UNCLASSIFIED

INSTRUCTION BULLETIN

Bulletin No. 233
64$^2$ Memory Maintenance

# 64$^2$ MEMORY MAINTENANCE REMOVAL AND REPLACEMENT PROCEDURES

July, 1958

MILITARY PRODUCTS DIVISION

INTERNATIONAL BUSINESS MACHINES CORPORATION

KINGSTON, NEW YORK

IBM
KINGSTON
TECHNICAL PUBLICATIONS



UNCLASSIFIED

## FOREWORD

The information contained herein supersedes the related text on removal and replacement procedures in the Preliminary Maintenance Data Book on Core Memory, and in T.O. 31P2-2FSQ7-142 dated April 1, 1957. Supplementary information on memory array assembly and part details is available in Volume III of T.O. 31P2-2FSQ7-4, Illustrated Parts Breakdown (first revision) pages 322-359.

This bulletin is intended to be self-contained with regard to removal and replacement procedures only. In those instances where replacement of a critical unit necessitates electrical adjustment, reference is made in the text to the applicable Instruction Bulletin.

## TABLE OF CONTENTS



## LIST OF ILLUSTRATIONS

## LIST OF TABLES

# REMOVAL AND REPLACEMENT PROCEDURES

**WARNING**

**All removals and replacements must be performed when unit or panel power is disconnected.**

## 1. MEMORY ARRAY COVER REMOVAL

### 1.1 General

Cover replacement, as such, is not generally required except in rare cases where a cover is physically damaged beyond practical repair. However, a knowledge of cover removal is needed to permit access to component parts at the bottom of the array in order to facilitate troubleshooting and part replacement, as necessary. In addition, the bottom of the array must be exposed for some of the preventive maintenance checks.

The covers to be analyzed are located at the front, right and left sides, and the top of the array. The covers used at the rear of the array will not be discussed since they are equipped with doors and hence provide sufficient clearance for maintenance purposes. Unless otherwise indicated, figure 1 must be referred to in the following paragraphs.

### 1.2 Front, Left and Right Side Cover Removal Procedure

To remove any one of the subject covers proceed as follows:

1. Remove the associated kick plate - each is held in place with four machine screws (3000589).

2. Remove the driver panel located directly above the cover to be detached - this is accomplished by releasing the four turnlock fastener wing studs (two at each side), and withdrawing the driver panel straight out.

3. Place both hands on the bottom of the cover, at opposite sides, and tilt the cover out at an angle of approximately 45°. The cover will now release with no pressure applied.

4. To reassemble, reverse the procedures in steps 3 to 1 in that order. Correct placement of the cover must be achieved with no pressure applied. This can best be accomplished by observing that the oblong holes in the gusset plates (3008240), located under each end of the cover stainless steel trim, engage the guiding shoulder screws (3008254) on the array mounting brackets.

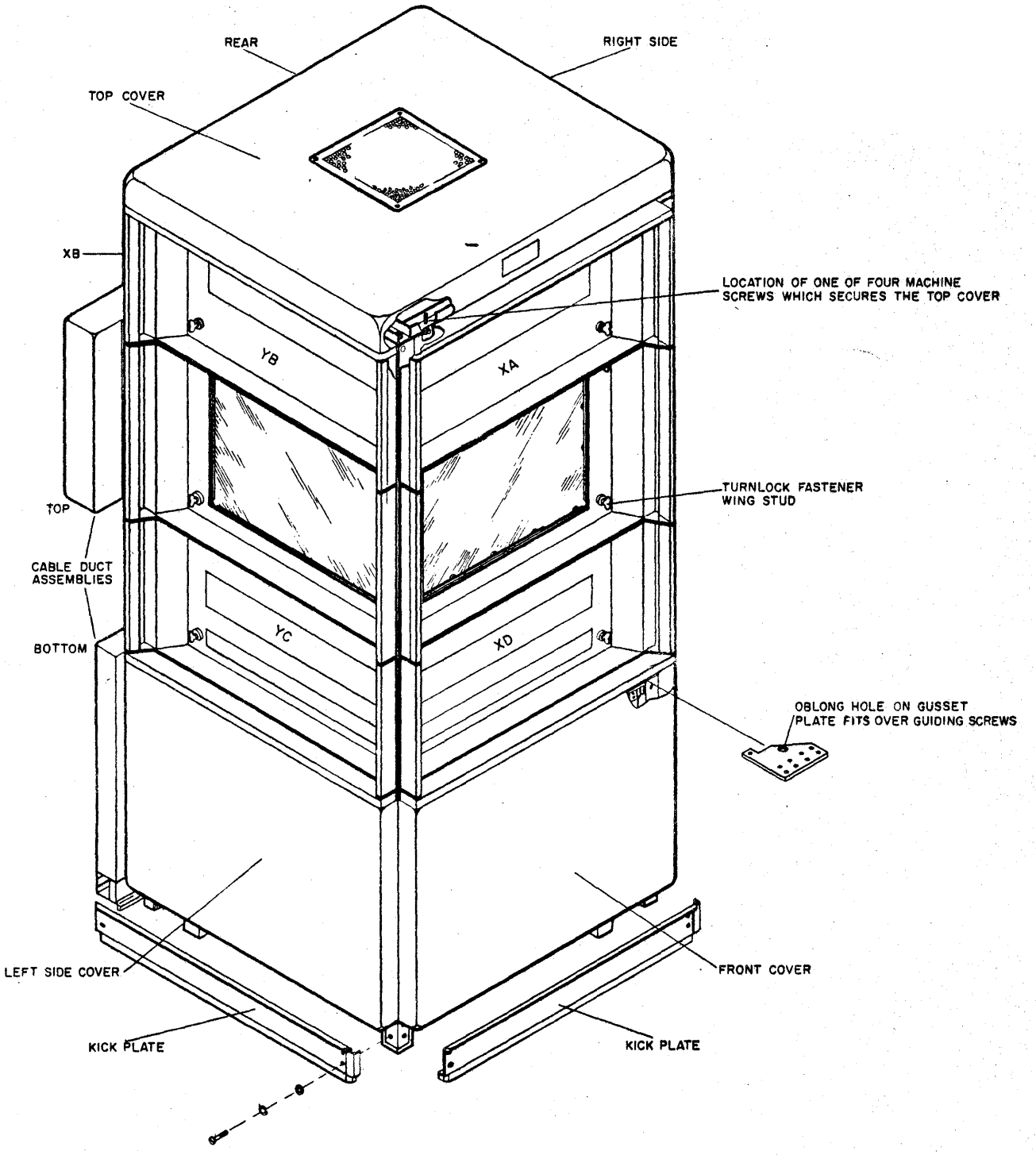


**FIGURE 1. MEMORY ARRAY, MECHANICAL CONFIGURATION**

### 1.3 Top Cover Removal Procedure

To remove the top cover proceed as follows:

1. Remove the XA and XB driver panels - this is achieved by releasing the four turnlock fastener wing studs on each driver panel, and withdrawing the driver panels straight out.

2. Remove a total of four machine screws (3003537) from the top cover. These are accessible through the recessed cutout holes in the front and rear top horizontal crossarms (two holes in each) of the array frame.

3. The cover may now be removed. Two men are required to lift it off the array frame.

4. To reassemble the cover, reverse the procedures in steps 3 to 1, in that order.

## 2. CONNECTING THE SPARE PLANE

### 2.1 General

Whenever a bad plane is suspected, the spare plane provided in the memory stack may be substituted to confirm the defect. The change in planes is accomplished by transferring the sense and inhibit winding external connections from the defective plane to the spare plane. This is readily achieved by jumpering between the proper female receptacles on the taper pin terminal board that is accessible through the top rear cable duct door opening of the memory array. To jumper between the spare plane and any other active plane requires, in some cases, that special jumper leads be made up to reach the applicable terminals. The reason for this should be apparent from figure 2. As shown, the terminal connections to the spare plane are physically located at the center of the right half-word terminal board; therefore, to substitute it for another plane in either the right or left half-words requires only that the sense and inhibit circuit leads, associated with the plane to be substituted, have sufficient slack to be moved directly to the spare plane terminals. If the slack is insufficient then a jumper is required. It can be appreciated, therefore, that the need for a jumper of any specific length is left to the discretion of the field engineer.

If a jumper is indicated, it can be constructed with the following equipment:

a. PVC Wire (3002639)

b. Taper pins (3002762). Taper pin connections should be plugged into their edge connector receptacles using special pliers 3033425.

The detailed procedure for connecting the spare plane is contained in the next paragraph. It is presented as an analysis of two specific examples involving the substitution of planes L11 and R9, respectively. It must be understood that similar techniques apply to the other planes as well.

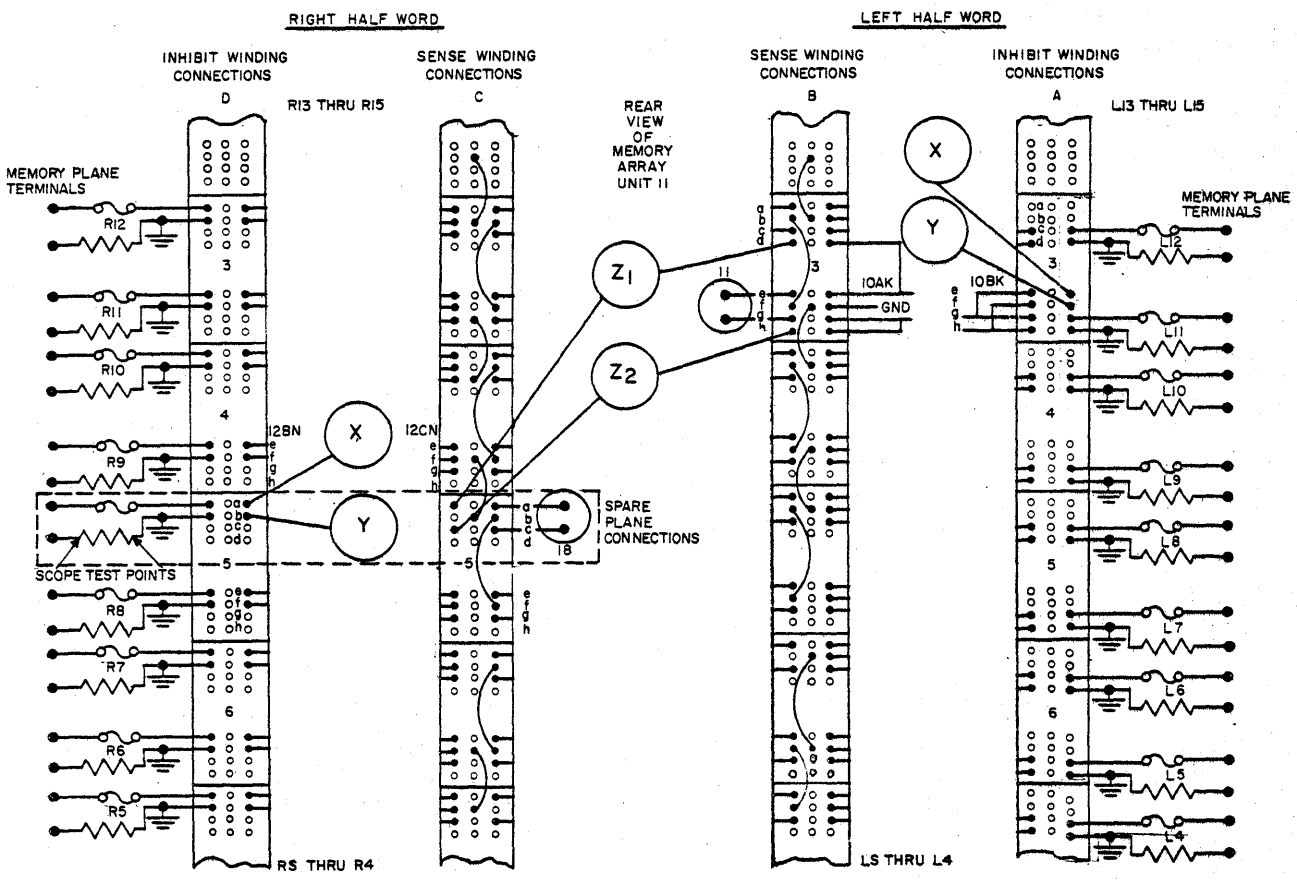


FIGURE 2. TAPER PIN TERMINAL BOARD

## 2.2 Procedure for Connecting the Spare Plane

The spare plane terminal board designations for sense winding connections, see figure 2, are identified as 11C5a and 11C5c; for the inhibit winding connections they are 11D5a and 11D5b. Reviewing, the first number represents the unit number of the array, the capital letter refers to the column, the next number is the terminal block, and the lower case letter represents the row within the designated terminal block. The three receptacles in any row of a given column are common; for example (see fig. 2), if it is desired to connect an external taper pin to the sense winding (11C5a), it may be accomplished by inserting the taper pin in either of the two unoccupied receptacles in row a (the third receptacle is occupied).

The preceding analysis including the numbering system applies equally to the entire taper pin terminal board. In addition, there are rows which are totally unused and may, therefore, be used to advantage in connecting the spare plane; they are:

a. In column A, rows a and e

b. In column B, rows d and h

c. In column C, rows d and h

d. In column D, rows c and g.

To substitute the spare plane for the L11 plane, see figure 2, proceed as follows:

1. Remove dc and ac power from the array.

2. Open the top rear cable duct cover door to provide access to the taper pin terminal board.

3. Transfer the inhibit winding external connections that are routed from the DPD in unit 10 - this is accomplished by removing the applicable taper pin from 11A3g and connecting it instead to a vacant receptacle at 11A3e. Connect a jumper between 11D5a and 11A3e. These points are identified in the figure by the letter X. Remove the cable shield connection from 11A3h and reconnect it to a vacant receptacle on 11A3f. Connect a jumper between 11A3f and 11D5b as shown in the figure by the letter Y. The inhibit winding transfer is now complete.

4. Transfer the sense winding external connections that are routed to the sense amplifier in unit 10 - this is accomplished by removing the applicable taper pins from 11B3e and 11B3g, and connecting them instead to the vacant receptacles at 11B3d and 11B3h, respectively. Connect a jumper between 11C5a and 11B3d, and another jumper between 11C5c and 11B3h. These points are identified in the figure by the designations $Z_1$ and $Z_2$. The sense winding transfer is now complete.

5. Due to the transfer of planes, identification tags should be placed across the terminating resistors of both the original L11 and spare planes, designating them as the spare and L11 planes respectively, pending the outcome of the investigation.

6. Bring up ac and dc power to the array.

7. Place a scope across the terminating resistor of the original spare plane (which is now L11) to check the inhibit current and adjust the DPD, if necessary. Refer to Instruction Bulletin 232 for the detailed DPD adjustment procedure.

Consider another example which involves the substitution of the spare plane for the R9 plane; see figure 2. Due to the proximity of the R9 plane to the spare plane no jumpers are required. Except for this, and the fact that the pin locations are different, the procedural steps outlined above apply and must be followed judiciously. The pertinent transfer paths for this particular example follow:

a. For the inhibit winding external connections from the DPD in unit 12 - transfer the applicable taper pins from 11D4e and 11D4f, to the vacant receptacles on 11D5a and 11D5b, respectively.

b. For the sense winding external connections to the sense amplifier in unit 12 - transfer the applicable taper pins from 11C4e and 11C4g, to vacant receptacles on 11C5a and 11C5c, respectively.

## 3. REPLACING BROKEN BUS WIRES ON THE CORE MEMORY ARRAY UNIT

The following procedure has been established to cover the possible necessity of replacing a broken bus wire on the memory array. These bus wires are used to interconnect the X-Y lines of adjacent planes. Extreme caution must be used when working with the wires so that the X or Y line in the subject planes will not be broken. The equipment required consists of:

a. Small-tipped soldering iron and 25-watt transformer (3033498)

b. Needle-nose pliers (3033487)

c. Sharp-nosed tweezers

d. Small diagonal cutters (3033371)

e. No. 32 tinned solid wire (3002894)

The procedure is as follows:

1. Remove all power and air flow from the array unit.

2. Remove the appropriate window panels and driver panels, and cover the driver panel below the work area with a clean cloth.

3. Remove the broken wire from the connecting lugs. The wire is wrapped around the lug only one full turn; therefore, use heat sparingly and pull the wire gently.

4. To insure that the replacement lead will be taut, use a procedure similar to that shown in figure 3. The new bus wire should be wrapped around the tip of the terminals.

5. As noted in figure 3, if the broken bus wire was connected between pins 2 and 3, the new wire should first be wrapped around pin 1 to provide an anchor. With the wire taut, wrap the new wire around pins 2, 3, and 4 one full turn.

6. Solder connections 2 and 3.

7. Carefully cut excess wire at pins 2 and 3.

8. Remove excess wire from pins 1 and 4.

9. Replace panels, air supply, and power to the array.

## 4. REPLACING AN X OR Y DRIVE LINE IN A DIGIT PLANE

The following procedure has been established to cover the possible necessity of replacing an X or Y drive line without replacing the plane. An X or Y drive line runs from a terminal on one side of a plane, straight through 64 cores in the plane, to a terminal on the other side. This wire carries the drive current for $64_{10}$ addresses. Replacement of one of the X or Y lines is possible only if it breaks at the terminal end of a plane. A break at any other point will necessitate the replacement of the entire plane. The equipment required consists of the following:

a. Small-tipped soldering iron (orex 11A) and a 25-watt transformer (3033468)

b. Two pairs of tweezers (Dumont 3C)

c. One pair of needle-nose pliers (3033487)

d. Small diagonal cutters (3033371)

e. Two pieces of No. 34 enameled wire (No. 3008073) 11 inches long. After the wire has been cut to 11 inches, masking tape should be placed 1-1/2 inches from each end. Burn the insulation from the exposed ends of the wire (using flame from a match), and then tin these ends.

f. Sharpening stone (3287806)

g. IBM card or equivalent

h. Tape (masking scotch or electrician's).

The procedure is as follows:

1. Remove power and air flow from the array.

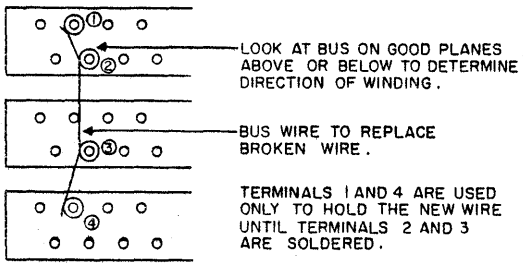


FIGURE 3. BUS WIRE CONNECTION, X-Y ARRAY WIRING

2. Remove necessary glass panels (or open rear door); also any additional panels necessary to provide head room.

3. Double-check to find the correct terminal by counting and by using a continuity check.

4. Remove the bus (jumper) wire attached to the same terminals as the broken wire on both sides of the plane.

5. Have another person hold the broken end of the drive line with tweezers so that it cannot be pulled into the plane.

6. Carefully unsolder and unwind the three turns of wire on the terminal at the unbroken end of the drive line. Straighten out the wire as much as possible.

7. The unwound wire must be soldered to a single 11-inch piece of wire. This is best accomplished by taping both wires to a convenient support such as an IBM card. Tape them on the card so that the ends overlap by approximately 1/16-inch, see figure 4. Brush them with a soldering iron to achieve a satisfactory mechanical bond. Remove the tape and supporting card.

8. Connect another 11-inch piece of wire to the opposite, or broken, end of the drive line. This is done by slowly pulling the broken end of the wire away from the plane, which in turn, draws the other, or newly soldered wire toward the plane. Continue this until the soldered connection is about 1/4-inch from being drawn into the plane. This should provide sufficient slack on the broken end of wire to permit it to be connected to the 11-inch length of wire using the same techniques stipulated in step 7.

9. Determine which of the two ends of the wire is straighter and has the smaller and smoother solder joint. Smooth the best joint with the sharpening stone until there are no ends or sharp bulges at the joint. From the other side of the array, gently draw the old wire from the plane. If the joint binds within the plane, try gently jockeying the wire back and forth. Excessive pull on the wire can cause it to break in the plane, damage a core, or damage another winding; in such cases, the plane has to be replaced. If jockeying does not help, pull the wire out and trim the joint for another try.

10. After the new wire is in place in the plane, clip off the old wire at the solder joint.

11. Wrap each end of the new drive line three times around its associated terminal.

12. Replace the bus wire as described in paragraph 3.

13. Replace panels and turn on air flow and power to the array.

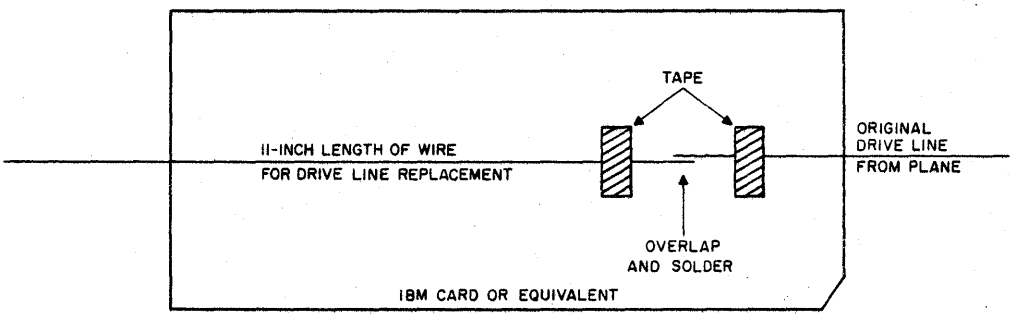


FIGURE 4. METHOD FOR CONNECTING DRUM LINE REPLACEMENT WIRE

## 5. MEMORY PLANE REPLACEMENT

This procedure has been established to cover the possible necessity of replacing a defective plane in the core memory array. The wiring procedure outlined in this text has proved to be less difficult and, therefore, less time-consuming than previous procedures. Before using the procedure, every possible avenue of analysis should be explored to prove that the plane in question is really defective before a request for authorization to replace the plane is made to the site manager. The equipment required consists of the following:

a. No. 32 solid tinned wire; No. 3002849 must be used.

b. Wiring tool No. 3034141

c. Special needle-nose pliers, No. 3033487.

d. Special tapered-nose diagonals

e. Soldering iron (24 watt)

f. Drop light (3287601)

g. Masking tape

h. Four pieces of cheese cloth to be used as drop cloths to protect the rest of the array from solder splashes and wire cuttings.

i. Tweezers

j. Red grease pencil

The procedure is as follows:

1. Obtain authorization from the site manager.

2. Shut off all power to the array.

3. Shut off 72° and 55° air flows by closing their respective dampers at the bottom of the array. Access to these dampers is obtained through the door at the bottom rear of the array. The 75° air flow is shut off by lifting the screen at the bottom of the array and closing the shutter-type damper. The 55° air flow is shut off by turning the damper handle next to the 55° pipe-type conduit.

4. Remove the glass panels from the door and sides and open the rear door.

5. Remove the four top driver panels for extra head room.

6. Shield the lower array by using masking tape and cheese cloth from a point immediately below the next plane beneath the defective plane.

7. Using a red grease pencil, mark the bad plane on all four sides so no mistake is made when removing wire.

8. Cut all jumpers to adjacent planes by cutting close to the lug on the defective plane.

9. Remove cut jumpers from adjacent planes by grasping the jumper with needle-nose pliers and unsoldering at the lug. Ensure that the lugs on these planes are wiped clean of surplus solder.

10. Remove the tape used as an air seal between planes.

11. Remove the two screws on the two sides of the array that hold the plane (four screws total). Loosen the four screws on each of the two adjacent planes.

12. Make note of the proper position of the defective plane before removing it so the new plane may be inserted in the same position. Slide the defective plane out from the front of the array.

13. Insert the new plane in the same relative position as the removed plane. If an odd plane in the array is replaced, such as plane nine, the plane is inserted with the wire jumper on the end two lugs placed to the left, as viewed from the front of the array. If the plane being replaced is even, the plane is inserted with the wire jumper to the right.

14. Replace the four screws, two on each side of the array, that hold the plane in place.

15. Tighten the screws on the adjacent planes that were loosened in step 12.

16. Place new strips of tape above and below the new plane on all four sides to reseal the air flow.

17. Thread the No. 32 solid-tinned wire through the slot in the No. 3034141 wiring tool.

18. Figure 5 illustrates the three steps to be followed in each wiring run. These three steps are performed for all wiring runs involved. When wiring the plane, use a wiring tool to make two complete wraps around the terminal where run is to be started and one complete wrap around all other terminals in run until last terminal, which also gets two complete wraps, is reached. The wraps are made around each terminal in such a manner that the vertical portion of the run will be on the same side of the terminal as the corresponding vertical run on the good plane above. There are four distinct wiring runs for each side and they should be made in the order illustrated on the applicable wiring diagram.

    The wiring diagrams for each side of the array are contained in the following figures:

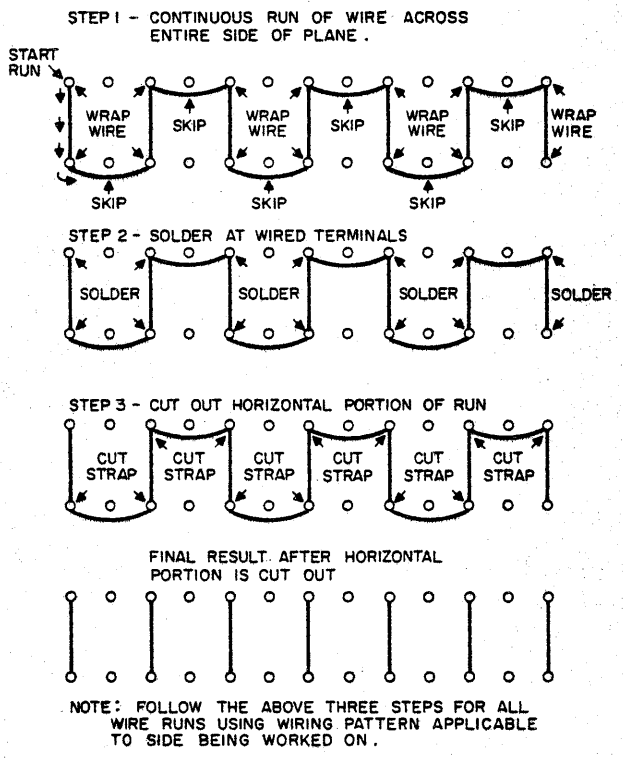


**FIGURE 5. REPLACEMENT PLANE WIRING**

| View | Plane | Figure |
|---|---|---|
| Front | Even | 6 |
| Rear | Even | 7 |
| Right side | Even | 8 |
| Left side | Even | 9 |
| Front | Odd | 10 |
| Rear | Odd | 11 |
| Right side | Odd | 12 |
| Left side | Odd | 13 |

19. When all four sides are completely wired, check for wire scraps and solder splashes that may have managed to fall past the cloth shield. Check for wire scraps on the resistor boards and fuses.

20. Replace the glass panels and driver panels.

21. Turn on air flow and apply power to array.

## 6. DPD, MGG, OR CLOCK PLUGGABLE UNIT REPLACEMENT CONSIDERATIONS

Special precautions must be taken when any of the subject units are replaced. The precautions are not related to the physical replacement technique itself, which is the same as for any other pluggable unit, but rather are related to the electrical considerations arising from such a replacement, as follows:

a. If a DPD is involved, the output current of the replacement unit must be adjusted to conform to memory specifications.

b. If a MGG is involved, it is necessary to perform a memory tuneup, since adjustment of any MGG results in interaction with the other MGG circuits. If an emergency exists, in which case time is not available to perform a memory tuneup, the output current of the replacement MGG unit must be adjusted to conform to memory specifications.

c. If the clock is involved, it is necessary to remove all three pluggable units which comprise the clock function. Replace these units only with the three pluggable units of the spare colck which are specifically tuned for the memory under test.

Note

Refer to Instruction Bulletin 232 for the electrical adjustment procedures applicable to each of the above noted units.

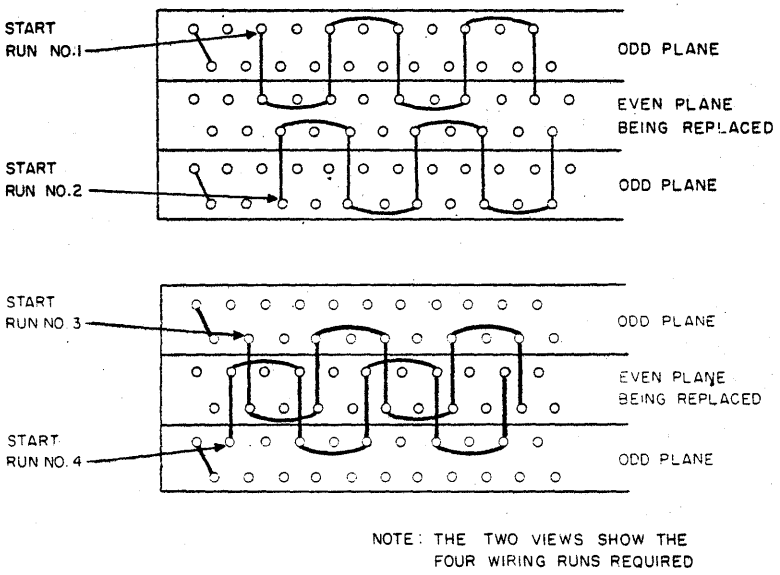


**FIGURE 6. FRONT VIEW REPLACING EVEN PLANE**

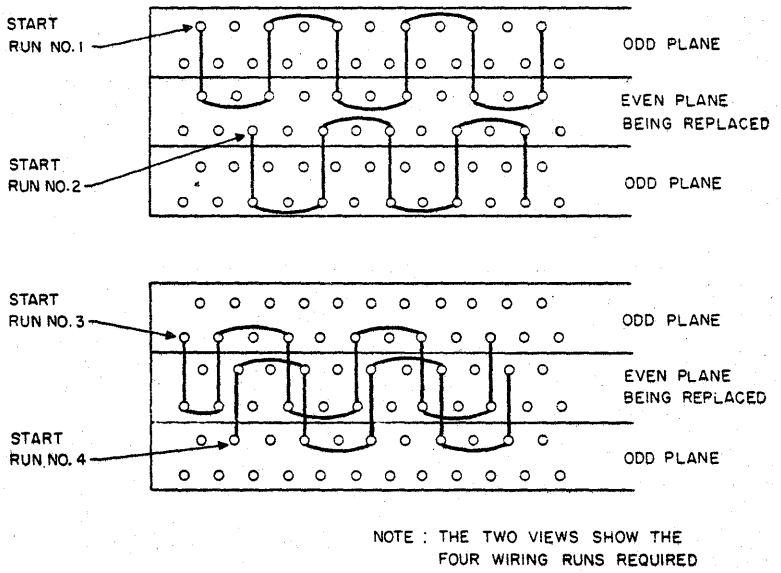


**FIGURE 7. REAR VIEW REPLACING EVEN PLANE**

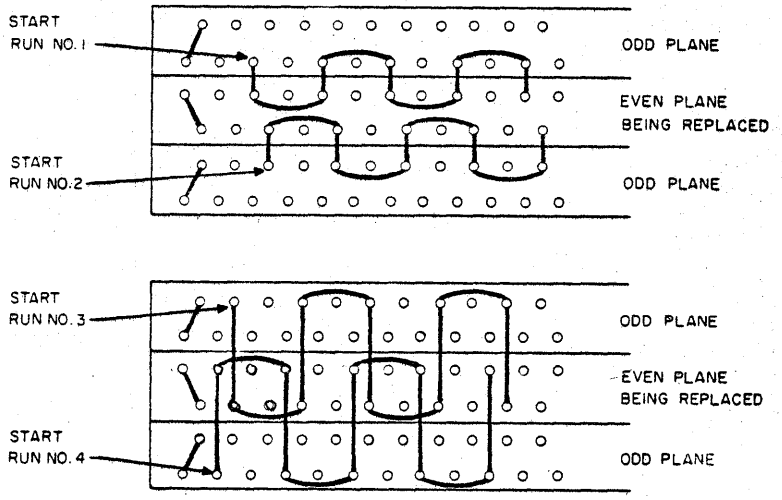


**FIGURE 8. RIGHT SIDE REPLACING EVEN PLANE**

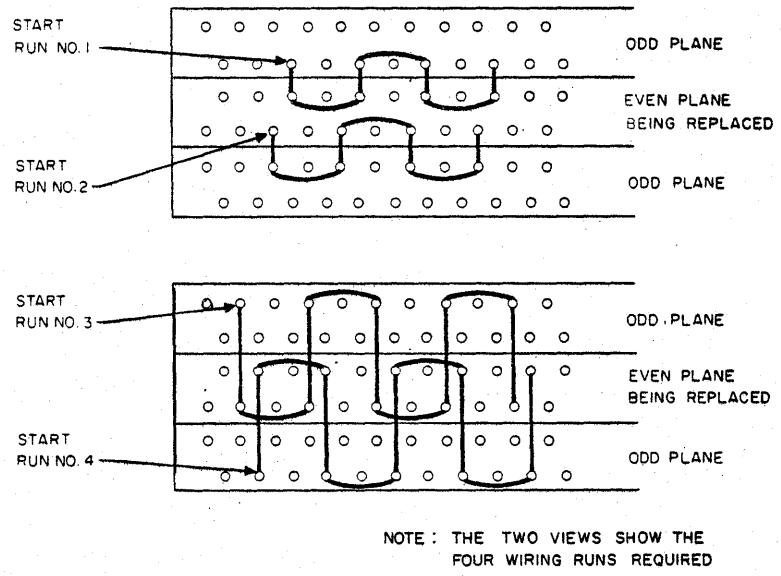


**FIGURE 9. LEFT SIDE REPLACING EVEN PLANE**

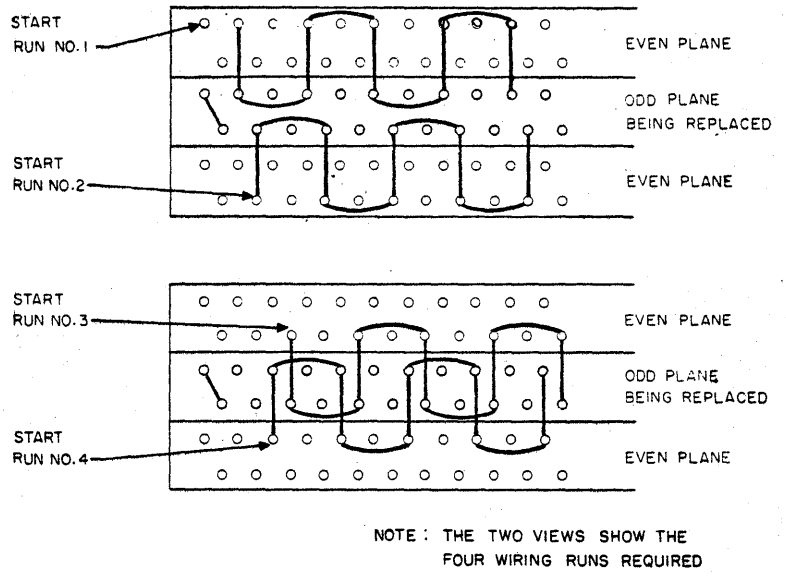


**FIGURE 10. FRONT VIEW REPLACING ODD PLANE**

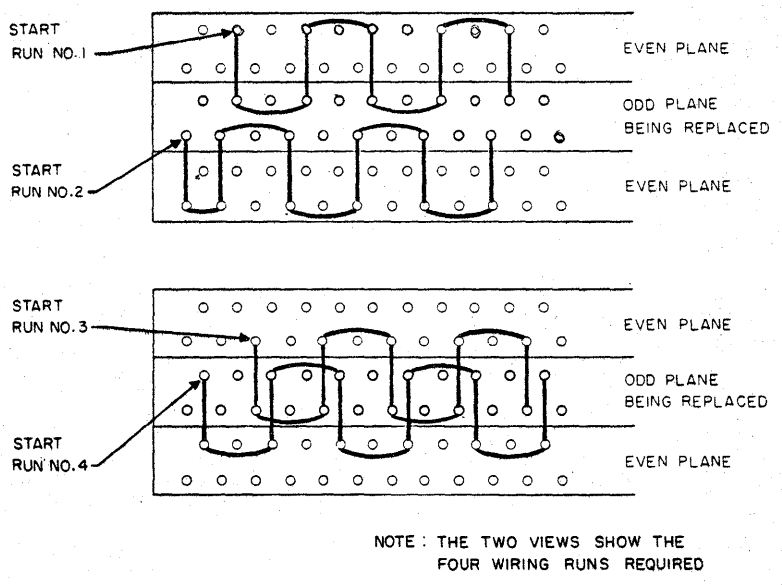


**FIGURE 11. REAR VIEW REPLACING ODD PLANE**

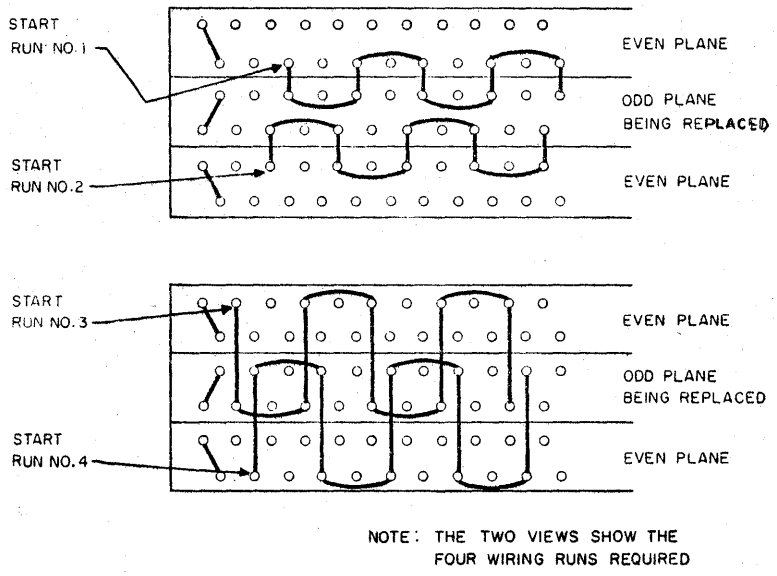


**FIGURE 12. RIGHT SIDE REPLACING ODD PLANE**

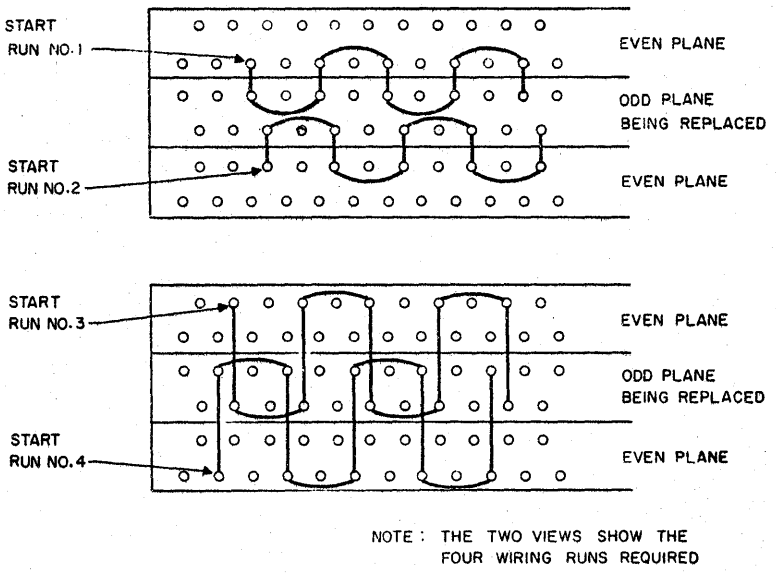


**FIGURE 13. LEFT SIDE REPLACING ODD PLANE**

## 7. MEMORY ARRAY CAGE ASSEMBLY REPLACEMENT

This procedure has been established to cover the possible necessity of replacing a core memory array cage assembly (3008400). The equipment required includes a screwdriver, a 7/16-inch wrench, and a 3/8-inch wrench. The procedure is as follows:

1. Turn power and air flow off to core memory array unit.
2. Remove all driver panels, all glass panels, and the top cover.
3. Refer to figure 14 foldout, and remove the two horizontal channel bars (1) in front of the array.
4. Remove the conduit (2) on front left of the unit.
5. Remove the taper pin leads that come from other units and plug into the edge connectors in the rear of this unit.
6. Remove the eight black wire jumper leads that plug into the edge connectors from the terminal block located at the lower left of the rear side of the unit. These should be labeled with tape for identification.
7. Remove the main bolt (3) from each of the eight array cage mounting brackets (3008415); also, the washers, spacers, and nuts.
8. Slip the two rubber gaskets (3008077) away from the air duct joints (top and bottom) and push them onto the air ducts.
9. Remove the two screws, two washers, and two nuts that hold the top air duct (4) in place.
10. Lift the top duct and use two of the spacer blocks to hold it up.
11. Two men should lift the array cage until it clears the bottom set, and remove it from the front.
12. If the rubber gaskets are bad, remove and replace them immediately with new ones (3008077).
13. Insert the new array cage from the front.
14. Remove the spacer blocks holding up the top air duct. Lower the duct into place. Make sure the top and bottom are well seated.
15. Bolt the top duct (4) into place using the hardware removed in step 9.
16. Slip the rubber gaskets into place.
17. Loosen four screws on each cage assembly bracket (5) so that adjustment is possible. A total of 32 screws are involved. Do not retighten until step 19.

18. Bolt the eight array cage mounting brackets (3) to the unit using the spacers, bolts, washers, and nuts removed in step 7.

19. Tighten each of the screws (5) loosened in step 17.

20. Replace the cable taper pins (cable from lower left terminal block and from the other units) removed in steps 5 and 6.

21. Replace the conduit (2) around the cable at the front left, removed in step 4.

22. Replace the two front horizontal channel bars (1) removed in step 3.

23. Replace the top cover and glass panels and driver panels.

24. Return air flow and power to the unit.

## 8. FILAMENT TRANSFORMER REPLACEMENT

There are eight filament transformers (3002730) used in the core memory array. They are located at the bottom of the array and are designated T1 through T8, as shown in figure 14, foldout. Replacement of a transformer should be attempted only after a test analysis confirms the presence of a defect. Due to the physical arrangement of the transformers there is very little clearance between adjacent units, and between the transformers and the array frame. Access to a defective transformer, therefore, may first necessitate the removal of adjacent units. Table 1 provides the proper sequence to be followed in removing the filament transformer(s), once the defective unit is known.

TABLE 1. TRANSFORMER REMOVAL SEQUENCE

| Defective Transformer | Transformers to be Removed |
|---|---|
| T1 | T1 |
| T2 | T1, T2 |
| T3 | T1, T2, T3 |
| T4 | T1, T2, T3, T4 |
| T5 | T8, T7, T6, T5 |
| T6 | T8, T7, T6 |
| T7 | T8, T7 |
| T8 | T8 |

To remove a transformer, proceed as follows:

1. Identify the transformer(s) from table 1.

2. Disconnect all leads and electrical clamps from the indicated units. Tag those leads without terminal identification to ensure proper reconnection.

3. Remove the four mounting nuts from the first transformer in the indicated sequence while supporting it with one hand to prevent it from falling into the air duct.

4. To lift the transformer free of the array frame, tilt it to the side for desired clearance.

5. Repeat steps 1 through 4 for each transformer to be removed.

6. To reassemble, replace the transformers in the reverse order starting with the replacement for the defective transformer. Mount each securely with all nuts originally supplied, and reconnect all leads and electrical clamps.

7. Turn on power and check for proper filament voltage.

## 9. TURNLOCK FASTENER RECEPTACLE MOUNTING BRACKET REPLACEMENT

When an individual turnlock fastener receptacle (of the type designated A in figure 14, foldout) breaks, no attempt should be made to repair it. Instead, a complete new turnlock fastener receptacle mounting bracket (3008210) should be installed in the applicable support column. An identical type mounting bracket is used in each of the four vertical support columns of the array, two in front and two at the rear. Each bracket is mounted securely within its column by two screws (3000585) located in the area designated B in figure 14, foldout. A similar location is used for the other three columns.

The equipment required includes a regular screwdriver, and a Yankee offset ratchet screwdriver (3033384). The procedure is as follows:

1. Remove all four top driver panels, and the two bottom driver panels which utilize the turnlock bracket to be replaced.

2. Remove the three glass panels and, if the broken turnlock fastener receptacle is in either of the two rear support columns, open the top cable duct door at the rear of the array and loosen the turnlock fastener wing studs which secure the cable duct cover assembly to the array frame.

3. Remove the top cover (refer to 1.3).

4. As a precaution, temporarily insert a screwdriver or equivalent type tool through the applicable column holes in the area designated C in figure 14. (In production arrays these column holes are readily visible and are not covered completely by the black rubber seal as are those

in the illustration). This precaution will prevent both the defective and replacement brackets from falling to the bottom of the column when the mounting screws are removed.

5. Remove the two mounting screws (B in figure 14) from the defective bracket. If the defective bracket is in either of the rear support columns, it will be necessary to have someone hold the top cable duct assembly as far from the frame as cable slack will permit. This will provide the necessary clearance for removing the mounting screws with the ratchet screwdriver.

6. Remove the defective bracket from the top of the support column.

7. Insert the new replacement bracket and secure it with the mounting screws removed in step 5.

8. Remove the obstacle used in step 4.

9. Replace the top cover.

10. Replace all covers and tighten all turnlock fastener wing studs.

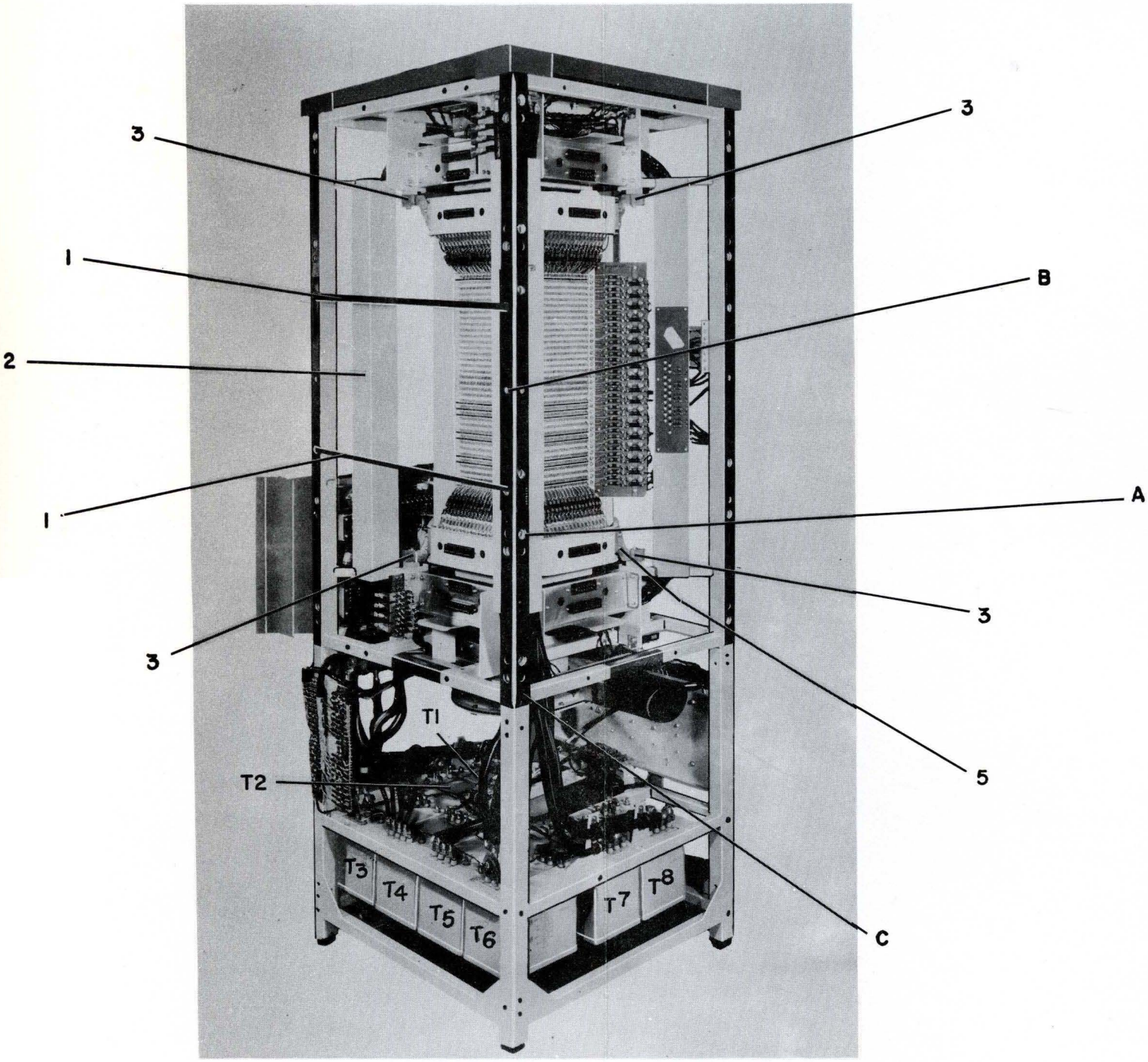


FIGURE 14. MEMORY ARRAY UNIT, COVERS REMOVED