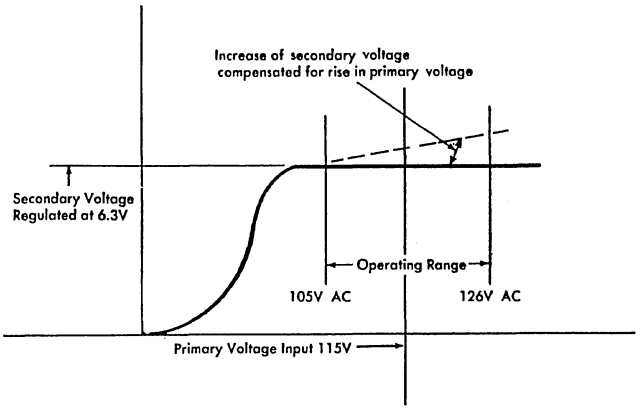


Figure 60. Schematic of Filament Transformer Output

corresponding reduction in the compensating winding voltage. This produces a 6.3v output because less compensating voltage opposes the secondary winding voltage.

POWER TRANSFORMER (FIGURE 57)

The power transformer provides the voltage for the DC supplies. One secondary winding provides 96 volts AC for the +60v DC supply. The other winding provides 78 volts AC for the +48v and —48v DC supplies.

The 96 (RMS) winding is center tapped to provide full wave rectification producing +60 volts DC across R1 and C1. The +60v supply provides the plate voltage for the 2D21 tubes.

The 78v (RMS) winding is center tapped to provide full wave rectification for both the +48v DC supply across R2 and C2, and the —48v DC supply across R3 and C3. The +48v section is used to supply the relay circuits for counting functions. The —48v supply provides the bias voltage for the twelve 2D21 tubes.

Assuming that post 18 is negative and post 16 is positive at an instant of time, the circuit for the +48v supply is: post 17, T35, C2, R2, T37, rectifier, post 16. C2 charges and filters the rectified AC voltage across R2 to +48 volts DC. With the polarity reversed, the circuit is through the other half of the transformer winding: post 17, T35, C2, R2, T37, rectifier, post 18.

With the same polarity (post 18 negative) the circuit for —48v DC supply is: post 18, rectifier, T36, C3, R3, T35, post 17. Electron flow is through R3 to the center tap of the secondary winding, which is at zero-volt potential. Across R3, the rectified voltage is filtered by C3 to —48 volts DC. T35 is at zero volts and T36 is 48 volts more negative than T35, or —48 volts.

Conditioning Circuits

To count cards, the count switch must be in the on position. This provides a circuit to pick R51 (Figures 61 and 62). The points of R51 electrically connect the counting unit into the circuits of the 82. The R51BU points transfer and allow the pick of R113 and R118. A circuit to the time delay relay R52 is also established allowing the pick of this relay when the bi-metallic contacts make. Picking R52 completes the circuit necessary to interlock the 978 with the 82 Sorter. It is now possible to start the 82 Sorter by depressing the start key. The counter switch also picks R54 which isolates the counter network while the machine is idle.

Sort Only (Figure 63)

The principles of sorting are in no way altered when the 978 card counting unit is installed on the 82 Sorter. Three distinct operations are possible; sort only, count only, and simultaneous sorting and counting. When the machine is conditioned for a sort only operation, the circuit remains the same as the normal 82 sort circuit with the exception of added normally-closed relay points.

OBJECTIVE: A sort-only operation. The count switch is in the OFF position.

1. A plus potential is applied to the main anode of the thyratron tube through the following circuit: +150v, R113-5N/C, commutator outer brush, commutator center brush, R113-4N/C, octal plug pin 4, OA4G pin 5.
2. A hole in the card establishes circuit from +150v through R113-5N/C, commutator outer brush, commutator inner brush, R113-3N/C, common brush, contact roll, card brush, R113-2N/C, octal plug pin 5, OA4G pin 7 (starting anode) to cause the OA4G to fire and go into conduction.

Count Only (Figures 63, 64, and 65)

OBJECTIVE: A count-only operation. The count-only switch (Figure 63) is in the ON position. The count switch (Figure 61) is also in the ON position, conditioning the counting circuits and transferring the normally-closed relay points in the sort circuit.

1. Reading a hole in the card establishes a circuit from the +150v line, through C1, R113-3N/O, common brush, contact roll, card brush, R113-1N/O to the number 2 grids of all the counter tubes.
2. The emitter (same timing as inner segments of commutator) conditions grid 1 of tubes 9 through 12 in succession.
3. The counter tube corresponding to the hole read in the card conducts because both grids have been conditioned positive.
4. Firing a tube permits the pick of a digit memory relay.
5. The counter magnet (Figure 65) is energized by C13 through a network of digit memory relay points.
6. The fact that the count-only switch is in the ON position prevents a circuit to the commutator inner brush to prevent sorting.

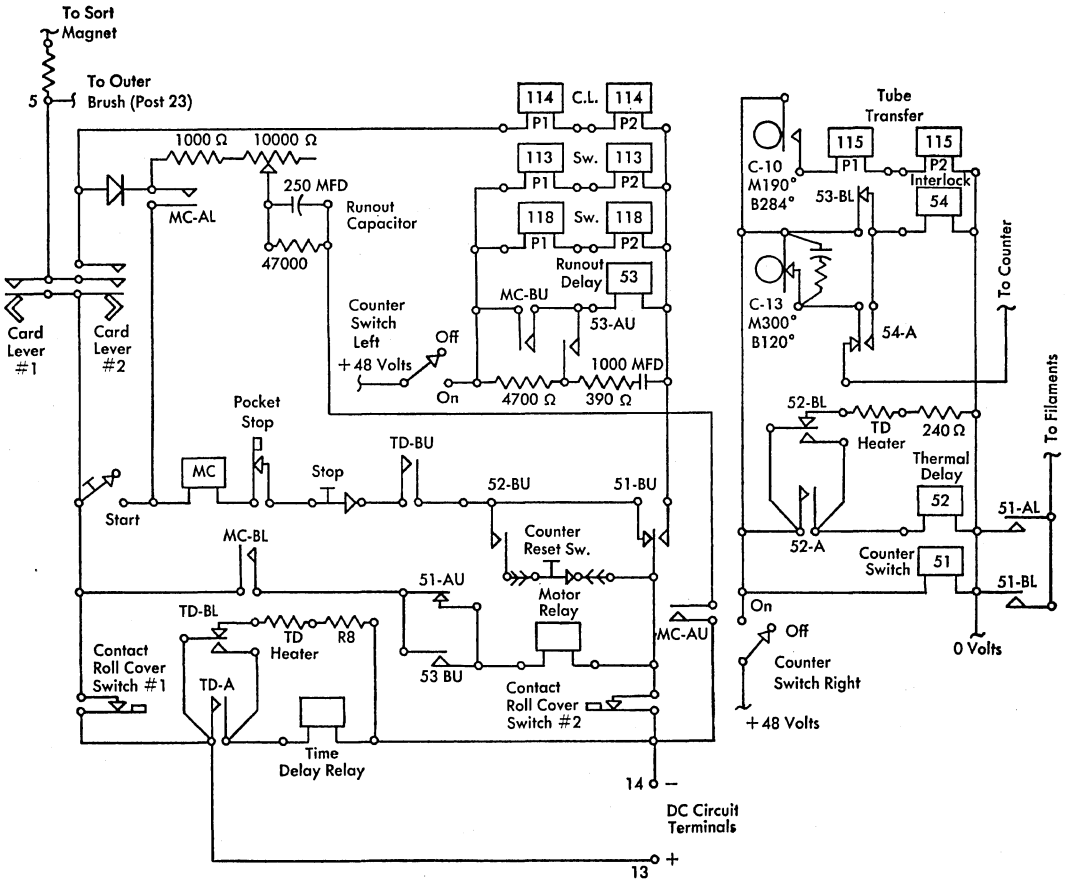


Figure 61. Start and Run Schematic

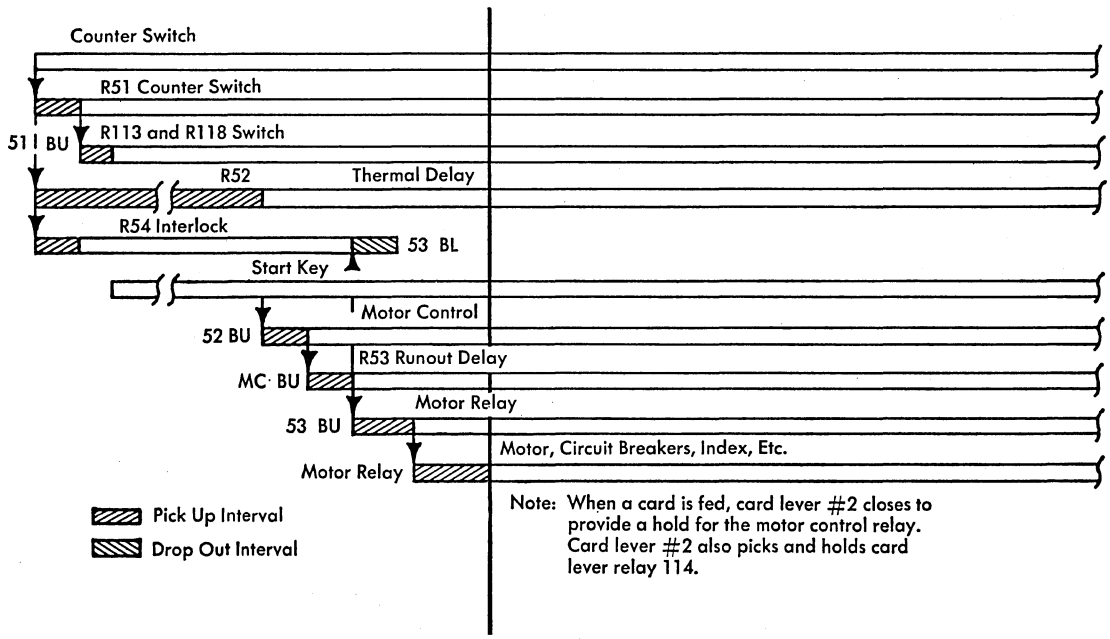


Figure 62. Conditioning Circuits (Sequence Chart)

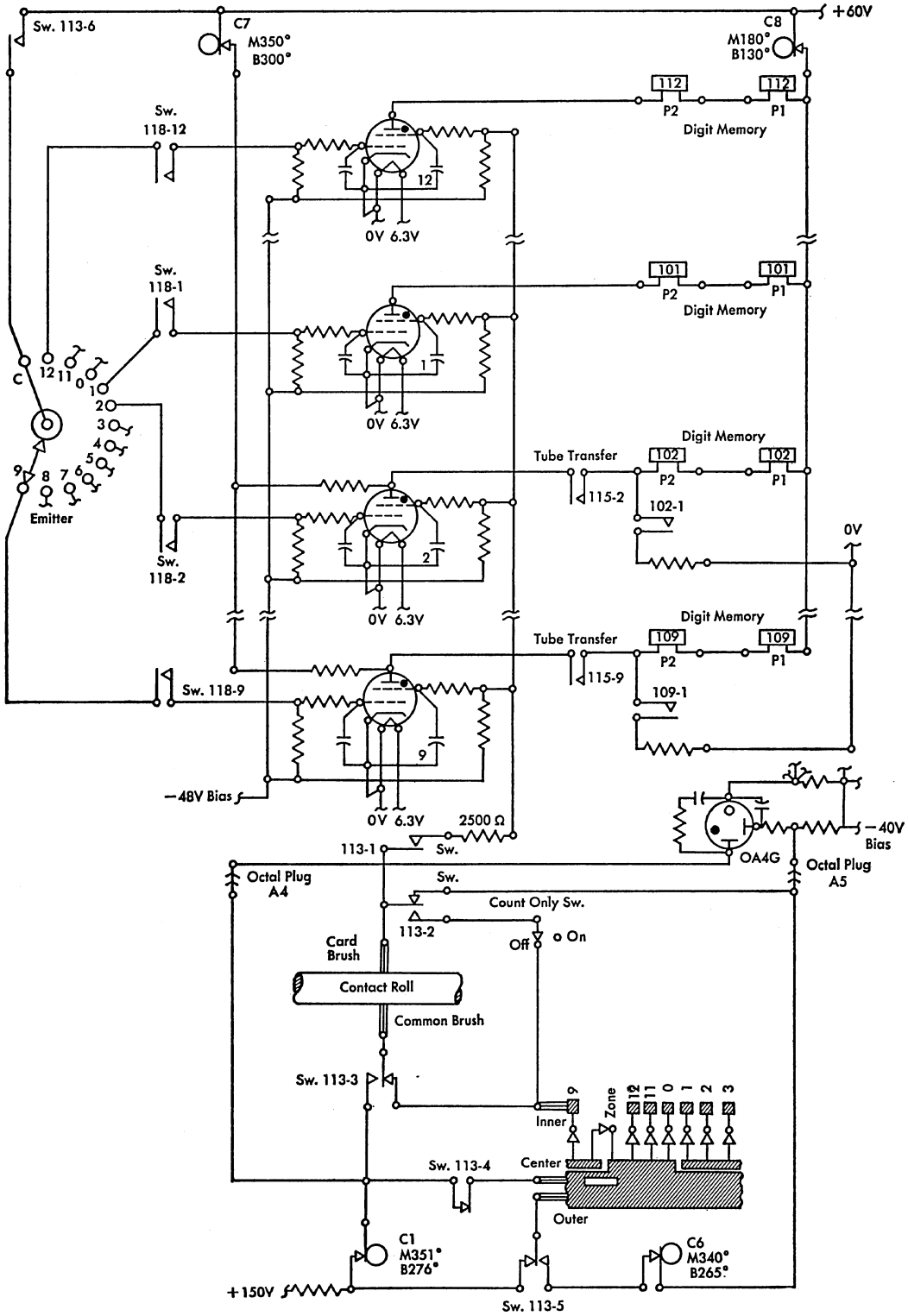


Figure 63. Sort and Count Schematic

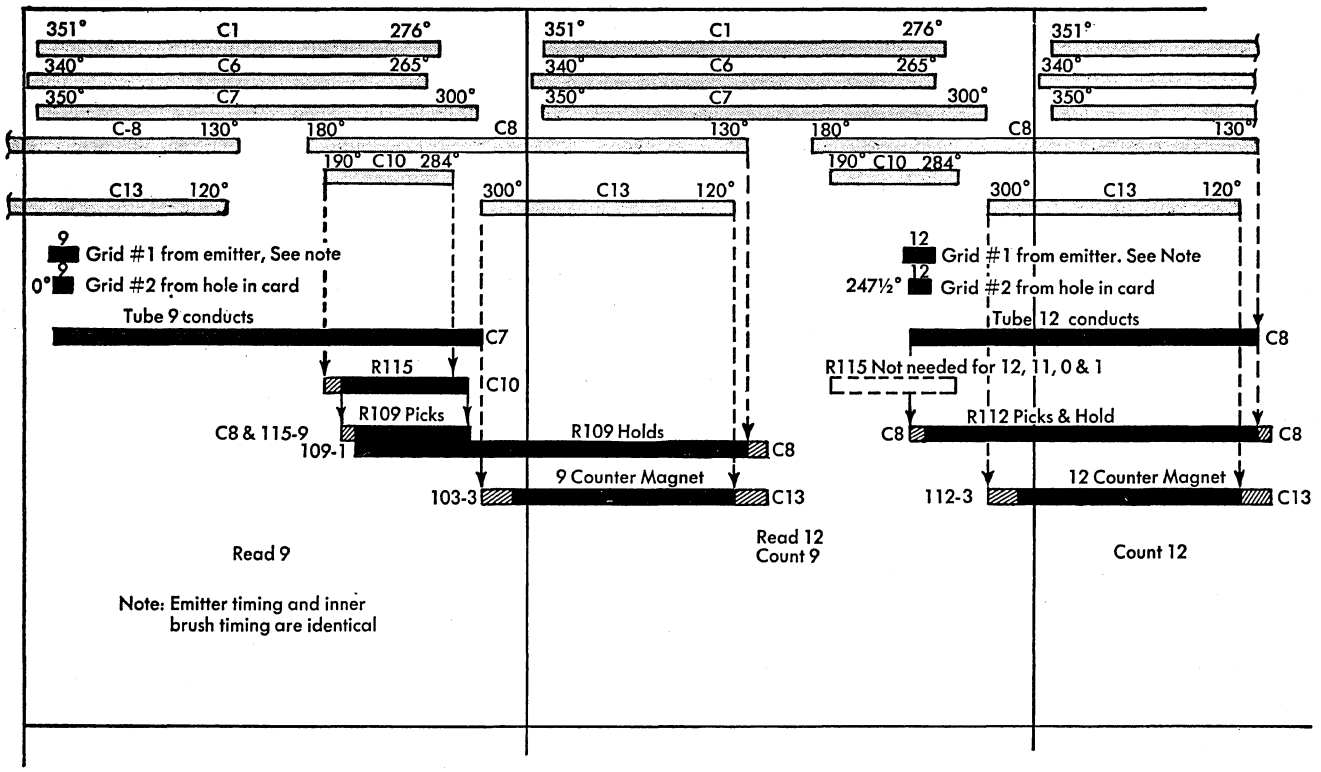


Figure 64. Counting Operation (Sequence Chart)

Sort and Count (Figures 63, 64, and 65)

OBJECTIVE: A simultaneous sort and count operation. The count-only switch (Figure 63) is in the OFF position, the count switch is in the ON position. This changes the sort circuit, but the principles remain the same.

1. A +150v through C1, octal plug pin 4, is applied to the main anode (pin 5) of the OA4G.
2. Reading a hole in the card permits a circuit from +150v, C1, R113-3N/O, common brush, contact roll, card brush, R113-2N/O, count only switch, commutator inner brush, commutator outer brush, R113-5N/O, C6, octal pin plug 5 to pin 7 OA4G (starting anode). This causes the OA4G to go into conduction.
3. At the same time a circuit is available from +150v, C1, R113-3N/O, common brush, contact roll, card brush, R113-1N/O to the number 2 grids of all the counter tubes.
4. Refer to items 2 through 5 in the preceding section for the remainder of circuit.

PURPOSE OF CIRCUIT COMPONENTS

Wire Contact Relays

R101 through R112 (digit memory) are picked by corresponding counter tubes. R101, R110, R111 and R112 are picked as soon as the corresponding tube is fired. R102 through R109 pick after 190° (C10) in the cycle when the R115 (tube transfer) points close. C8 (180°-130°) provides a hold for relays 101 through 112, until 130° of the following cycle.

–1 points of R102 through R109 provide a hold circuit through C8.

–2 points are not used.

–3N/O points close to provide a circuit to the corresponding counter magnets.

–4N/C points open to prevent the pick of the reject counter magnet.

R113 (switch) is picked and held through 51BUN/O and the counter switch in the ON position. It is used to condition circuits for counting operation.

R113-1N/O closes to provide a circuit to grid 2 of all counter tubes.

R113-2N/C provides a circuit from the card brush to the starting anode of the OA4G with the counter switch off.

R113-2N/O provides a circuit from the card brush to the commutator inner brush when the counter switch is on.

R113-3N/C provides a circuit from the commutator inner brush to the common brush with the counter switch off.

R113-3N/O provides a circuit from C1 to the common brush with the counter switch on.

R113-4N/C opens the circuit from the main anode of the OA4G to the commutator center brush when the counter switch is on.

R113-5N/C provides plus potential to the outer brush of the commutator with the counter switch off.

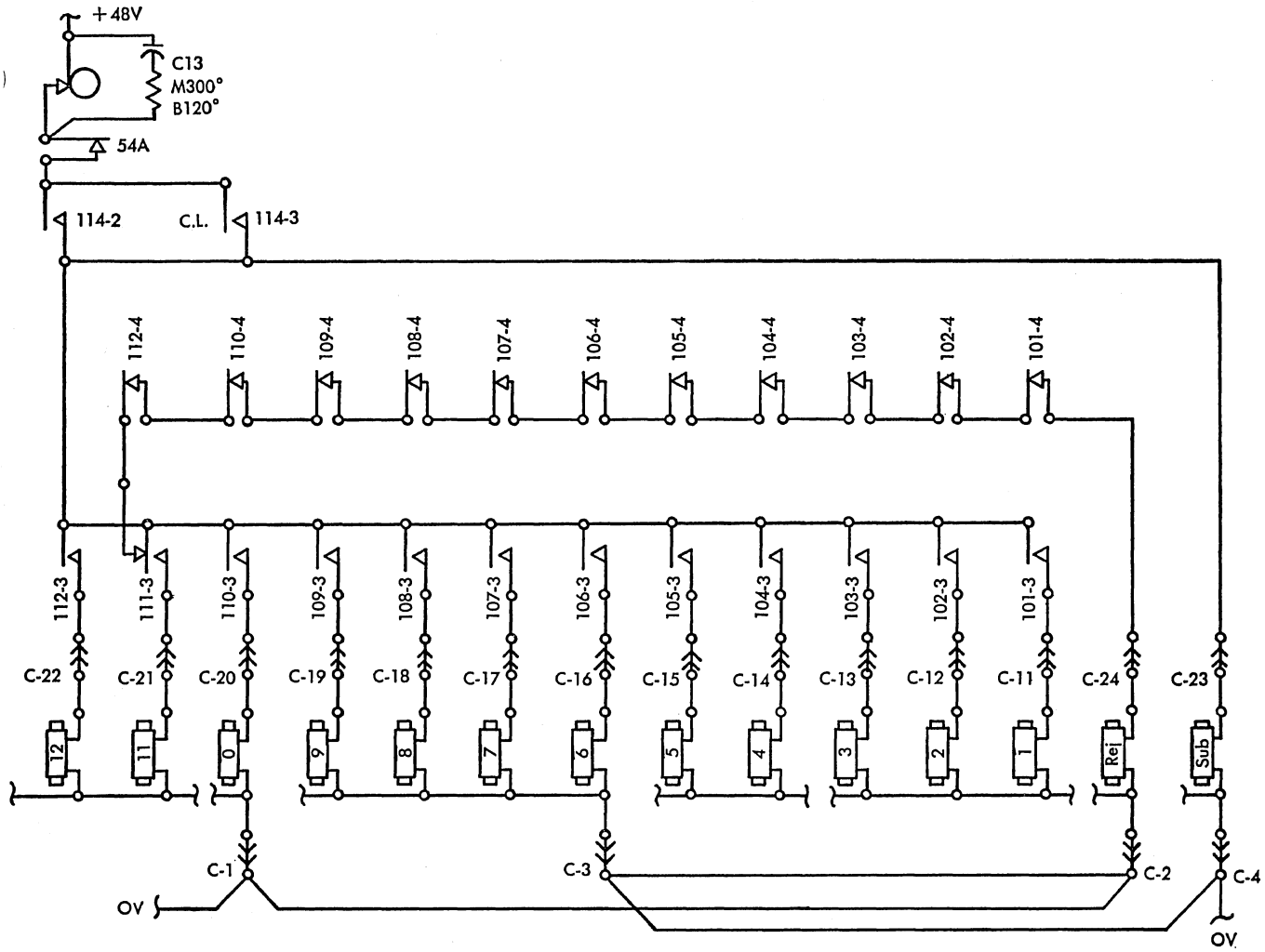


Figure 65. Counter Magnet Schematic

*R113-5*N/O provides a circuit from the outer brush of the commutator to the starting anode of the OA4G with the counter switch on.

*R113-6*N/O closes to provide +60 volts to the common of the emitter used to condition grid 1 of the counter tubes.

R114 (card lever) is picked when card lever 2 closes and the counter switch is on. It is used to condition the circuits to the counter magnets from C13.

R114-1 is not used.

*R114-2 and 3*N/O close to provide +48 volts from C13 to the counter magnet network for as long as card lever 2 is closed and the counter switch is on.

R114-4 is not used.

R115 (tube transfer) is controlled by C10 (190° —284°) with the counter switch on. R115 is used to transfer digit memory from counter tubes to relays for digits 2 through 9.

R115-1 is not used.

*R115-2 through 9*N/O close at 190° to permit counter tubes to pick corresponding digit memory relays.

R115-10 through 12 are not used.

R118 (switch) is picked and held in the same manner as R113 (switch).

*R118-1 through 12*N/O close to complete a circuit from the emitter to grid 1 of the corresponding counter tube.

Duo Relays

R51 (counter switch) is picked and held by the counter switch in the ON position. It is used to condition machine circuits for counter operation.

R51AU opens to place the motor relay under the control of 53BU.

R51AL, in parallel with 51BL, provides a circuit to

counter tube filaments only during counter operation.

*R51BU*N/C opens to put the start circuit under the control of 52BU and the counter reset switch. The N/O point closes so that R114 (card lever) is picked only during counter operation.

R51BL is in parallel with 51AL.

R52 (thermal delay) provides a time delay to assure that the machine cannot be started until the counter tube filaments reach operating temperature.

52A is the thermal delay point.

52BU prevents starting the machine until tube filaments are at operating temperature.

52BL provides a circuit to the thermal delay heater until 52A closes to pick the relay. 52BLN/O then closes to provide a hold for R52.

R53 (run-out delay) is picked and held by MC BU when the counter switch is on. A resistor-capacitor network in parallel with R53 keeps it energized for a short time after the motor control relay drops.

R53AU provides a discharge path for the capacitor (in parallel with R53) to keep R53 energized for a short time after the motor control relay drops.

R53AL points are not used.

R53BU provides a circuit to the motor relay after the counter control circuits are conditioned.

R53BL assures that R54 cannot be energized while the machine is running.

R54 (interlock) is picked and held at any time the machine is in a static condition with the counter switch on.

*R54A*N/O provides a hold for R54 through C13. The N/C point opens to prevent a circuit to the counter magnets when the machine is in a static condition.

Cam Contacts

Electrical cams and index are located below the card feed hopper. C1 (351° —276°) (installed if machine is not equipped with GS device or MCS) provides a circuit to the common brush of the contact roll that spans 9 through 12 time during counting. C1 also completes the circuit to the main anode of the OA4G when counting is taking place.

C6 (340° —265°) (installed if machine is not equipped with MCS device) is used with C1 as a make-break combination to complete a circuit to the starting anode of the OA4G during simultaneous sorting and counting.

C7 (350° —300°) controls the plate circuits of 2D21 counter tubes 9-2 to extinguish the tube after memory has been transferred to digit memory relays.

C8 (180° —130°) controls the pick and hold of the digit memory relays. The hold lasts until C13 can energize the proper counter magnet.

C10 (190° —284°) controls the tube transfer relay (R115) to permit memory to be transferred from tubes to digit memory relays for digits 2 through 9.

C13 (300° —120°) provides the impulse to the counter magnets through the network of digit memory relay points.

Switches

Counter Switch. The counter switch conditions the machine for counting operation. The counter switch right in the ON position provides +48 volts to R51, R52, R54, C13, C10, and R115. The counter switch left in the ON position provides +48 volts to R113, R118, and R53.

Count-Only Switch. The count-only switch in the OFF position completes a circuit to the starting anode of the OA4G to provide sorting while counting. The ON position interrupts the circuit to the OA4G, starting anode to cripple sorting but permit counting.

Rectifier

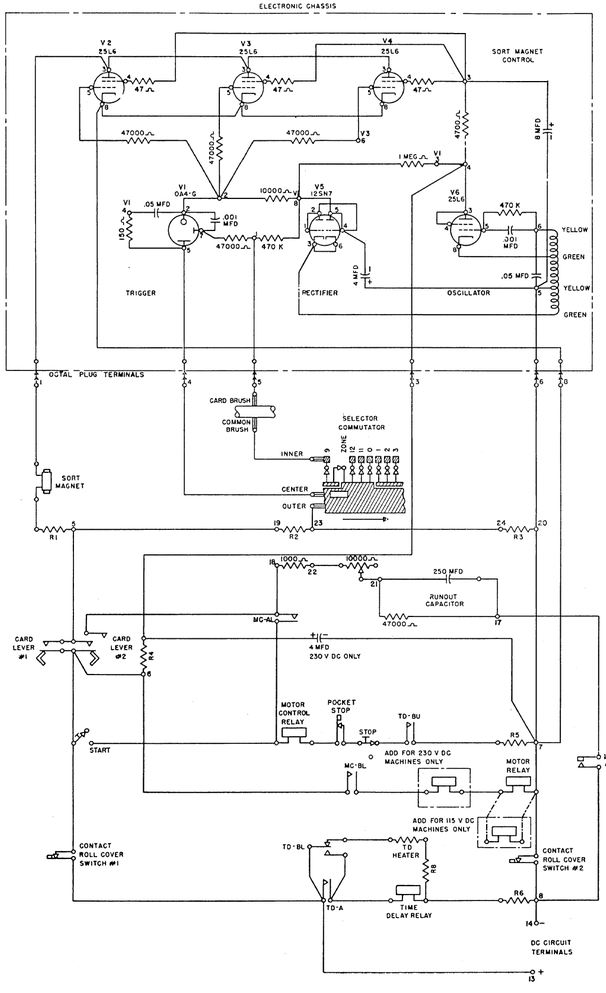
The rectifier between card lever 2 and MC-ALN/O is to prevent the pick of R114 (Card Lever) until card lever 2 is closed. Without the diode, when the start key picks the MC relay, there is a circuit through MC-ALN/O to pick R114.

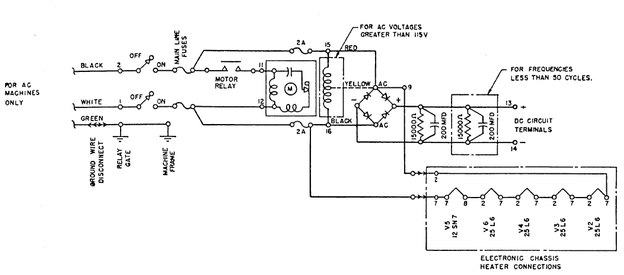
Resistor

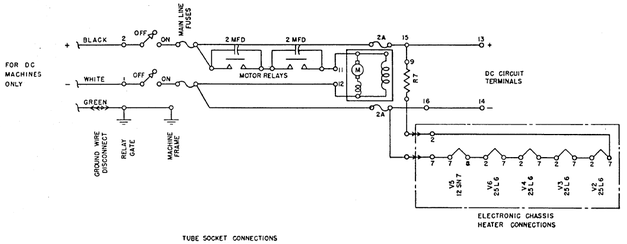
The 2500-ohm resistor in the circuit to grid 2 of the counter tubes provides a voltage drop from +150 volts to +60 volts. Voltages in excess of +60 volts impressed on either grid of a 2D21 can cause the tube to conduct even though the remaining grid is not conditioned.

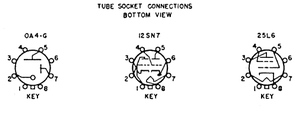
RELEASED FOR ASSEM. 301700 — DTC — 301701D

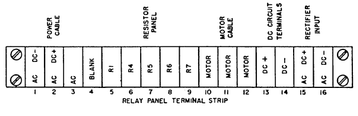
DATE	CHANGE NO
SEE INDEX CARD	
2-27-50	23671
5-27-50	25536
3-21-51	25246A

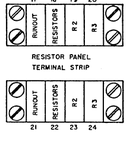


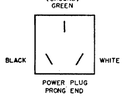






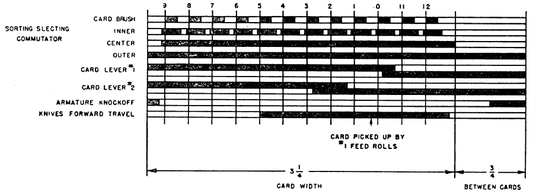






VOLTAGE CHART — ELECTRONIC CHASSIS

LINE VOLTAGE	DC INPUT POST 13	25L6 GRID PIN 5 * * *	25L6 PLATE PIN 3	25L6 SCREEN PIN 1	0A4G GRID PIN 5 *	12SN7 PLATE PIN 2 * *	0A4G PIN 6 * *
115V 60 CY AC NOT CONDUCTING							
105	+133	-38	+133	-20.0	-38	-38	
115	146	-43	146	-22.5	-43	-43	
125	162	-47	162	162	-25.0	-47	-47
CONDUCTING							
105	+120	—	+109	+60	-17.0	-27.0	+9.5
115	133	—	120	66	-19.0	-29.9	17.0
125	145	—	131	71	-21.0	-32.0	24.0
115 V DC NOT CONDUCTING							
105	+105	-30	+105	105	-15.7	-30	-30
115	115	-33	115	115	-17.1	-33	-33
125	125	-36	125	125	-17.5	-36	-36
CONDUCTING							
105	105	—	+96	+52	-14.6	-21.5	+27
115	115	—	105	57	-15.9	-23.7	32
125	125	—	113	60	-17.7	-25.5	40



NOTES

Ⅹ MEASUREMENTS TAKEN BETWEEN POINTS INDICATED AND PIN 6 OF OCTAL PLUG WITH ELECTRONIC VOLTMETER. OTHER TYPE METERS SUFFICIENTLY ACCURATE FOR TROUBLE SHOOTING WITH FOLLOWING RESTRICTIONS:
* USE ONLY ELECTRONIC OR 20,000 OHMS PER VOLT METER
* * 1000 OHMS, 10,000 OHMS OR 20,000 OHMS PER VOLT METER WILL REDUCE THESE READINGS APPROX. 3—5 VOLTS.
* * * 1000 OHM, 10,000 OHM AND 20,000 OHMS PER VOLT METER REDUCE THESE READINGS APPROX. 14V, 8V AND 6V RESPECTIVELY

Ⅺ NORMAL SORT MAGNET CURRENT APPROX. 220 MA FOR AC MACHINE AND 165MA FOR 115V DC MACHINE. OPERATION CRITICAL BELOW 140 MA (18.4V ACROSS SORT MAGNET). NEG. BIAS AT 12SN7 PLATE CRITICAL BELOW 25V WITH 0A4-G NOT FIRED.

RESISTOR CHART

RES.	115 V DC	230 V DC	AC
R1	JUMPER	500 Ω	JUMPER
R2	1500 Ω	7500 Ω	1500 Ω
R3	OPEN	10000 Ω	OPEN
R4	JUMPER	1200 Ω	JUMPER
R5	JUMPER	4800 Ω	JUMPER
R6	JUMPER	4800 Ω	JUMPER
R7	JUMPER	410 Ω	JUMPER
R8	1000 Ω	1000 Ω	1500 Ω

MAIN LINE FUSES

VOLTAGE			FUSETRON
115V	DC		5.0A
230V	DC		3.2A
115V	AC	1PH.	8.0A
230V	AC	1PH.	4.0A
208V	AC	1PH.	4.0A
230V	AC	3PH.	2.5A

INTERNATIONAL BUSINESS MACHINES CORP.			
MACH.	CARD SORTING MACHINE		
	MODEL	082	
NAME	WIRING DIAGRAM AND TIME CHART		
DRAW	A C V	10-19-50	SCALE NONE
CHECK	A E B	3-19-51	TRACE G E D 3-21-51
APPRO	R J W	3-21-51	CHECK [illegible] 3-22-51

Figure 66. IBM 82 Wiring Diagram and Time Chart

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