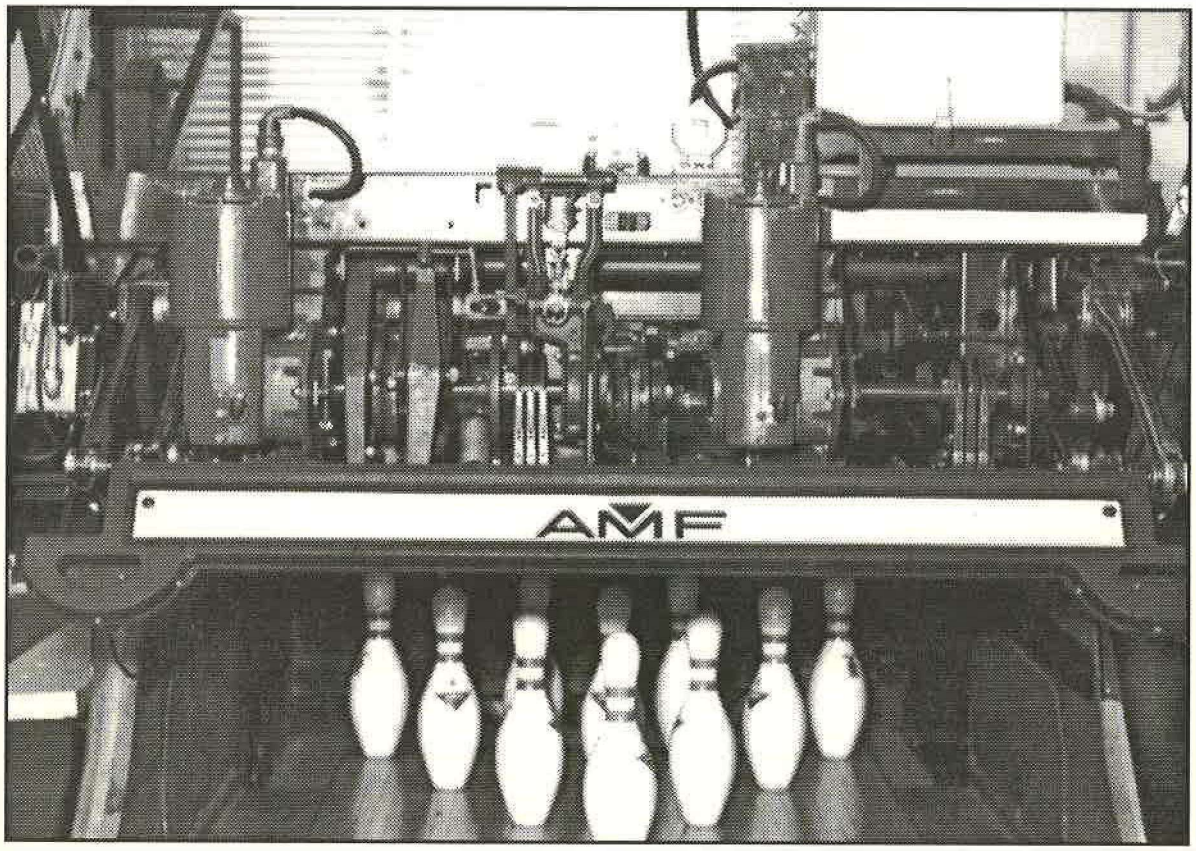
AMF 82-70 MICROPROCESSOR

PINSPOTTER



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INTRODUCTION

Power-line voltage has been standardized throughout the country at 115/230 volts, 60 hertz (cycle), A.C (alternating current) single phase. This figure represents nominal voltage and line voltage in a particular area may be between 110 and 125 volts. Voltage average across the country is approximately 117 volts. The domestic 82-70 pinspotter will operate satisfactorily between 104 and 127 volts, 60 cycle. The foreign version 82-70 pinspotter operates on 50 hertz (cycle) current. Either 115 or 230 volts.

With a single-phase system three wires are brought into the bowling centers distribution panel from the power company's transformer. In the three-wire system, the third wire is neutral which is grounded. Voltage between the other two wires is 230, while half of this voltage (115) appears between each of these wires and neutral. In this system, pinspotter load is divided between the two sides of the circuit, half the pinspotters in the center being connected between one wire and the neutral, while the other half connected between the other wire and neutral.

Each pinspotter requires its own 25 AMP circuit breaker. The circuit breaker must be in the "hot" side of the line going to the pinspotter. A 3-conductor power cord (Russell-Stoll plug) connects the 115 volts to the pinspotter. Two of the conductors in this cord carry power, one hot and one neutral or return. 115 volts can be measured between these two conductors. The third conductor is connected to the frame of the machine, while having its other end connected to an earth ground. This grounds the machine preventing the possibility of electrical shock. Power to the machine and machine g round will only be present when the 3-contact polarized plug (Russell-Stoll) is properly seated in its receptacle.

Some of the pinspotters' electrical components require 115 volts A.C. to operate and therefore use the line voltage. Components using 115 volts include the table, sweep and back-end motors, solenoids, pit light and 115 volts is applied to the primary transformer windings in the chassis.

Transformers are used to step-up (increase) line voltage or step-down (decrease) line voltage to the level needed for relays, lights and other pinspotter controlling devices. Not all chassis used on the 82-70 machine supply the same operating voltages. Voltage used to operate and control the pinspotter might include 12, 24 and 115 A.C. (alternating current) and 5, -6.8, 10, 12 and -
160 volts D.C. (direct current). The increased or decreased voltage will be present at the transformer secondary winding but will always be A.C. Direct current (D.C.) is required for most solid-state devices and is obtained by using a rectifier to convert A.C. to D.C. Capacitor filtering is used to remove any ripple from the rectified voltage.

Control voltage found at various machine switches will vary depending on the type of control chassis being used. There will be 24 volts A.C. at some machine switches while -160 D.C. will appear at others when a five-board chassis is on the machine and that will change if a one board replacement (XOP) is used. With an "A" or "B" chassis 24 volts A.C. and 24 volts D.C. will be at the switches. 5 volts D. C. and 24 volts A. C. will be at the switches with an MP chassis. Regardless of the voltage found there, the switches are used to control relays and/or chassis logic to give the machine its sequence of operation.

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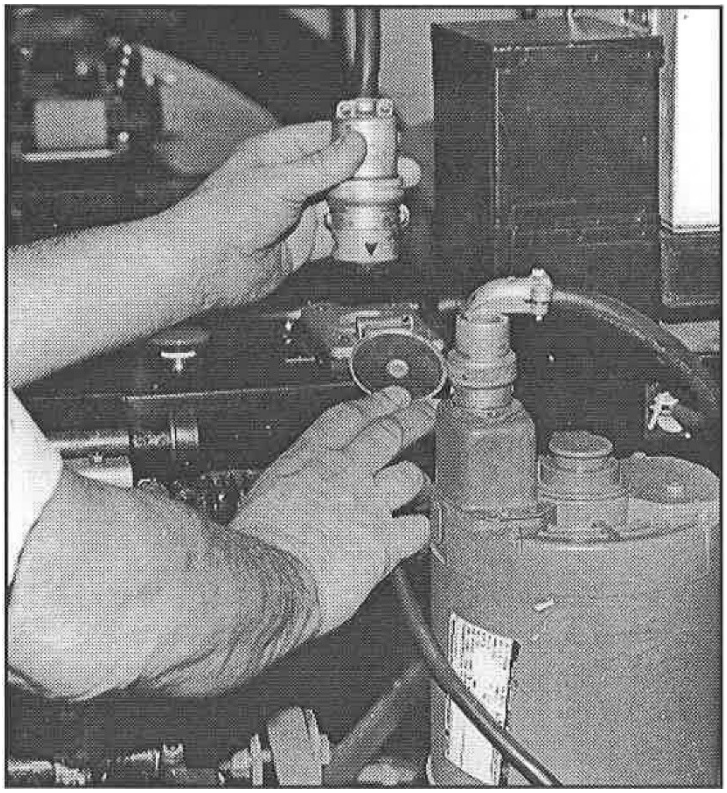
The newer 82-70 Pinspotters (after 1979) have a stop switch located to the left of the power plug on the front wireway of the machine. This safety switch, when pressed, turns off the machine circuit breaker on the rear control panel. This disables all control circuitry; however, power is still in the pinspotter unless the power plug is removed. Another safety switch, C.I.S., was added in1981. This switch, located under the plug duct cover, will turn off the circuit breaker on the rear control panel if the plug duct cover is raised.



Remove Power Plug When Working on Machine.

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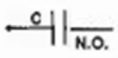
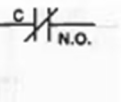
NOTE: AN "OPEN" SWITCH WILL PASS NO CURRENT (OFF).
A "CLOSED" SWITCH WILL PASS CURRENT (ON).

1.) 

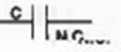
SWITCH CONTACTS, OPEN WHEN SWITCH IS NOT ACTUATED. SWITCH BUTTON IS OUT.

2.) 

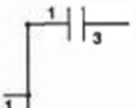
SWITCH CONTACTS, CLOSED WHEN SWITCH IS NOT ACTUATED. SWITCH BUTTON IS OUT.

3) 

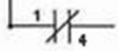
SWITCH CONTACTS, CLOSED WHEN SWITCH IS ACTUATED. SWITCH BUTTON IS IN.

4.) 

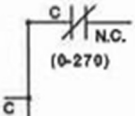
SWITCH CONTACTS, OPEN WHENSWITCH IS ACTUATED. SWITCH BUTTON IS IN.

5.) 

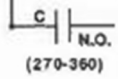
RELAY CONTACT 1 & 3, OPEN, WHEN RELAY IS NOT ENERGIZED. NO VOLTAGE TO RELAY COIL. CONTACT 1 & 3 WILL CLOSE WHEN VOLTAGE IS APPLIED TO RELAY COIL.

6.) 

RELAY CONTACT1 & 4, CLOSED, WHEN RELAY IS NOT ENERGIZED. NO VOLTAGE TO RELAY COIL. CONTACT 1 & 4 WILL OPEN WHEN VOLTAGE IS APPLIED TO RELAY COIL.

7.) 

SWITCH CONTACTS, CLOSED WHILE CONTROLLING CAM IS BETWEEN O AND 270 DEGREES. DEGREE MARKINGS ALWAYS INDICATE WHEN THE SWITCH WILL BE ON.

8.) 

SWITCH CONTACTS, CLOSED WHILE CONTROLLING CAM IS BETWEEN 270 AND 360 DEGREES. DEGREE MARKINGS ALWAYS INDICATE WHEN THE SWITCH WILL BE ON.

9.) 

TWO WIRES CROSSING BUT NO ELECTRICAL CONNECTION

10.) 

TWO WIRES CROSSING AND HAVING AN ELECTRICAL CONNECTION

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11.) 

TRANSFORMER PRIMARY (MAIN WINDINGS). LINE VOLTAGE PRESENT

12.) 

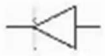
TRANSFORMER SECONDARY. OPERATING VOLTAGE PRESENT. SOME TRANSFORMERS HAVE MORE THAN ONE SECONDARY WINDING.

13.) 

RELAY COIL

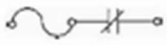
14.) 

SOLENOID WINDINGS

15.) 
DIODE OR RECTIFIER

16.) 

FUSE

17.) 
OVERLOAD OR CIRCUIT BREAKER OR KLIXON

18.) 
CAPACITOR

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19.)		GROUND (ALL GROUNDS SHOWN ON SCHEMATIC ARE CONNECTED TO EACH OTHER WHEN ALL PLUGS ARE IN)
20.)		RESISTOR
21.)		JUNCTION TERMINAL FOR TWO OR MORE WIRES.(LOCATED IN WIREWAY UNDER CHASSIS)
22.)	C-1	UPPER PLUG ON LEFT SIDE OF CHASSIS. (AS VIEWED FROM FRONT OF MACHINE) (115 VOLT)
23.)	C2A	LOWER PLUG ON LEFT SIDE OF CHASSIS. (AS VIEWED FROM FRONT OF MACHINE) (CONTROL CIRCUITS)
24.)	PM	FRONT PLUG ON RIGHT SIDE OF CHASSIS. (AS VIEWED FROM FRONT OF MACHINE) (WIRES FOR MASK)
25.)	BP	REAR PLUG ON RIGHT SIDE OF CHASSIS. (AS VIEWED FROM FRONT OF MACHINE) (SPAREMAKER 6700 OR 7750 CHASSIS)
26.)	APS	REAR PLUG ON RIGHT SIDE OF CHASSIS. (AS VIEWED FROM FRONT OF MACHINE) (FOR AUTOMATIC SCORING 9800 & 9900 CHASSIS)
27.)	C 1 - 16 Z	PIN IN C1 PLUG (ROW 1, PIN 6, LABELED Z)
28.)	C2A-312 BB	PIN IN C2A PLUG (ROW 3, PIN 12, LABELED BB)

29.)	TAP-15 P	PIN IN TABLE CABLE PLUG (ROW 1, PIN 5, LABELED P)
30.)	PC1-15	PRINTED CIRCUIT BOARD #1, TERMINAL 15
31.)	P-1 A-101	M. P. CIRCUIT BOARD PLUG #1, TERMINAL A-101
32.)	TMP-X	TABLE MOTOR PLUG, TERMINAL X
33.)	SMP-Y	SWEEP MOTOR PLUG, TERMINAL Y
34.)	BEMP-2	BACK END MOTOR PLUG, TERMINAL 2
35.)	A & MC- 11A	A & MC PLUG, (ROW 1, TERMINAL 1, LABELED A)
36.)	TBA-3	A & MC BOX (TERMINAL STRIP A, TERMINAL 3) (LOCATED ON CURTAIN WALL) (MAY BE UNDER DOWNSWEEP ASSEMBLY)

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82-70 WITH 9800 CHASSIS

RELAYS

M	MASTER	CONTROLS POWER TO THE T1 TRANSFORMER, HALO AND PIT LIGHT. LIGHT.
M2	SWEEP REVERSE	CAUSES SWEEP TO RUN IN REVERSE WITH AUTOMATIC SCORING.
BE	BACK END	CONTROLS BACK END DRIVE MOTOR.
s	SWEEP	CONTROLS SWEEP MOTOR.
T	TABLE	CONTROLS TABLE MOTOR.
SP	SPOT	CONTROLS SPOTTING ACTION OF MACHINE BY SWITCHING SPOT SOLENOID.
M1		TURNS ON BALL RETURN.
KLIXON		DEVICE THAT PROTECTS CIRCUITS FROM OVERLOADS.

TRANSFORMERS

T1	SUPPLIES VARIOUS VOLTAGES TO THE CHASSIS FOR OPERATIONAL PURPOSES.
T2	SUPPLIES 24 VOLTS AC TO THE MANAGER's CONTROL CIRCUIT.
T3	SUPPLIES 24 VOLTS FOR CIRCUIT BOARD.
T4	SUPPLIES 24 VOLTS FOR BE RELAY AND M1 RELAY.

CAMS

TA1	TABLE	RUNS TABLE UP AND STOPS TABLE AT ZERO. (355°}
TA2	TABLE	STARTS SWEEP RUN THROUGH,AND STARTS SWEEP UP AT END OF CYCLE. (260°}
TB	TABLE	CONTROLS TABLE-SWEEP INTERLOCK.
SA	SWEEP	STOPS SWEEP AT 2ND GUARD, RUNS SWEEP UP AND STOPS SWEEP AT ZERO. (360°}
SB	SWEEP	STOPS SWEEP AT FIRST GUARD (66°) STARTS TABLE SPOTTING. (186)
SC	SWEEP	CONTROLS TABLE-SWEEP INTERLOCK.

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82-70 WITH 6700 CHASSIS (5 BOARD)

		RELAYS
M	MASTER	CONTROLS POWER TO M2, HALOLIGHT AND PITLIGHT
M2	TIME DELAY	CONTROLS POWER TO T1 AND KEEPS BACK-END MOTOR AND BALL RETURN RUNNING FOR 30 SECONDS WHEN MACHINE IS TURNED OFF
SP	SPOT	CONTROLS SPOTTING ACTION OF MACHINE BY SWITCHING SPOT SOLENOID. (AND RESPOT SOLENOID)
BE	BACKEND	CONTROLS BACKEND MOTOR
s	SWEEP	CONTROLS SWEEP MOTOR
T	TABLE	CONTROLS TABLE MOTOR
KLIXON		DEVICE THAT PROTECTS CIRCUITS FROM OVERLOADS
H		THERMAL UNIT FOR TURNING OFF M2
KX		PIN PRESENCE RELAY FOR SPAREMAKER
		TRANSFORMERS
T1		SUPPLIES VARIOUS VOLTAGES TO CHASSIS FOR OPERATIONAL PURPOSES
T2		SUPPLIES 24 VOLTS AC TO THE MANAGERS CONTROL CIRCUIT
		CAMS
TA1	TABLE	RUNS TABLE UP AND STOPS TABLE AT ZERO (355°) STARTS SWEEP UP AT END OF CYCLE
TA2	TABLE	STARTS SWEEP RUN THROUGH (260°)
TB	TABLE	CONTROLS TABLE-SWEEP INTERLOCK
SA	SWEEP	STOPS SWEEP AT 2ND GUARD, RUNS SWEEP UP AND STOPS SWEEP AT ZERO (360).
SB	SWEEP	STOPS SWEEP AT THE FIRST GUARD. (66°) STARTS TABLE SPOTTING (186)
SC	SWEEP	CONTROLS TABLE-SWEEP INTERLOCK.

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SWITCHES

MGR	CONTROL	TURNS MACHINE ON (BOWL OR INSTRUCTOMAT).
SS	START SWITCH	CYCLES MACHINE WHEN BALL HITS CUSHION.
OS	OFF SPOT	SIGNALS CHASSIS WHEN TABLE CONTACTS OFF SPOT PIN
GS	GRIPPER SWITCH	SIGNALS CHASSIS WHEN PIN OR PINS ARE PRESENT ON PIN DECK AS TABLE PICKS UP STANDING PINS.
GP	GRIPPER PROTECTION SWITCH	PROTECTS TABLE FINGERS ROM DAMAGE. (WON'T LET TABLE FEEL FOR PINS WHEN OFF).
CB	CIRCUIT BREAKER	PROTECTS MACHINE FROM OVERLOAD OR SHORT CIRCUIT.
T	TABLE SWITCH	MANUAL SWITCH CONTROLLING TABLE RELAY.
S	SWEEP SWITCH	MANUAL SWITCH CONTROLLING SWEEP RELAY.
BS	BIN SWITCH	SIGNALS CHASSIS WHEN THE NUMBER NINE PIN IS PRESENT IN BIN.
SWS	SWEEP RUN SWITCH	RUNS SWEEP FROM REAR OF MACHINE MANUAL.
SWSR	SWEEP REVERSE	RUNS SWEEP IN REVERSE. MANUAL. (USED WITH SWS)
PBZ	ZERO SWITCH	CONTROLS MACHINE FIRST BALL OR SECOND BALL STATUS. (USED TO RESTART MP CHASSIS "MANUAL INTERVENTION")
PBC	CYCLE SWITCH	CYCLES MACHINE FROM REAR
	10TH FRAME SWITCH	CYCLES MACHINE FROM APPROACH. BOWLER CONTROLLED

MOTORS

BE	DRIVES PIN ELEVATOR', BALL ELEVATOR, PITVEYOR (CARPET), DISTRIBUTOR, PADDLE ASSY.
T	DRIVES TABLE
S	DRIVES SWEEP

SOLENOIDS

SPOT SOLENOID	CONTROLS TABLE WHEN SPOTTING PINS. (LATCHES SPOT LEVER, REMOVES SHUTTLE STOP, UNLOCKS TABLE DRIVE)
RESPOT SOLENOID	CONTROLS SPOT LEVER ON EARLY MACHINES (PRIOR TO #101696)

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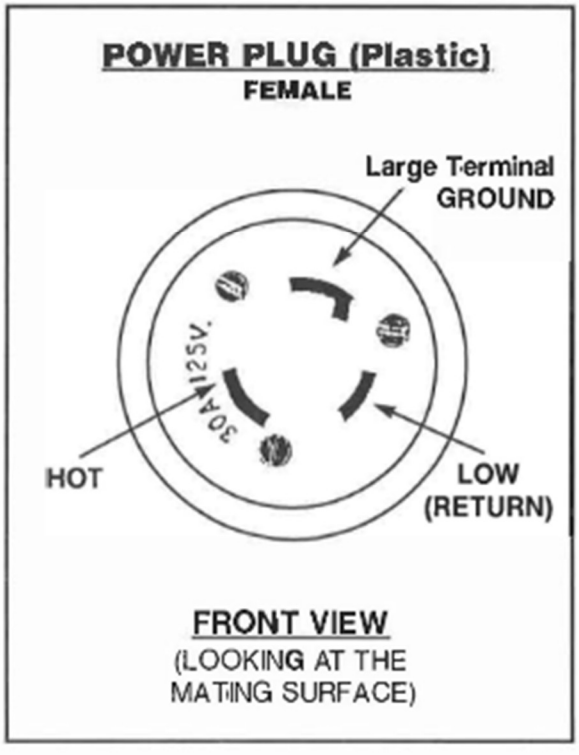
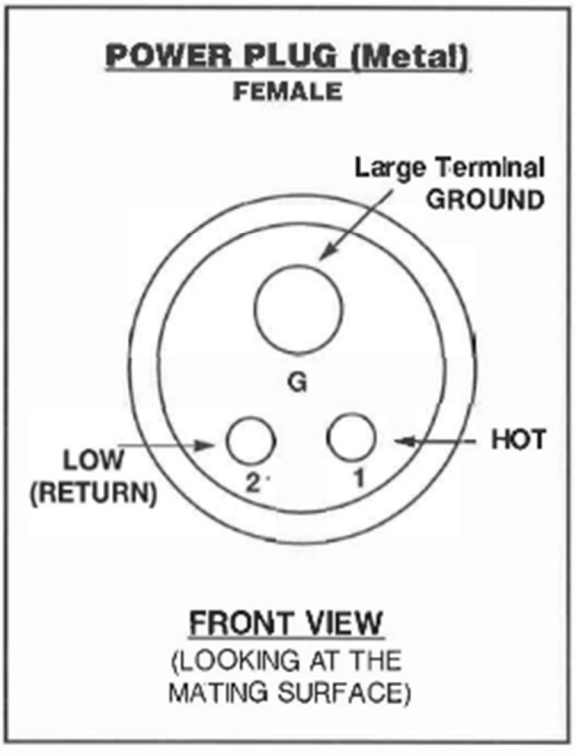
POWER PLUGS (115 VOLTS)

How the power plug is wired does make a difference. The hot side of the power line is the one with the protection device in it (circuit breaker or fuse). Also, switch contacts are in the hot side of the line. Power plugs or machines that are wired improperly can cause early component failure. In addition, an improperly wired plug makes the machine dangerous to work on. 115 volts will be present where a mechanic doesn't expect it to be. The lack of a proper ground connection also presents a hazard for the mechanic. To test the plug for voltage, a neon voltage tester or an A.C. volt meter capable of reading 250 volts can be used. Insert one lead of tester into the hot terminal and the other lead into the ground terminal. The neon light should light or the meter should indicate about 115 volts. Remove the lead from the ground terminal and place it into the low or return terminal. Readings should be the same. Place one lead of tester into the ground terminal and the other lead into the return terminal. There should be **no** reading. If you do not get the above results, the plug is wired wrong, a wire may be broken, or the main circuit breaker is off. To reverse the connections in the power plug, first turn off the main circuit breaker. Check the plug again for voltage to be certain the power is off, Then dismantle the plug and make the necessary repairs.





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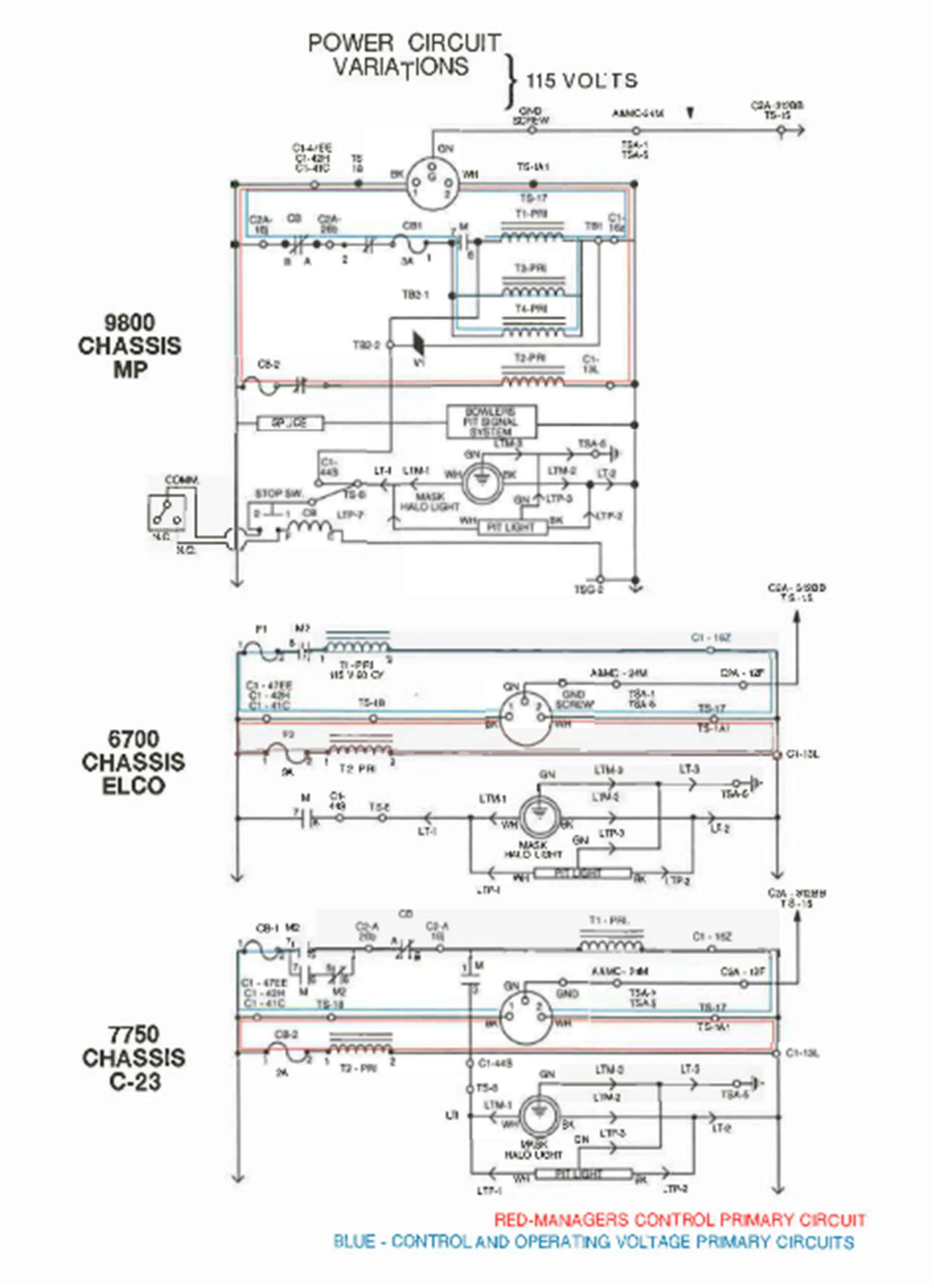

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MANAGERS CONTROL CIRCUIT

BOWL

When the managers control switch is moved into the bowl position, 24 volts A.C. is sent to the M relay coil. This voltage is available at the secondary winding of the T-2 transformer. The circuit consists of the T-2 transformer secondary winding, managers control switch, masking unit switch, and with some chassis, CB contacts A and B to the coil of the M relay. The other side of the M relay coil is connected directly to the other side of the transformer winding. M now becomes energized and its normally open contacts close, completing the necessary circuits to turn the machine on.

INSTRUCT-O-MAT

When the managers control switch is moved into the Instruct-O-Mat position, the circuit is completed in the same way as it was in the bowl position. In addition, the managers control circuit is grounded. This ground prevents chassis logic from running the sweep down. The machine will not go through its cycles until the managers switch is returned to the bowl position. However, the back end motor will run normally with the managers switch in the Instruct-O-Mat (practice play)
position.

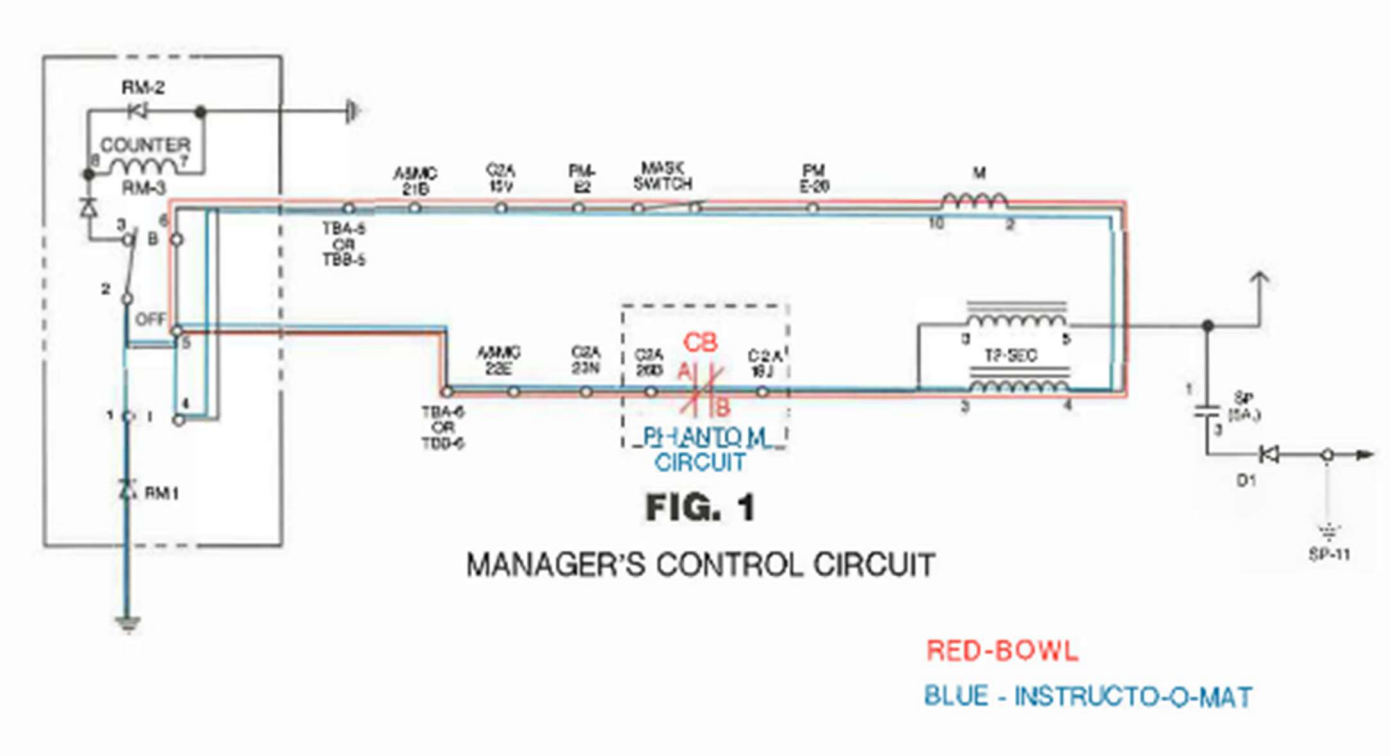

FIG. 1

MANAGER'S CONTROL CIRCUIT

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INTERLOCK

In order to energize the table or sweep motor relay, the 24 volt controlling voltage must pass through the table sweep interlock circuit consisting of TB (table cam switch) and SC (sweep cam switch) contacts wired in parallel. One of these switches, either TB or SC, must be on to run the table and sweep motors. If the table and sweep are on a collision course, both TB and SC will turn off. This removes the controlling voltage from both relays, stopping the table and sweep motors. Table and sweep run switches are inoperative in an interlock condition. Cranking the table or
sweep motor to clear the interference zone is the safest procedure to follow.

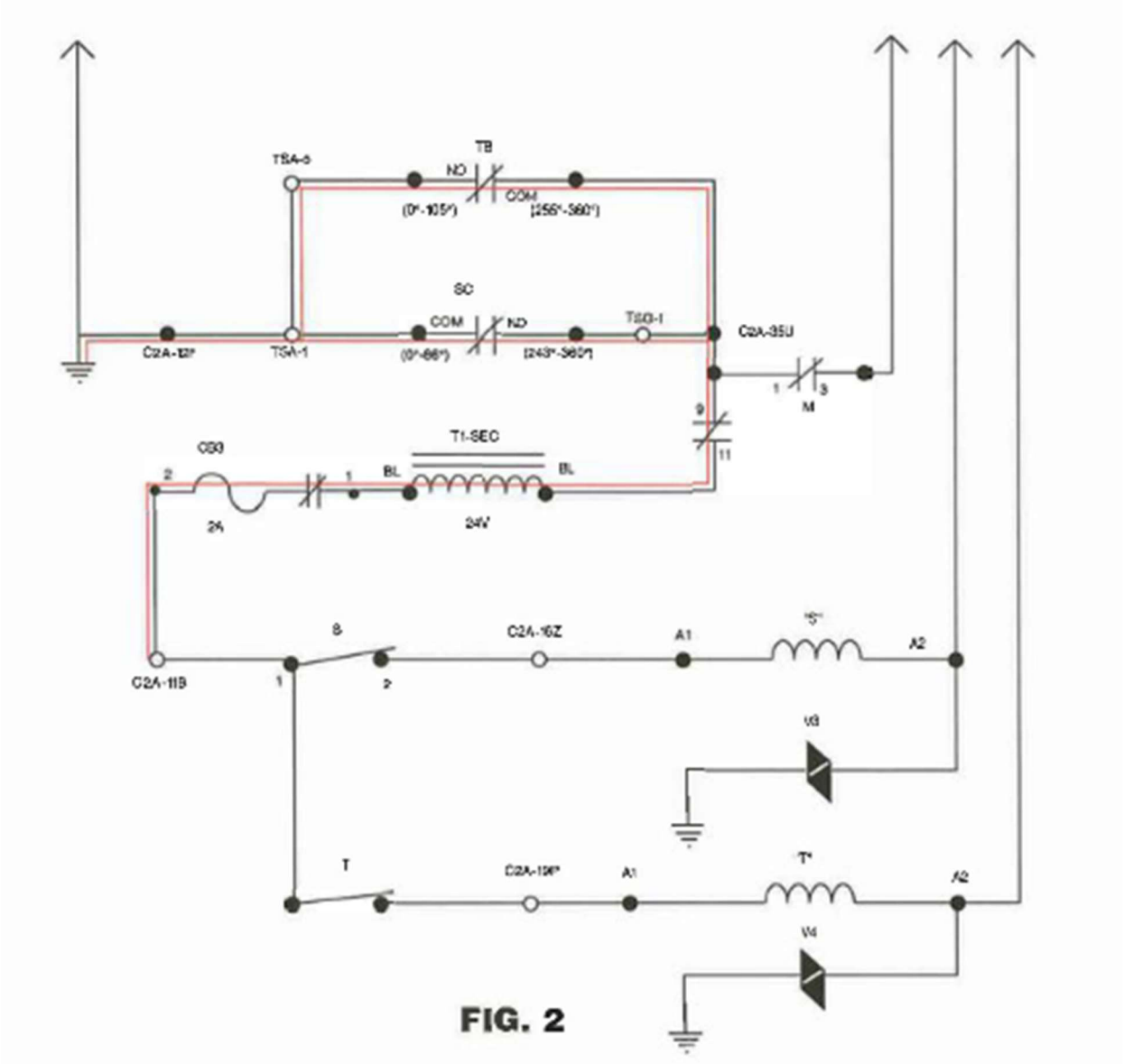


FIG. 2

INTERLOCK CIRCUIT

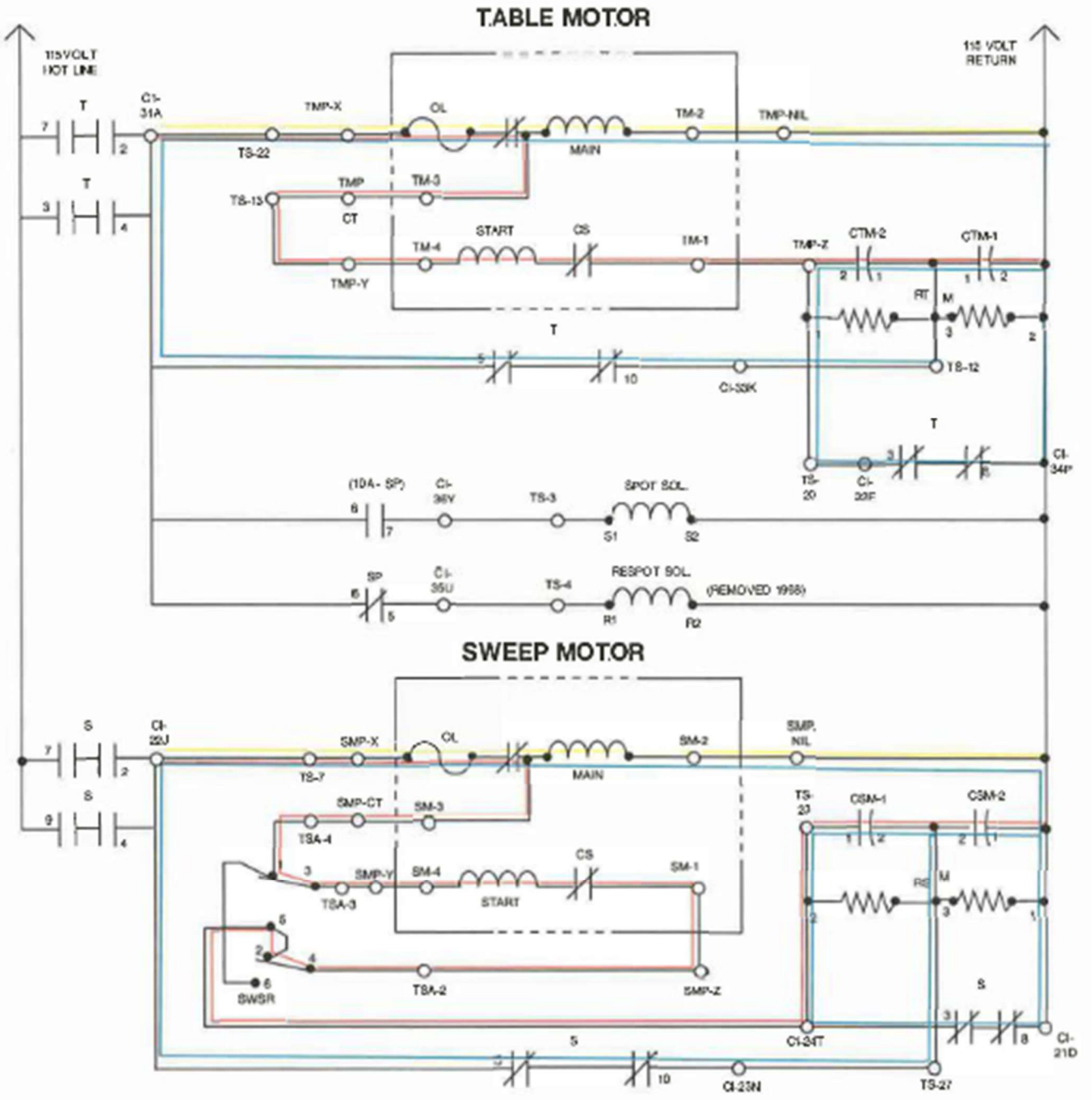
TABLE AND SWEEP CONTROL RELAY OPERATION

MOTOR RUNNING

On control relays T and S, two sets of contacts (normally open (N.0.) and normally closed (N.C.)) are used. For example, when S or T is energized, the normally open (N.0.) contacts close and power is sent to the main winding and to the starting winding through the capacitors and centrifugal switch starting the motor. When the motor gets up to speed, the centrifugal switch opens, removing the start winding, and the motor continues to run on the main winding. If the capacitors are in a charged state at this time, resistors connected in parallel with the capacitors will discharge them. (Fig. 3)

MOTOR BRAKING

When T or S is de-energized, the normally closed (N.C.) contacts close, connecting the capacitors across the main winding. When power is cut off to the motor, the armature still turning acts as a generator and induces a voltage in the main winding. The capacitors connected in parallel with the main winding provide a current path for the generated voltage, producing a magnetic field. This magnetic field polarity opposes the rotating armatures magnetic field which effectively slows down the motor. The motor slowing down closes the centrifugal switch connecting the start winding across the main winding, producing additional field strength and stopping the motor. When the armature has stopped turning, there is no more braking. Friction in the motor's gearcase will hold the table and sweep at their zero positions. Some motors incorporate friction braking in addition to regenerative braking to stop motors and hold them at zero.



MOTOR CIRCUITS

FIG. 3

NOTE: Main winding has approximately 1.5 OHM resistance.
Start winding has appoximately 4.2 OHM resistance.

YELLOW RUN
RED START
BLUE BRAKING

SWEEP MOTOR WIRING MP

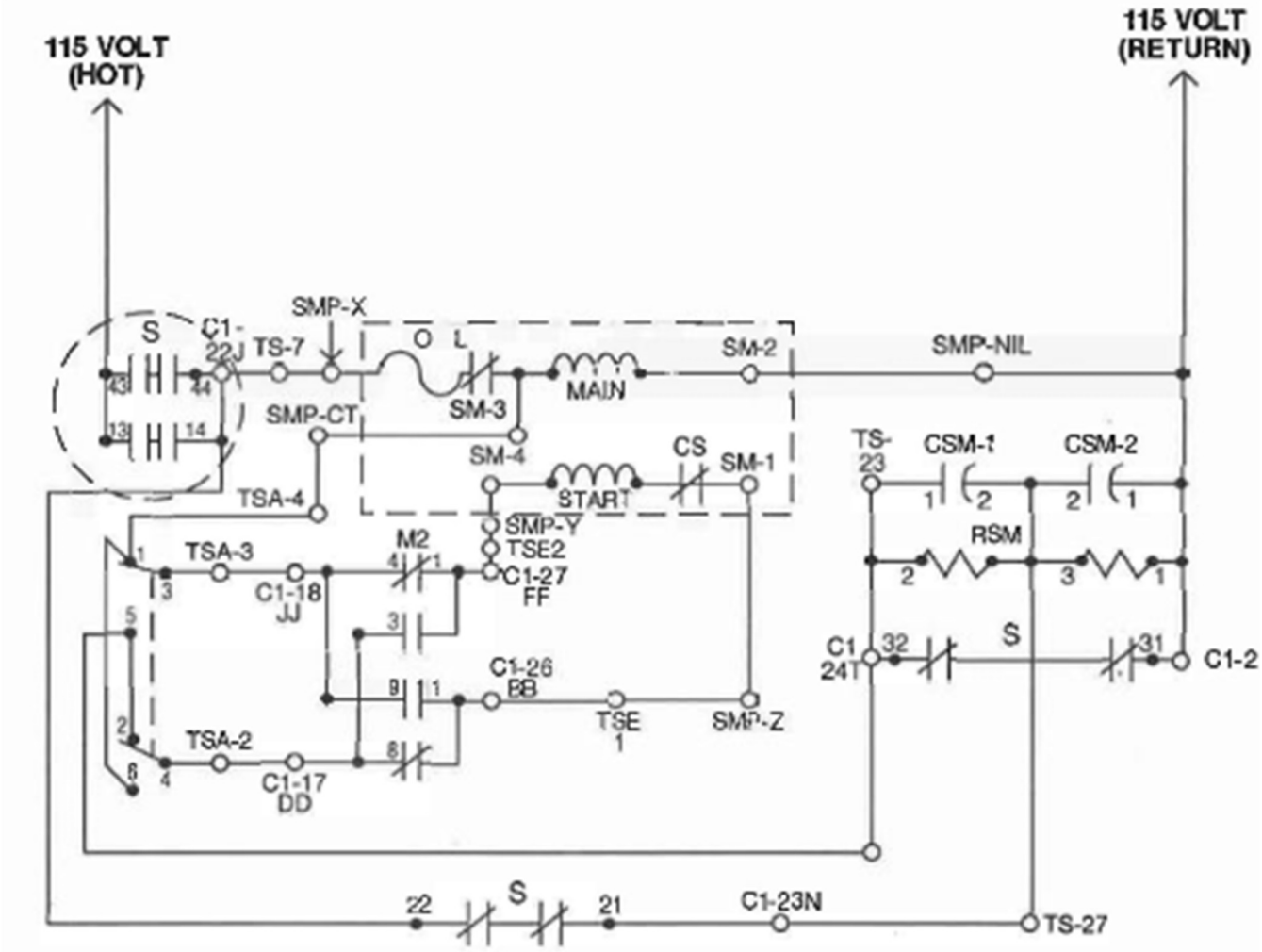


FIG. 4

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TESTING MOTOR PLUGS

A voltmeter or neon voltage tester can be used to check for voltage at the motor plugs. Voltage will only be present at the plugs when the machine is on and the appropriate motor relay in the chassis is energized. With the motor cable disconnected from the motor, look at the mating surface of the plug. Table and sweep motor plugs are viewed with the index pin at nine o'clock (Fig. 5.) Plug terminals can now be identified. The back-end motor plug only has two terminals. Voltage must be present between these two terminals when the back-end relay is energized. Voltage must be present between terminals X and NIL and between terminals X and Z of the table and sweep motor plugs. In addition, there must be continuity between terminals Y and C.T.

Power must be removed from the pinspotter before making continuity tests. If voltage or continuity is not present at the proper test points the motor cable plug can be disassembled and connections inspected. Wires in the motor cable can be checked for continuity from the motor plug to the terminal strip in the wireway. The C-1 plug is another likely component to suspect when motors fail to run or drifts. Look for pins pushed in, burned or corroded. Terminal strip and C-1 plug numbers can be found on the 6730, 9807 or 5500 drawings. If voltage and continuity are present at all the proper test points, but the motor fails to run, the motor itself may be at fault or a motor capacitor may have failed. (See section on capacitor testing.)

TESTING MOTOR PLUGS

(Plug Viewed From Mating Surface)

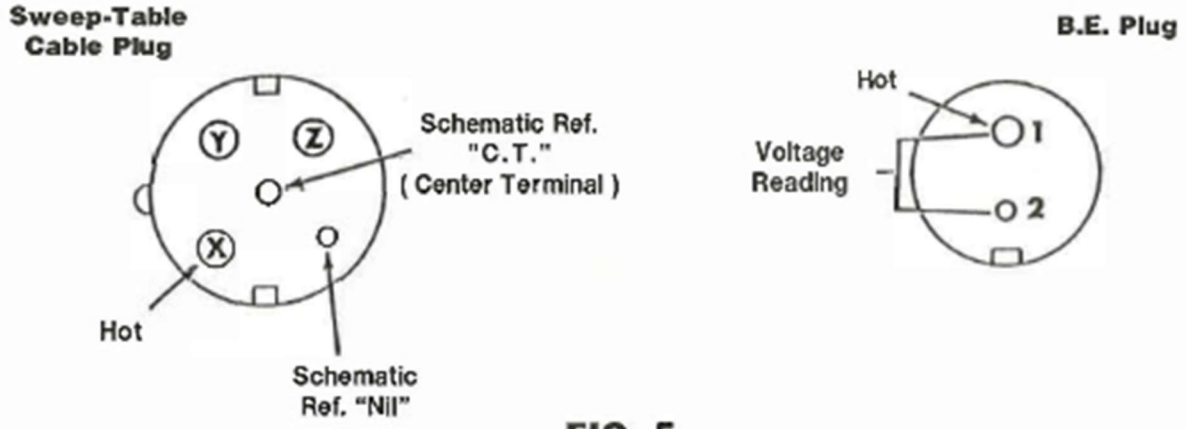


FIG. 5

Voltage Tests With Power On

Between			
X	and	Nil	} Sweep & Table)
X	and	Z	
X	and	Y	(Sweep Reverse)
1	and	2	(BE Plug)

Continuity Tests With Power Off

Between			
(Braking)	X	and	nil (300 OHMS)*
(Braking)	X	and	Z (300 OHMS)*
(Run)	Y	and	C.T.
(Braking)	Z	and	NIL

* Any resistance reading more or less than 300 indicates trouble.

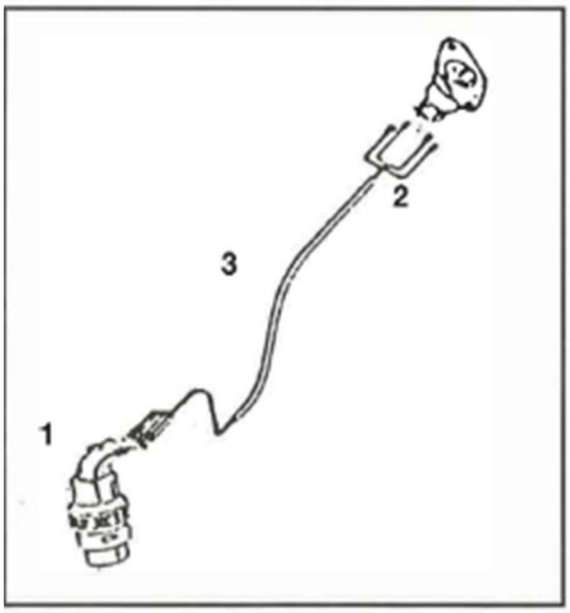
82-70 COMBINATION MOTOR TEST CABLE

Here is a quick way to determine if the trouble is in the pinspotter or the motor when a table or sweep motor fails to run or brake properly.

If the appropriate relay in the chassis is on, table or sweep, control circuitry is not at fault. The trouble is in the 115 volt motor run circuit or in the motor itself. Using a homemade test cable to gain the additional length needed, plug the table motor cable into the sweep motor, or sweep motor cable into the table motor as the case may be.

Example: If the table motor failed to run or brake properly on its own machine circuitry, but runs properly on the sweep motor machine circuitry, the trouble is in the machine's table circuit. But if the table motor will not run on either its own circuit or the sweep motor circuit, and the sweep motor will run properly, the table motor is at fault.

MOTOR TEST CABLE



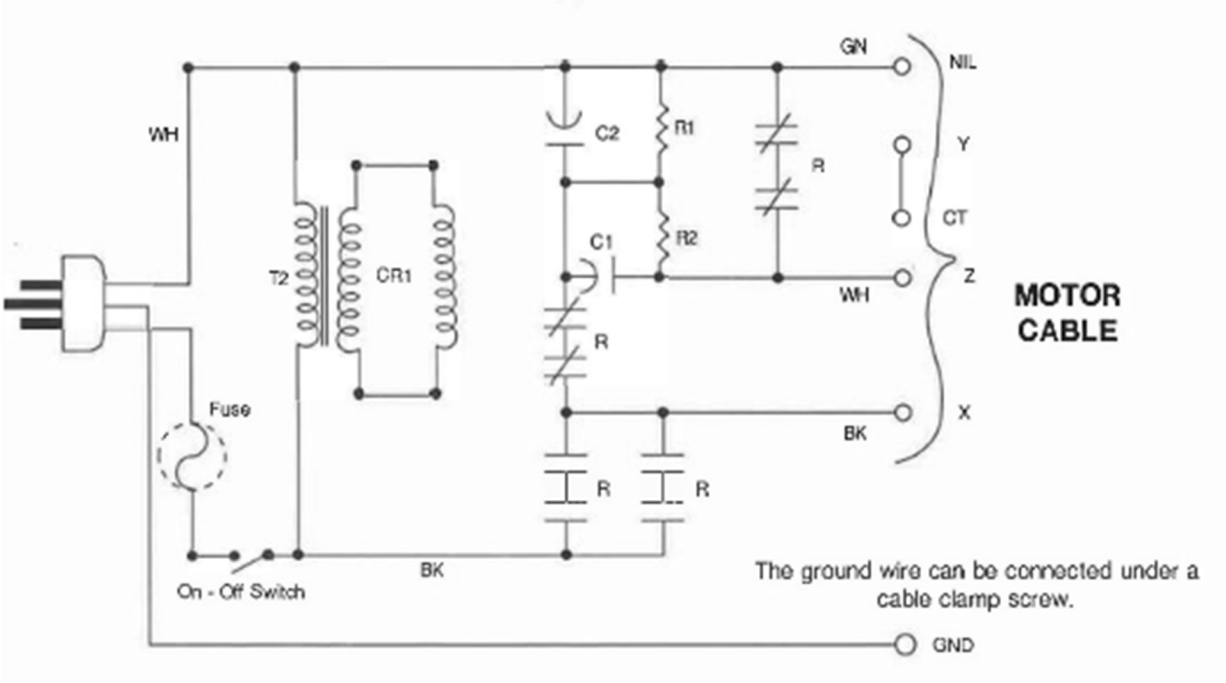
1) 000-027-660 Plug Female - 5 Prong
2) 000-027-655 Receptacle Male - 5 Prong
3) 3 Feet 5 Conductor Cable 16 GA.

NOTE: In assembling the test cable, simply match letters on plug and receptacle. Example:

X to X CT to CT
Y to Y NIL to NIL
Z to Z

Start windings 4Ω (+/- .5Ω)
Run 1.5Ω

82-70 COMBINATION MOTOR TEST BOX



These components can be mounted in any suitable metal box. A fuse or circuit breaker may be added to the hot line if desired. However, the outlet that the test box is plugged into should be on a 15 AMP circuit that will be protected. This test box will check both run and braking circuits of a combination motor. All internal connections are made with 16 GA. wire. Parts used to construct
this test box and the motor cable are listed below.

THE TEST BOX CONSISTS OF	THE MOTOR CABLE CONSISTS OF
(1) T-2 Transformer, 000-026-836 (2) Capacitor 460-550MFD, 743-000-020 (2) Resistor 1250 OHM, 916-931-256 (1) Switch, 000-029-857 (1) Relay, 070-011-755 Assorted Terminals 10 AMP Fuse or Circuit Breaker	(1) 16 GA. 5 Conductor Cord, 010-101-010 (5)Spade Terminals, 760-017-038 (1)Plug- Female, 000-027-660 (1)Con nector, 746-001-016 (1) Lock Nut, 846-100-000

AMF BOWLING INC.
PINSPOTTER TRAINING

BACK END MOTOR

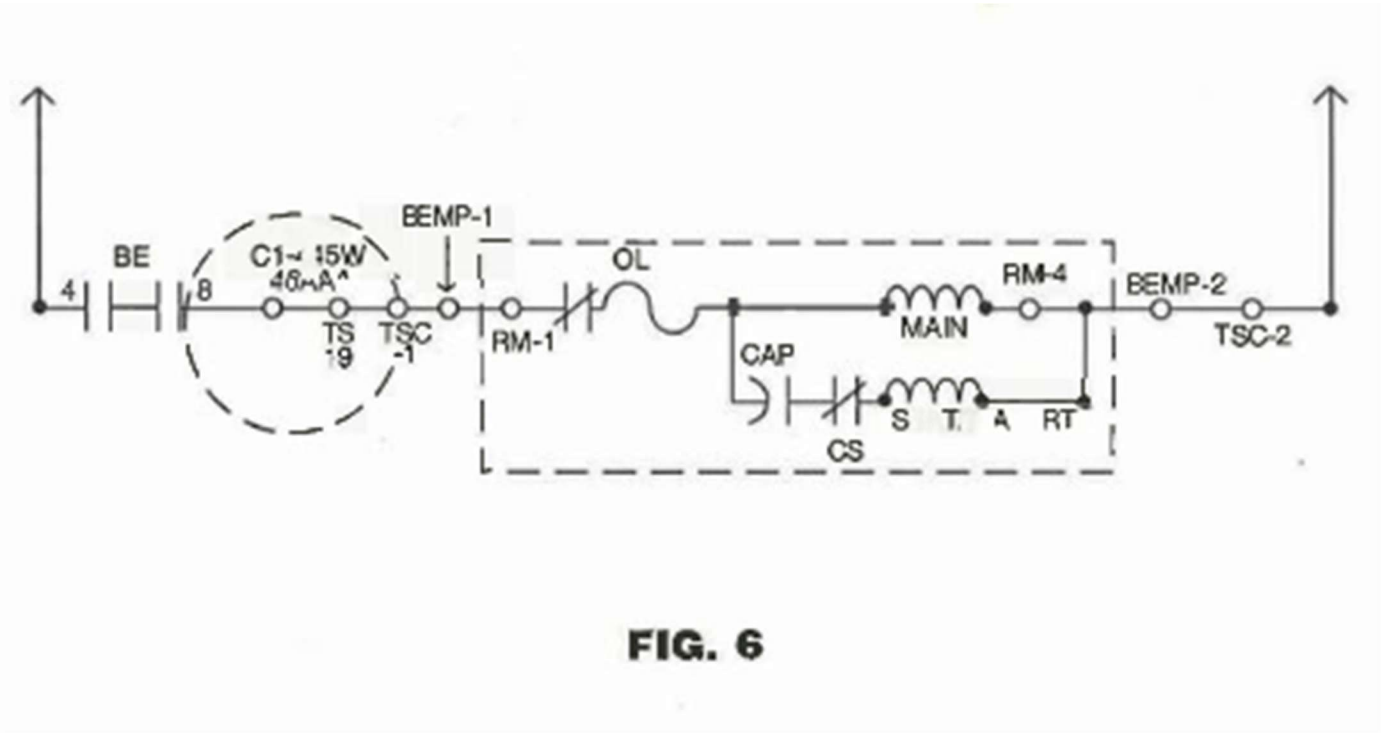


FIG. 6

USING A VOLTAGE TESTER

NOTE:

All power to the machine must be turned on. Do not touch exposed metal on test leads.
CAUTION Should be used when testing live circuits.

To check for voltage at the motor plug, the machine must be on and the motor relay must also be on. Insert one test lead into each hole of the plug. (Fig. 7) If the neon lamp glows the circuit is "hot". If the neon lamp does not glow the circuit is open. The tester test leads do not have polarity
- either lead can be inserted into either hole.

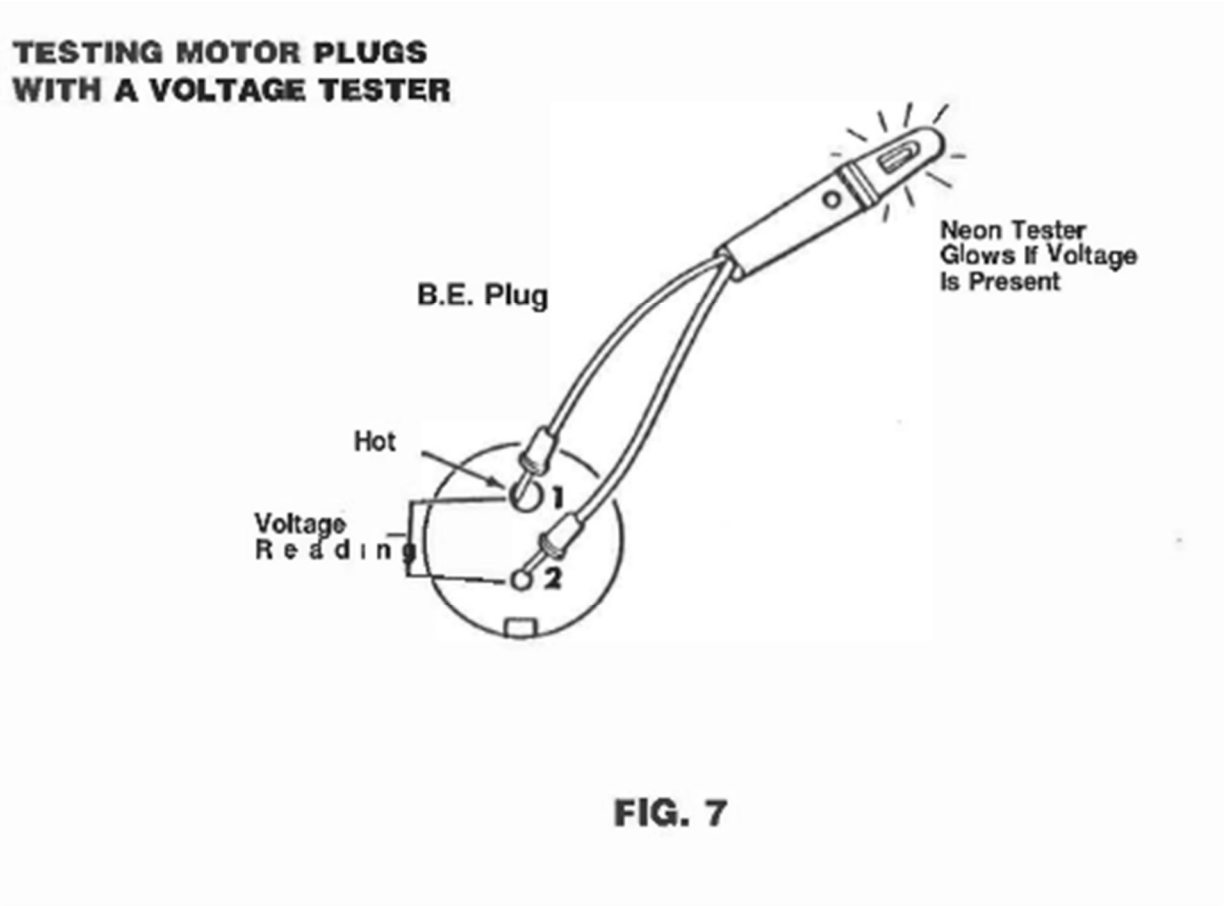


FIG. 7

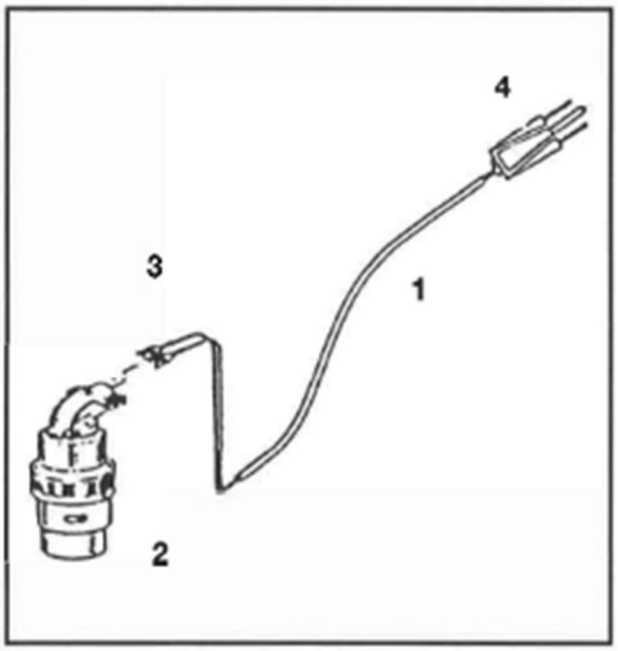
AMF BOWLING INC.
PINSPOTTER TRAINING

82-70 BACK END MOTOR TEST CABLE

Here is a quick way to determine if the trouble is in the pinspotter or the motor when a back end motor fails to run.

If the BE relay in the chassis is on, control circuitry is not at fault. The trouble is in the 115 volt motor run circuit or the motor itself. A homemade test cable can be used to determine if the motor is capable of running. One end of the cable plugs into the motor, the other end into a 115 volt outlet. If the motor fails to run, the motor is at fault. If the motor runs with the test cable, machine wiring or chassis is at fault. This cable can be used to run the BE motor indefinitely, but the motor cannot be turned off from the desk.

BACK END MOTOR TEST CABLE



1) 010-013-210 16GA Cable - 3 Conductor
2) 000-025-907 Plug Female - 2 Pin
3) 760-017-038 Flat Spade Terminal-2 Needed
4) 754-020-325 Plug Male

NOTE: In assembling the test cable, the hot side of the line should be connected to the large BE plug terminal. The return side of the line is connected to the small BE plug terminal. The ground wire can be connected under a cable clamp screw.

MOTOR CAPACITORS

Two capacitors are used in the starting and electrical braking circuits of the table and sweep motors. Only one capacitor is used in the starting circuit of the back end motor. The back end motor does not have a braking circuit. Occasionally a capacitor may fail, resulting in an inoperative motor. If a capacitor opens internally, the motor will not start. The motor will hum, get hot and the klixon will trip. If a capacitor shorts internally, the motor will run but may start with a strange sound. With a shorted capacitor, electrical braking will not work, and the motor will coast (drift) to a stop.

Burnt or loose connections may cause coasting or failure to run and the trouble could be intermittent. Trouble areas include relay contacts, C1 plug, motor plug and the centrifugal switch in the motor. If the centrifugal switch is open, the motor will not start. The motor just hums, gets hot and trips the klixon. If the centrifugal switch fails to open when the motor runs, once again the motor gets hot. Also, one or both capacitors may explode.

An ohmmeter can be used to determine if a capacitor is good, open or shorted. Capacitors store an electrical charge and could be in a charged state in the machine. Before handling a capacitor, remove the power plug (Russell Stoll), lift the cover from the wireway behind the table motor (Fig.
9) and short across the terminals of the capacitors. An insulated screwdriver can be used to do this. If a capacitor is charged, this will discharge it. However, it is unlikely you will find a charged capacitor in the pinspotter. The capacitors are identified as CTM for capacitor table motor and CSM for capacitor sweep motor. The back end motor capacitor is mounted on the BE motor stator.

To test a capacitor, after making certain it is discharged, remove the connections from one capacitor terminal (Fig. 10). Using the highest resistance scale of an ohmmeter, connect the meter leads to the two capacitor terminals and leave them connected of approximately one minute. The battery in the meter will charge the capacitor. A resistance reading of 50,000 ohms or more indicates a good capacitor. If the meter reads zero ohms, a shorted capacitor is indicated. No reading at all (infinite) indicates an open capacitor. After testing a capacitor, it should be discharged by shorting across its terminals. When replacing a capacitor, it should be installed with the vent plug at the top (12 o'clock position). Capacitor terminal screws must be tight. The resistors to the right of the capacitors in the wireway are used to discharge the capacitors.

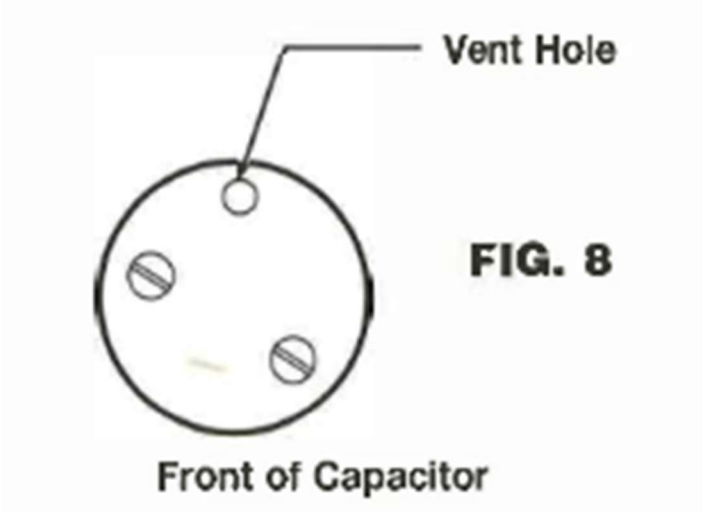


FIG. 8

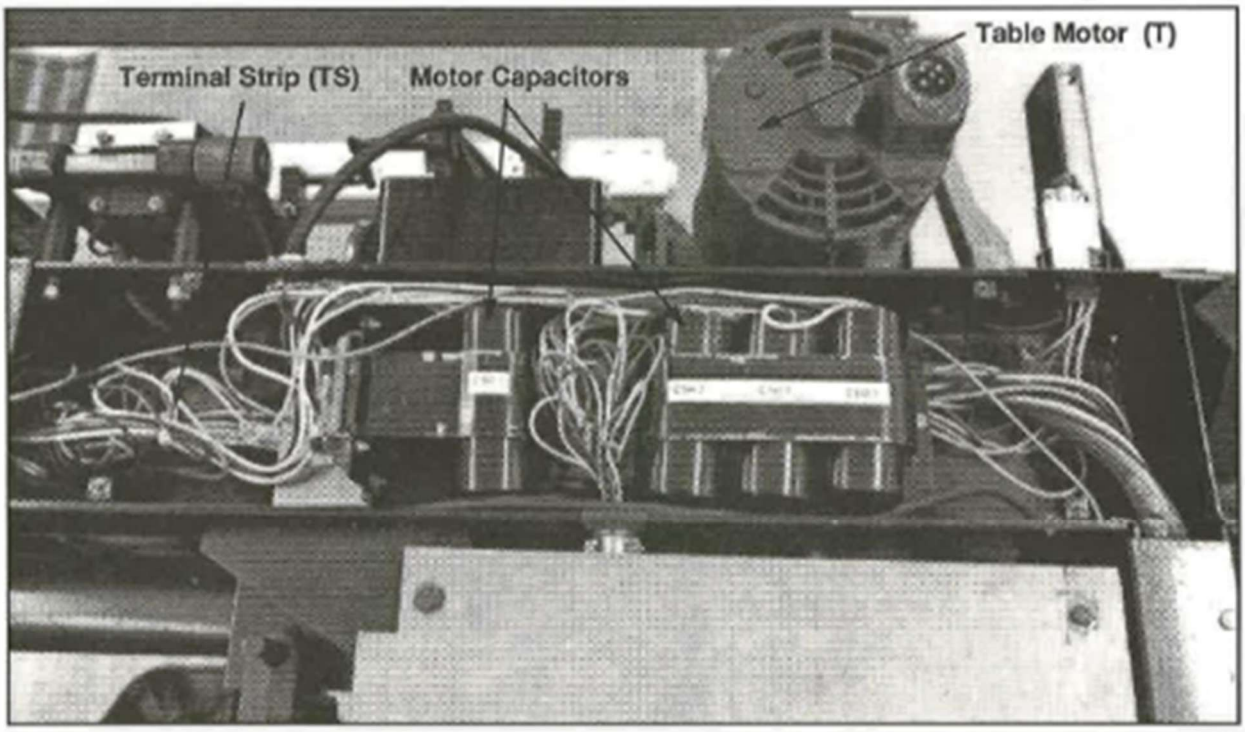


FIG. 9

MOTOR CAPACITORS

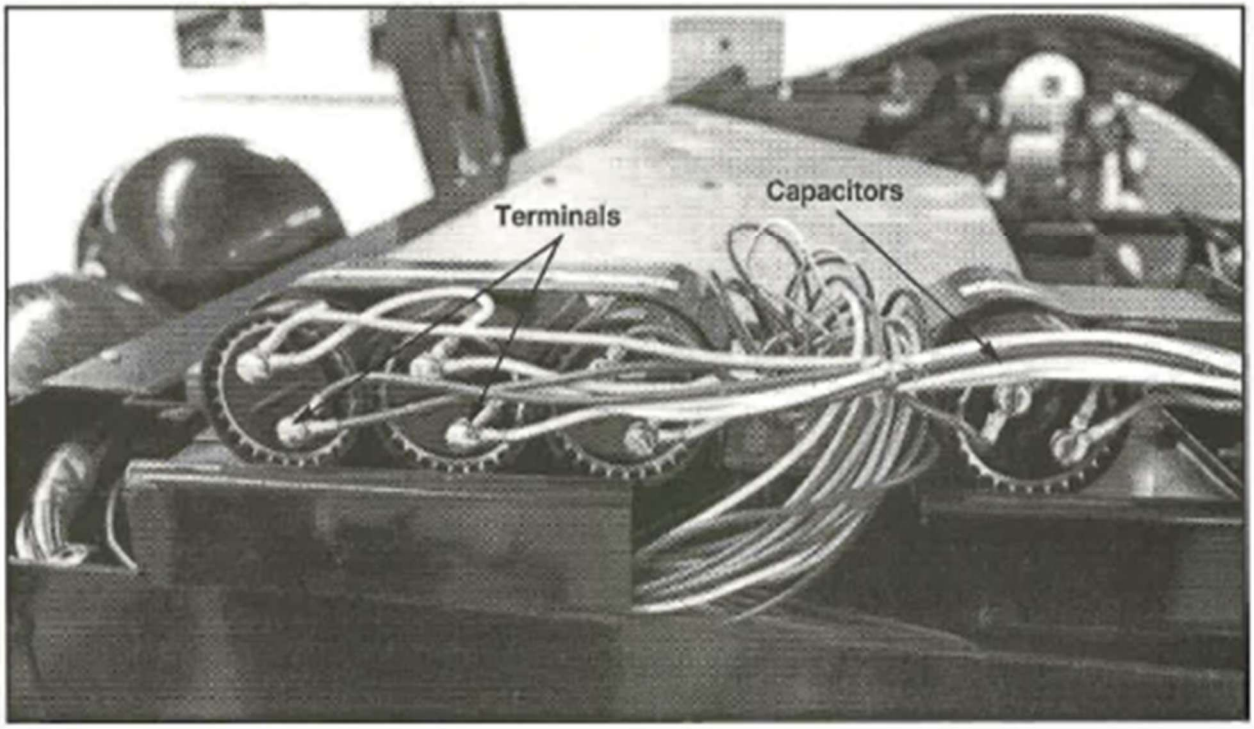


FIG. 10

TROUBLE SHOOTING PROCEDURES FOR WIRING AND SWITCHES

Wires are used to connect individual circuit components, such as switches, lights, motors, and control chassis. Wire used in the Pinspotter is called stranded wire. It is made up of individual strands of wire, twisted together in a bundle and wrapped in insulation. Wires sometimes break at stress points where they are twisted, subjected to continual bending, or just have normal use over a long period of time. Normally, wire has very low resistance. When wires break or "open", their resistance is very high or “infinite”, and no current will flow. An open circuit test would indicate a broken wire. In addition to an "open" wire causing trouble, wires "shorted" to other wires or a wire "grounded" to the machine frame will cause trouble. Each condition, “open", "shorted", or "grounded" requires a different test procedure to isolate the problem. Testing for continuity, ("open" circuit test) is probably the most common test made. This test can be used to check wires, switches, fuses, bulbs, relay contacts and many other electrical devices.
Any of the various types of continuity testers available can be used to make these tests. However, continuity testers supply their own voltage to the circuit or device being tested. **Make certain that the device or wire being tested is unplugged so that no voltage exists in the circuit. Electricity can kill.**

When a machine malfunctions and the cause is not obvious, the machine control chassis can be replaced with a chassis known to be good, thus eliminating the chassis as a possible cause of the problem. If changing the chassis cures the problem, we would then repair the chassis. However, if the problem remains, we will trouble shoot the machine wiring and switches. What the machine does or does not do dictates what circuit a problem is in and what type of test should be used.

EXAMPLE:

If a pindication light never comes on, we would look for an open wire.

If a pindication light always comes on, we would look for a ground or short.

USING A CONTINUITY TESTER

A simple flashlight type continuity tester is easy to use. It consists of a flashlight with plug in test leads. The test leads must be shorted together to make the light come on. To use the continuity tester, turn it on and touch the leads together. The light should come on. Always perform this preliminary step before using any continuity tester. It verifies that the tester is working.

Open Circuit Test

To check continuity of a wire, switch, fuse or relay contact, remove it from the circuit by disconnecting one end of the wire or one wire from the switch. Connect one test lead to one end of the suspected wire, and the remaining test lead to the other end of the disconnected wire. If the wire is good, the tester will light. With an open wire, the tester will not light. When testing a switch, it should be turned on and off several times to detect intermittent closings. (See Fig.11)

Short Circuit Test

To check for a short between two wires, disconnect both ends of the suspected wires. Connect one test lead to each wire. If the tester lights, the wires are shorted to one another. If the tester does not light, the wires are okay.

Ground Test

If a grounded wire is suspected, disconnect both ends of the wire, connect one test lead to the frame of the machine. This connection should be made to unpainted metal. The other test lead connects to the wire being tested. If the wire is grounded, the tester will light.

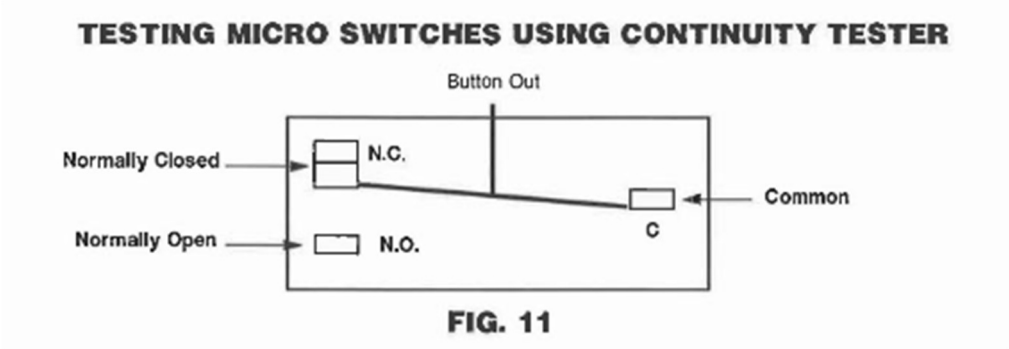


FIG. 11

NOTE: To make this test on machine remove wire connected to common terminal of switch.

1. Connect continuity tester across common (C) and normally closed (N.C.) contacts of switch. Tester should light. Depress button on switch several times to check mechanical action. Tester light should go off and on.

2. Connect continuity tester across common (C) and normally open (N.O.) contacts of switch. Tester should not light. Depress button on switch several times. Tester light should go on and off.

HOW TO LOCATE BREAKS IN WIRES

If you have a wire that is broken (no continuity) a continuity tester will tell you the wire is broken, but not where the break is. Here is one method that can be used to locate the break. The first test would be over the entire length of the wire indicating a break (no continuity). An extension wire can be used if the test leads are not long enough. Next, test from one end of the wire to a point somewhere near the center. A pin can be used to pierce the insulation, so contact is made with the wire. If there is continuity perform the same test on the remaining length of the wire. If there is no continuity, take half the length of the wire and repeat the test. Continue to use this half the length of previous test approach until the break is found (see Fig. 12)

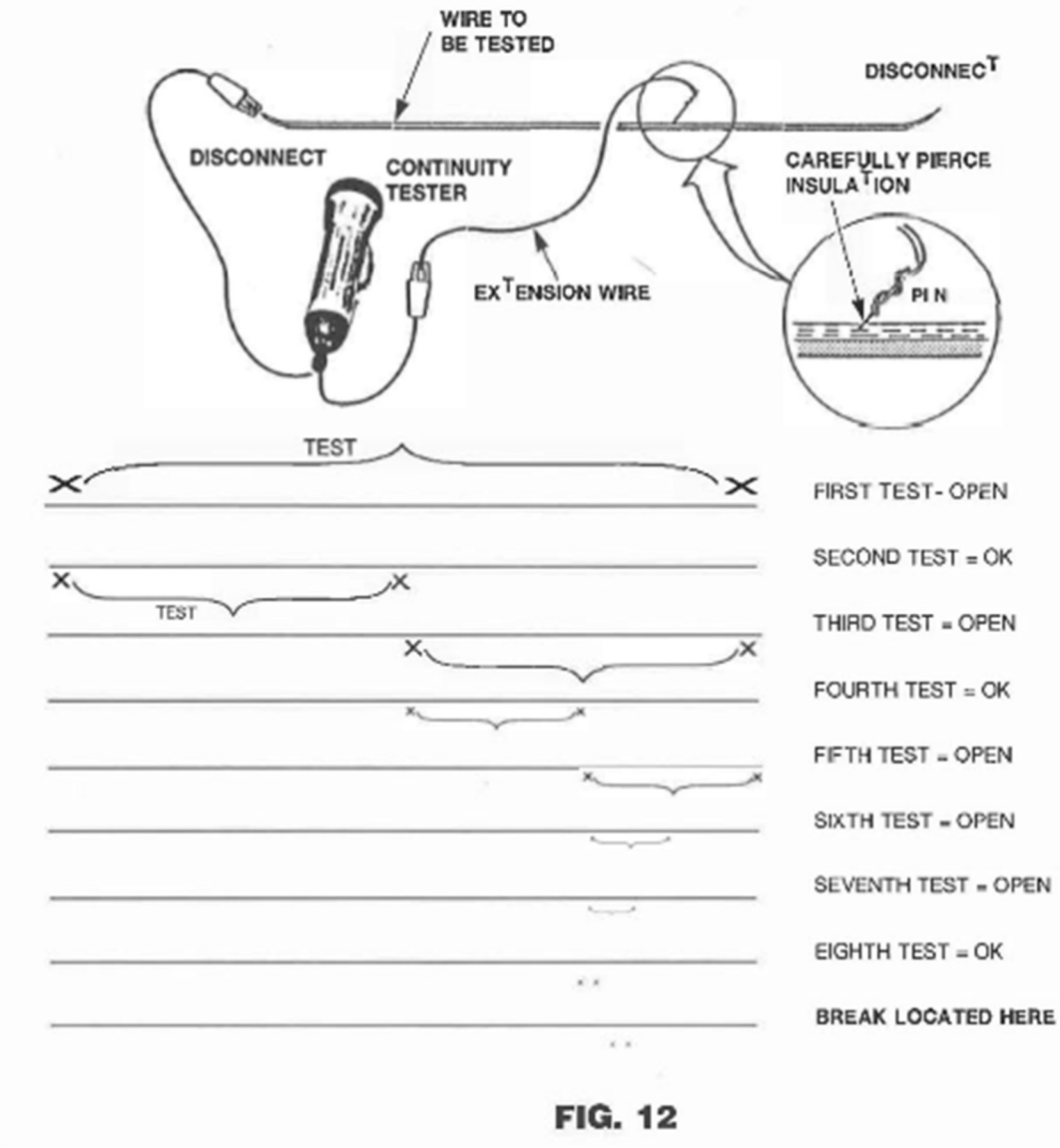


FIG. 12

PLUG TERMINAL IDENTIFICATION

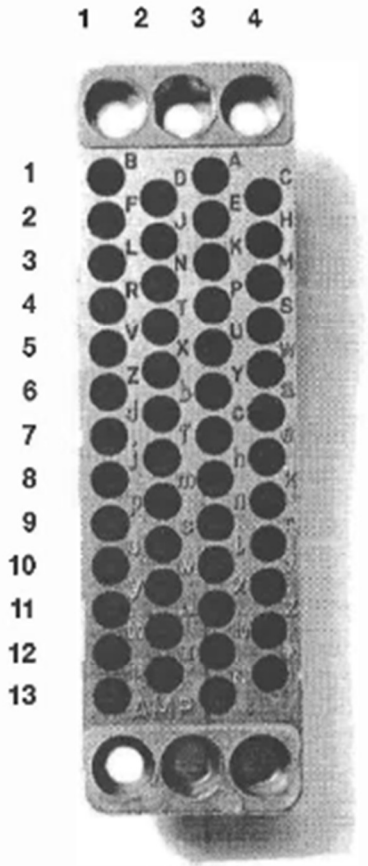


FIG. 13
Plug Terminal Numbers
Plug viewed from mating surface with the 13 terminal row to your left.

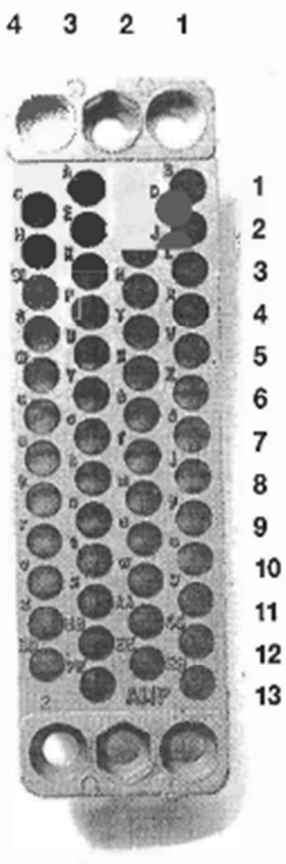


Fig. 14
Receptacle Terminal Numbers
Receptacle viewed from mating surface with the 13 terminal row to your right.

With the mating surface of the plug held vertically and facing you, and with the outside row of 13 terminals to your left, the left column of 13 terminals is column 1 (Fig. 13). The next column to the right, having 12 terminals, is column 2, the next is column 3 and the right-hand column, having 12 terminals, is column 4. Starting at the top of the plug, the first pin in a column is pin 1. The next one below it is pin 2, the next is pin 3, etc. The last pin in column 1 is pin 13. The last pin in column 2 is pin 12. Every hole in the plug must be counted, even if it's empty. The drawings are marked to indicate what plug is being used, e.g., C1, C2A, table or A&MC. Numbers are used to indicate the column and pin. The first digit of the number indicates the column, the second digit(s) indicates the pin. Example: C2A 3 5 - this is the C2A plug, column 3, 5th pin down. C2A 311 would mean the C2A plug, column 3 11th pin down. Letters of the alphabet are also used at each terminal for their identification. Example: C2A 11 B. The exact same method of numbering is incorporated for the receptacle, except the receptacle columns are numbered from right to left (Fig. 14). All AMP type "M" plugs and receptacles used on the pinspotter are read in a similar fashion.

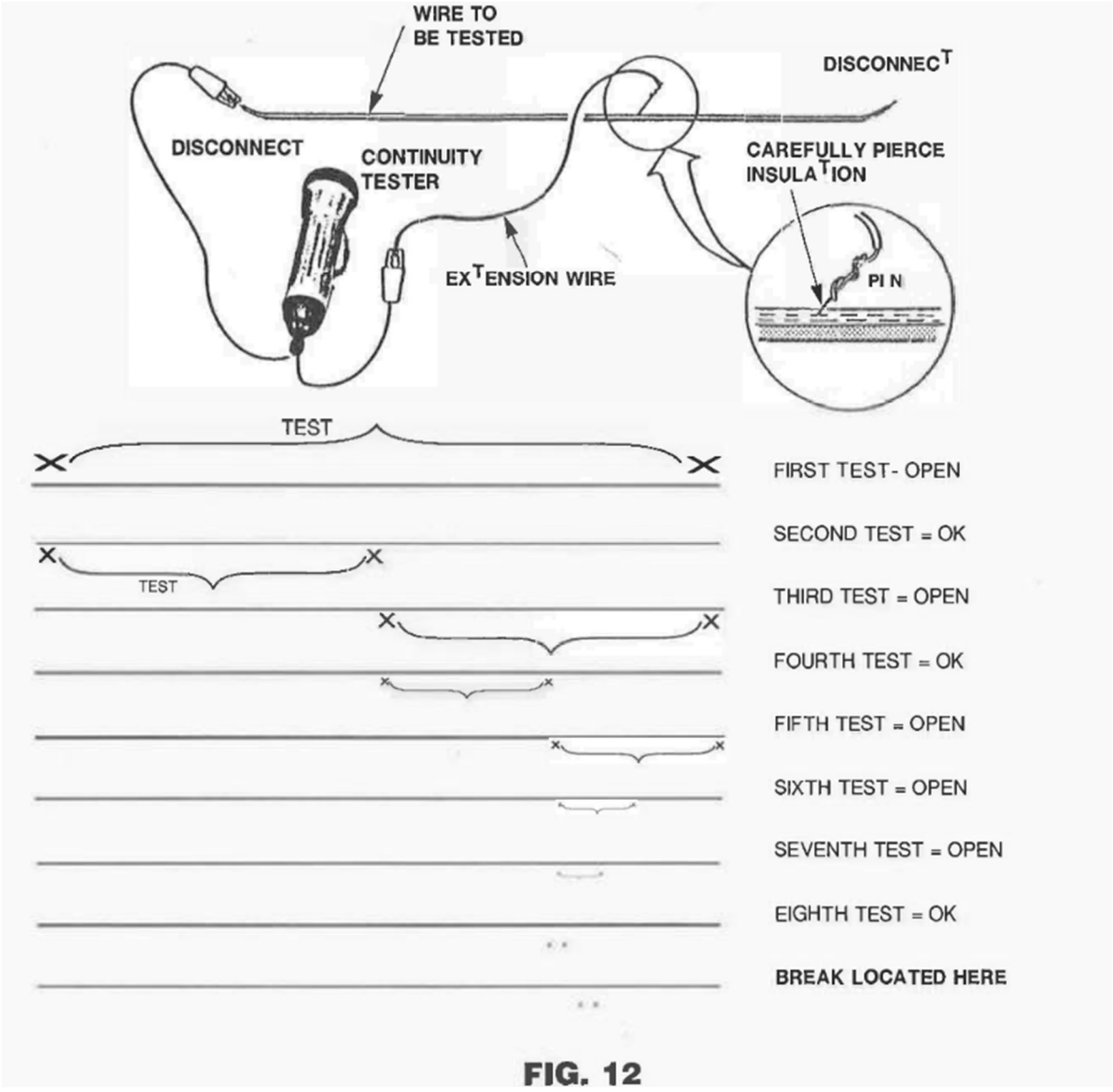


FIG. 12

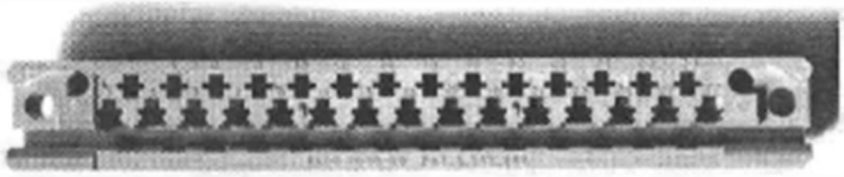
AMF BOWLING INC.
PINSPOTTER TRAINING

MASK PLUG TERMINAL IDENTIFICATION

RECEPTACLE USED ON 6700 ELCO CHASSIS

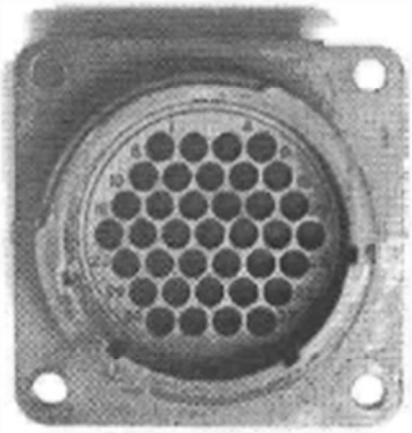
PM (plug Mask) and BPP (Ball Path Plug) Receptacle viewed from mating surface with the row of odd numbered terminals toward the bottom of the chassis.

PLUG USED ON 6700 ELCO CHASSIS (EARLY 5 BOARD)



PM (plug Mask) and BPP (Ball Path Plug) Plug viewed from mating surface with plug held horizontaly with the guide slot down. Mask plug numbers on the drawings are called out as PM E-1. Meaning Plug Mask-Elco-Pin Number 1.

RECEPTACLE USED ON C-23,(7750) 9800 AND 9900 CHASSIS

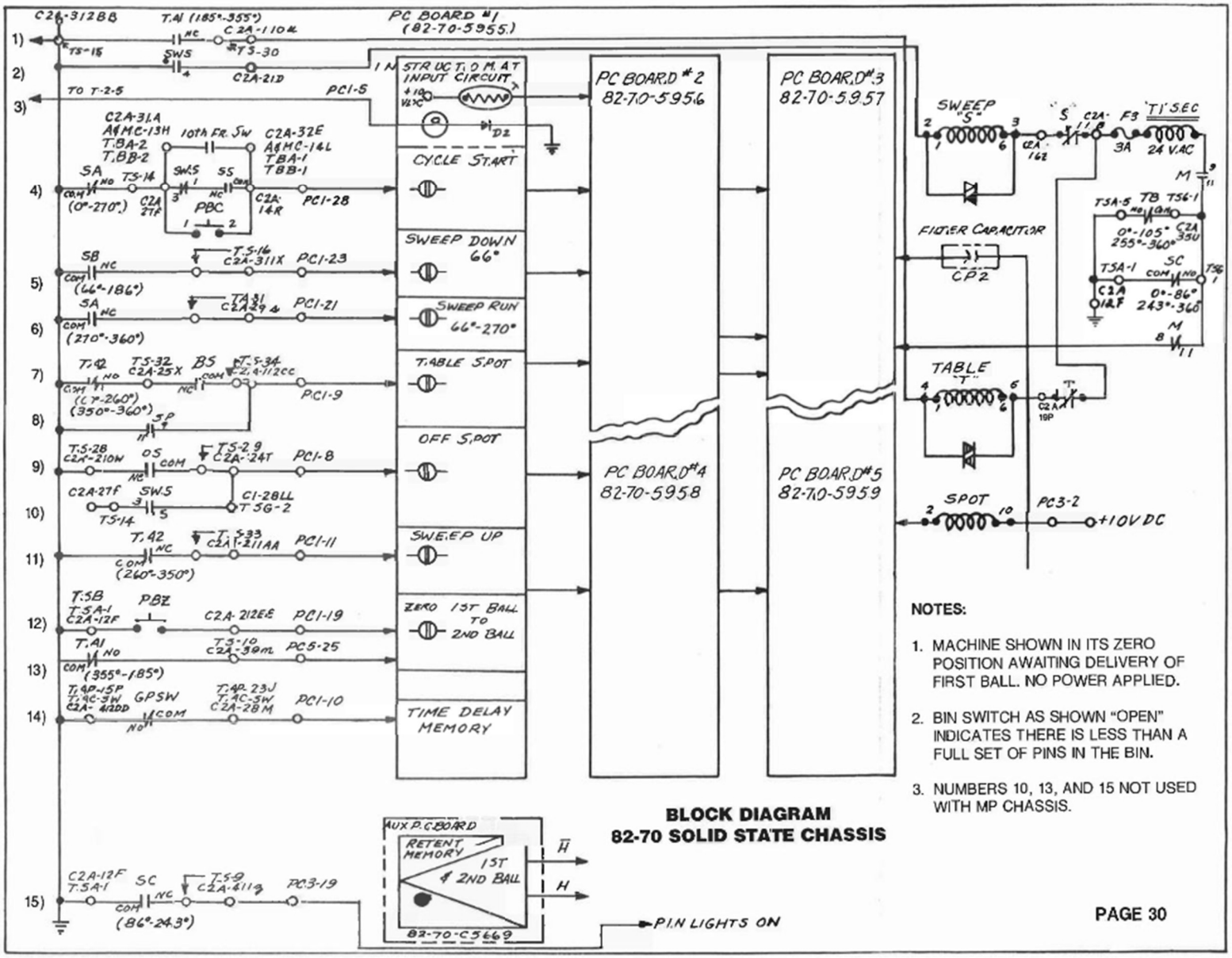


PM and BPP AMP Receptacle viewed from mating surface. The guide pins are in the bottom row. The numbers in the schematic indicated as E1 through E29 correspond to the same number on the AMP connectors and on the Elco connectors.

PLUG USED WITH 7750 (C-23) 9800 AND 9900 CHASSIS

PM and BPP AMP Plug viewed from mating surface with plug held so that the guide pins are in the bottom row.

AMF BOWLING INC.
PINSPOTTER TRAINING



BLOCK DIAGRAM
82-70 SOLID STATE CHASSIS

NOTES:

1. MACHINE SHOWN IN ITS ZERO POSITION AWAITING DELIVERY OF FIRST BALL. NO POWER APPLIED.
2. BIN SWITCH AS SHOWN "OPEN" INDICATES THERE IS LESS THAN A FULL SET OF PINS IN THE BIN.
3. NUMBERS 10, 13, AND 15 NOT USED WITH MP CHASSIS.

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AMF BOWLING INC.
PINSPOTTER TRAINING

82-70
SWITCH AND WIRE TESTING ON THE MACHINE

1. USE DRAWING 82-70 E 5500, 6730 OR 9807.
2. **REMOVE MACHINE POWER PLUG
3. USE CONTINUITY TESTER
4. FILL IN WHAT TERMINALS USED TO CHECK EACH SWITCH

EXAMPLE: TO TEST: SW BE USE - C2A TERMINALS 13L AND 313FE

TO TEST:	USE- C2A TERMINAL	TO TEST:	USE- C2A TERMINALS:
T SWITCH		SA N.O.	
S SWITCH		SAN.C.	
PBZ		SBN.O.	
SWS 4/6		SBN.C.	
SS		SC N.O.	
PBC		SCN.C.	
10TH FRAME		Gs-1	
BS		GS-2	
OFF SPOT		GS-3	
GP		GS-4	
TA1 N.O.		GS-5	
TA1 N.C.		GS-6	
TA2 N.O.		GS-7	
TA2 2 N.C.		GS-8	
TBN.O.		GS-9	
TBN.C		GS-10	

*N.C. REFERS TO NORMALLY CLOSED TERMINAL AS IDENTIFIED ON THE SWITCH.
**N.O. REFERS TO NORMALLY OPEN TERMINAL AS IDENTIFIED ON THE SWITCH

MANAGERS CONTROL CIRCUIT (EARLY)

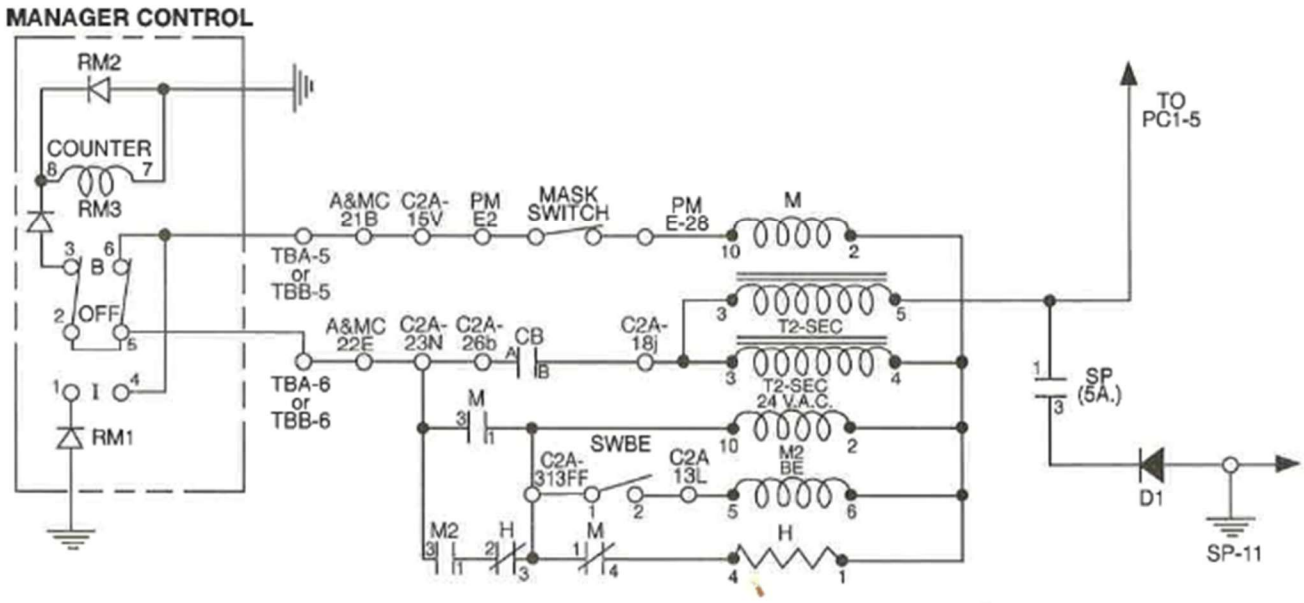


FIG. 15

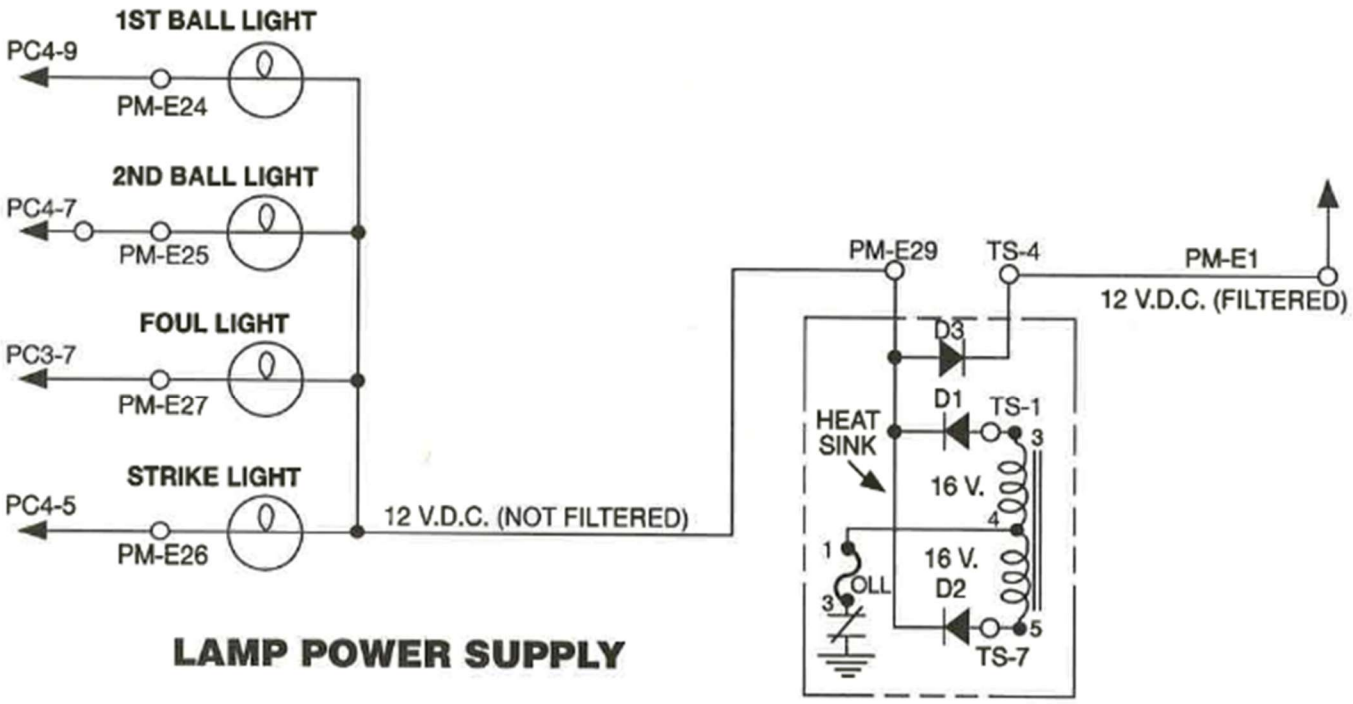

1ST BALL LIGHT
PC4-9
PM-E24
2ND BALL LIGHT
PC4-7
PM-E25
FOUL LIGHT
PC3-7
PM-E27
STRIKE LIGHT
PC4-5
PM-E26
12 V.D.C. (NOT FILTERED)
PM-E29
TS-4
PM-E1
12 V.D.C. (FILTERED)
D3
D1
TS-1
HEAT SINK
16 V.
16 V.
D2
OLL
TS-7
LAMP POWER SUPPLY

FIG. 16

NEON LAMP SUPPLY

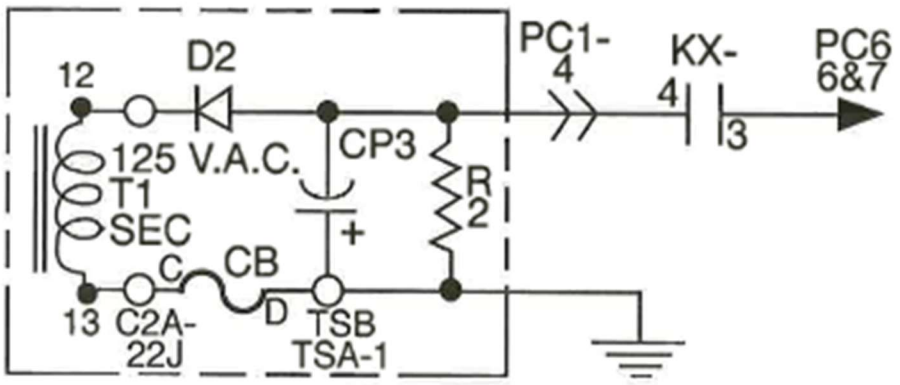
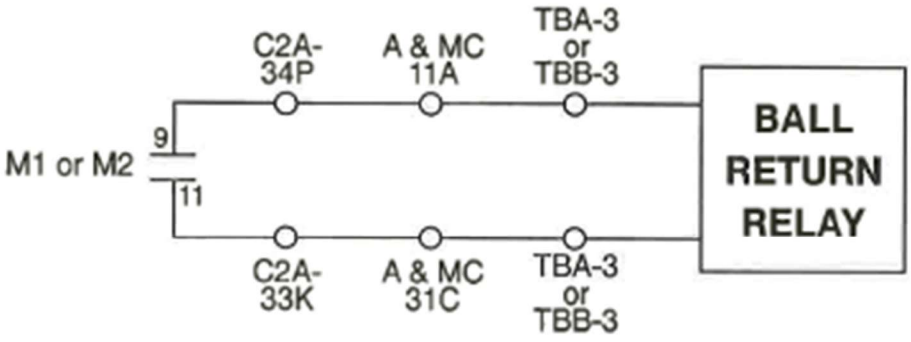


FIG. 17



GRIPPER PROTECTION (G.P.) CIRCUIT TEST PROCEDURES

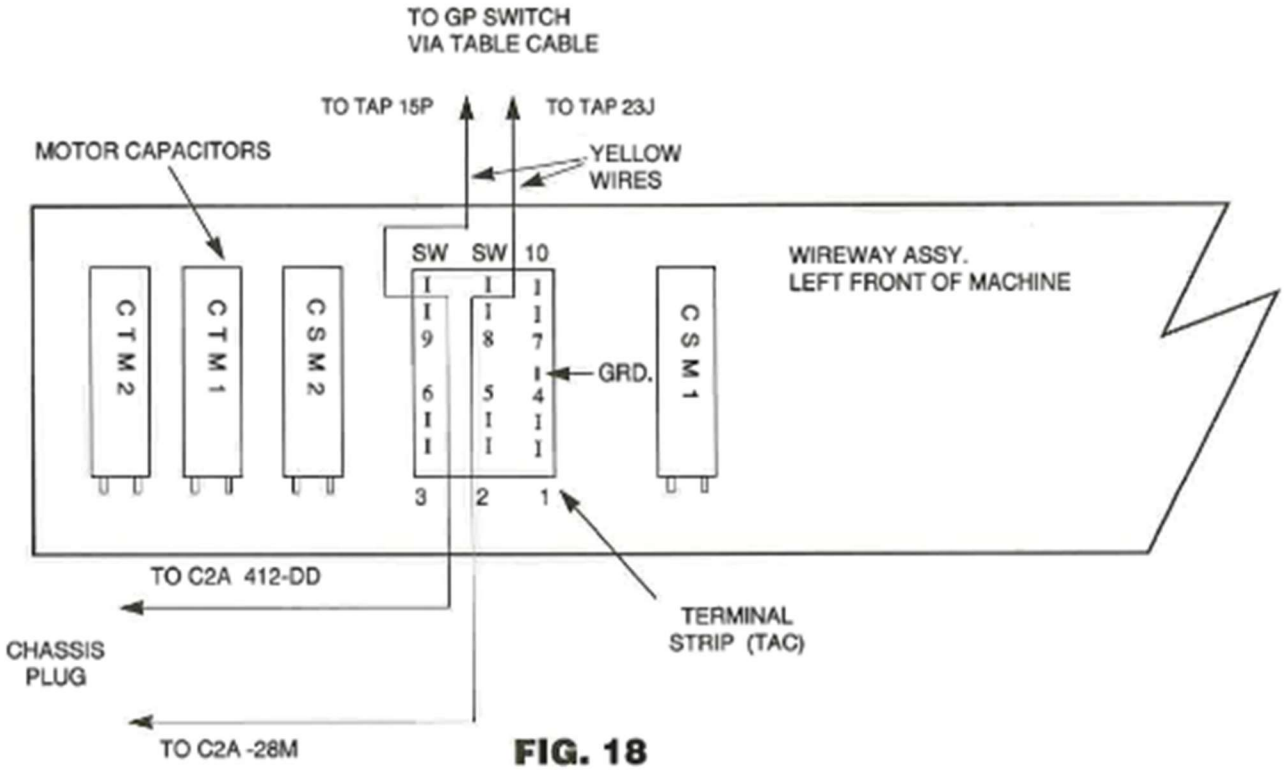


FIG. 18

1. If an open occurs in the GP switch, wire assy. or table cable, the table will not feel for pins during the first ball cycle.

2. Test - make sure respot cells are open, then connect jumper between (SW) contacts on terminal strip. If table feels for pins, there is an open in this circuit. Visually check all plugs, and connections, then test for continuity in the GP circuit and table cable.

3. If the table does not feel for pins with the jumper in place, the open is between the chassis (C) plugs and the terminal strip, or the problem is in the chassis, replace chassis and try again.

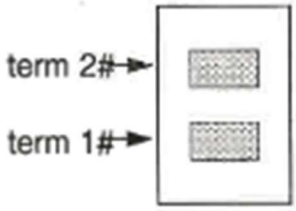
NOTE:
The contacts on TAC terminal strip I thru 10 are wire connections coming from (GS) gripper switch in respot cells 1 thru 10.

AMF BOWLING INC.
PINSPOTTER TRAINING

REAR CONTROL PANEL WIRING

MASTER CB

	R or L 66 Pink	to term A	
	R or L 57 Blue	to term B	
	R or L 64 Green	to term C	
	(jumper) 151 Green	to term D	from Gnd 1
	(jumper) 173 Black	to term E	from term 2 in Rear of Box
	R or L 172 Red	to term F	
Pit	R or L 74 Yellow	to term 1	
	R or L 53 Yellow	to term 2	
Sweep	R or L51 Yellow	to term 1	w/piggyback
	(jumper) 165 Yellow	to term 1	to table term 1
	R or L 55 Orange	to term 2	
Table	R or L 58 Gray	to term 2	



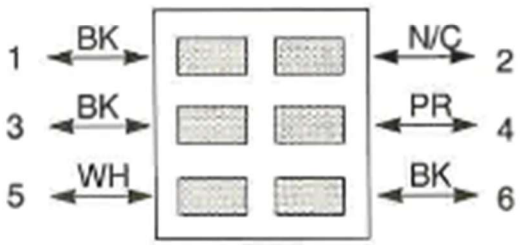
1st Ball Zero

R or L 102 Orange	to term 2	
(jumper) 161 Green	to term 1	from Gnd 1

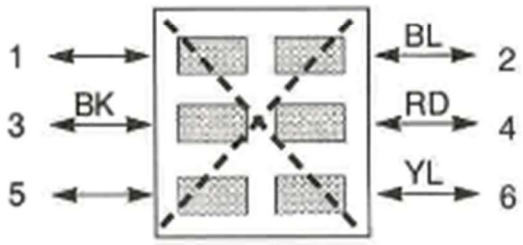
Cycle

R or L 129 Blue	to term 1	w/piggy back
R or L 54 Black	to term 2	

Sweep Run



Sweep Rev.



Sweep Run

Hot Black from start switch	to term 1
Term 2 Empty	
Jumper from cycle term 1	to term 3
R or L 63 Purple	to term 4
128 white	to term 5
R or L 132 Black	to term 6

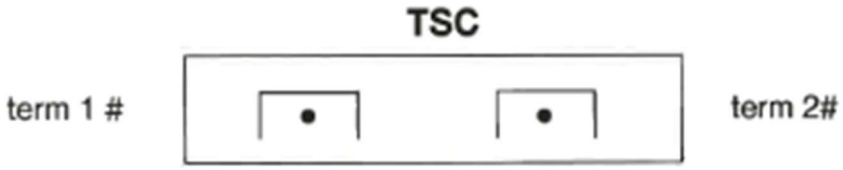
AMF BOWLING INC.
PINSPOTTER TRAINING

REAR CONTROL PANEL (cont.)

Sweep Rev.

from Term 1 jumper gray	to term 6	w/piggy back
from Term 2 jumper gray	to term 5	w/piggy back
R or L133 Blue	to term 2	
R or L 135 Black	to term 3	
R or L 138 Red	to term 4	
Term 5 jumper	from term 2	
R or L 136 Yellow	to term 6	w/piggy back
Term 6 jumper	from term 1	
Ground term strip		
151 Green	from Master CB	
161 Green	from PBZ	
R or L 130 Green	from Harness	

Term. strip in left rear of Control Box



R or L 167 Black to term 1
R or L 170 Black to term 1
} from TS 19

Back end motor plug Hot Black to term 1
Back end motor plug com. White to term 2
173 Black from Master CB term E to term 2
R or L 166 white to term 2

Splice 157 Black from term 19
tape & stow away wires 112 Yellow and 111 Brown (Extra)

AMF BOWLING INC.
PINSPOTTER TRAINING

TABLE CABLE WIRING

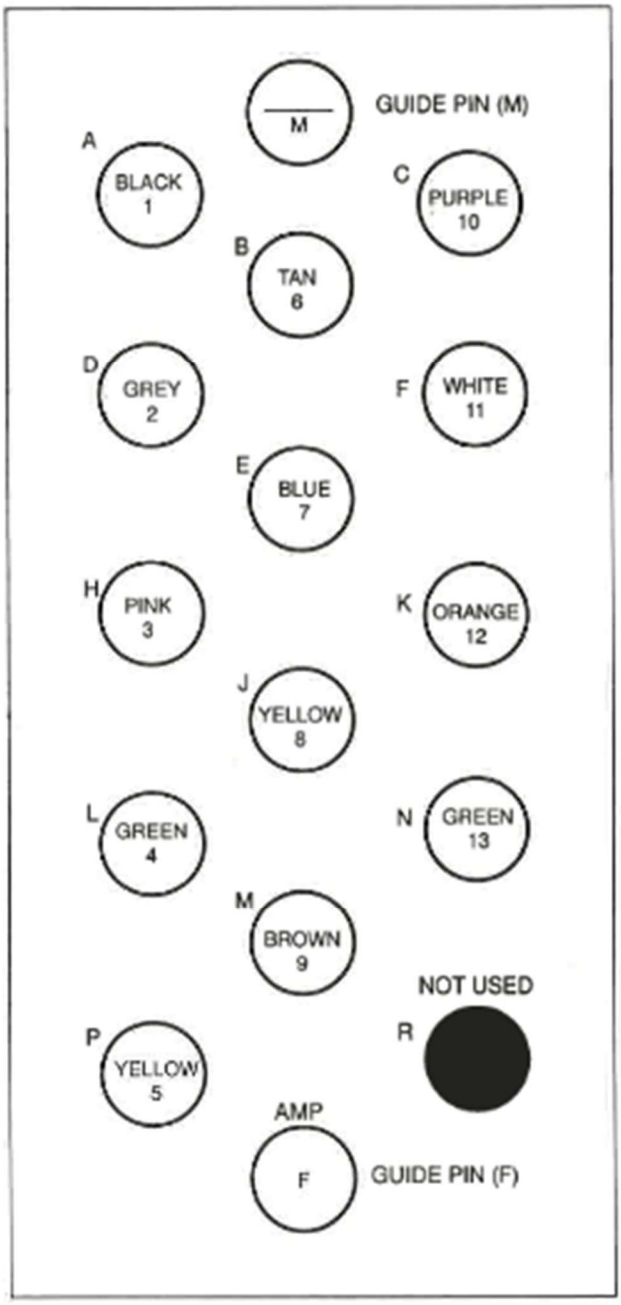


TABLE PLUG (TAP)

(TAC) Located On Capacitor Terminal Board In Wireway

5	yellow on	(sw)
8	yellow on	(sw)
1	black on	(10)
12	orange on	(7)
9	brown on	(8)
3	pink on	(9)
13	green on	(gnd)
11	white on	(4)
7	blue on	(5)
2	grey on	(6)
6	tan on	(1)
10	purple on	(2)
4	green on	(3)

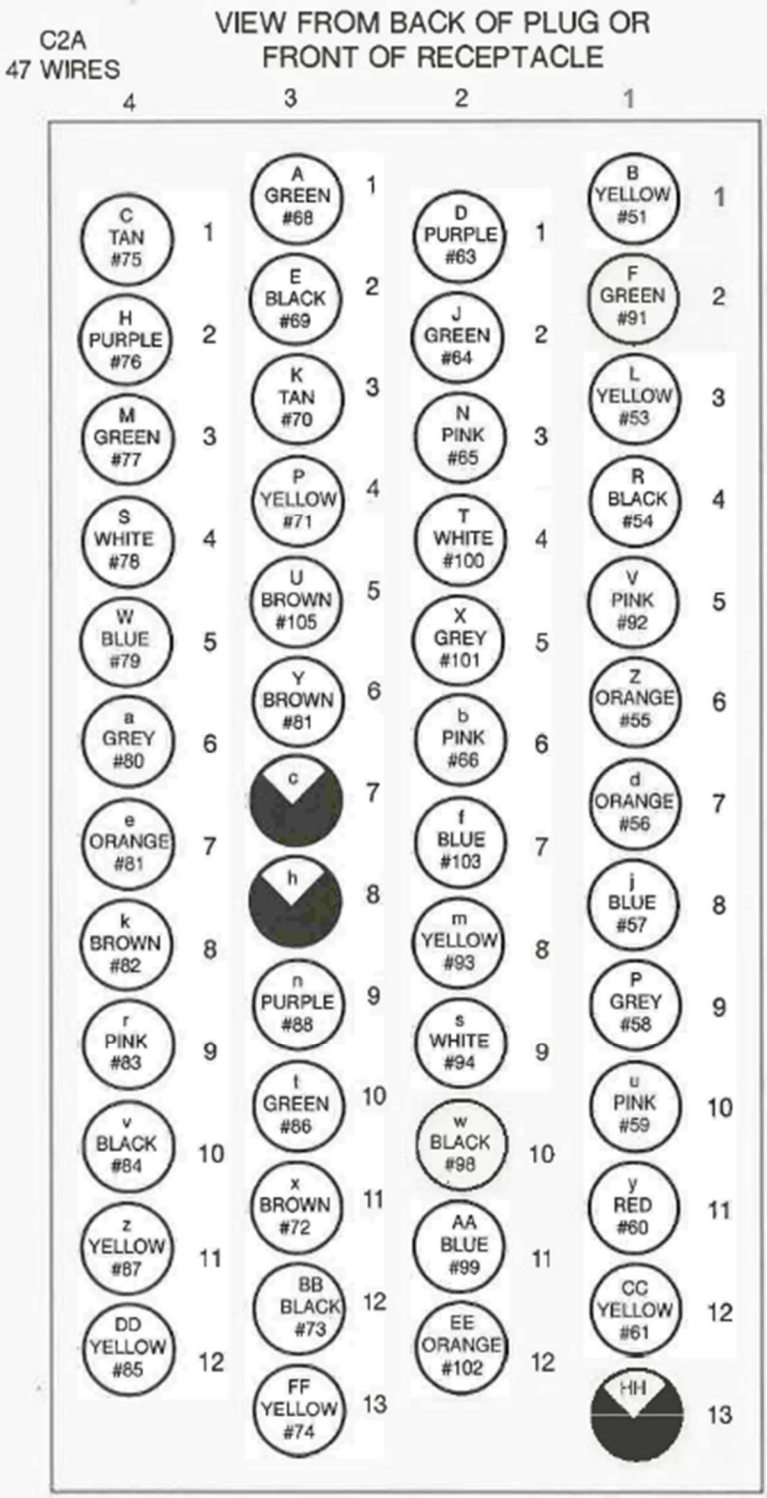
WIRE HARNESS SWEEP CAM SWITCH

WIRE NO.	COLOR	DESTINATION	C2A
49	WHITE	SA (N.C.) TO TS (31)	29s
48	BROWN	SB (N.C.) TO TS (16)	311x
47	RED	SB (N.O.) TO TS (1A2)	111y
46	GREEN	SC (COM.) TO TSA (1)	12F
45	BLACK	SA (COM.) TO TS (15)	312BB
43	PINK	SC (N.O.) TO TSG (1)	35U
42	YELLOW	SC (N.C.) TO TS (9)	411z
41	BLUE	SA (N.O.) TO TS (14)	27f

WIRE HARNESS TABLE CAM SWITCH

WIRE NO.	COLOR	DESTINATION	C2A
47	GREEN	TB (N.O.) TO TSA (5)	12F
46	BLUE	TA-2 (N.C.) TO TS (35)	211AA
45	GRAY	TA-2 (N.O.) TO TS (32)	25X
44	PINK	TA-1 (N.C.) TO TS (30)	110u
43	PURPLE	TA-1 (N.O.) TO TS (10)	39n
42	BROWN	TB (COM.) TO TSG (1)	35U
40	BLACK	TA-1 (COM.) TO TS (16)	312BB

AMF BOWLING INC.
PINSPOTTER TRAINING

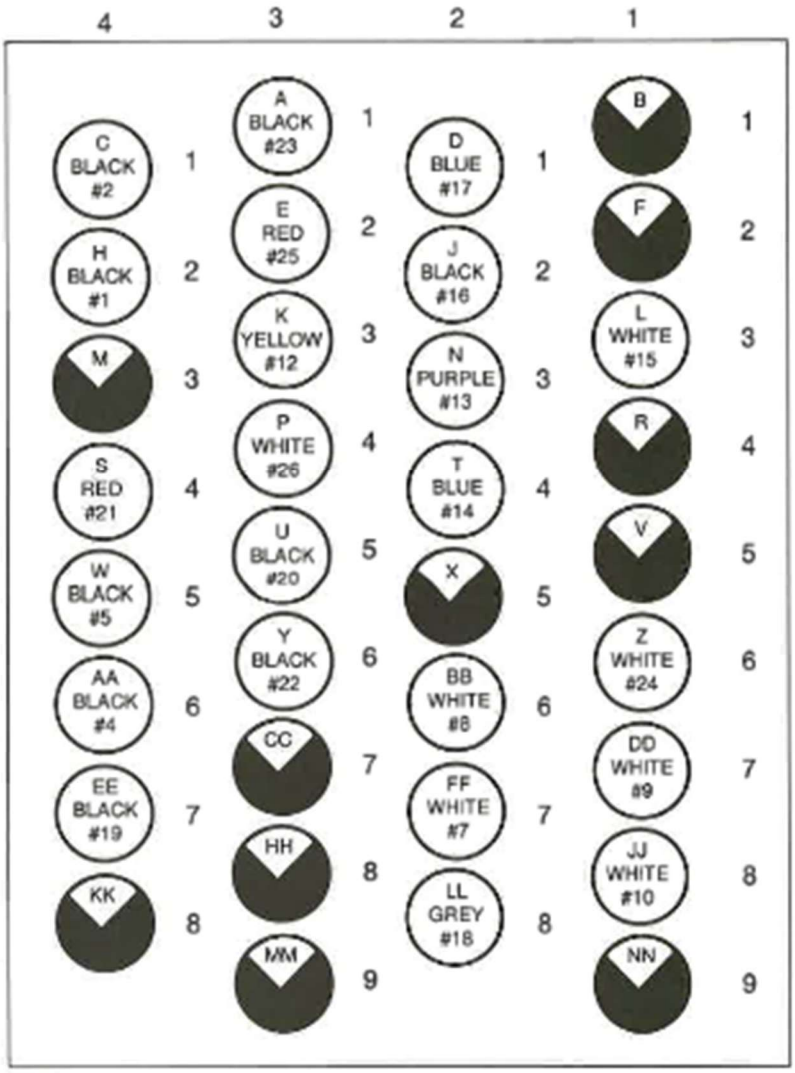


WIRE NO.	FROM	TERMINAL NO.	TO	TERMINAL NO.	WIRE COLOR
R51	C2A	11B	S	1	YL
R53	C2A	13L	SWBE	2	YL
R54	C2A	14R	PBC	2	BK
R55	C2A	16Z	S	2	OR
R56	C2A	17d	A&MC	12D	OR
R57	C2A	18j	CB	B	BL
R58	C2A	19p	T	2	GY
59	C2A	110u	TS	30	PK
60	C2A	111y	TS	1A2	RD
61	C2A	112CC	TS	34	YL
R63	C2A	21D	SWS	4	PUR
R64	C2A	22J	CB	C	GN
R65	C2A	23N	A&MC	22E	PK
R66	C2A	26b	CB	A	PK
R68	C2A	31A	A&MC	13H	GN
R69	C2A	32E	A&MC	14L	BK
R70	C2A	33K	A&MC	31C	TAN
R71	C2A	34P	A&MC	11A	YL
72	C2A	311x	TS	16	BN
73	C2A	312BB	TS	15	BK
R74	C2A	313FF	SWBE	1	YL
75	C2A	41C	TAC	1	TAN
76	C2A	42H	TAC	2	PUR
77	C2A	43M	TAC	3	GN
78	C2A	44S	TAC	4	WH
79	C2A	45W	TAC	5	BL
80	C2A	46a	TAC	6	GY
81	C2A	47e	TAC	7	OR
82	C2A	48k	TAC	8	BN
83	C2A	49r	TAC	9	PK
84	C2A	410v	TAC	10	BK
85	C2A	412DD	TAC	SW	YL
86	C2A	310t	TAC	GND	GN
87	C2A	411z	TS	9	YL
88	C2A	39n	TS	10	PUR
89	C2A	36Y	TSG	3	BN
90					
91	C2A	12F	TSA	1	GN
R92	C2A	15V	A&MC	21B	PK
93	C2A	28m	TAC	SW	YL
94	C2A	29s	TS	31	WH
98	C2A	210w	TS	28	BK
99	C2A	211AA	TS	33	BL
100	C2A	24T	TS	29	WH
101	C2A	25X	TS	32	GY
R102	C2A	212EE	PBZ	2	OR
103	C2A	27f	TS	14	BL
105	C2A	35U	TSG	1	BN

AMF BOWLING INC.
PINSPOTTER TRAINING

C1
23 WIRES

VIEW FROM BACK OF PLUG OR
FRONT OF RECEPTACLE



WIRE NO.	COLOR	DESTINATION	
		PIN NO.	T.S. NO.
1	BLACK	42H	18
2	BLACK	41C	18
4	BLACK	46AA	19
5	BLACK	45W	19
6	BLUE	19NN	35
12	YELLOW	33K	12
13	PURPLE	23N	27
14	BLUE	24T	23
15	WHITE	13L	1A1
16	BLACK	22J	7
17	BLUE	21D	1A1
18	GRAY	28LL	TSG2
19	BLACK	47EE	18
21	RED	44S	8
22	BLACK	36Y	3
23	BLACK	31A	22
24	WHITE	16Z	17
25	RED	32E	20
26	WHITE	34P	17

17DD TO TSA2
18JJ TO TSA3
27FF TO TSE2
26BB TO TSE1

} AUTOMATIC SWEEP REVERSE FOR MP CHASSIS

35U TO TS-4 RESPOT SOLENOID

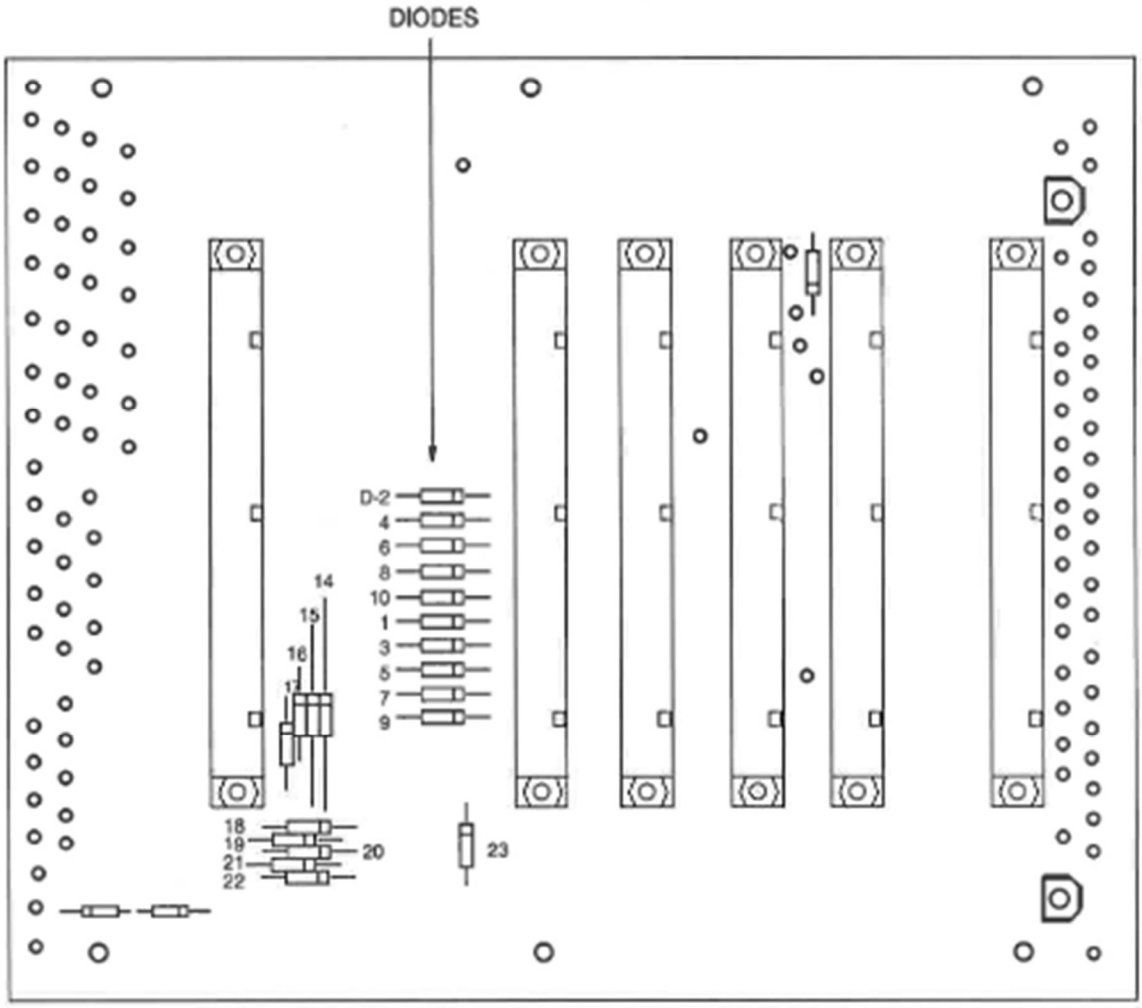
NOTE: TO USE A 5 BOARD CHASSIS ON A MP MACHINE WIRED FOR AUTOMATIC SWEEP REVERSE, JUMPERS MUST BE ADDED TO THE CHASSIS C1 PLUG CONNECTING (C1-26BB TO C1-17DD) AND CONNECTING (C1-27FF TO C1-18JJ.

AMF BOWLING INC.
PINSPOTTER TRAINING

CIRCUIT BOARD HANDLING PRECAUTIONS

1. DO NOT remove the circuit board while power is on.
2. ALLOW one minute capacitor discharge period after removing power before removing circuit board.
3. USE a board removal tool if circuit board does not have card ejectors.
4. WEAR a grounding strap when working with microprocessor boards.
5. DO NOT handle boards with dirty hands.
6. DO NOT flex the circuit board, this could damage the foil.
7. DO NOT write on the boards, this could cause a short.
8. IF you need to indicate a defective part or solder joint, use a piece of masking tape.
9. Examine a suspected bad board for broken or loose components.
10. USE A pencil eraser to clean circuit board contacts where they mate with the terminal strip.
11. RECHECK a suspected bad board in another chassis before returning.
12. KEEP circuit boards in their protective container until they are to be installed in the chassis.
13. STORE spare boards in the box they are shipped in.

MOTHER BOARD (5 BOARD CHASSIS)
070 007 659



Diodes D-1 thru D-1 0 are in series with pindication lights 1 thru 10 on the mask. An open diode would prevent the corresponding light from lighting. Diodes can be checked with an ohmmeter for being open or shorted. Forward resistance should be low (10-50 OHMS) while reverse-resistance should be very high. (Infinity)

AMF BOWLING INC.
PINSPOTTER TRAINING

9800 MP CHASSIS WIRING

FROM	TERMINAL NO.	TO	TERMNAL NO.	COLOR	LENGTH INCH
C1	13L	T2	PR1	BL	**22**
C1	167	TB1		GN	**21**
C1	17DD	M2	8	YL	**14**
C1	18J	M2	9	RD	**14**
C1	19NN	GND.		GN	
C1	21D	s	31	WH	**15**
C1	22J	s	14	BL	**17**
C1	23N	s	21	GN	**16**
C1	24T	s	32	YL	**16**
C1	26BB	M2	11	BK	**14**
C1	27FF	M2	1	BL	**14**
C1	31A	T	44	GN	**14**
C1	32E	T	32	YL	**13**
C1	33K	T	21	RD	**13**
C1	34P	T	31	WH	**11**
C1	35U	SP	5	GN	**17**
C1	36Y	SP	7	YL	**17**
C1	41C	C2A	18J	BK	**8**
C1	42H	T	43	BK	**11**
C1	44S	TB2	2	BL	**21**
C1	45W	BE	7	BK	**28**
C1	47EE	BE	3	YL	**28**
M	6	TB2	2	BL	**10**
C2A	118	CB3	2	BK	**11**
C2A	12F	GND.		GN	**6**
C2A	13L	BE	6	BK	**25**
C2A	14	P2	R	RD	**19**

AMF BOWLING INC.
PINSPOTTER TRAINING

9800 MP CHASSIS WIRING

FROM	TERMINAL NO.	TO	TERMINAL NO.	COLOR	LENGTH INCH
C2A	167	S	A1	GN	14
C2A	17D	P2	H	YL	20
C2A					
C2A	19P	T	A1	RD	10
C2A	110U	P2	11	BL	20
C2A	112C	P2	18	GN	19
C2A	21D	S	A2	YL	16
C2A	23N	T2	SEC COM	BK	27
C2A	24T	P2	T	RD	20
C2A	26b	CB1	2	BK	15
C2A	28m	P2	Z	BL	19
C2A	29s	P2	1	GN	22
C2A	210w	GND.		GN	6
C2A	211AA	P2	21	YL	20
C2A	212EE	P2	7	RD	22
C2A	31A	C2A	27f	WH	7
C2A	32E	C2A	14R	RD	5
C2A	33K	M1	5	GN	23
C2A	34P	M1	9	YL	23
C2A	35U	M	9	RD	16
2A	310	GND.		GN	6
C2A	311x	P2	J	BL	21
C2A	312BB	GND.	h	GN	6
C2A					
C2A	41C	P2	13	GN	20
C2A	42H	P2	6	YL	20
C2A	43M	P2	16	RD	19
C2A	44S	P2	20	BK	19
2A	45W	P2	10	BL	20
C2A	46a	P2	N	GN	21
C2A	47e	P2	6	YL	21
2A	48k	P2	14	RD	21
C2A	49r	P2	L	BK	21
C2A	410v	P2	8	BL	22
C2A	412DD	GND.		GN	6
C2A	313FF	M1	COIL#2	GN	18

AMF BOWLING INC.
PINSPOTTER TRAINING

9800 MP CHASSIS WIRING

FROM	TERMINAL NO.	TO	TERMINAL NO.	COLOR	LENGTH INCH
MP	1	OLL#1	1	BK	
MP	1	P1	C	RD	
MP	2	C2A	15V	BN	
MP	3	P1	16	RD	
MP	4	P1	10	OR	
MP	5	P1	11	YL	
MP	6	P1	7	GN	
MP	7	P1	9	BL	
MP	8	P1	13	VI	
MP	9	P1	K	GY	
MP	10	P1	A	WH	
MP	11	P1	5	TN	
MP	12	P1	8	PK	
MP	16	P1	18	OR	
MP	17	P1	20	YL	
MP	18	P1	4	GN	
MP	19	P1	21	BL	
MP	20	P1	22	VI	
MP	21	P1	17	GY	
MP	22	P1	15	WH	
MP	23	P1	14	TN	
MP	24	P1	12	PK	
MP	25	P1	6	BK	
MP	26	P1	25	BN	
MP	27	P1	23	RD	
MP	28	M	10	OR	
MP	29	OLL#2	1	YL	
MP	33	GND.		GN	6

AMF BOWLING INC.
PINSPOTTER TRAINING

9800 MP CHASSIS WIRING

FROM	TERMINAL NO.	TO	TERMINAL NO.	COLOR	LENGTH INCH
M	1	M	9	BL	3
M	2	T2	SEC	BK	18
M	7	CB1	1	GN	21
M	3	P1	3	BL	23
SP	1	P2	A	BK	29
SP	1	T2	SEC	BK	16
SP	2	M2	2	YL	12
SP	3	D1	CATH.		
SP	11	D1	ANODE		
SP	11	GND.		WH	4
SP	6	T	22	RD	21
SP	10	P2	3	GN	29
M2	3	M2S	8	BK	3
M2	4	M2	9	BK	3
M2	10	pf	c	YL	25
BE	5	P2	5	RD	18
S	14	S	44	BL	4
S	14	S	22	BL	4
S	13	CB2	1	BK	20
S	13	S	43	BK	4
S	43	BE	4	BK	32
S	43	T	13	BK	11
S	A2	pt	y	RD	26
T	44	T	14	BL	4
T	14	T	22	BL	4
T	13	T	43	BL	4
T	A2	P1	b	BL	23
CB2	2	T2	PR1	BK	31
BE	5	Mt	COIL #1	RD	8
P1	1	GND.	BUSS		1
P1	2	GND.	BUSS		1
P1	A	GND.	BUSS		1
P1	B	GND.	BUSS		1
P1	M	GND.	BUSS		1
P1	N	GND.	BUSS		1
P1	P	GND.	BUSS		1
P1	R	GND.	BUSS		1
P1	S	GND.	BUSS		1
P1	U	GND.	BUSS		1
P1	V	GND.	BUSS		1
P1	Z	GND.	BUSS		1

AMF BOWLING INC.
PINSPOTTER TRAINING

9800 MP CHASSIS WIRING

FROM	TERMINAL NO.	TO	TERMINAL NO.	COLOR	LENGTH INCH
P2	C	GND.	BUSS		1
P2	C	GND.	BUSS		1
P2	D	GND.	BUSS		
P2	E	GND.	BUSS		1
P2	a	GND.	BUSS		f
P2	b	GND.	BUSS		f
P2	25	GND.	BUSS		1
P2	24	GND.	BUSS		1
P2	23	GND.	BUSS		4
P2	4	GND.	BUSS		1
P2	R	CSW	1	BL	31
APS	1	P1	E	BK	
APS	2	P1	W	BN	
APS	3	P1	D	RD	
APS	4	P1	X	R	
APS	5	P2	15	YL	
APS	6	P2	M	GN	
APS	32	P2	P	VI	
APS	33	P2	12	GY	
APS	29	P2	17	TN	
APS	30	GND.		BK	
APS	21	P2	F	VI	
APS	22	GND.		GN	

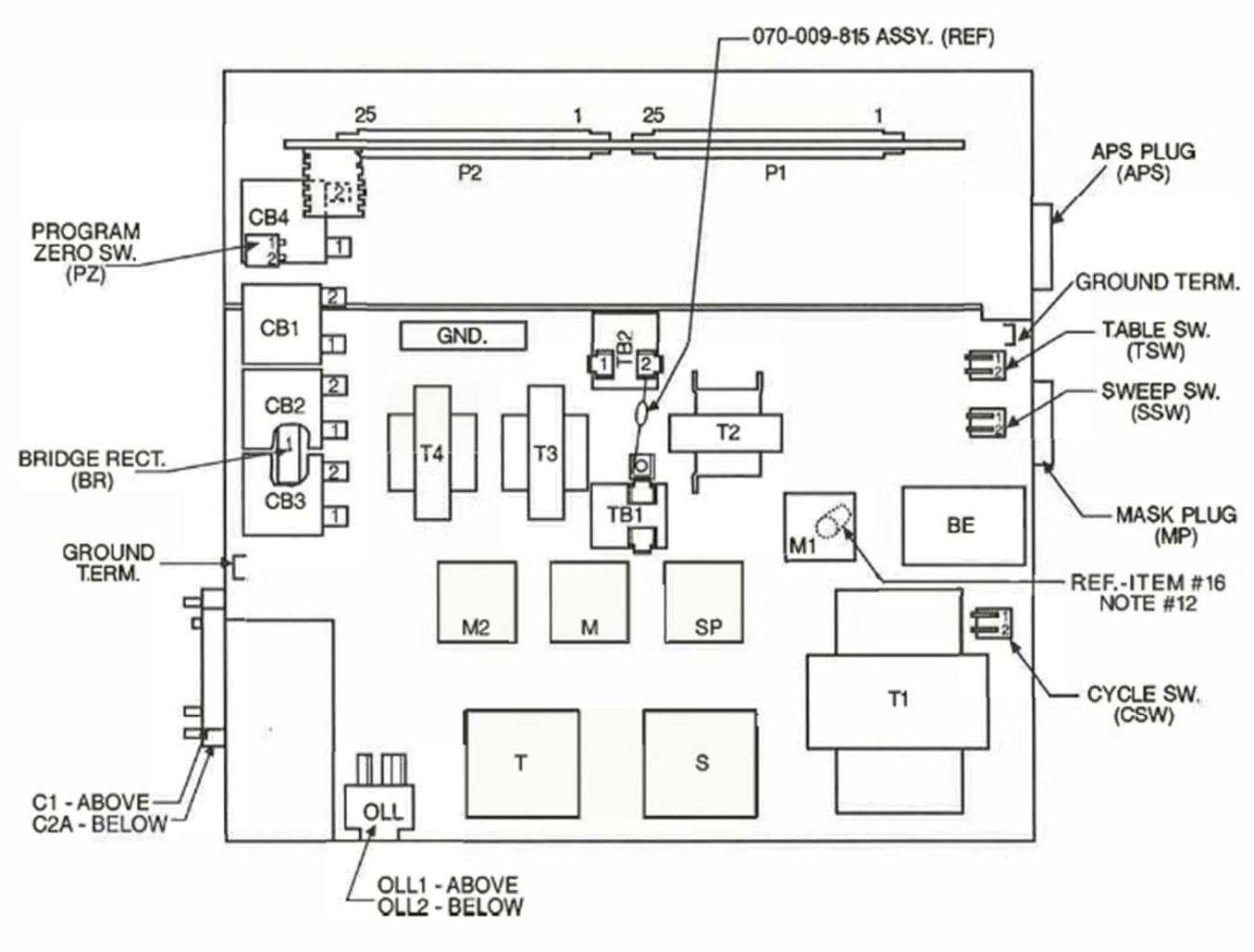
AMF BOWLING INC.
PINSPOTTER TRAINING

9800 MP CHASSIS WIRING

FROM	TERMINAL NO.	TO	TERMINAL NO.		COLOR	LENGTH INCH
OLL#1	3	OLL#2	3		WH	3
OLL#1	3	BR	(+)		WH	9
BR	(--)	GND.			WH	5
TB1		TB1			WH	3
T3	PR1	TB2	1	TRANS LEAD	BK	8
T3	PR1	TB1		TRANS LEAD	BK	4.5
T3	SEC	P2	9	TRANS LEAD	GN	9
P2	9	P2	K		WH	3
T3	SEC	CB4	1	TRANS LEAD	YL	6
T3	SEC	P2	19	TRANS LEAD	GN	9
P2	9	P2	W		WH	3
CB4	2	GND.	BUSS		BK	5
T4	PR1	TB2	1	TRANS LEAD	BK	8
T4	PR1	TB1		TRANS LEAD	BK	4.5
T4	SEC	M1	COIL#2	TRANS LEAD	GN	8
T4	SEC	NOT USED		TRANS LEAD	YL	9
T4	SEC	GND.		TRANS LEAD	GN	9
T1	PR1	TB1		TRANS LEAD	BK	13
T1	PR1	M		TRANS LEAD	BK	13
T1	SEC	M2		TRANS LEAD	YL	13
T1	SEC	SPLICE		TRANS LEAD	YL	13
T1	SEC	NOT USED		TRANS LEAD	GN	13
T1	SEC	NOT USED		TRANS LEAD	GN	13
T1	SEC	M	11	TRANS LEAD	BL	23
T1	SEC	CB3	1	TRANS LEAD	BL	28
T1	SEC	BR	AC	TRANS LEAD	RD	28
T1	SEC	BR	AC	TRANS LEAD	RD	28
TB2	1	M	7		BK	10
PZ	1	P2	22		BL	29
PZ	2	GND.			WH	7
CSW	2	SSW	2		WH	5
TSW	1	T	A2		GN	27
TSW	2	GND			WH	4
SSW	1	S	A2		YL	25
SSW	2	TSW	2		WH	3
M	2		VARSITOR LEAD		ITEM #32	
M	10		VARSITOR LEAD			
P1	B	TRANSZORB LEAD				.375
TRANSZORB LEAD		GND.	BUSS			.50
P1	Y	TRANSZORB LEAD				.375
TRANSZORB LEAD		GND.	BUSS			.50
P2	3	TRANSZORB LEAD				.375
TRANSZORB LEAD		GND.	BUSS			.50

AMF BOWLING INC.
PINSPOTTER TRAINING

9800 MP CHASSIS WIRING



AMF BOWLING INC.
PINSPOTTER TRAINING

6700 ELCO CHASSIS WIRING

FROM	TERMINAL NO.	TO	TEMINAL NO.	COLOR	LENGTH INCH
C1	13L	T2	2	RD	19
C1	16Z	T1	2	BK/RD TRANS. LEAD	
C1	19NN	GND.	--	GN	12.5
C1	21D	S	8	PUR	17.5
C1	22J	S	2	GY	20
C1	23N	S	10	WH	16.5
C1	24T	S	3	BK	20
C1					
C1	31A	T	2	OR	17.5
C1	32E	T	3	YL	16.5
C1	33K	T	10	GN	18
C1	34P	T	8	BL	18
C1	35U	SP	5	PUR	17
C1	36Y	SP	7	GY	16.5
C1					
C1	41C	S	7	RD	17.5
C1	42H	T	7	BK	19
C1	44S	M	6	RD	13.5
C1	45W	BE	4	YL	25
C1	47EE	BE	3	BK	26
C1	28LL	C2A	24T	GN	4
C1	17DD	1	26BB	WH	4
C1	18J	C1	27FF	WH	4
C1	46AA	BE	4	YL	25
AUX. P.C.	1	PC2	1	GN	14
AUX. P.C.	2	PC2	2	RD	14
AUX. P.C.	3	PC2	3	OR	14
AUX. P.C.	4	PC2	6	BK	16.5
AUX. P.C.	5	PC2	26	PUR	14
PM	28	M	10	YL	5
PM	1	CP2	(+)	GN	6
PM	29	HEAT SINK	QUICK CONNECT	GN	15

AMF BOWLING INC.
PINSPOTTER TRAINING

6700 ELCO CHASSIS WIRING

FROM	TERMINAL NO.	TO	TERMINAL NO.	COLOR	LENGTH INCH
C2A	118	CB3	2	PUR	20.5
C2A	12F	GND.	⏤	GN	12.5
C2A	13L	BE	5	RD	20
2A	14R	PC1	28	OR	15.5
C2A	14R	C2A	32E	OR	4
C2A	15V	PM	2	RD	17.5
C2A	167	HEAT SINK	3	YL	18.5
C2A	17d	PC1	31	BL	15.5
C2A	18i	T2	COM	PUR	13.5
C2A	19p	HEAT SINK	5	GY	19.5
C2A	110u	HEAT SINK	4	WH	19
C2A	411v	PC3	19	BK	15.5
C2A	112CC	SP	9	BL	10
C2A	21D	HEAT SINK	2	OR	19
C2A	22J	T1	13	YL TRANS. LEAD	
C2A	23N	C2A	26b	GN	3
C2A	24T	PC1	8	GN	14
C2A					
C2A	27f	C2A	31A	BK	4
C2A	28m	PC1	10	OR	15
C2A	29s	PC1	21	BL	15
C2A	210w	GND.	⏤	GN	12.5
C2A	211AA	PCT	11	YL	15.5
C2A	211AA	C2A	38h	YL	4
C2A	212EE	PCT	19	PUR	15.5
C2A	33K	M2	11	RD	14.5
C2A	34P	M2	9	OR	12
C2A	35U	M	11	RD	11
C2A	3101	GND.	d	GN	13.5
C2A	311x	PCT	23	PUR	15
C2A	312BB	GND.	⏤	GN	13.5
C2A	313FF	CB3	2	WH	13
C2A					
C2A	41C	PC4	23	BK	16.5
C2A	42H	PC4	13	BN	12
C2A	43M	PC4	25	RD	17.5
C2A	44S	PC4	15	OR	16.5
C2A	45W	PC4	27	YL	16.5
C2A	46a	PC4	17	GN	16
C2A	47e	PC4	29	BL	17
C2A	48k	PC4	19	PUR	16
C2A	49r	PC4	31	GY	17.5
C2A	410v	PC4	21	WH	16.5
C2A	412DD	GND.	⏤	GN	13.5
C2A	36y	MBD	7	GY	14
C2A	37c	PC4	7	OR	17.5
C2A	39n	PC5	25	YL	16

AMF BOWLING INC.
PINSPOTTER TRAINING

6700 ELCO CHASSIS WIRING

FROM	TERMINAL NO.	TO	TERMINAL NO.	COLOR	LENGTH INCH
CP3	(-)	KX	4	PUR	8.5
CP3	(-)	PC1	4	GY	7
CP3	(-)	R2		RESISTOR LEADS	
CP3	(-)	D-2		DIODE LEADS	
CP3	(+)	R2		RESISTOR LEADS	
CP3	(+)	GND.		GN	2.5
CP2	(+)	HEAT SINK	6	PK	21
TRI-3	GATE	PC3	26-27	YL	7
CP2	(+)	R1		RESISTOR LEADS	
CP2	(-)	R1		RESISTOR LEADS	
CP1	(+)	PC5	8	OR	
CP1	(-)	PC5	9	YL	
D-1	(+)	SP	3	DIODE LEADS	
D-1	(-)	SP	11	DIODE LEADS	
T1	1	M2	7	BK. TRANSF. LEAD	
T1	3	HEAT SINK	1	RD. TRANSF.LEAD	
T1	4	OLL	3	RD./WH. TRANSF. LEAD	
T1	5	HEAT SINK	7	RD. TRANSF.LEAD	
T1	6	M	9	GN. TRANSF.LEAD	
T1	7	CB3	1	TRANSF.LEAD	
T1	8	PC5	11	BL TRANSF.LEAD	
T1	9	PC5	12	BL TRANSF.LEAD	
T1	10	PC5	6	OR TRANSF.LEAD	
T1	11	PC5	5	OR TRANSF.LEAD	
T1	12	D-2	(4)	YL TRANSF.LEAD	
T2	1	CB2	2	PK	28
T2	(---)	M	2	RD	11.5
T2	(---)	SP	1	GY	12
S	9	CB1	1	BL	27.5
S	9	T	9	BK	12.5
S	9	S	7	BK	4
S	7	BE	3	WH	28
S	6	HEAT SINK	3	YL	18
	4	S	5	BK	4
S	4	S	2	BK	4
S	1	HEAT SINK	2	OR	15.5

AMF BOWLING INC.
PINSPOTTER TRAINING

6700 ELCO CHASSIS WIRING

FROM	TERMINAL NO.	TO	TERMINAL NO.	COLOR	LENGTH INCH
T	9	T	7	BK	4
T	7	M	7	WH	14
T	6	HEAT SINK	5	GY	20.5
T	5	SP	6	BL	17.5
T	5	T	4	BK	4
T	4	T	2	BK	4
T	1	HEAT SINK	4	WH	19.5
M	3	C2A	23N	GY	18
M	4	H	4	BK	15.5
M	9	BE	6	BL	16.5
BE	7	BE	8	BK	3
CB1	1	CB2	1	BL	5
M2	10	M	1	WH	4
M2	10	H	3	WH	11
M2	6	CB1	2	BL	9.5
M2	3	M	3	GY	6
M2	2	M	2	RD	6
M2	2	H	1	RD	11.5
M2	1	H	2	BL	11.5
PC3	2	SP	10	PUR	7
PC3	20	SP	2	RD	6.5
PC3	30-31	HEAT SINK	4	WH	18
PC3	28-29	HEAT SINK	2	OR	17
PC1	5	SP	1	GY	6
PC1	9	SP	9	BL	7
PC1	30	GND.		GN	7
PC4	1	GND.		GN	5.5
PC5	1	GND.		GN	5.5
GND.		GND.		GN	12
SP	11	GND.		GN	3
OLL	1	GND.		GN	7
CP2	(--)	HEAT SINK TRI-3	A2	GY	16
TR1-3	A1	PC3	21822	GN	6

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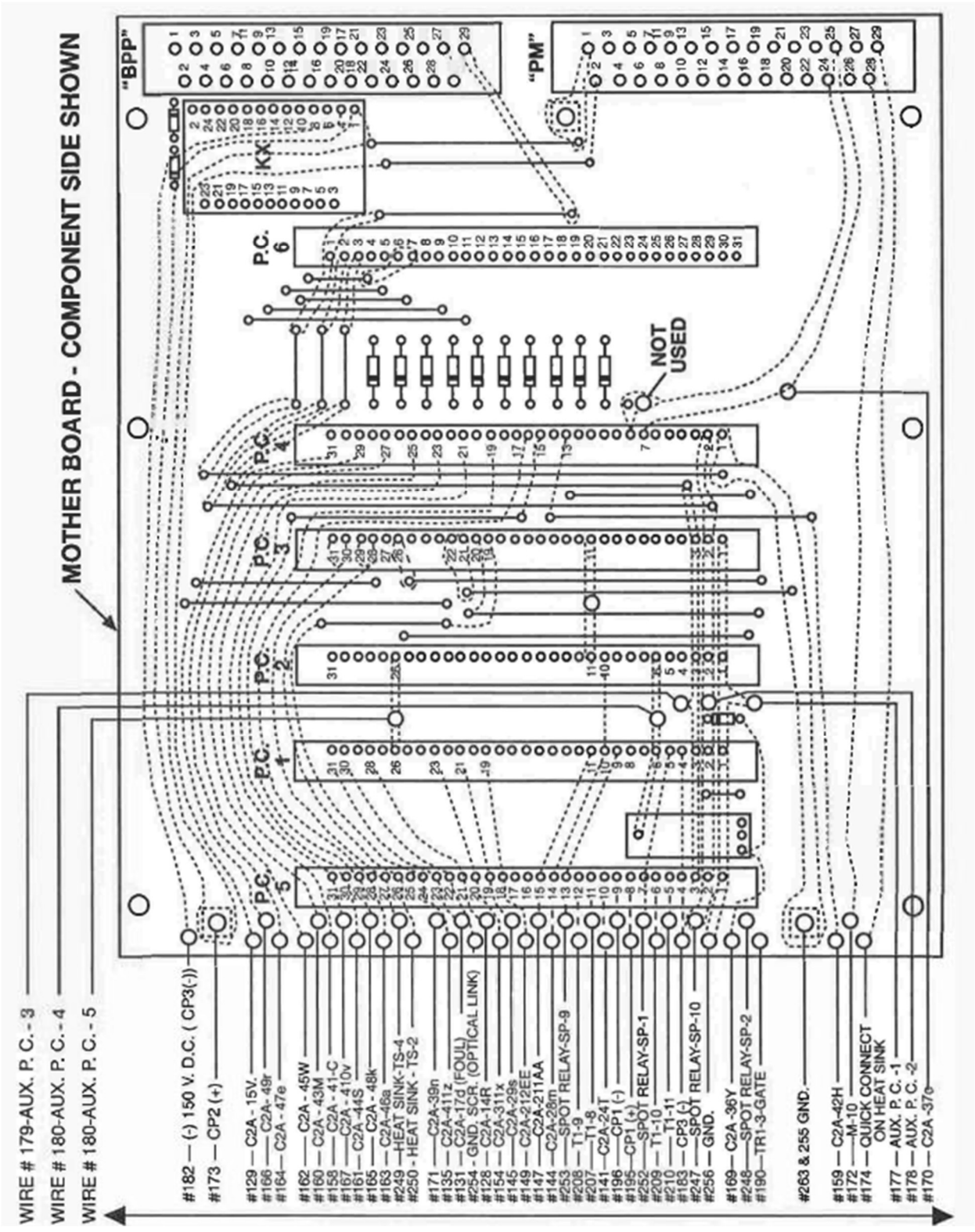
6700 ELCO CHASSIS WIRING



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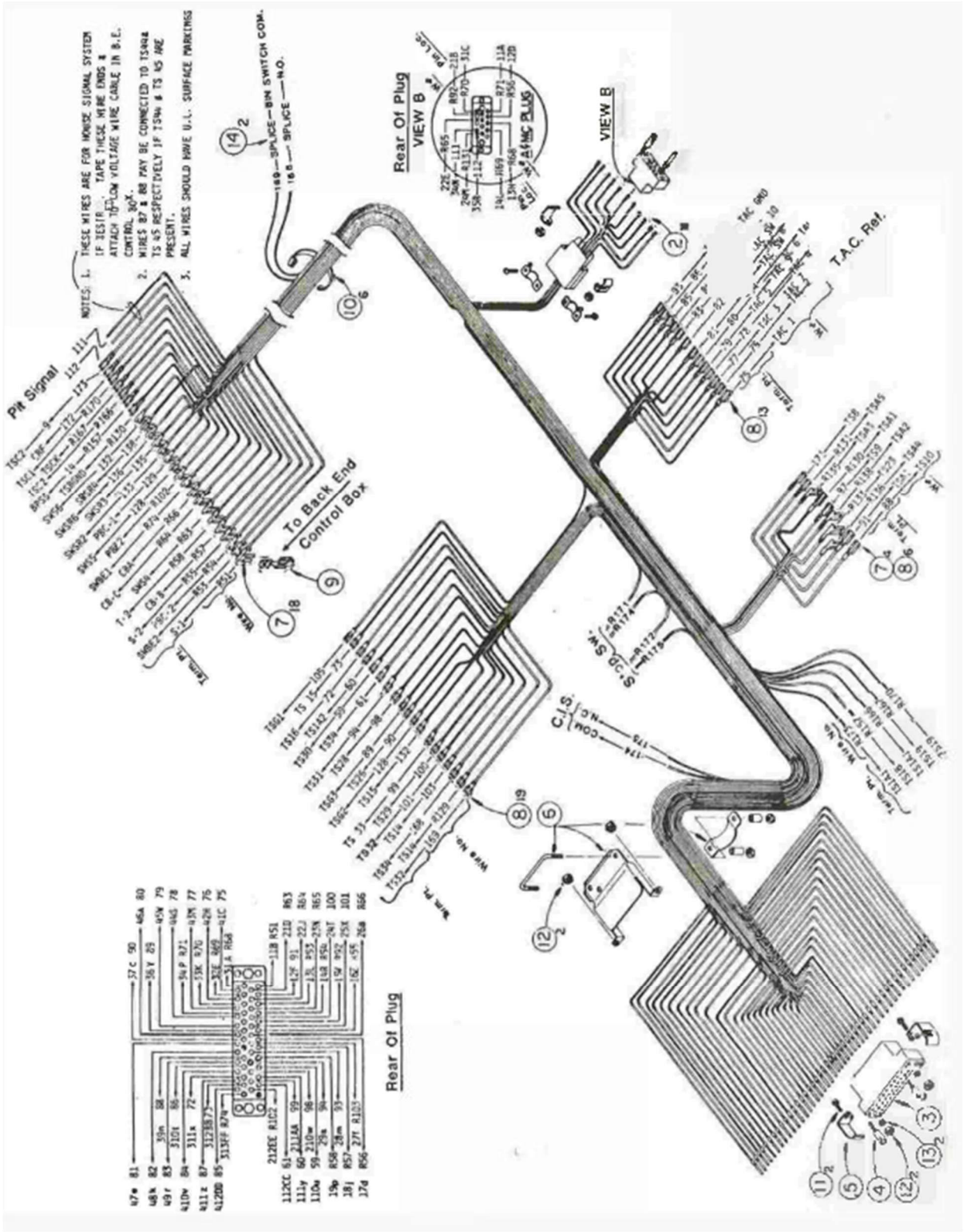
C2-A HARNESS ASSEMBLY (RIGHT)



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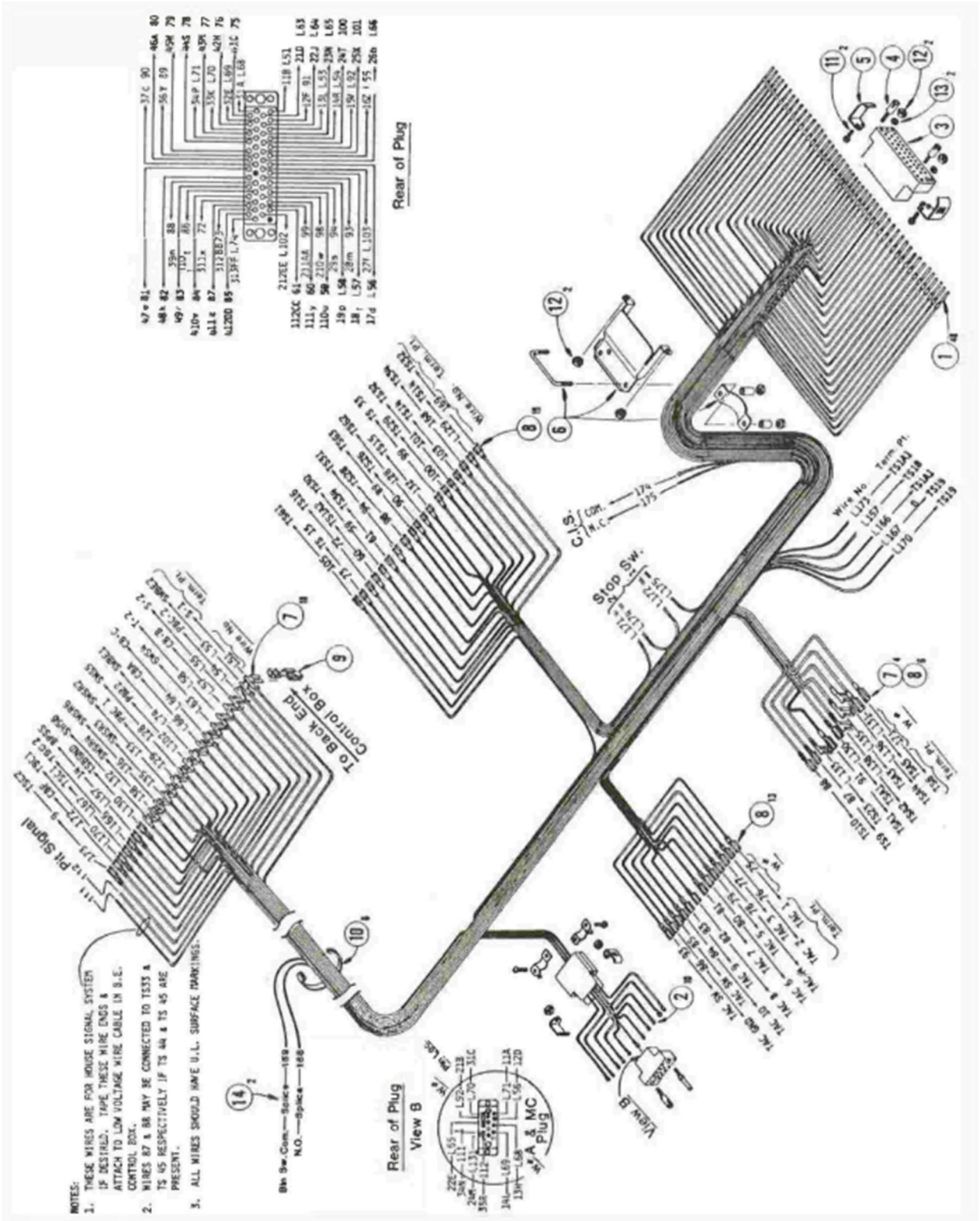
C2-A HARNESS ASSEMBLY (RIGHT)



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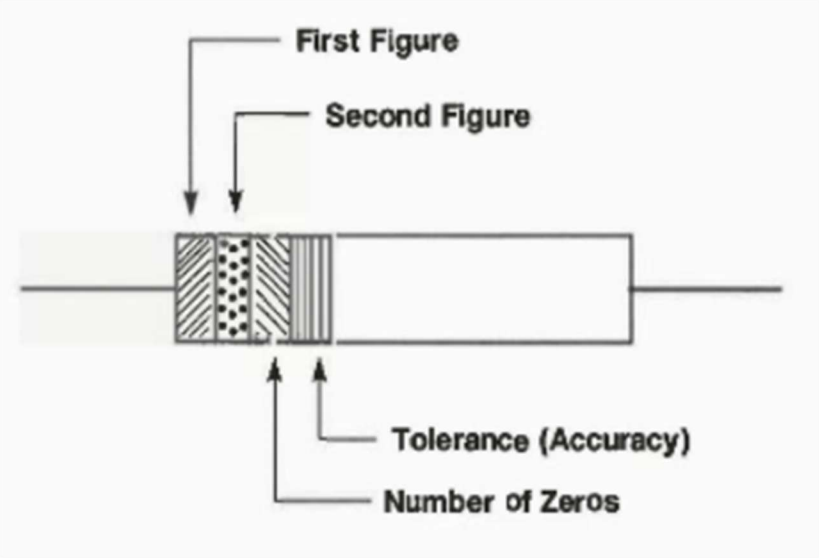
RESISTOR COLOR CODE

A resistor is an electronic part which offers resistance to the flow of electrical current. A resistor is measured in ohms or meg-ohms. One meg is equal to 1,000,000 ohms. The power rating of a resistor is measured in WATTS and is determined by its physical size, that is, the larger the resistor the more power it can handle. The WATT rating of a resistor is the amount of power which the resistor can safely dissipate as heat. Resistors are generally classified as being of the carbon or wire-wound type. The wire wound resistor consists of many turns of wire wound on an insulating form and usually has the greater power rating. The more common type of resistor is the carbon. If a resistors value is not stamped on its body it can be determined by use of the color code. Example: An 82 ohm resistor is indicated by a Gray ring (8), a Red ring (2), and a Black ring (0).



RESISTOR COLOR CODE

Black - 0
Brown - 1
Red - 2
Orange - 3
Yellow - 4
Green - 5
Blue - 6
Purple - 7
Gray - 8
White - 9

Tolerance
Gold - 5%
Silver - 10%
No Color - 20%

AMF BOWLING INC.
PINSPOTTER TRAINING

ELECTRO- MECHANICAL DICTIONARY

A.C.	-	ALTERNATING CURRENT
ACTUATED	-	PUT INTO MOTION
BALL PATH	-	THE LINE OF MOVEMENT OR COURSE TAKEN BY A BOWLING BALL AS IT CROSSES THE PIN DECK.
BLUEPRINT	-	A DETAILED PLAN OR OUTLINE OF A PIECE OF EQUIPMENT.
BRIDGE RECTIFIER	-	A FULL WAVE RECTIFIER WITH FOUR ELEMENTS CONNECTED IN THE FORM OF A BRIDGE. CHANGES A.C. TO D.C.
CAM	-	A MOVING PART, IRREGULARLY SHAPED, OPERATES LEVERS OR CONTROL MECHANISMS.
CAPACITOR	-	AN ELECTRONIC COMPONENT WHICH HAS THE ABILITY TO PASS A.C. AND BLOCK D.C. ALSO HAS THE ABILITY TO HOLD AN ELECTRICAL CHARGE
CHASSIS	-	A METAL ENCLOSURE WHERE ELECTRICAL OR MECHANICAL PARTS ARE CONTAINED WITHIN ITSELF.
CIRCUIT	-	AN ELECTRONIC PATH BETWEEN TWO OR MORE POINTS CAPABLE OF CARRYING CURRENT.
CIRCUIT BREAKER	-	A PROTECTION DEVICE FOR ELECTRICAL CIRCUITS. WHEN AN OVERLOAD OCCURS, THE CIRCUIT BREAKER OPENS, PROTECTING THE CIRCUIT. SOME MUST BE RESET MANUALLY WHILE OTHERS RESET AUTOMATICALLY.
CIRCUIT BOARD	-	SEE PRINTED CIRCUIT.
CLOSED CIRCUIT	-	SAME AS CIRCUIT.
COIL	-	MANY TURNS OF WIRE WOUND ON AN INSULATED FORM
COMPONENT	-	ANY OF THE BASIC PARTS USED IN BUILDING ELECTRONIC EQUIPMENT.
COMPUTER	-	A DEVICE CAPABLE OF PERFORMING SEQUENCES OF ARITHMETIC AND LOGICAL OPERATIONS FROM A STORED PROGRAM.
CONDENSER	-	SAME AS CAPACITOR.
CONDUCTOR	-	A MATERIAL THAT OFFERS LOW RESISTANCE TO CURRENT.
CONNECTION	-	WIRES FASTENED TOGETHER.
CONNECTOR	-	A COUPLING DEVICE, PLUG OR RECEPTACLE WHICH CAN BE EASILY JOINED TO OR SEPARATED FROM ITS MATE.

AMF BOWLING INC.
PINSPOTTER TRAINING

ELECTRO- MECHANICAL DICTIONARY

CONTACT	-	ONE OF THE CURRENT CARRYING PARTS OF A SWITCH OR RELAY.
CONTACTOR	-	SAME AS RELAY.
CONTINUITY	-	A CONTINUOUS PATH FOR THE FLOW OF CURRENT IN AN ELECTRIC CIRCUIT.
CONTINUITY TESTER	-	A TEST LIGHT OR DEVICE THAT WOULD INDICATE CONTINUITY IN A CIRCUIT.
CURRENT	-	THE MOVEMENT OF ELECTRONS THROUGH A CONDUCTOR.
DAISY CHAIN	-	AN INTERCONNECTED LINE BETWEEN UNITS THAT PASSES A SIGNAL FROM ONE UNIT TO THE NEXT IN SERIAL FASHION.
DIAGRAM	-	A LAYOUT OR PLAN OF A PIECE OF EQUIPMENT.
DIODE	-	A DEVICE WHICH WILL ALLOW CURRENT TO PASS IN ONE DIRECTION ONLY.
D.C.	-	DIRECT CURRENT.
D.P.D.T.	-	DOUBLE POLE, DOUBLE THROW SWITCH.
D.PS.T.	-	DOUBLE POLE, SINGLE THROW SWITCH.
EDGE CONNECTOR	-	A MULTIPLE CONTACT RECEPTACLE WHICH CAN BE EASILY JOINED TO OR SEPARATED FROM ITS MATE.
ELEMENT	-	ANY ELECTRICAL DEVICE WITH TERMINALS AT WHICH IT MAY BE CONNECTED TO OTHER ELECTRICAL DEVICES.
ENERGIZE	-	APPLY VOLTAGE IN ORDER TO ACTIVATE A DEVICE.
FASTON TERMINAL	-	SEE TERMINAL.
FLEXIBLE CONDUIT	-	METAL PIPE ABLE TO BEND WITHOUT BREAKING. USED TO PROTECT ELECTRICAL WIRING.
FULL WAVE RECTIFIER	-	A CIRCUIT THAT USES BOTH THE POSITIVE AND NEGATIVE ALTERNATIONS OF AC CURRENT TO PODUCE DC
FUSE	-	A PROTECTION DEVICE FOR ELECTRIC EQUIPMENT.
GRIPPER	-	A THING THAT GRIPS (RESPOT CELL).
GROUND	-	WHEN A WIRE IN A CIRCUIT MAKES CONTACT WITH A METAL RETURN TO GROUND. SUCH AS THE MACHINE FRAME.
INSULATOR	-	A MATERIAL WHICH CANNOT PASS ELECTRICITY.
JUNCTION BOX	-	A POINT WHERE ELECTRICAL CONNECTIONS ARE MADE.
KLIXON	-	SAME AS OVERLOAD OR CIRCUIT BREAKER.
LOGIC	-	THE SCIENCE DEALING WITH THE BASIC PRINCIPLES AND APPLICATIONS OF TRUTH TABLES.

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PINSPOTTER TRAINING

ELECTRO- MECHANICAL DICTIONARY

LOW VOLTAGE	-	A CIRCUIT IN WHICH VOLTAGE BELOW 110 VOLTS ARE USED.
MAGNETISM	-	THE ABILITY OF A MATERIAL TO ATTRACT IRON.
MICRO SWITCH	-	A SNAP ACTION SWITCH WHICH IS SENSITIVE TO ACTUATION.
MINUS (-)	-	INDICATES THE NEGATIVE SIDE OF A POWER SUPPLY.
MOTHER BOARD	-	A PIECE OF INSULATING MATERIAL ON WHICH COMPONENTS, MODULES OR CIRCUIT BOARDS CAN BE MOUNTED.
MP (MICRO-PROCESSOR)	-	A COMPUTER WHICH FUNCTIONS AS A CENTRAL PROCESSOR FOR EXECUTING INSTRUCTIONS. A VOLATILE MEMORY FOR STORING DATA AND AN INTERFACE UNIT THROUGH WHICH INSTRUCTIONS ARE TRANSMITTED.
NATIONAL ELECTRIC CODE	-	RULES AND REGULATIONS REGARDING INSTALLATION AND CONSTRUCTION OF ELECTRICAL EQUIPMENT.
NOMINAL VOLTAGE	-	SPECIFIED VALUE AS OPPOSED TO ACTUAL VALUE.
OHM	-	THE UNIT OF ELECTRICAL RESISTANCE.
OPEN CIRCUIT	-	A CIRCUIT WHICH DOES NOT PROVIDE A COMPLETE PATH FOR THE FLOW OF CURRENT.
OVERLOAD	-	SEE CIRCUIT BREAKER
PARALLEL CIRCUIT	-	A CIRCUIT IN WHICH THE CURRENT IS DIVIDED INTO TWO OR MORE PATHS.
PHOTO ELECTRIC CELL	-	A LIGHT SENSITIVE DEVICE WHICH PRODUCES CHANGES IN VOLTAGE WITH CORRESPONDING CHANGES IN LIGHT.
PINDICATION	-	LIGHTS ON THE MASK OR MONITOR USED TO INDICATE PINS LEFT STANDING AFTER FIRST BALL.
PLUG	-	SEE CONNECTOR.
PLUS (+)	-	INDICATES THE POSITIVE SIDE OF A POWER SUPPLY.
POWER	-	MEASURED IN WATTS - A PRODUCT OF VOLTAGE AND CURRENT.
POWER CIRCUITS	-	A CIRCUIT IN WHICH 110 VOLTS OR MORE ARE USED.
POWER CORD	-	A CABLE OR SET OF WIRES THAT CARRIES POWER TO AN ELECTRICAL LOAD.
POWER SUPPLY	-	A DEVICE WHICH CONVERTS THE POWER AVAILABLE INTO VOLTAGES RE QU IRED FOR A PARTICULAR CIRCUIT.
PRIMARY	-	THE INPUT SIDE OF A TRANSFORMER.
PRINTED CIRCUIT	-	A CIRCUIT IN WHICH THE INTER-CONNECTING WIRES HAVE BEEN REPLACED BY CONDUCTIVE STRIPS PRINTED OR ETCHED ONTO AN INSULATING BOARD.

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ELECTRO- MECHANICAL DICTIONARY

PUSH BUTTON	-	A SWITCH MOMENTARILY OPERATED
RECTIFIER	-	A DEVICE WHICH CHANGES A.C. TO D.C.
RESISTOR	-	AN ELECTRONIC COMPONENT WHICH OFFERS RESISTANCE TO CURRENT FLOW.
RELAY	-	AN ELECTROMAGNETIC DEVICE WHICH CONTROLS A FLOW OF CURRENT IN ONE CIRCUIT BY MEANS OF A LESSER CURRENT IN ANOTHER CIRCUIT. AN ELECTRONICALLY OPERATED SWITCH.
RESIDUAL MAGNETISM	-	MAGNETISM WHICH REMAINS IN AN ELECTROMAGNET AFTER THE POWER IS DISCONNECTED.
RPM	-	REVOLUTIONS PER MINUTE.
SCHEMATIC	-	A DRAWING WHICH SHOWS THE ELECTRICAL CONNECTIONS DIAGRAM IN A CIRCUIT.
SECONDARY	-	THE OUTPUT SIDE OF A TRANSFORMER.
SERIES CIRCUIT	-	A CIRCUIT IN WHICH THE SAME CURRENT MUST FLOW THROUGH ALL PARTS.
SHORT CIRCUIT	-	WHEN TWO WIRES BETWEEN TWO SIDES OF A CIRCUIT TOUCH EACH OTHER.
S.P.S.T.	-	SINGLE POLE, SINGLE THROW SWITCH.
SOLDER	-	A METAL COMPOSED OF 60% TIN AND 40% LEAD USED TO MAKE ELECTRICAL CONNECTIONS.
SOLDERING IRON	-	AN INSTRUMENT WHICH APPLIES HEAT TO MATERIAL TO BE SOLDERED.
SOLENOID	-	AN ELECTRO-MAGNET HAVING A MOVABLE IRON CORE.
SPAREMAKER	-	AN ELECTRONIC DEVICE USED TO HELP A BOWLER DIRECT HIS SECOND BALL TO HAVE THE MAXIMUM CHANCE OF EFFECTING A SPARE. BALL PLACEMENT IS INDICATED BY A LIGHTED ARROW ON THE MASKING UNIT OR MONITOR.
STEP-DOWN	-	A TRANSFORMER THAT DELIVERS LESS VOLTAGE THAN TRANSFORMER IS SUPPLIED TO IT.
STEP-UP TRANSFORMER	-	A TRANSFORMER THAT DELIVERS MORE VOLTAGE THAN TRANSFORMER IS SUPPLIED TO IT.
SWITCH	-	A MECHANICAL OR ELECTRICAL DEVICE THAT COMPLETES OR BREAKS THE PATH OF CURRENT.
SYMBOL	-	A DESIGN WHICH INDICATES AN ELECTRONIC OR ELECTRICAL PART.

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ELECTRO- MECHANICAL DICTIONARY

TERMINAL	-	A SPRING TYPE METAL CLIP WHICH IS CLAMPED ON THE END OF A WIRE. PERMITS ELECTRICAL CONNECTION TO BE MADE WITHOUT THE USE OF SOLDER.
TEST LEADS	-	A PAIR OF WIRES USED TO CONNECT A METER OR INSTRUMENT TO AN ELECTRICAL CIRCUIT.
THERMAL	-	HAVING TO DO WITH HEAT.
TIME DELAY	-	THE ELAPSED TIME REQUIRED FOR RESULTS TO BE SEEN AFTER A COMMAND IS GIVEN.
TRANSFORMER	-	A DEVICE WHICH STEPS UP OR REDUCES THE AVAILABLE LINE VOLTAGE.
TRANSISTOR	-	A SEMI-CONDUCTOR DEVICE SIMILAR IN OPERATION TO A VACUUM TUBE.
TRUTH TABLE	-	A TABULATION SHOWING OUTPUT LOGIC LEVEL IN RELATION TO ALL POSSIBLE INPUT COMBINATIONS.
VOLT	-	UNIT OF MEASUREMENT OF ELECTRICITY.
VOLTAGE TESTER	-	A NEON TYPE TESTER USED TO INDICATE THE PRESENCE OF VOLTAGE
VOLT METER	-	AN INSTRUMENT USED TO MEASURE VOLTAGE.
WATT	-	A UNIT OF MEASUREMENT OF ELECTRICAL POWER.
WIRE STRIPPER	-	A TOOL USED TO REMOVE INSULATION FROM WIRE.

AMF BOWLING INC.
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GOOD METER MEASUREMENT PRACTICES

1. **CAUTION:** There is always the possibility of dangerous voltages being present in any piece of electrical/electronic equipment. Always use extreme caution when making measurements.

2. Always use only well insulated test leads. Never use test leads without insulated test prods.

3. Never allow your fingers to touch the bare metal part of the test probe.

4. Never attempt to measure voltages or currents above the specified maximum the meter is designed for; refer to specifications section.

5. For safety's sake, disconnect leads as soon as you've completed measurements.

6. Always turn off power (remove power plug) to the unit before connecting test leads. This is especially true when working on circuits with 100 or more volts.

7. Get into the habit of keeping one hand in your pocket when troubleshooting any equipment containing high voltage circuitry.

8. You should remember that even a small shock can be dangerous, because your body's reaction to a minor shock can cause you to bump or fall against a higher voltage contact.

9. Discharge filter capacitors before connecting test leads; such capacitors can retain hazardous charges in units with high voltage circuits.

10. When making voltage and current measurements always start with the highest range available.

11. Never attempt to measure a voltage when the function is set to resistance or current. Never attempt to measure current with the meter set for resistance.

12. Never attempt to measure AC voltages or current with the meter set to a DC mode.

13. Avoid using meters in locations with high magnetic fields. (Inaccurate measurements can result).

14. Remember that voltage and resistance measurements are made with the meter connected in parallel. Current measurements are made with the meter connected in series.

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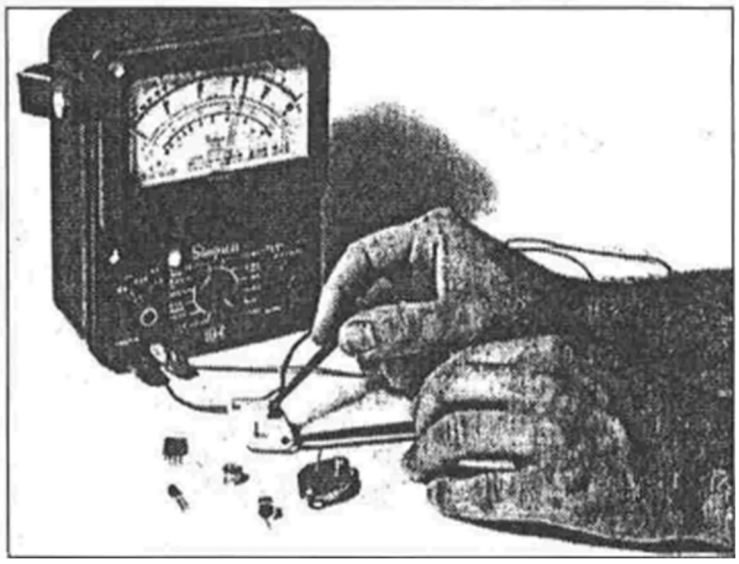
SOME BASICS FOR EQUIPMENT SERVICING

DIODE TESTING



We can determine the general condition of germanium and silicon diodes by means of an ohmmeter. One end of the suspected diode must be unsoldered from the circuit board to isolate it from other components. If this is not done, transistors or resistors that are attached to the immediate circuit of the diode can cause false resistance readings.

Diodes can be tested for forward and back resistance as shown in Fig. 1. Silicon diodes will show a forward resistance between 200 and 300 ohms (R x 100 scale) and a back resistance of 100 to 1000 megohms, typically (R x 1-megohm scale). Germanium diodes will show a forward resistance of roughly 200 to 400 ohms, with a back resistance of 100 k to 1 megohm. These two readings are obtained with either type of diode by simply reversing the leads of the VOM and changing the VOM multiplier scale. This procedure is useful when selecting matched diodes from a group of diodes. They should be matched as closely as possible for the forward-resistance characteristic.

If no resistance reading is obtained, the diode junction is open. Conversely, if a low resistance reading is obtained in both directions, the diode is shorted.

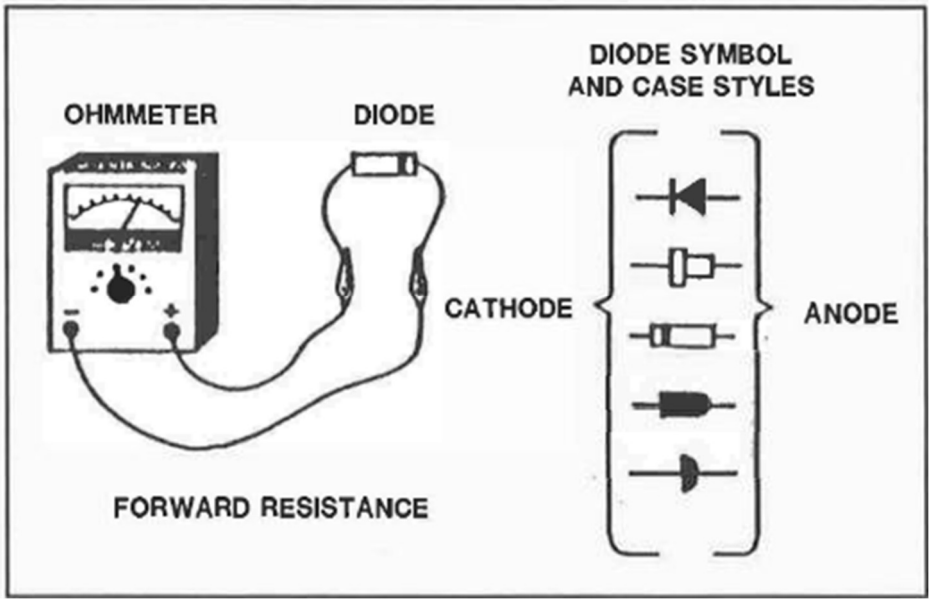


Fig. 1 Method for checking the condition of small-signal and rectifier diodes with an ohmmeter.