IBM Customer Engineering

Manual of Instruction

7151 Console Control Unit

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1.0.00 CONSOLE

1.1.00 INTRODUCTION

The console is a separate unit that may be placed at any convenient location within certain cable length restrictions. It provides manual and semi-automatic control over the system.

The console consists of three panels: an operator's panel, a customer engineer's test panel, and a marginal check panel.

With proper use, the console can be one of the customer engineer's most powerful tools. The time spent learning how to use it effectively is returned many times when diagnosing system errors.

This section introduces the keys, lamps, switches, and test facilities, their function, and any associated logic.

1.2.00 GENERAL LOGIC

During the progress of a program, the operator may want some amount of control. For example, at a given point in a calculation, the computer is given the instruction to halt. The operator then can make a visual check of the information developed thus far in the program. At this point, one of several alternate manual steps may be performed, depending on the data observed. For this operation, the automatic-manual switch is set to manual. With the machine in this state, the operator may enter and execute an instruction, interrogate any locations in storage for a visual check of the information stored, or load data from the operator's panel keys. After the desired manipulations have been made, the machine is returned to automatic status; the start key is depressed and the program continues.

The start and stop of the machine are under control of the master stop trigger. This trigger in turn controls "B cycle interrupt," which gates the I, E, and L cycles.

The keys, switches, and lamps on the console provide a means to:

1. Start or stop the machine
2. Step through a program at reduced speed
3. Check the status of the CPU
4. Display or revise the contents of storage
5. Alter the program

In addition, the customer engineer has facilities for several testing features which include:

1. Auxiliary start and reset key
2. I-O interlocks
3. Continuous execution of an instruction
4. Power jacks for test equipment
5. B cycle control

1.3.00 PHYSICAL LAYOUT

The console (Figure 1.3-1) is divided into three sections; an operator's panel, a customer engineer's test panel, and a bias panel. Figure 1.3-2 designates system page locations for the keys and indicators located on the console.

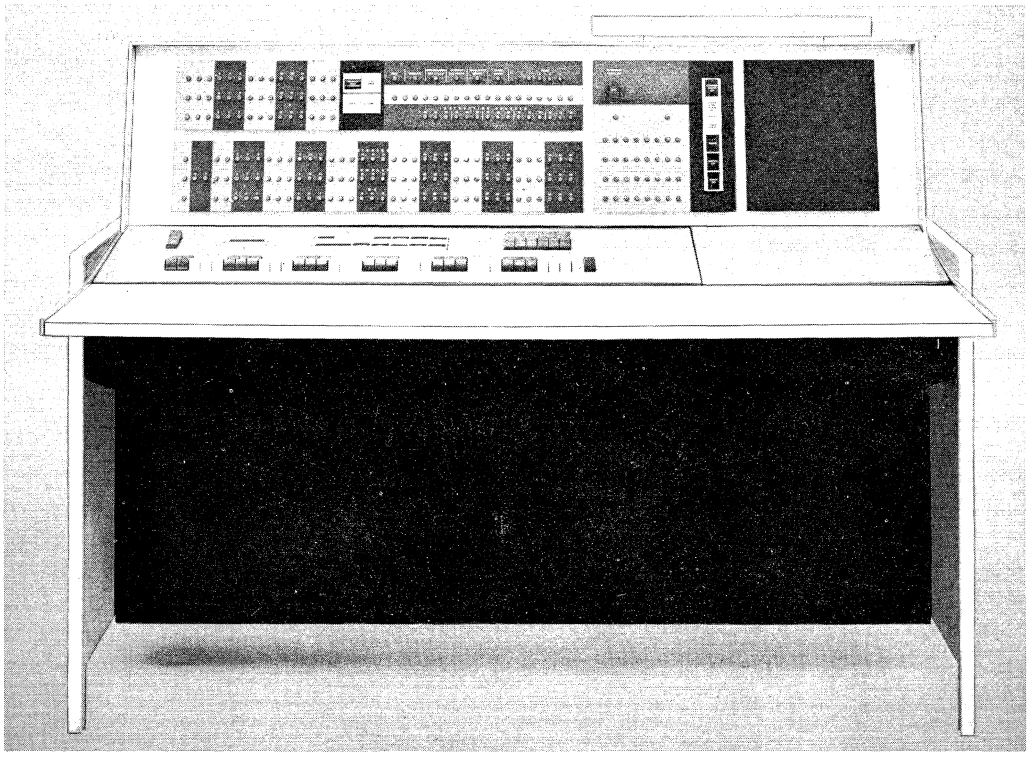


FIGURE 1.3-1. IBM 7151 CONSOLE

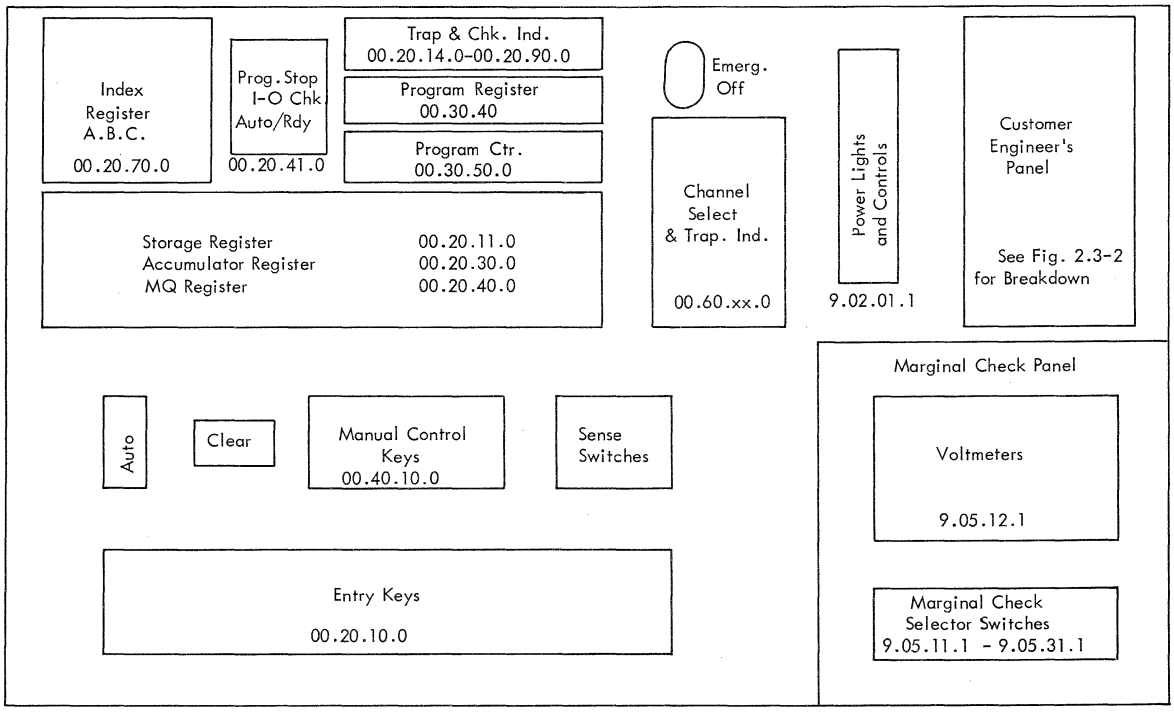


FIGURE 1.3-2. BLOCK DIAGRAM OF CONSOLE

2.0.00 OPERATOR'S PANEL

2.1.00 FUNCTION

The operator's panel provides for visual checking of the information in the computer and for manual control of the computer's functions. It is also a station from which power may be applied to or removed from the system.

2.2.00 INDICATORS

All indicators on the system are of the incandescent type. When used to indicate the condition of a register, a lamp being on signifies a 1, while a lamp being off signifies a 0.

2.2.01 Internal Registers

The contents of the internal registers (accumulator, multiplier-quotient, storage register, instruction counter, instruction register, and index registers A, B, and C) are displayed directly on the panel.

2.2.02 Trap

This lamp is on whenever the machine is in the transfer trapping mode.

2.2.03 Simulate

The simulate lamp is on when the 7090 is operating in any of the following modes associated with the 704, 709, or 7090 compatibility program:

1. I-O select and sense trap mode
2. Copy and load drum address trap mode
3. Storage nullification mode

2.2.04 Accumulator Overflow

The accumulator overflow lamp is on any time during a fixed-point or shifting operation that a carry out of position 1 of the accumulator occurs. It may be turned off by the TNO or TOV instruction.

2.2.05 Quotient Overflow

This lamp is on whenever the computer is using the compatibility program and an MQ overflow occurs.

2.2.06 Read-Write Select

The read-write (R-W) select lamp is on whenever an I-O unit has been selected for reading or writing. The lamp goes out when the unit is disconnected.

2.2.07 Divide Check

The divide check lamp is turned on in fixed point division if the dividend accumulator (AC) is greater than or equal to the divisor (storage register). In floating-point divide the lamp is on if the divisor is 0 or if the magnitude of the fraction of the dividend is greater than or equal to twice the magnitude of the fraction of the divisor. The indicator may be tested by the DCT instruction.

2.2.08 Channel Select (A-H)

The channel select (A-H) lamps, one for each channel, are on according to the data channel that is in operation. They are off when the channel is not in operation.

2.2.09 Command Word Trap (Channels A-H)

These lamps are turned on according to the corresponding channel that is enabled to trap on command word or end of file. The lamp for a particular channel is turned off when the channel is disabled.

2.2.10 Tape Check Trap (Channels A-H)

These lamps are on according to the corresponding channel that is enabled to trap on a tape check. The lamp for a particular channel is off when the channel is disabled.

2.2.11 Channel Tape Check

These lamps, one for each channel, are on if any error is detected while writing, or if both the high (Hi) and low (Lo) check registers are in error on reading. The lights may be turned off by the execution of a Transfer on Redundancy Check instruction.

2.2.12 Trap Control

This lamp is on when the channel is not executing a channel trap. It is off when any channel enters a trap condition. While the light is off, no channel traps may be executed. Channel traps may be executed only when the light is on at the same time as any of the enabled lamps.

2.2.13 Program Stop (Red)

The program stop lamp is turned on whenever the computer executes a halt instruction.

2.2.14 I-O Check (Write)

The I-O check lamp may be turned on by any of the following conditions:

1. If a RCH or LCH is executed and the specified data channel has not been selected.
2. If, when writing, a data channel data register has not been loaded with a word from storage by the time its contents are to be sent to the output unit.

3. If, when reading, a data channel data register has not transmitted its contents to storage by the time new information is to be loaded into it from an output unit.

The I-O check lamp may be turned off by the execution of an IOT.

2.2.15 Ready Light (White)

The ready lamp comes on after power comes up and remains on except when the machine is in automatic status.

2.2.16 Automatic (Yellow)

The automatic lamp is on whenever the computer is executing instructions in the automatic mode or whenever a data channel is in operation.

2.2.17 Console Power-On (Red)

The console power-on lamp is on whenever power is applied to the console.

2.2.18 Central Components Power Check (Yellow)

The central components power check comes on whenever a fuse or circuit breaker opens in CPU frame 1 or 2, multiplexor, or core storage. It also lights when core storage has improper oil temperature or low oil pressure.

2.2.19 I-O Power Check (Yellow)

The I-O power check lamp is turned on whenever a fuse or circuit breaker opens in a data channel or a fuse is open in a card machine. A power fault in a data channel or its attached card equipment does not light this indicator if a data channel is switched "off line" for customer engineer testing.

2.2.20 Power (Red)

The power indicator is turned on whenever power is applied to the system.

3.0.00 MANUAL CONTROLS

3.1.00 INTRODUCTION

Figure 3.1-1 shows the keys and switches on the operator's panel that provide for starting and stopping the machine and initiating computer functions. All keys are of the spring-returned variety with the exception of the auto-manual key, entry keys, sense switches, and emergency-off key.

3.2.00 POWER-ON

When the power-on key is depressed, it applies AC and DC power to the system.

3.3.00 NORMAL-OFF

Depressing the normal-off key removes power from the system in a manner that prevents possible component damage. This is accomplished by not removing power from the blowers; they continue to run for a short period to allow cooling of components.

3.4.00 EMERGENCY-OFF

Using the emergency-off key removes all power immediately, including blower power. This key should be used only in emergencies.

3.5.00 RESETS

The reset circuits control the resetting of various components in the system. There are three types of resets which may be initiated from the panel.

An interlock reset is initiated by the load keys, clear key, and power-on key. It causes the resetting of all registers, panel light (except power on and ready), all channels that are in operation and their associated registers.

An operator's reset is initiated by the reset key. It performs all the functions of an interlock reset plus a bias reset for CPU triggers.

A power-on reset occurs when power is applied to the system. This reset accomplishes an interlock reset, an operator's reset, plus the resetting of the clock and setting core storage to all zeros. The clear key also initiates a power-on reset if the machine is in automatic status.

3.5.01 Reset Key

When depressed, this key initiates an operator's reset.

3.6.00 AUTOMATIC-MANUAL KEY

This key must be in the automatic position to start the computer. Positioning the switch from automatic to manual while the computer is running stops the computer after it has completed execution of the instruction being processed, unless an I-O unit is in operation. In this case, the computer stops after the I-O unit has been disconnected.

In automatic status, the start key, clear key, load keys, and reset key are active. All other keys, plus the reset key, are active in the manual position.

3.7.00 ENTRY KEYS

There are 36 entry keys on the operator's panel: S, 1-35. Depressing a key sets a 1 in that position; leaving a key normal sets a 0 in that position. Information set in the entry keys may be entered into storage, executed, or used for a storage inquiry address. The entry keys may all be reset to 0 by depressing the reset key to the right of position 35.

3.8.00 START KEY

The start key is effective only in automatic status. When depressed, this key initiates machine operation. This is accomplished by turning off the master stop trigger which, in turn, brings up "not B cycle interrupt." "Not B cycle interrupt" allows the computer to proceed in whatever time it is set for (Figure 3.8-1). In manual status depressing the start key turns off the program stop light.

3.9.00 CLEAR KEY

The clear key is only operative if the computer is in automatic status. When depressed, this key resets all storage locations to 0. This is accomplished by forcing a store operation and inhibiting the writing of 1's. See Figure 3.9-1.

3.10.00 DISPLAY

The display keys enable one to display the contents of the storage indicators, any storage location, or an effective address. The display keys are only effective in manual status.

3.10.01 Display Storage

The display storage key, when depressed, allows information stored at any address to be observed. The operation interrogates the address set in the entry keys to determine which storage address to display. See Figure 3.10-1.

3.10.02 Display Indicators

The display indicators key gates the true value of the sense indicators to the storage register for display (Figure 3.10-2).

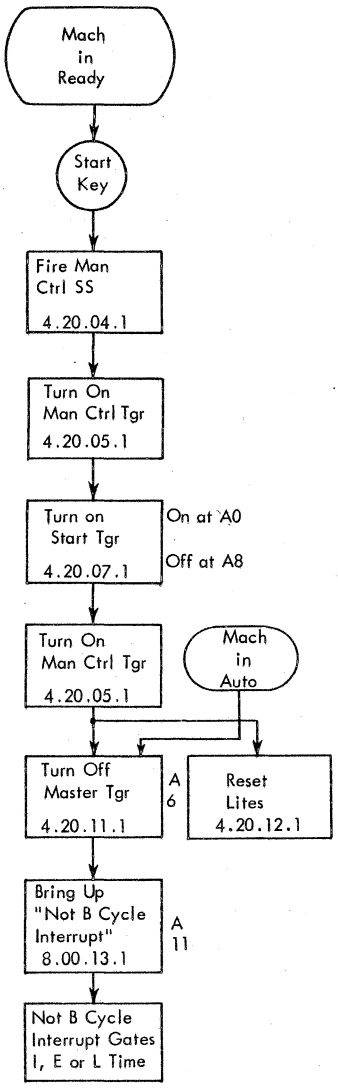


FIGURE 3.8-1. START

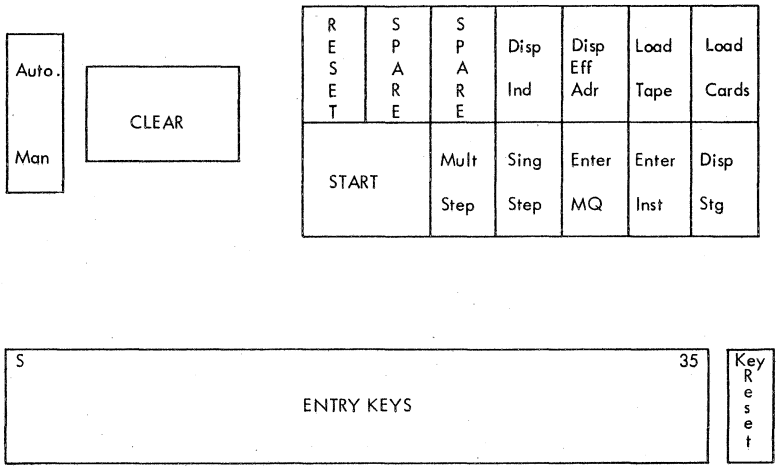


FIGURE 3.1-1. OPERATOR'S PANEL

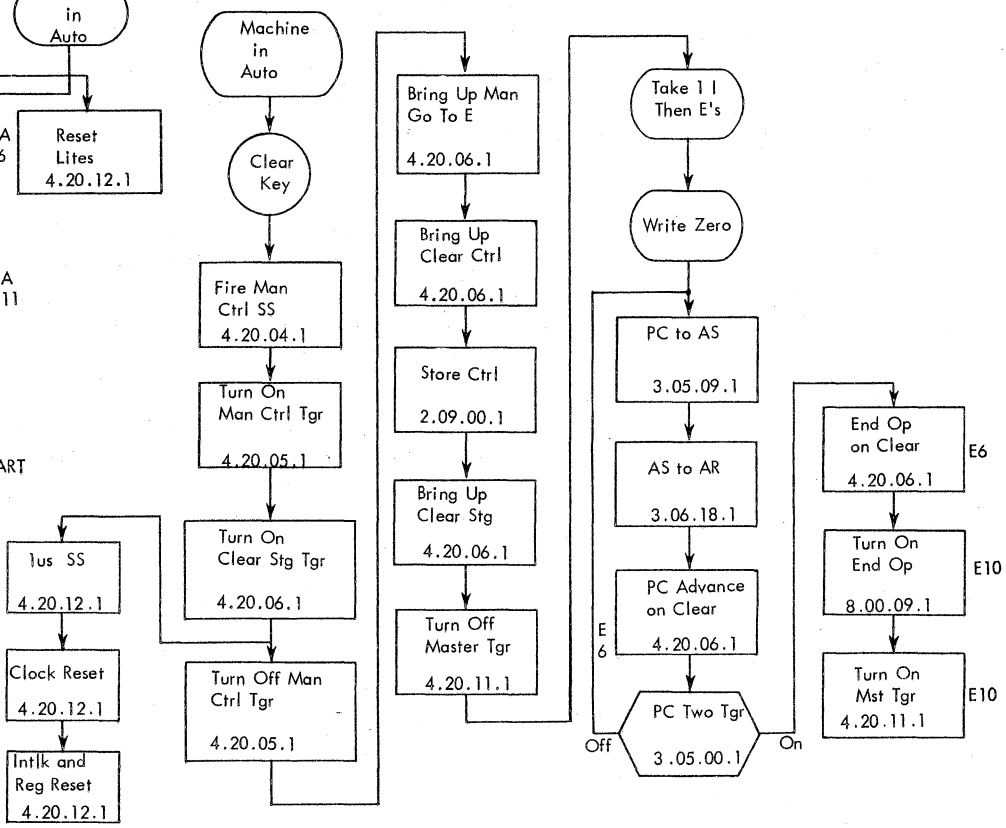


FIGURE 3.9-1. CLEAR STORAGE

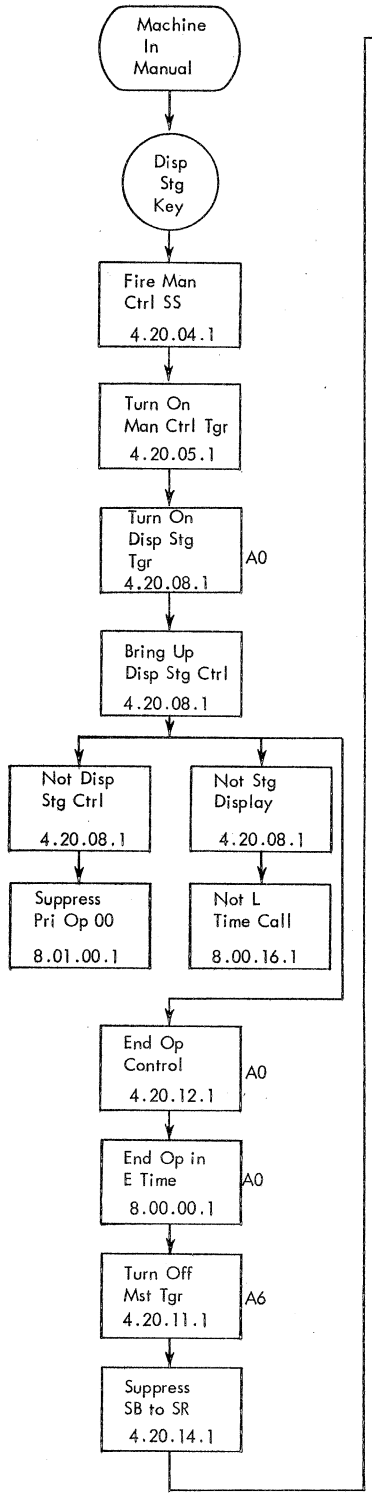
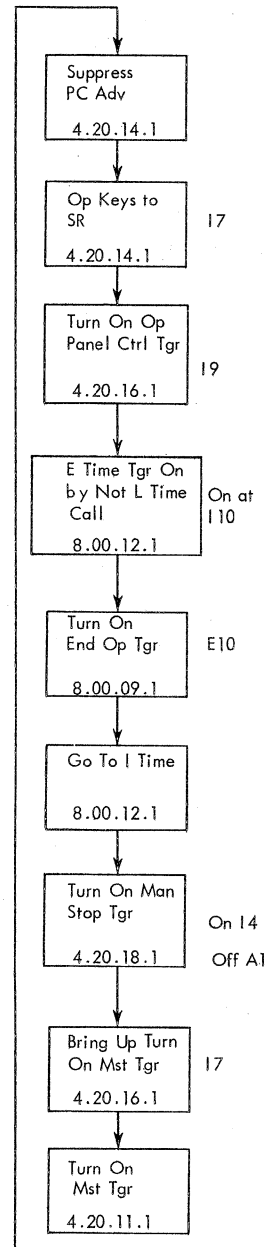


FIGURE 3.10-1.
DISPLAY STORAGE



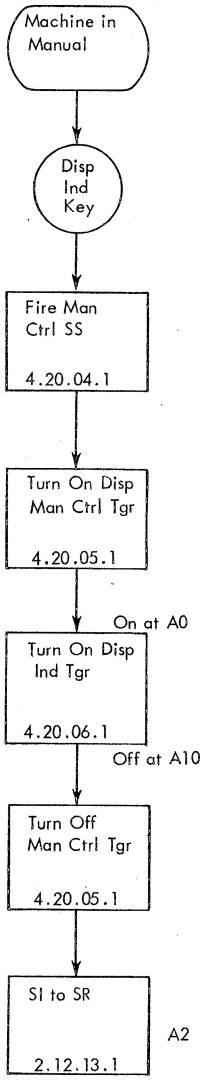
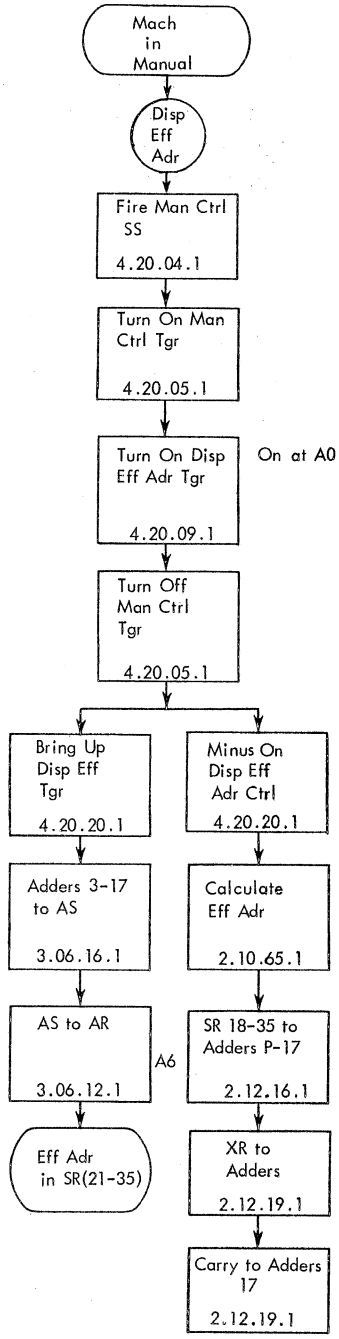


FIGURE 3.10-2
DISPLAY INDICATORS



Note: Hold Tag Reg Reset
as Output of SR 18,19,20,
Gates XRC, B or A to Adders

FIGURE 3.10-3
DISPLAY EFFECTIVE ADDRESS

3.10.03 Display Effective Address

The display effective address key calculates the effective address of any instruction in the storage register by subtracting the contents of the specified index register from the address. The resulting address then is displayed in positions 21-35 of the storage register. See Figure 3.10-3.

3.11.00 SINGLE STEP KEY

The single step key is effective only in manual status. Depressing it causes the computer to perform one program step and stop. This allows analyzing of a program, step by step, to check for program errors or machine errors. The single step key is not effective if the program stop light is on. See Figure 3.11-1.

3.12.00 MULTIPLE STEP KEY

The multiple step key is effective only if the computer is in manual status. This key allows single program steps to be executed, every 100 ms, for as long as the key is held depressed. The multiple step key is not effective if the program stop light is on. See Figure 3.12-1.

Multiple step may be executed at a reduced speed under control of a switch on the customer engineer's test panel. This is covered in Section 4.5.00.

3.13.00 ENTER MQ KEY

The enter MQ key provides a means for loading the MQ register from the operator's entry keys. The information may then be loaded into storage by placing the instruction STQ along with the desired address in the entry keys and depressing the enter instruction key. The enter MQ key is effective only when in manual status. See Figure 3.13-1.

3.14.00 ENTER INSTRUCTION KEY

Depressing the enter instruction key causes the computer to execute the instruction set in the entry keys. Instructions executed in this manner are executed while taking the required number of cycles and at normal operating speeds. See Figure 3.14-1.

3.15.00 LOAD CIRCUITS

There are two load keys on the operator's panel: the load cards and load tape keys. These keys provide circuits to select an I-O unit and read information from the unit into core storage. The system reads the first three words from the I-O unit selected and puts them into storage locations 0000, 0001, 0002. To sustain loading, these first three words must provide instructions to carry on additional loading. These keys also reset all channels except channel A.

3.15.01 Load Cards Key

Depressing the load cards key selects the card reader on channel A and reads the first three words from the card. The next command is then taken from location zeros. The CPU gets its next instruction from location 0001. See Figure 3.15-1.

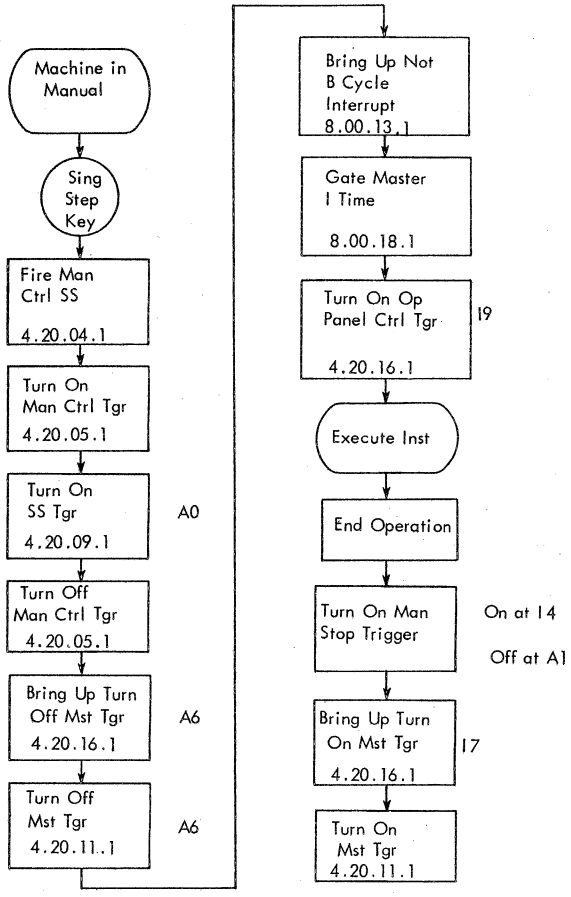


FIGURE 3.11-1. SINGLE STEP KEY

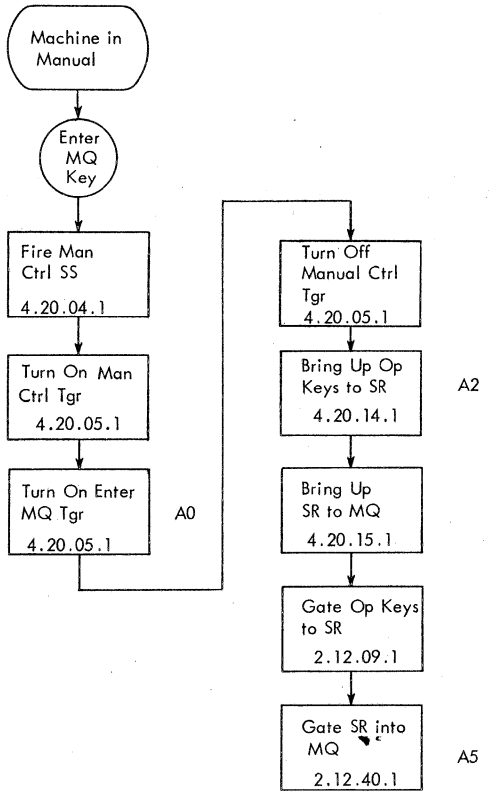


FIGURE 3.13-1. ENTER MQ

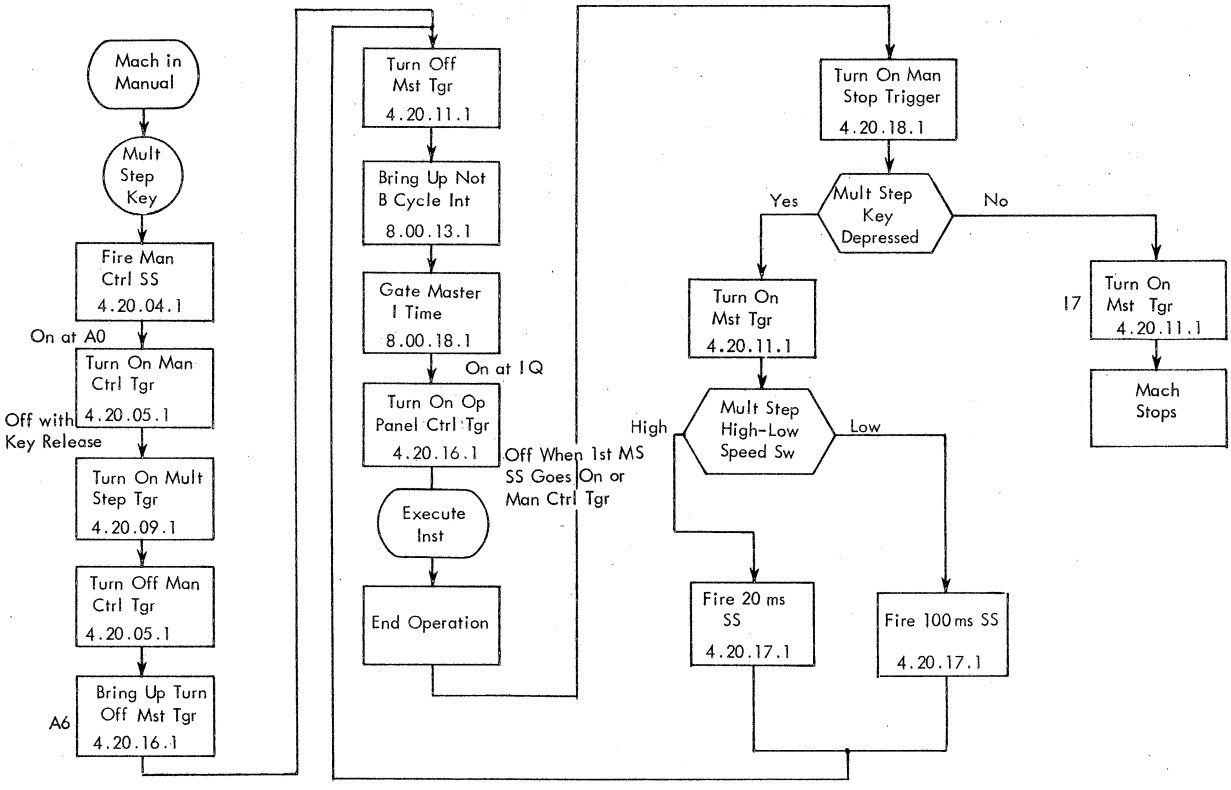


FIGURE 3.12-1. MULTIPLE STEP KEY

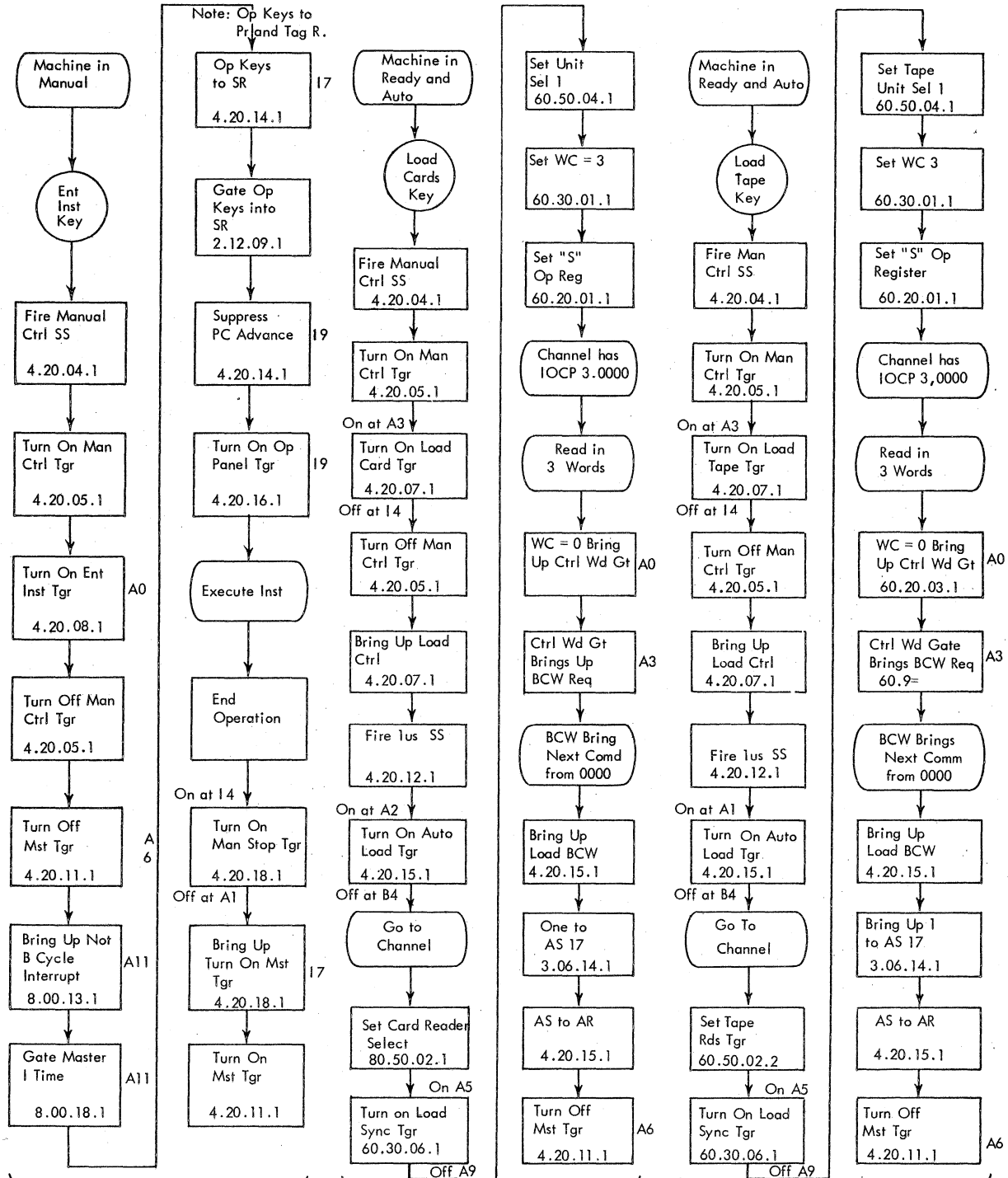


FIGURE 3.14-1. ENTER INSTRUCTION

FIGURE 3.15-1. LOAD CARDS

FIGURE 3.15-2. LOAD TAPE

3.15.02 Load Tape Key

The load tape key, when depressed, selects tape unit 1 on channel A and reads the first three words into storage. These three words must provide instructions to sustain loading. The logic is very similar to "load cards." See Figure 3.15-2.

3.16.00 SENSE CONTROL

There are two types of sense controls on the operator's panel: sense lights and sense switches. The conditions of these sense devices may be checked by machine instructions and used to control program flow.

3.16.01 Sense Lamps

The four sense lamps on the panel may be turned on or off by instructions in the main program and then checked by the sense instructions. The condition of the lamp determines if the program steps are to be skipped.

3.16.02 Sense Switches

The six sense switches may be set on or off from the operator's panel. The condition of the switch may then be checked by sense instructions in the program to determine whether to skip the following program step.

4.0.00 CUSTOMER ENGINEER'S TEST PANEL

4.1.00 FUNCTION AND PHYSICAL LAYOUT

In addition to the indicators and manual controls on the operator's panel, the customer engineer has at his disposal the indicators and controls on the customer engineer's test panel.

The indicators provide a means for checking the address register contents, the tally counter, various test triggers, and the cycle time. The switches and jacks provide means to continually execute any instruction, control I-O operation, control B time, and step through instructions cycle by cycle.

Figure 4.1-1 shows the layout of indicators and controls for this panel and designates system page locations.

4.2.00 INDICATORS

Indicators on the customer engineer's test panel are of the incandescent type. Indicators connected to test triggers are on when the trigger is on and off when the trigger is off. Indicators concerned with the registers and counters signify a 1 when they are on and a 0 when off.

4.2.01 Address Register

The address register contains the address portion of the instruction under execution.

4.2.02 Cycle Time

The cycle time indicators indicate in which cycle the machine is currently operating: I, E, L, or B time. Also, in connection with cycle time, is the "multiple error" indicator. This lamp is on whenever the machine is trying to perform two different cycles at the same time.

4.2.03 Tally Counter

The tally counter differentiates between the L cycles of floating point instructions and provides gating for their different operational steps. The tally counter is divided into five steps. The lamps on the test panel indicate in which of the five steps the machine is currently operating.

4.2.04 T-2

Indicator T-2 signifies the condition of the T-2 trigger in floating add or subtract and floating divide. During floating add or subtract, T-2 is used to indicate whether or not the multiplier quotient equals 0. During floating divide, T-2 is turned on if the quotient is greater than 2. The T-2 trigger is found on Systems 2.10.38.1.

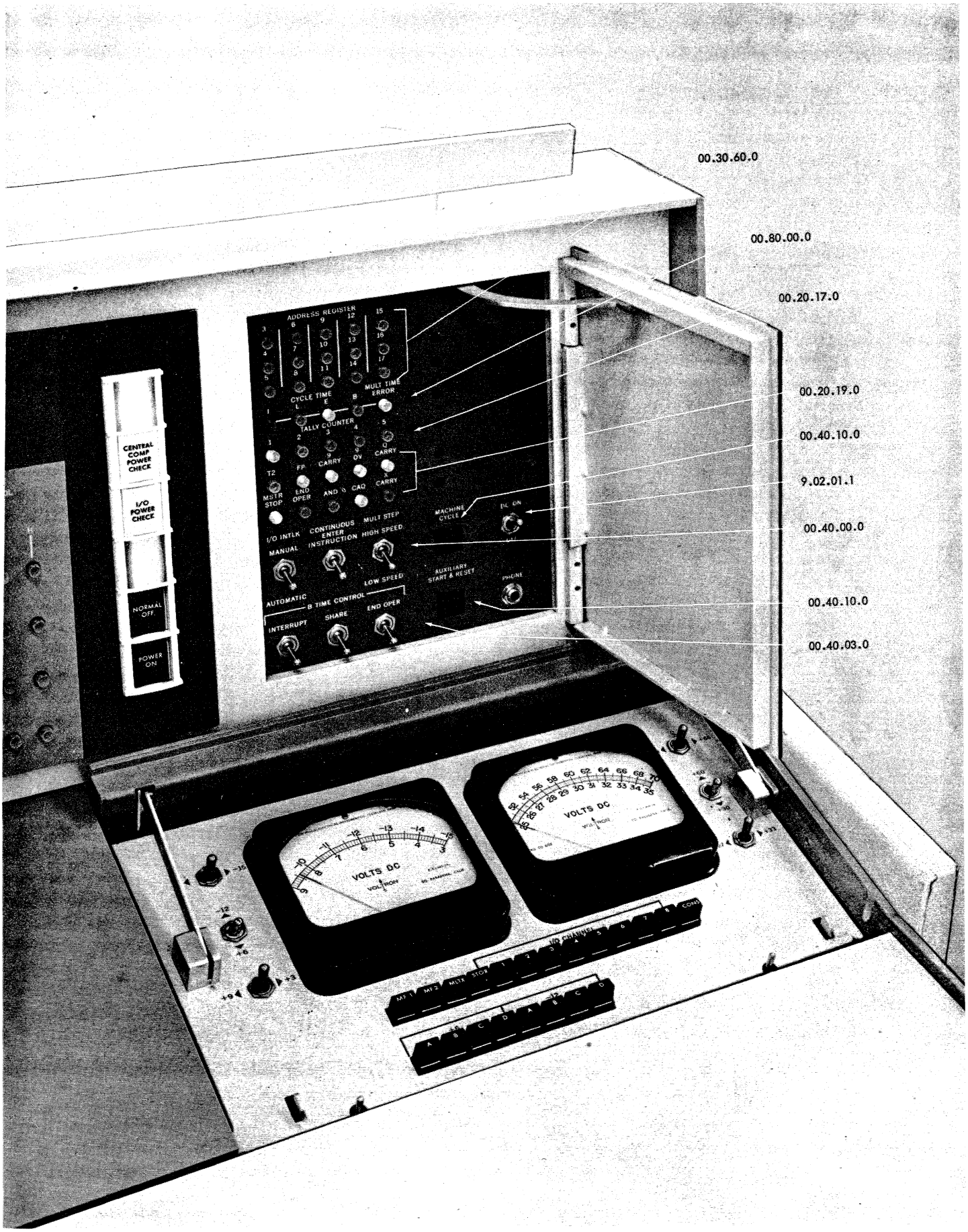


FIGURE 4.1-1. CE TEST PANEL INDICATORS AND KEYS

4.2.05 FP

The floating point (FP) lamp indicates the condition of the FP trigger on Systems 2.10.29.1. The trigger is used to store certain conditions throughout the floating point operations. The conditions that turn on this trigger and indicator are shown in Figure 4.2-1.

4.2.06 9 Carry

This lamp indicates the condition of the 9 carry trigger on Systems 2.10.37.1. The trigger is turned on whenever there is a carry from adder position 9.

4.2.07 9 Overflow

The 9 overflow lamp signifies the condition of the 9 overflow trigger on Systems 2.10.39.1. The trigger and lamp come on whenever AC 9=1 during an accumulator left shift, or during a multiply add cycle when there is an adder 9 carry.

4.2.08 Q Carry

The Q carry lamp indicates the condition of the Q carry trigger on Systems 2.10.36.1. This trigger is turned on whenever there is a carry out of adder position Q.

4.2.09 Master Stop

The master stop lamp is turned on whenever the master stop trigger on 4.20.11.1 is turned on.

4.2.10 End Operation

The end operation indicator is turned on whenever the end operation trigger on Systems 8.00.09.1 is turned on.

4.2.11 AND

The AND lamp indicates the condition of the AND trigger on Systems 2.09.46.1. It can be used to distinguish between the first and second E cycles of an ANS operation. It is on during the first E cycle of an ANS or ANA and off during the second E cycle of an ANS. See Figure 4.2-1.

4.2.12 CAQ

The CAQ indicator signifies the condition of the CAQ trigger on Systems 2.09.49.1. It denotes the difference between the first and succeeding E cycles of a CAQ instruction. The trigger is off for the first E cycle and on for the remaining E cycles. See Figure 4.2-1.

4.2.13 X Carry

The X carry lamp indicates the condition of the X carry trigger on Systems 2.12.76.1. The trigger is on when the machine is not in memory nullification mode and a carry occurs from adder position 3. If the machine is in memory nullification mode, a carry from adder position 4 turns on the trigger.

4.3.00 I-O INTERLOCK SWITCH

The I-O interlock switch is used in conjunction with the automatic-manual switch on the operator's panel to aid the customer engineer in locating I-O troubles. It may be in one of two positions, automatic or manual. It is left in the automatic position for normal operation. The switch functions as follows:

1. If an I-O unit is selected with the I-O interlock switch set to automatic, system operation reverts to automatic status, even though the machine may be in manual.
2. If the I-O interlock switch and the machine are in manual when an I-O unit is selected, the machine executes the select and remains in manual status.

4.4.00 CONTINUOUS ENTER INSTRUCTION

This switch forces the system to continuously execute the instruction set in the entry keys if the machine is in automatic status and the start key is depressed. See Figure 4.4-1. This switch provides an easy way to scope the operation of a particular instruction.

4.5.00 MULTIPLE STEP HIGH AND LOW SPEED

The following explanation is with reference to Section 3.12.00. With this switch in the high position, the multiple step key on the operator's panel performs program steps, one after another, every 20 ms. With the switch in the low position, program steps are performed every 100 ms. The high-speed position is advantageous when stepping through index loops.

4.6.00 B TIME CONTROLS

The B time control switches make possible the testing of the three conditions for initiating a B cycle. The three switches, interrupt, share, and end operation, are normally left in the on position. Any switch in the off position prevents a B cycle from being initiated by that particular condition. For instance, if the share circuit is to be tested, the interrupt and end operation switches would be turned off. In this manner, the only way to go to B time would be through the share circuits.

4.7.00 MACHINE CYCLE KEY

The machine cycle jack on the customer engineer's test panel accepts the machine cycle key. This key is used to sequence through the basic machine cycles, I, E, and L. This function allows the customer engineer a closer look at an instruction than is afforded by the single or multiple step key. Each depression of the key executes only one cycle, then turns on the MST trigger. See Figure 4.7-1.

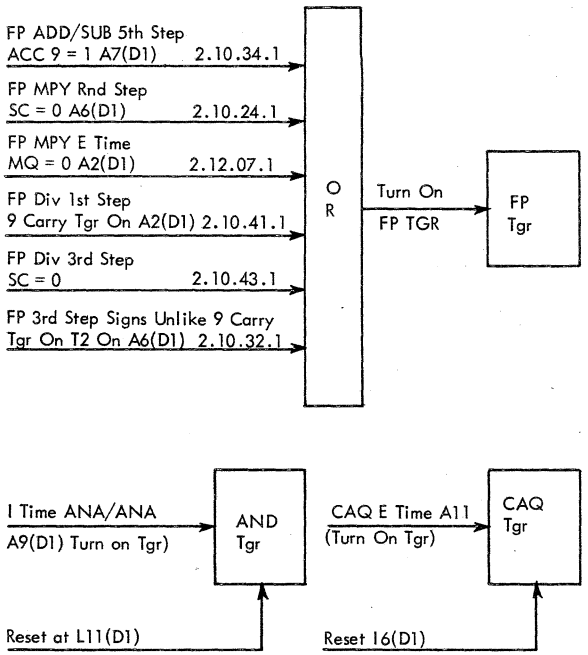


FIGURE 4.2-1. AND, CAQ, AND FP TRIGGERS

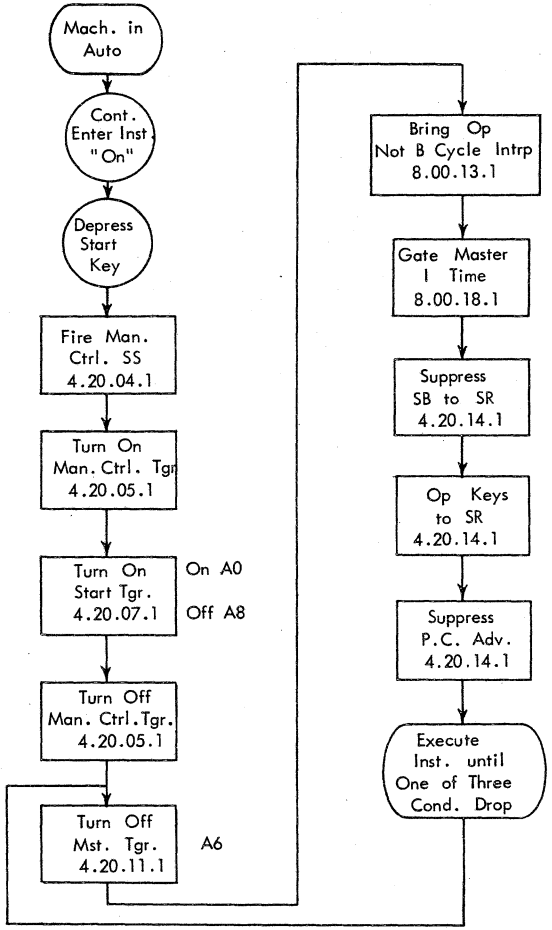


FIGURE 4.4-1. CONTINUOUS ENTER INSTRUCTION

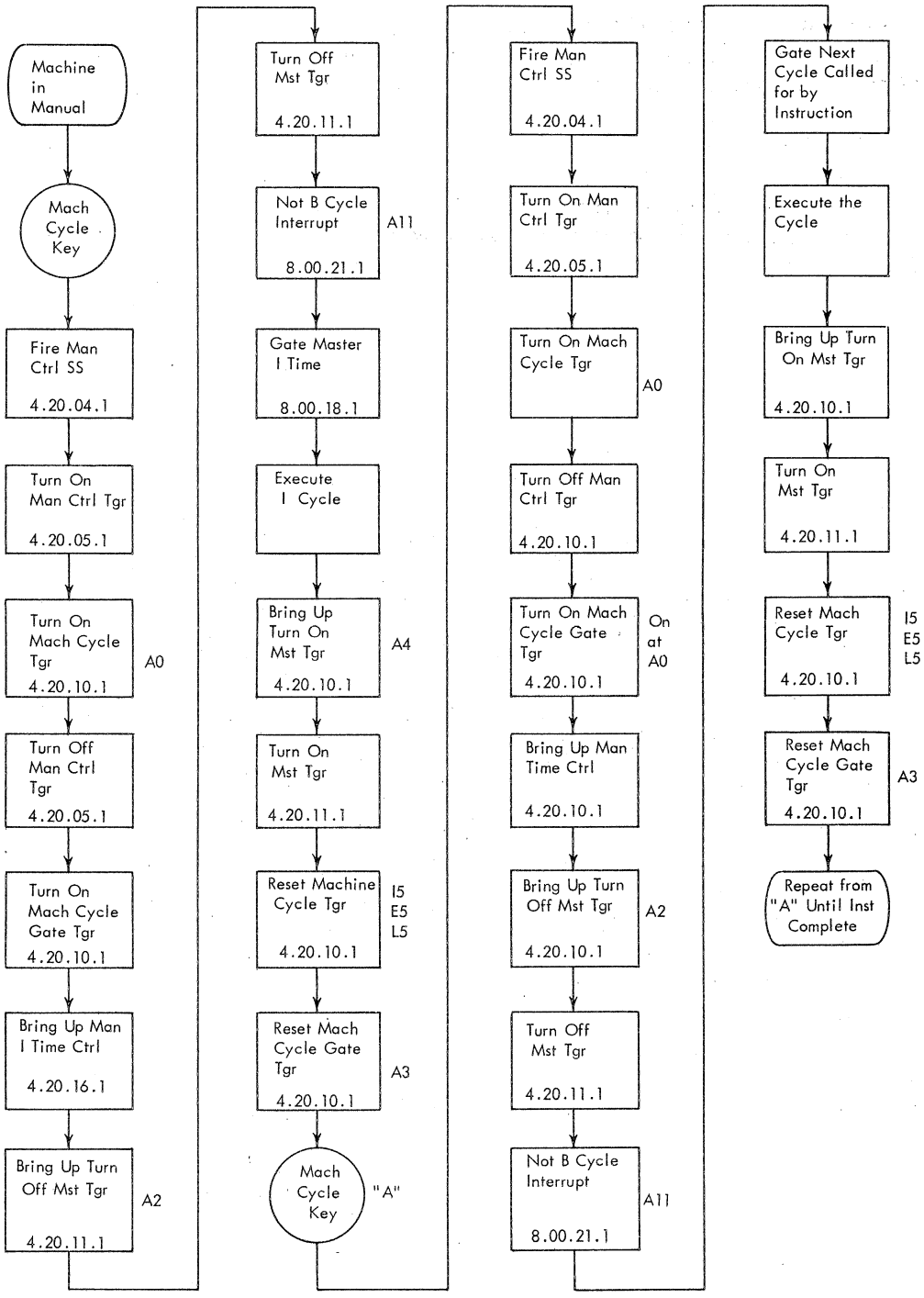


FIGURE 4.7-1. MACHINE CYCLE KEY

4.8.00 AUXILIARY START AND RESET

This jack accepts the auxiliary start and reset key. The key is on a long cable, giving the customer engineer a means for starting and resetting the machine at points other than the console.

4.9.00 PHONE JACK

The phone jack, in conjunction with the phone jacks on the other units in the system, provides a means of communication between customer engineers working at different units.

5.0.00 MARGINAL CHECK PANEL

5.1.00 FUNCTION

The marginal check panel on the console houses all the controls necessary to marginal check the -12v and +6v supplies to the entire system and the +60v and +30v to the core storage frame. From the panel, one may marginal-check any or all frames and any or all gates within the frames. The selection of units to be checked is set up by means of keys on the panel.

In addition to the selection keys, the panel houses switches to vary the particular voltage to be checked and two voltmeters to indicate the voltage readings. One meter indicates the setting of the -12v and -6v, the other indicates the setting of the +60v and +30v. A switch is associated with each meter to select the desired scale.

Figure 4.1-1 shows the panel layout.

5.2.00 OPERATION

Marginal check of the -12v or +6v is accomplished by either bucking or boosting the normal voltage by means of a variac. The -12v or +6v supply may be varied ±3v. At these extremes, limit switches cut out any further control of the voltage.

The +60v and +30v supplies are varied in much the same way as the -12v and +6v. The difference is that the +60v and +30v are varied by means of motor-driven potentiometers. The variance limit on the +60v is ±6v and on the +30v it is ±3v. Limit switches on the motor prohibit varying the voltage beyond these limits.

The selection of the module units is under control of a group of keys on the panel. The keys are labeled MF 1, MF 2, MULTX, STOR, 1-8 (for channel frames), and console. These keys select the frames to be marginal checked. The keys to select the gates are in two groups, one for the +6v and the other for the -12v. They are labeled A, B, C, and D.

The method of marginal checking from the panel is the same for all voltages. To illustrate the operation, consider the problem of biasing the +6v to all gates, in MF 1, MF 2, MULTX, and storage.

The first step is to depress the keys labeled MF 1, MF 2, MULTX, storage, and A, B, C, D, (for the +6v). This selects circuitry to allow the variac control over the +6v supply in the specified frames.

The switch beside the -12v, +6v meter should be thrown to the +6v position. This selects the proper meter scale to indicate the +6v readings.

The variac motor to drive the +6v variac is under control of the switches labeled +9 and +3. The switch is spring loaded to return to center when the key is released.

In the center position, the circuit to the motor is open. To vary the voltage, the switch must be held to one side or the other, depending on the direction one wishes to vary the voltage. The voltage may be varied anywhere from +3v to +9v. The voltage varies for as long as the switch is held. When released, the variac motor stops and the meter shows the present setting of the voltage. If the switch is held until the voltage reaches either +3 or +9, the circuit to the motor is automatically opened.

Once the voltage has been varied either way from +6v, selection of any more frames or gates is interlocked for the +6v marginal check. This is to prevent a sudden surge or drop in voltage to any particular location.

To return the system to normal operation, set the +6v to its normal reading by means of the +9 -- +3 switch. The frame selection keys are released by pushing forward on the key.

If desired, all of the voltages to the selected frames may be biased at the same time. The -12v is controlled by the -15 -- -9 switch, the +60v by the +56 -- +66 switch and the +30v by the +27 -- +33 switch.

Although no change in module selection is effective for a voltage that has been varied, module selection is still operative for any voltage setting at its normal reading. This means that marginal checking of one voltage may take place in a particular section of the system, while another voltage is marginal-checked in a different section.