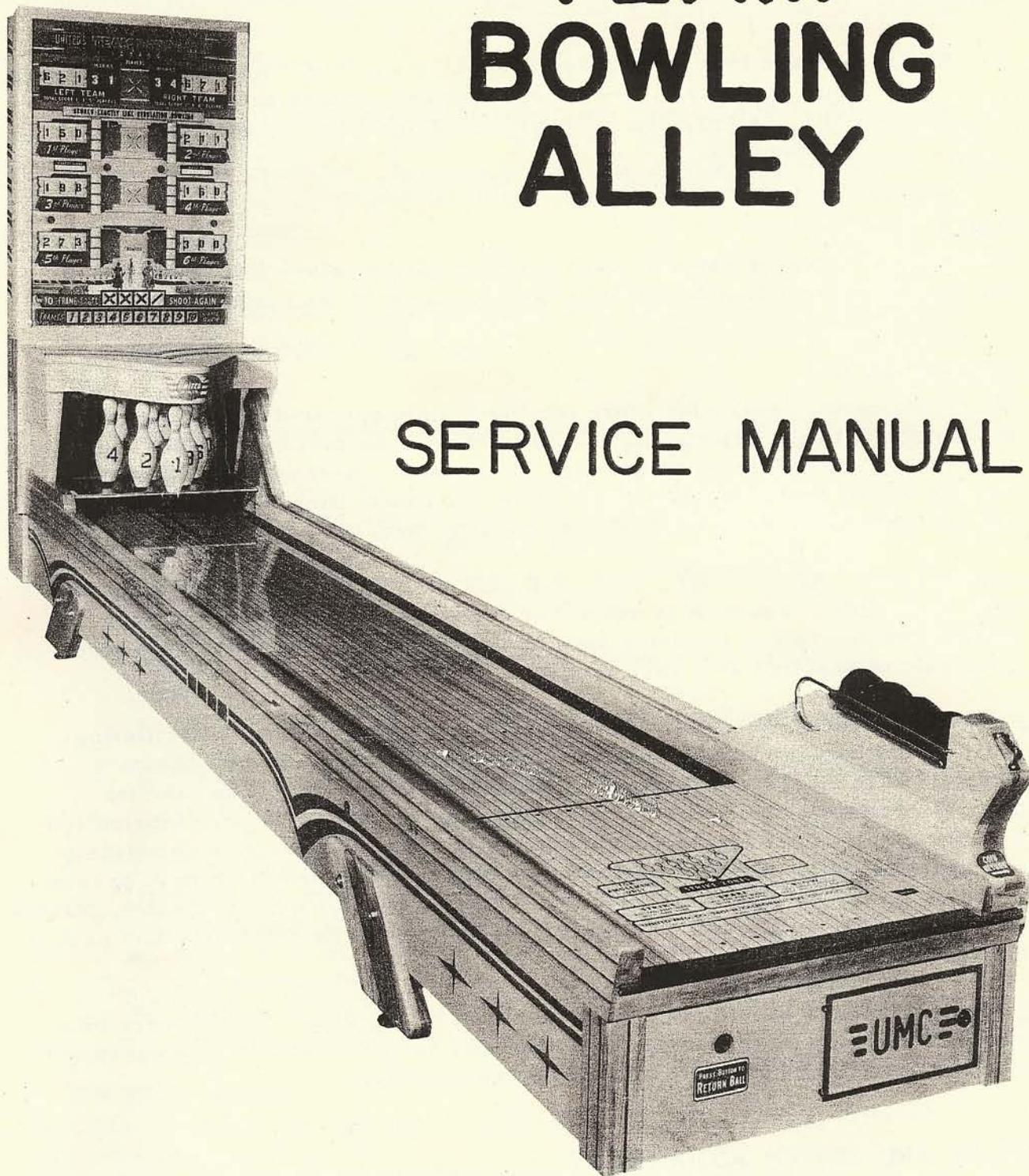


"TEAM" BOWLING ALLEY



SERVICE MANUAL

UNITED MANUFACTURING COMPANY

3401 NORTH CALIFORNIA AVENUE

CHICAGO 18, ILLINOIS

I GENERAL

NEVER EXPERIMENT with any of the mechanism. Locate any trouble with the aid of Wiring Diagrams or Operating & Servicing Information supplied with the machine, then check for proper adjustment of the units involved before making any changes. Improper adjustment or make-shift repair will only cause serious damage to other parts of the machine or repeated failure of the part.

NOTE: Always look for a possible loose wire, bad connection at a plug and socket, broken or unhooked springs on step-up units, relays, etc., before adjustments are made or wires reconnected.

II FUSES

IMPORTANT: Never replace fuses with any rating, other than specified on the fuse block; this fuse block is located adjacent to the transformer.

III LUBRICATION

Over-lubrication causes far more trouble in coin operated equipment than under-lubrication. Practically all cases of poor contact on switches and wiper discs are due to oil or grease, or oil vapor, which forms a film or residue on the contacts and will not allow current to pass through. Excess lubricant may also seep into clutches causing them to slip.

IMPORTANT: NEVER USE VASELINE FOR LUBRICATION OF ANY PART OF THE MACHINE. Vaseline is not a true lubricant. It leaves a dirty and gummy residue and it becomes very thick when cold. A special Coin Machine Lubricant is supplied with each machine.

STEP-UP Levers, Ratchets, Cams, Shafts and other sliding or oscillating parts should be very lightly greased with special Coin Machine Lubricant (supplied with machine) not oftener than every six months. The bakelite discs (biscuits) on the Motor Units and Step-up Units will require lubrication with the special Coin Machine Lubricant only after the grease is completely evaporated (3 to 12 months, depending on climate) or when the film of grease becomes dirty. In either event, clean the parts thoroughly with Benzol, Naptha, White Gasoline, or Carbon Tetrachloride, then apply an extremely thin coat of the special grease.

Solenoid Plungers should not have a lubricant of any kind. Should there be a sluggish tendency or if plungers are sticking, the parts should be cleaned with a solvent and flaked graphite applied on reassembly.

IV RELAY AND SWITCH ADJUSTMENT

A Where relay adjustments are called for, before bending blades, in all cases, on any machine, make certain that the screws holding the switch stacks are down very tightly. This is suggested because the plastic spacers in the switch stacks have occasionally shrunk by drying out, causing a poor adjustment.

- B** With the exception of a few instances, such as on drum unit impulse relays, all blade-type switches should have at least 1/32 inch between the contact points and should follow through for at least 1/32 inch beyond the point at which the contacts close. This follow-through action provides a wiping motion between the contacts, keeping them clean and insuring good contact between the points.

V MOTORS

Whenever a motor is found that is noisy or too slow, it should be lubricated with a few drops of fine oil applied to the Rotor Shaft Bearings or in the oil cups on the Ball Lift Motor. It is not necessary to lubricate the Gears inside the Gear Housing. If the Clutch on the Motor is not disengaging, tap the bearing housing lightly.

A — SCORE MOTOR operates whenever a ball hits one of the six rear roll over forms; its main function is to impulse the relays that control the scoring.

1. The Score Motor always makes a full revolution on a strike.
2. While holding a Spare:
1st Shot with less than 10 Pins, the Motor makes a full revolution and stops at the first position.
The Motor returns to the Zero position on the second Shot.
3. While holding a Strike;
1st Shot with less than 10 Pins, the Motor stops at the 1st position.
 - a. A Spare is not made on the 2nd Shot, the Motor rotates 1-3/4 revolutions.
 - b. Spare is made on the 2nd Shot, the Motor rotates to the Zero position.
4. While holding two Strikes.
1st Shot with less than 10 Pins, the motor rotates a full revolution and then stops at the 1st Position.
 - a. A Spare is not made on the 2nd Shot, the Motor rotates 1-3/4 revolutions.
 - b. A Spare is made on the 2nd shot, the Motor rotates to the Zero Position.

B— PIN RESET MOTOR

This Motor should operate after any Strike or 2nd Shot. If it fails to operate check:-

1. Operation of the Pin Reset Relay. The Relay should stay energized until the Pin Reset Motor Switch moves out of the Zero Position.
2. The Switch on the Pin Reset Relay (Gray-Black and Yellow Wires.)

C—BALL LIFT MOTOR

This Motor should operate from the start of a Game until the Game is over. The Motor is 115 Volts and 50 RPM. If the Motor fails to operate, check;-

1. Game over switch adjustment (Blue and Green Wires.)
2. Hinged Playfield Switch adjustment. (Green and Orange Wires)

VI TRANSFORMER

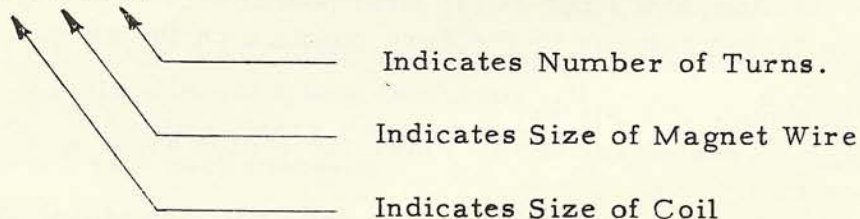
The Primary function of the Transformer is to reduce the Line Voltage or 115 Volts to 50 Volts for all Coils and to 6 Volts for all miniature bulbs. The exception to this is the Long Latch Bank Reset Coil, the Drum Unit Display Lights and the Ball Lift Motor, which are operated by 115 Volts.

In Low Voltage Areas, (105 Volts or Less,) a Boost in the Output Voltage can be obtained by inserting the Voltage Control Fuse into the "Low" Line. This Fuse is located adjacent to the Transformer.

VII MISCELLANEOUS

A. COIL DESIGNATIONS

#6-28-1800



A #6 Coil is used on A. C. relays, whereas a #1 Coil is used on Step Up Units, etc.

B. COIN METER: The Coin Meter is located adjacent to the Cash Box. The meter registers the total number of coins deposited.

C. CONTINUITY CHECKS.

Continuity of coils, contacts, wire connections, etc. may be checked with an Ohmmeter or several types of Test Lites. If regular test equipment is not available, an efficient Test Lite may be made from a few miscellaneous parts. The following paragraphs describe this equipment and give information that will prove helpful to the service man.

- a. Battery Test Lite should be used only with all current in machine turned OFF. When the leads from the Lite are placed across the wires leading to the Coils, Switches, etc., the bulb will light if there is a contact through the unit being checked. However, only open circuits on coils may be located by this method since shorted coils will also show contact through the coil. If a short is suspected use the Test Prod to check the coil.
- b. The Test Prod must be used with current turned ON. The clip on the end of the lead wire may be attached to any common ground in the machine. This would be Black Wire for 50 Volt tests, or White Wire for 6 Volt Tests. The Prod end of the tester may then be touched to various connections or contact points in the circuit being checked. Using the tester in this manner leaves the service man with one hand free to manually operate relays or other units.

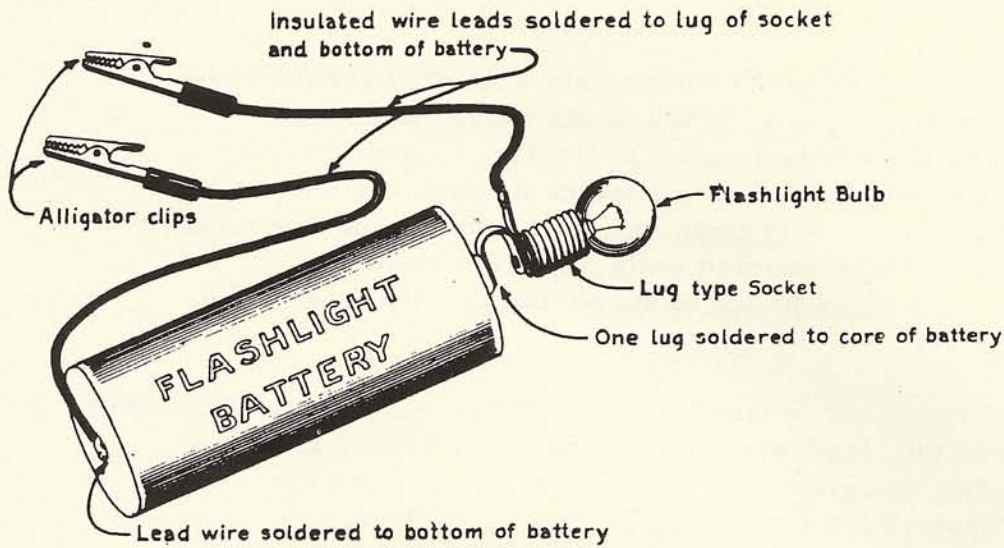
If a particular Coil on a Relay, Solenoid, etc., is not energized, place the clip end of the Test Prod on the Black lead to the Coil. Touch the Test Prod to the opposite lead of the Coil. If the bulb lights but the Relay Coil, or other unit being checked, is not energized then the coil is faulty and must be replaced.

Wiper Contacts may be checked by placing the Test Prod Clip on the Common ground wire for the circuit (Black for 50 Volts, White for 6 Volt circuits) and checking the solder lugs of the Contact Discs as follows:

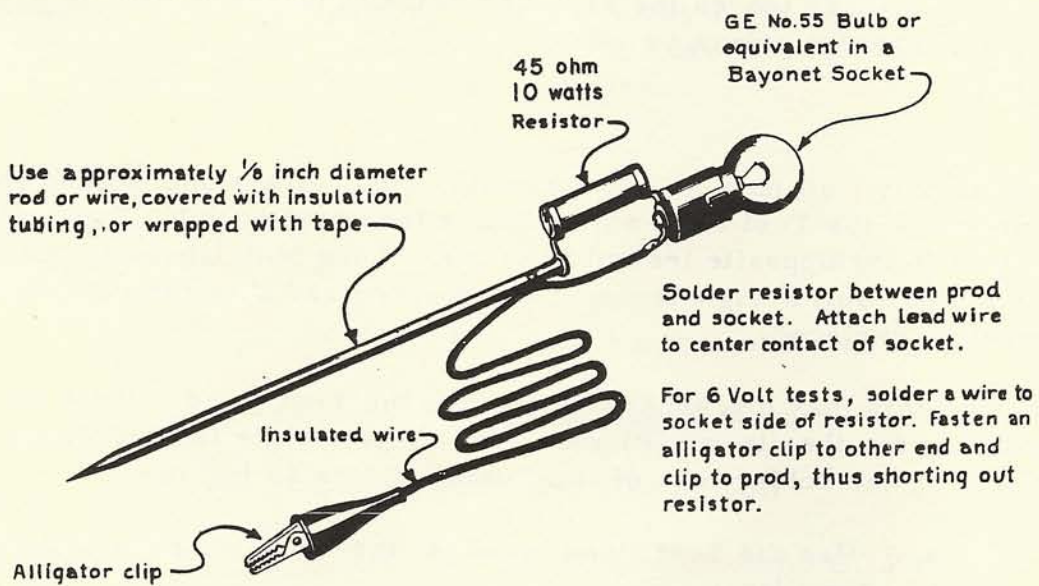
- a. Use the Test Prod to locate the "hot" wires leading into the Disc.
- b. Check the Wiring Diagram for the wire colors of the contacts opposite the hot leads.
- c. Place the Test Prod on the contacts, thus located, and turn the wipers of the unit by hand. The Test Lite should light proper positions as noted on Wiring Diagram.

Broken Wires may be located by placing the leads of the Battery Test Lite on each end of the wire in question. If the bulb fails to light, a break in the circuit is indicated.

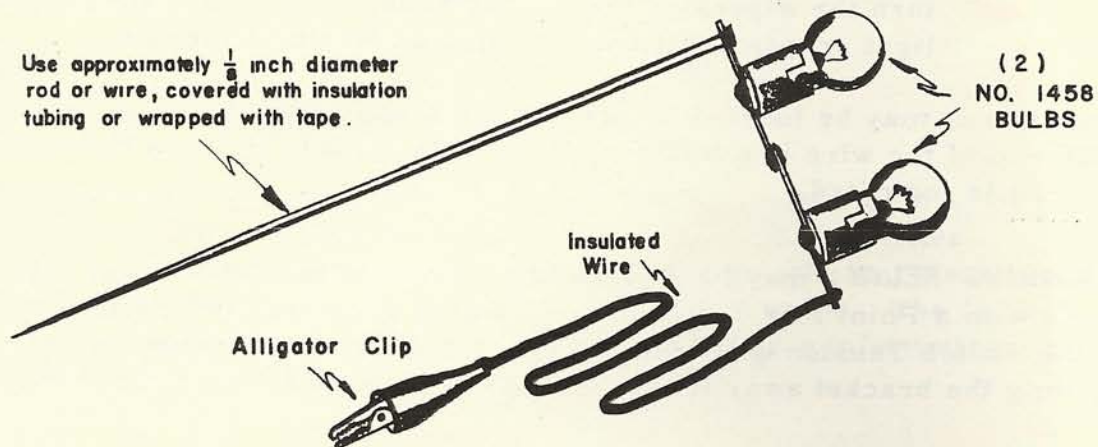
D. **HUMMING RELAY** may be silenced by filing the face of the coil pole piece with a Point File. If the trouble still persists, relieving some of the Switch Tension will tend to reduce the hum. As a last resort, bending the bracket away from the coil is suggested.



BATTERY TEST LIGHT



ALTERNATE METHOD WIRE (2) NO. 1458 BULBS IN SERIES FOR 50 VOLTS ONLY



VIII WIRING DIAGRAM EXPLANATION

The Wiring Diagram is the most useful tool the service man can possess. With the proper use of the Wiring Diagram, service becomes easy, quick and dependable. Without an understanding of the diagram, service becomes a hit and miss proposition and can only be overcome by an excess amount of actual experience.

The following instructions are presented in a simple, logical, step-by-step sequence to enable you to read a Wiring Diagram with the least amount of confusion.





The first requirement to read a Wiring Diagram is to understand the functions of the equipment used. The Basic Equipment used is:-

- A. **SWITCH** ————— It is a means to complete or open a circuit.
- B. **RELAY** ————— A Relay is essentially a remotely controlled Switch which can open or close contacts when suitable electrical conditions are met. When Electrical Current flows through the Relay Coil, a magnetic field results. This field attracts the armature flap, which in turn opens or closes the attached switches.
- C. **STEP-UP UNIT** ————— A Step Up Unit is essentially a switch or group of switches in the form of Wiper Fingers. These Wiper Fingers are mounted on a gear which is rotated by a Drive Arm. The Drive Arm is attached to a Solenoid Plunger. When the Step Up Unit Coil (Solenoid) is energized, the Magnetic Field attracts the Plunger and the Design of the Step Up Unit rotates the Wiper Fingers to the next Rivet Position. A Relay performs the same function all the time, whereas a Step-Up Unit can change circuits with each advancement.
- D. **MOTOR OPERATED UNIT** is a method of using a sequence of switching operations during every cycle or operation. A motor can have Cam operated switches and Wiper Fingers operating on a Motor Disc.
- E. **TRANSFORMER** The function of the Transformer is to take a line voltage (115 Volts) and reduce it to our needs.
 - 1. 6 Volts for the #55 and #81 Bulbs. (Wires from transformer are White and Yellow.)
 - 2. 50 Volts for the operation of the Coils. (Wires from Transformer are Black or Red and Yellow)

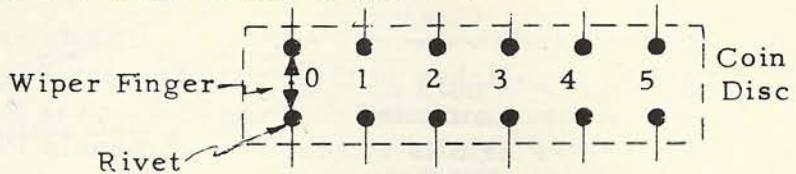
The Relay Bank Reset Coil and Ball Lift Motor Coil operate on 115 Volts.

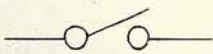
IX SYMBOLS Are just a Short Hand Method of describing part of a Circuit.

A. Switch Symbols -

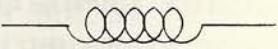
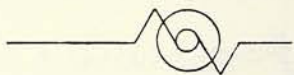
- 1. Normally open Switch, Closed when Energized. 
- 2. Normally closed Switch, Open when Energized. 
- 3. Make and Break Switch. 
- 4. Switch operated by a Motor Cam. 

- 5. Wiper Finger and Rivet Positions. All Units, such as Frame Unit, Score Motor, etc.

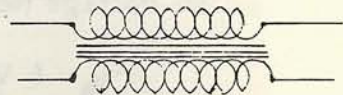


- 6. Push Button or Toggle Switches. 

B. COIL SYMBOLS

- 1. Step Up Unit and Relays 
- 2. Motors 

C. TRANSFORMER



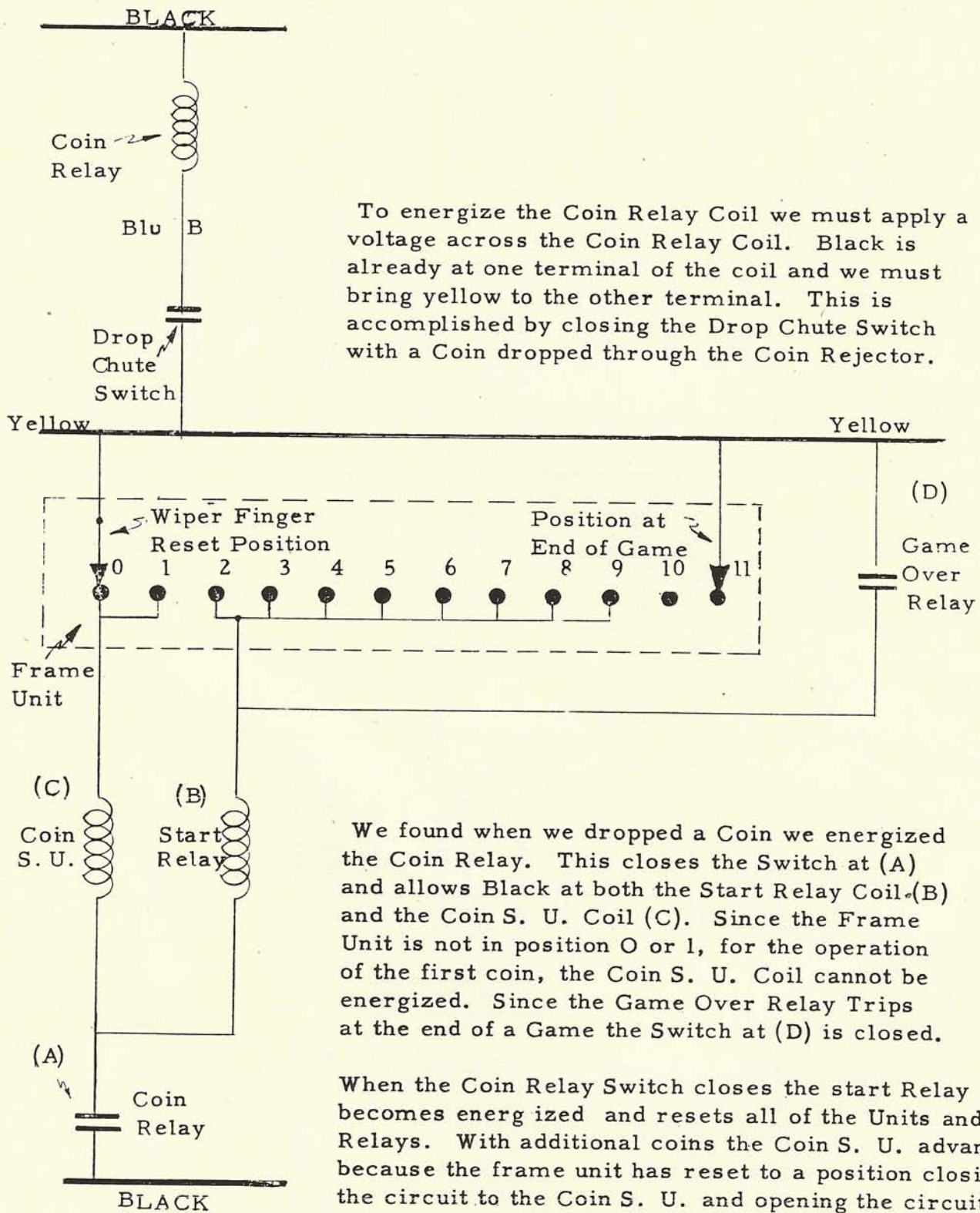
D. LIGHT BULBS



E. FUSES



Now that we understand the equipment and the symbols that describe the equipment, we can apply them to a simple circuit.



A Wiring Diagram is a large collection of simple circuits. If we look at it as a whole, it looks complex. If we isolate the circuit that is causing trouble, service work can be simple.

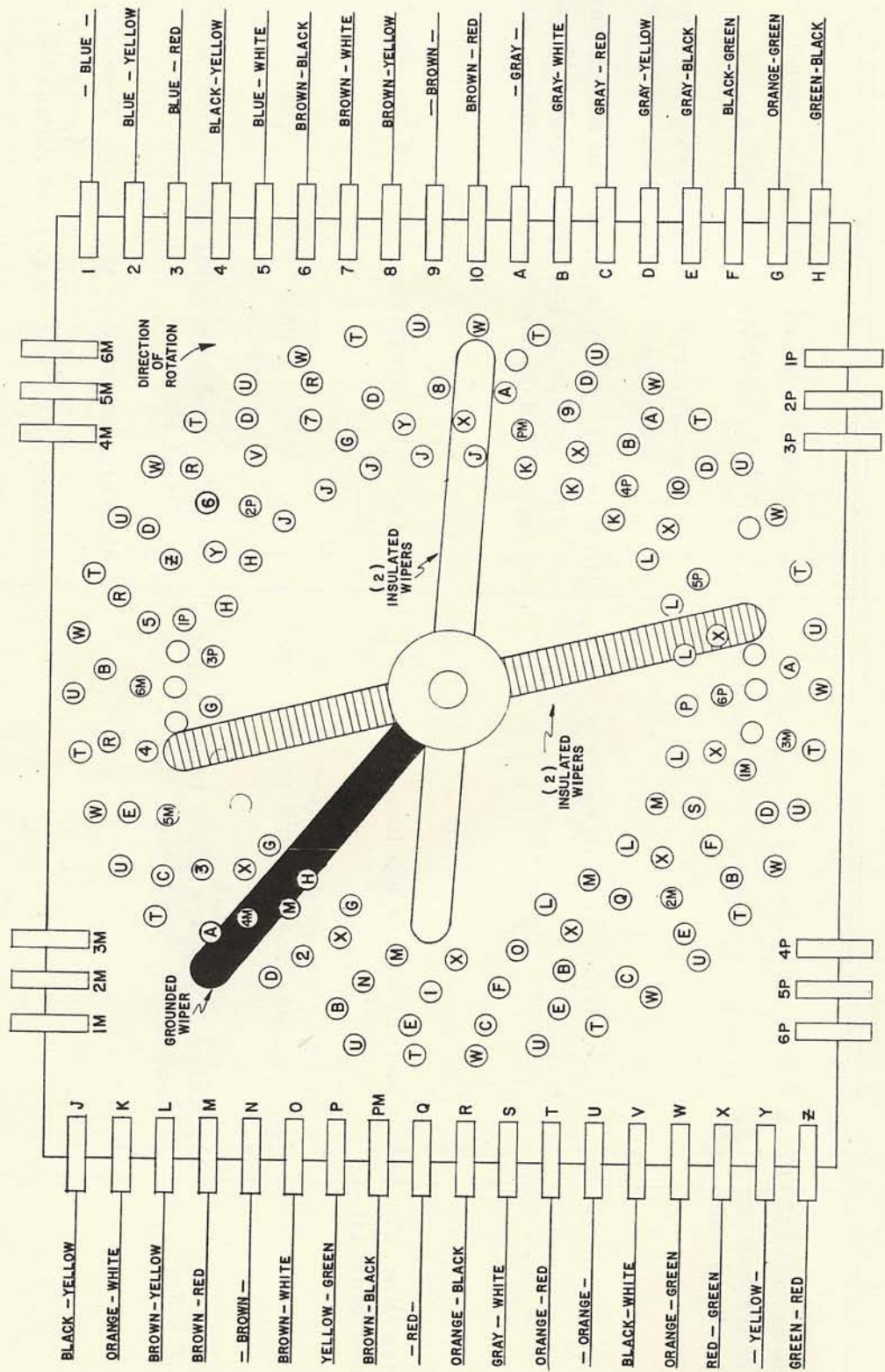
SERVICE CALL	CAUSE	CORRECTION
1. Game completely dead.	1. Line cord not making contact in outlet.	1. Repair or replace plug or outlet.
2. Drum units fail to score properly.	2a. Wires to drum unit coils and switches are hitting reels. 2b. Tape from coils rubbing reels. 2c. 1-9 or 10-90 Score Relay Switches not adjusted properly. 2d. Only one particular 10-90 unit fails to advance properly. 2e. Wiper fingers on Score Motor not adjusted with sufficient pressure.	2a. Rearrange wires. 2b. Remove Tape 2c. Make proper adjustment 2d. Check 9th position switch on the 1-9 unit. 2e. Make proper adjustment
3. Drum units fail to reset to Zero at start of game.	3a. Poorly adjusted Zero Switch on failing unit. 3b. Reset relays not operating properly. 3c. Check #2	3a. Adjust Zero switch to open at the zero position, and "make" at the 1st position with adequate contact pressure. 3b. Adjust switches on Reset relays.

SERVICE CALL	CAUSE	CORRECTION
<p>4. Spare does not register and game scores 10 points.</p> <p>.</p> <p>Strike does not register and pins do not reset</p>	<p>4. 1-10 Relay is not dropping</p>	<p>4. a. Adjust the 10 switches which trip the 1-10 Relay, starting from the #1 Relay and continuing to the #10 Relay</p> <p>4. b. Check the 1-10 Relay for tripping properly mechanically. This is generally caused by too much tension by the top switches.</p> <p>4. c. Apply lubrication to the tip of the Armature.</p>
<p>5. No 2nd shot for spare; Game scores on 1st shot.</p>	<p>5. a. 2nd shot relay is not being reset properly</p> <p>5. b. Score Motor is over-riding and is not stopping at the 1st Position</p>	<p>5. a. Adjust armature fl ap.</p> <p>5. b. Adjust 1st Position switch (Green-Red Wire). If clutch on motor is not dis-engaging, tap the bearing housing lightly.</p>
<p>6. Bowling pins do not reset.</p>	<p>6. a. Pin Reset Relay is not being energized</p> <p>6. b. Pin Reset Relay energizes, but drops out before the Pin Reset motor moves out of the Zero Position.</p>	<p>6. a. Adjust hinged playfield switch.</p> <p>6. b. Adjust the Zero Position switch on the Pin Reset motor to "make" before it "breaks."</p>

SERVICE CALL	CAUSE	CORRECTION
<p>7. Score motor operates continuously until "GAME OVER".</p>	<p>7a. Ball is lying on one of the six back rollover switches.</p> <p>7b. The Relay Bank fails to reset.</p>	<p>7a. Level Game</p> <p>7b. Adjust 3rd Position switch on Score Motor and normally closed switch on Score Control Relay (Brown Wire).</p>
<p>8. Unusual pin leave combinations</p>	<p>8a. Rollovers switches adjusted with too much gap.</p> <p>8b. Relays not tripping on the relay bank due to much friction of armature tip.</p>	<p>8a. Adjust rollover switches with a smaller gap.</p> <p>8b. Apply lubrication to tip of the armature.</p>
<p>9. Balls not being returned.</p>	<p>9a. Gate coil not being energized because 1st or 2nd Shot Relays are not being tripped.</p> <p>9b. Gate coil is being energized but balls hang on steel runway.</p>	<p>9a. Adjust the six rear rollover switches to have a smaller gap.</p> <p>Apply lubrication to the tips of the armatures on the 1st and 2nd Shot Relays.</p> <p>9b. Remove steel runway.</p>

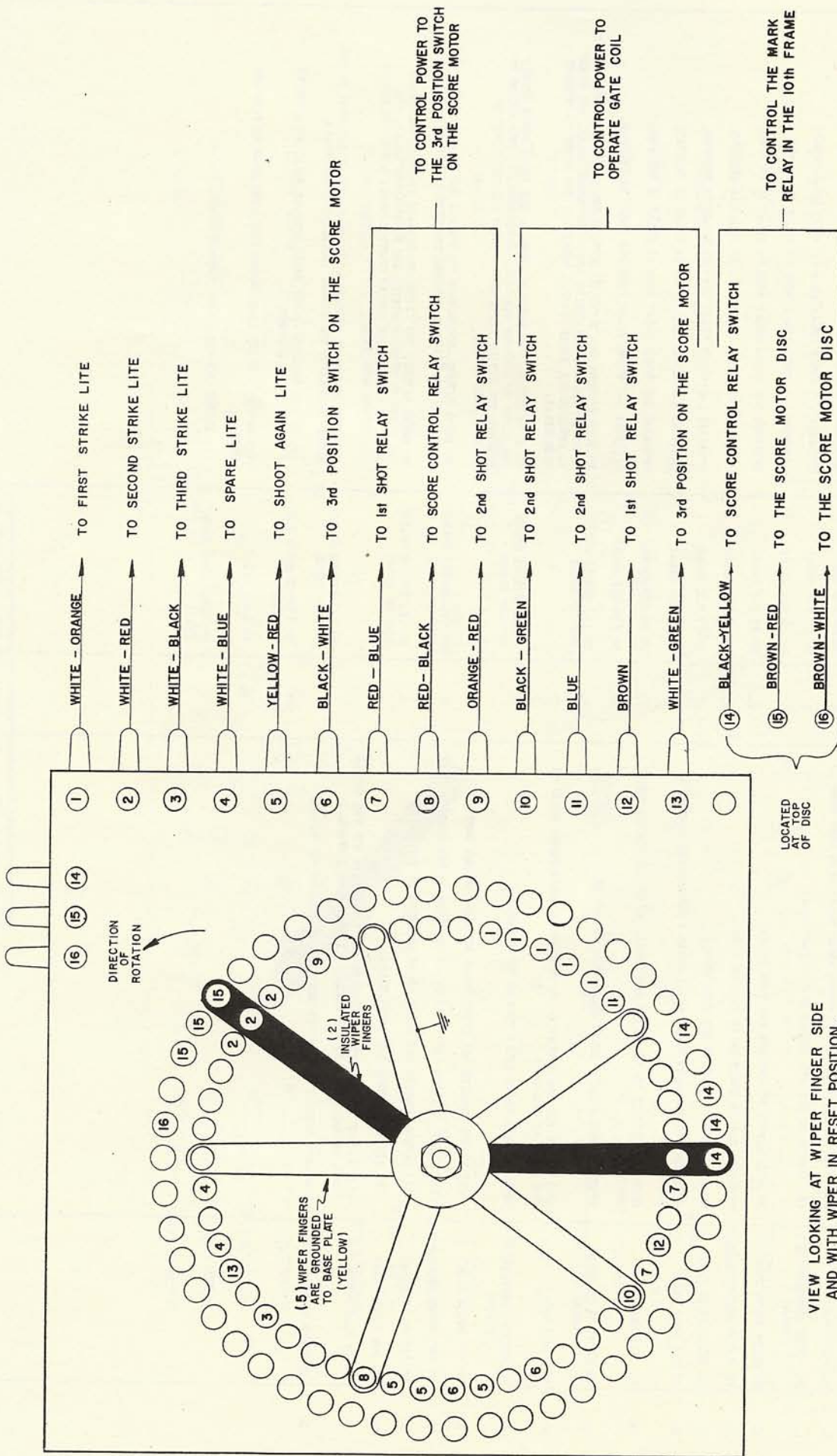
SERVICE CALL	CAUSE	CORRECTION
<p>10. Game shows "GAME OVER" in 1st Frame after depositing coin</p>	<p>10. Lock Relay does not energize.</p>	<p>10. Adjust the Make and Break switch to "Make before "Break."</p>
<p>11. Game shows "GAME OVER" too soon.</p>	<p>11. Tilt switches are improperly adjusted.</p>	<p>11. One tilt switch is located in the cabinet and another one is located in the backbox. Adjust in accordance with instructions.</p>
<p>12. Lights are dim; all units work sluggishly.</p>	<p>12. Line voltage is too low.</p>	<p>12. Install Voltage control fuse into the "LOW LINE".</p>
<p>13. Humming Coils.</p>	<p>13. Relay Armature Plate is not seated properly on Coil Pole Piece.</p>	<p>13a. File the Face of the Coil Pole Piece with a Point File.</p> <p>13b. Relieve some of the switch Tension.</p> <p>13c. Bend Bracket away from the Coil.</p>

SCORE MOTOR DISC



LUG POSITION	FUNCTION OF RIVETS CONNECTED TO LUG POSITION	LUG POSITION	FUNCTION OF RIVETS CONNECTED TO LUG POSITION
J.	TO 10-90 SCORE RELAY	1.	OPERATES 1-9 SCORE RELAY WHEN #1 RELAY IS TRIPPED.
K.	TO 1-10 RELAY	2.	OPERATES 1-9 SCORE RELAY WHEN #2 RELAY IS TRIPPED.
L.	TO STRIKE SPARE RESET RELAY	3.	OPERATES 1-9 SCORE RELAY WHEN #3 RELAY IS TRIPPED.
M.	TO EXTRA SHOTS DISC	4.	OPERATES 1-9 SCORE RELAY WHEN #4 RELAY IS TRIPPED.
N.	TO PLAYER RESET RELAY	5.	OPERATES 1-9 SCORE RELAY WHEN #5 RELAY IS TRIPPED.
O.	TO EXTRA SHOTS DISC	6.	OPERATES 1-9 SCORE RELAY WHEN #6 RELAY IS TRIPPED.
P.	TO 2ND SHOT RELAY	7.	OPERATES 1-9 SCORE RELAY WHEN #7 RELAY IS TRIPPED.
PM.	TO COIN UNIT DISC	8.	OPERATES 1-9 SCORE RELAY WHEN #8 RELAY IS TRIPPED.
Q.	TO EXTRA SHOTS RESET RELAY	9.	OPERATES 1-9 SCORE RELAY WHEN #9 RELAY IS TRIPPED.
R.	TO START RELAY	10.	OPERATES 1-9 SCORE RELAY WHEN #10 RELAY IS TRIPPED.
S.	TO HINGED PLAYFIELD SWITCH	A.	TO FOUR RIVETS, OFF RIVET TO OPERATE THE 10-90 SCORE RELAY, ONE RIVET TO OPERATE THE STRIKE AND SPARE RESET RELAY, ONE RIVET TO OPERATE THE SCORE CONTROL RELAY AND ONE RIVET TO OPERATE MARK RELAY.
T.	TO "C" RESET RELAY	B.	TO FIVE RIVETS, ONE RIVET TO OPERATE THE 10-90 SCORE RELAY, ONE RIVET TO OPERATE THE SCORE CONTROL RELAY, TWO RIVETS TO OPERATE THE STRIKE SPARE RESET RELAY AND ONE RIVET TO OPERATE MARK RELAY.
U.	TO "B" RESET RELAY	C.	TO THREE RIVETS, TWO RIVETS TO OPERATE THE 10-90 SCORE RELAY AND ONE RIVET TO OPERATE THE SCORE CONTROL RELAY.
V.	TO "A" RESET RELAY	D.	TO SEVEN RIVETS, TWO RIVETS TO OPERATE 10-90 SCORE RELAY, ONE RIVET TO OPERATE STRIKE AND SPARE RESET RELAY, ONE RIVET TO OPERATE THE STRIKE CONTROL RELAY AND THREE RIVETS TO OPERATE MARK RELAY.
W.	TO 1-9 SCORE RELAY	E.	TO THREE RIVETS TO OPERATE 10-90 SCORE RELAY AND ALSO TO ONE RIVET TO OPERATE THE STRIKE AND SPARE RESET RELAY.
X.	TO 50 TONS POWER	F.	(2) RIVETS OPERATE STRIKE SPARE STEP-UP RELAY ON A STRIKE. (1) RIVET ON A SPARE.
Y.	TO SCORE CONTROL RELAY	G.	(4) RIVETS OPERATE 10-90 SCORE WHEN LESS THAN 10 PINS ARE MADE. (3) RIVETS OPERATE SCORE CONTROL RELAY.
Z.		H.	TO EXTRA SHOT RESET RELAY

EXTRA SHOTS UNIT DISC



VIEW LOOKING AT WIPER FINGER SIDE AND WITH WIPER IN RESET POSITION.

THIS UNIT OPERATES ONLY IN THE 10th FRAME AND THE UNIT ADVANCES TWO TIMES PER STRIKE ONE TIME ON A SPARE.

EXTRA SHOTS UNIT

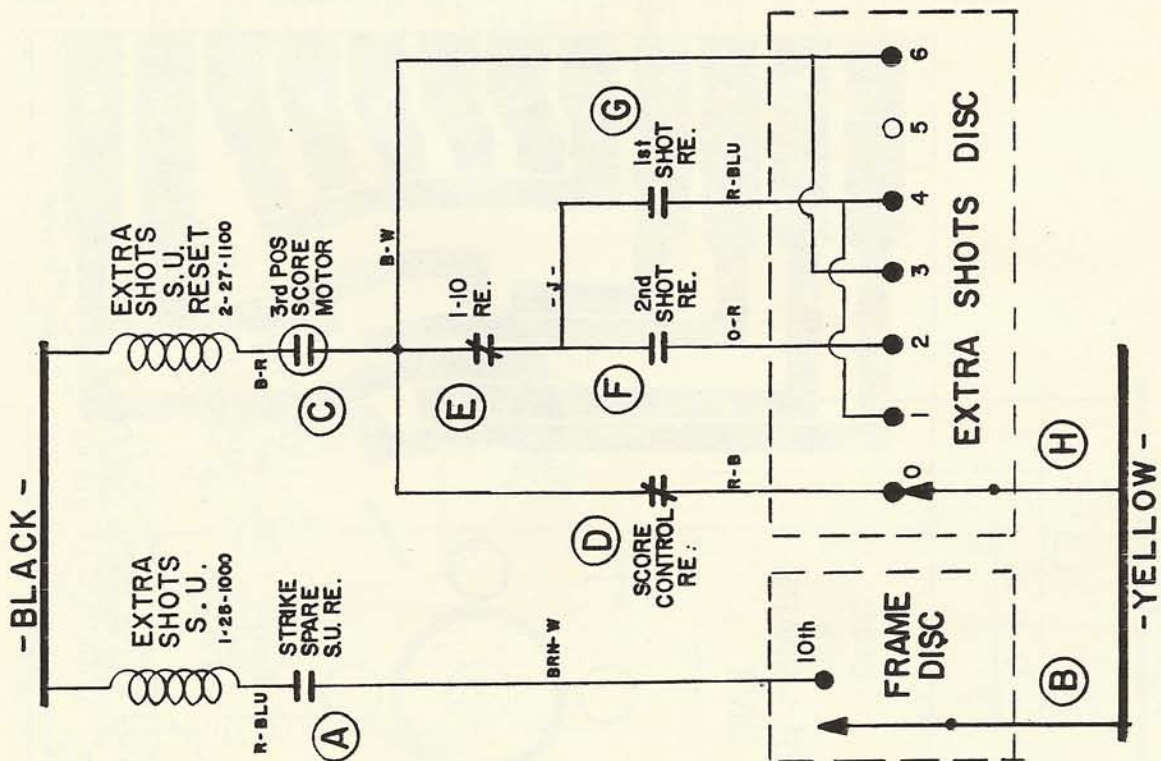
THE FUNCTION OF THIS UNIT IS TO GIVE EXTRA SHOTS TO THE PLAYER IN THE 10th FRAME. THIS UNIT ADVANCES TWO TIMES WHEN A STRIKE IS MADE AND ONCE WHEN A SPARE IS MADE; ONLY IN THE 10th FRAME.

IF THIS UNIT FAILS TO ADVANCE PROPERLY, CHECK:

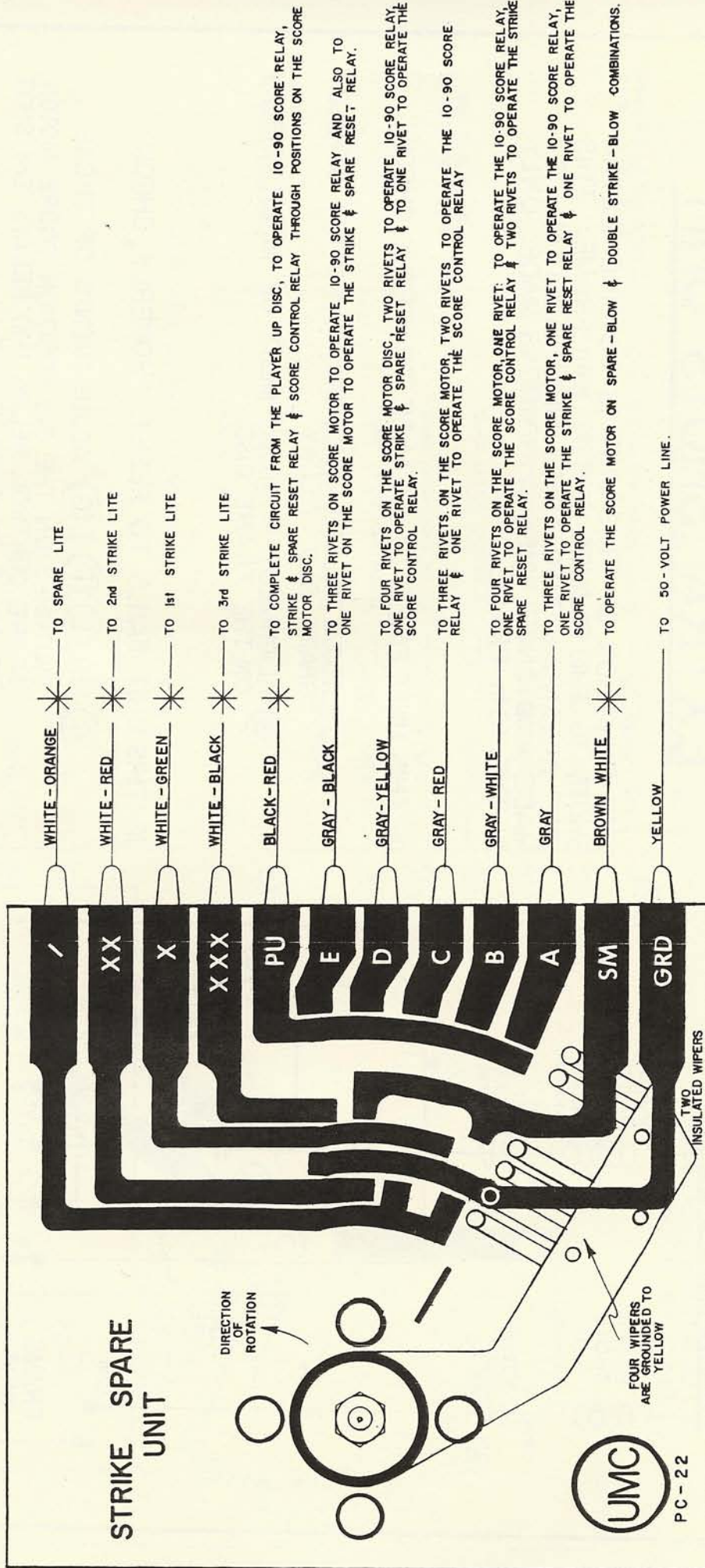
- (A) ADJUSTMENT OF THE SWITCH ON THE STRIKE SPARE S.U. RELAY.
- (B) ALIGNMENT & ADJUSTMENT OF WIPER FINGERS ON THE FRAME DISC.

IF THIS UNIT FAILS TO RESET PROPERLY, CHECK:

- (C), (D), (E), (F) & (G) ADJUSTMENTS OF THESE SWITCHES ON THE 3rd POSITION SCORE MOTOR, SCORE CONTROL RELAY, 1-10 RELAY, 2nd SHOT RELAY, & 1st SHOT RELAY.
- (H) ALIGNMENT & ADJUSTMENT OF WIPER FINGERS ON THE EXTRA SHOTS UNIT.



1st PLAYER STRIKE & SPARE UNIT



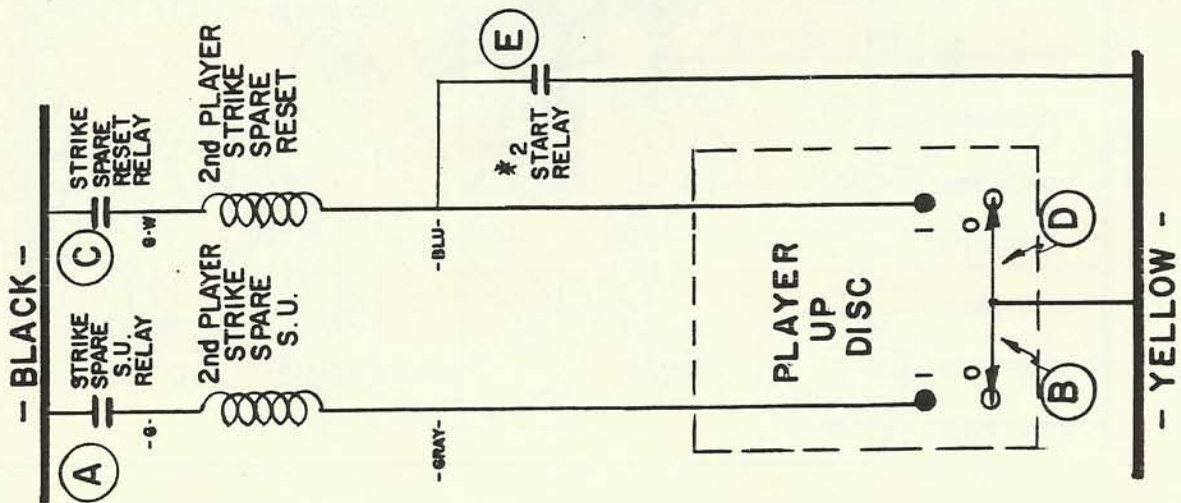
VIEW LOOKING AT WIPER FINGER SIDE AND WITH WIPER IN RESET POSITION.

* WIRE COLORS ARE DIFFERENT ON THE OTHER FIVE PLAYERS STRIKE AND SPARE UNITS.

2nd PLAYER STRIKE-SPARE UNIT

ALL OTHER PLAYER UNITS ARE SIMILIAR.

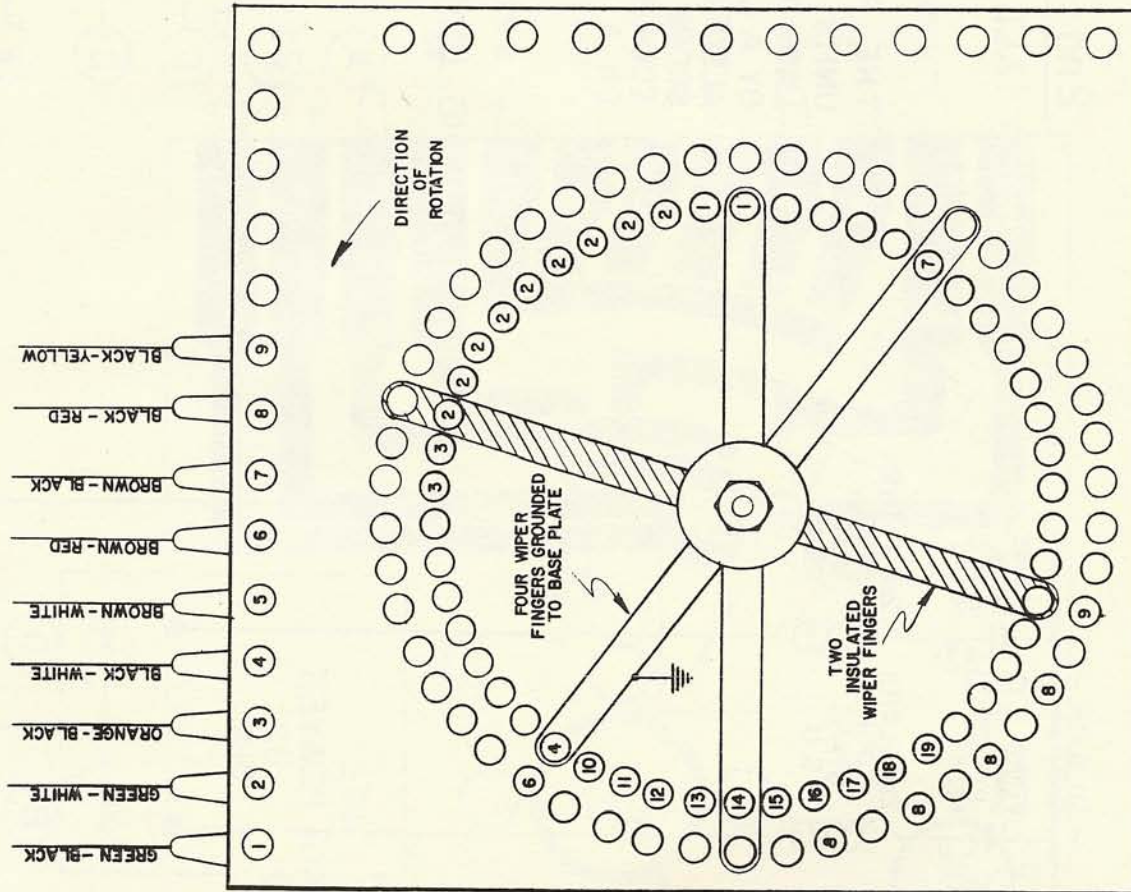
THE PRIMARY FUNCTION OF THE STRIKE-SPARE UNITS ARE TO HOLD THE RESULTS OF THE PLAYERS LAST ONE OR TWO FRAMES AND SHOW THE RESULT BY A LIGHT INDICATED ON THE BACK GLASS. THE UNITS ALSO CONTROL CIRCUITS TO THE SCORE MOTOR, 10-90 SCORE RELAY, STRIKE SPARE RESET RELAY & THE SCORE CONTROL RELAY. THE UNIT ADVANCES ONCE ON A SPARE & TWICE ON A STRIKE.



IF THE UNIT FAILS TO ADVANCE PROPERLY, CHECK:

- (A) THE ADJUSTMENT OF THE SWITCH ON THE STRIKE SPARE S.U. RELAY.
- (B) ALIGNMENT & ADJUSTMENT OF THE WIPER FINGER ON THE PLAYER UP UNIT.
- (C) THE ADJUSTMENT OF THE SWITCH ON THE STRIKE SPARE RESET RELAY.
- (D) ALIGNMENT & ADJUSTMENT OF THE WIPER FINGER ON THE PLAYER UP UNIT.
- (E) THE ADJUSTMENT OF THE *2 RELAY SWITCH FOR FAILURE OF THE UNIT AT THE START OF THE GAME.

FRAME S. U. DISC



VIEW LOOKING AT WIPER FINGER SIDE
AND WITH WIPER IN RESET POSITION

RIVET NUMBER	WIRE COLORS	FUNCTION OF RIVET
1	GREEN - BLACK	TO COIN UNIT COIL
2	GREEN - WHITE	TO START TRIP RELAY COIL
3	ORANGE - BLACK	TO GAME OVER RELAY COIL
4	BLACK - WHITE	TO 3rd POSITION ON THE SCORE MOTOR
5	BROWN - WHITE	TO STRIKE SPARE STEP-UP REPLAY SWITCH TO OPERATE EXTRA SHOTS UNIT IN THE 10th FRAME.
6	BROWN - RED	TO OPERATE GATE CONTROL RELAY IN 10th FRAME
7	BROWN - BLACK	TO OPERATE GATE CONTROL RELAY IN 10th FRAME
8	BLACK - RED	TO STRIKE ZONE ADJUSTMENT JACK TO OPERATE EASY STRIKE RELAY IN EVEN FRAMES.
9	BLACK - YELLOW	TO STRIKE ZONE ADJUSTMENT JACK TO OPERATE EASY STRIKE RELAY IN 10th FRAME ONLY.
10	WHITE - ORANGE	TO 1st FRAME LITE
11	WHITE - GREEN	TO 2nd FRAME LITE
12	WHITE - RED	TO 3rd FRAME LITE
13	WHITE - BLACK	TO 4th FRAME LITE
14	WHITE - BROWN	TO 5th FRAME LITE
15	WHITE - BLUE	TO 6th FRAME LITE
16	YELLOW - GREEN	TO 7th FRAME LITE
17	YELLOW - RED	TO 8th FRAME LITE
18	YELLOW - BLACK	TO 9th FRAME LITE
19	- ORANGE -	TO 10th FRAME LITE

FRAME UNIT

THE MAIN FUNCTION OF THIS UNIT IS TO DENOTE THE FRAME POSITION BY LIGHT INDICATION ON BACK GLASS. IN ADDITION IT CONTROLS THE EASY STRIKE RELAY, START RELAY, COIN UNIT, EXTRA SHOTS UNIT, GATE CONTROL RELAY & THE GAME OVER RELAY. THIS UNIT ADVANCES WHEN THE LAST PLAYER IN EACH FRAME HAS COMPLETED HIS SHOT.

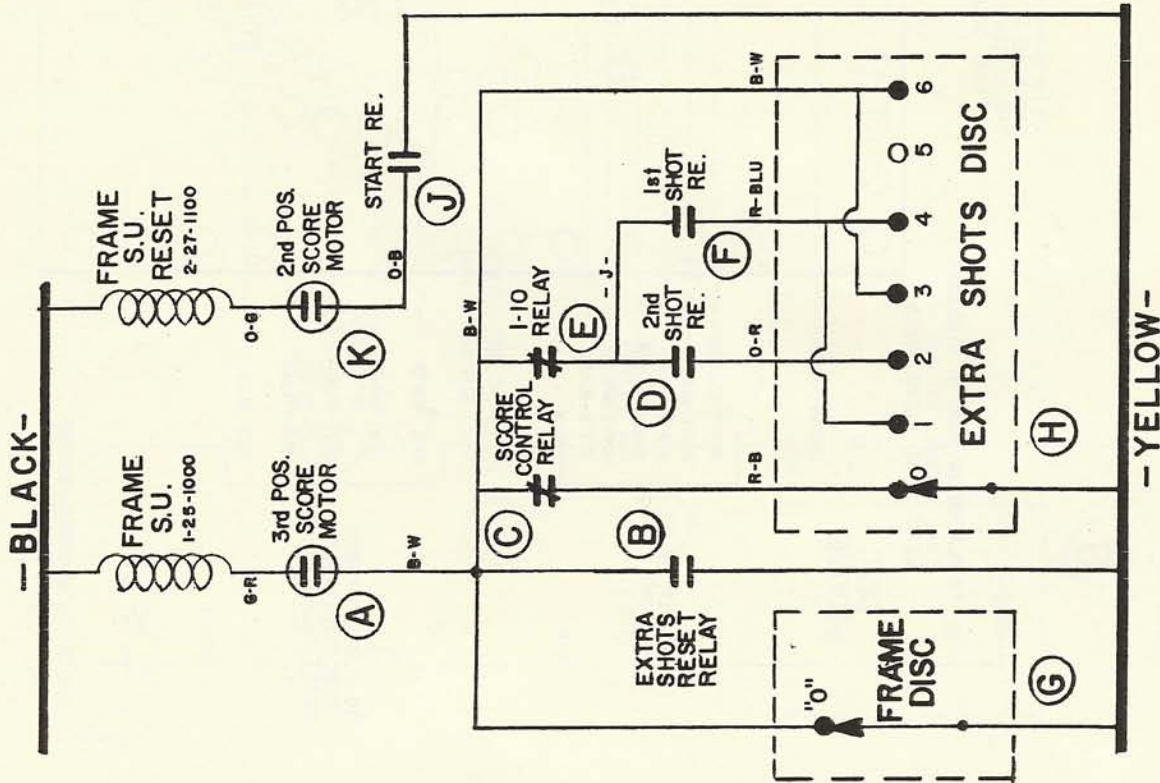
IF THIS UNIT FAILS TO ADVANCE PROPERLY, CHECK:

(A), (B), (C), (D), (E) & (F) THE ADJUSTMENTS OF THE INDICATED SWITCHES ON THE 3rd POSITION OF THE SCORE MOTOR, 2nd SHOT RELAY, EXTRA SHOTS RESET RELAY, SCORE CONTROL RELAY, 1-10 RELAY, & 1st SHOT RELAY.

(G) & (H) ALIGNMENT & ADJUSTMENT OF THE WIPER FINGERS ON THE FRAME UNIT & THE EXTRA SHOTS UNIT.

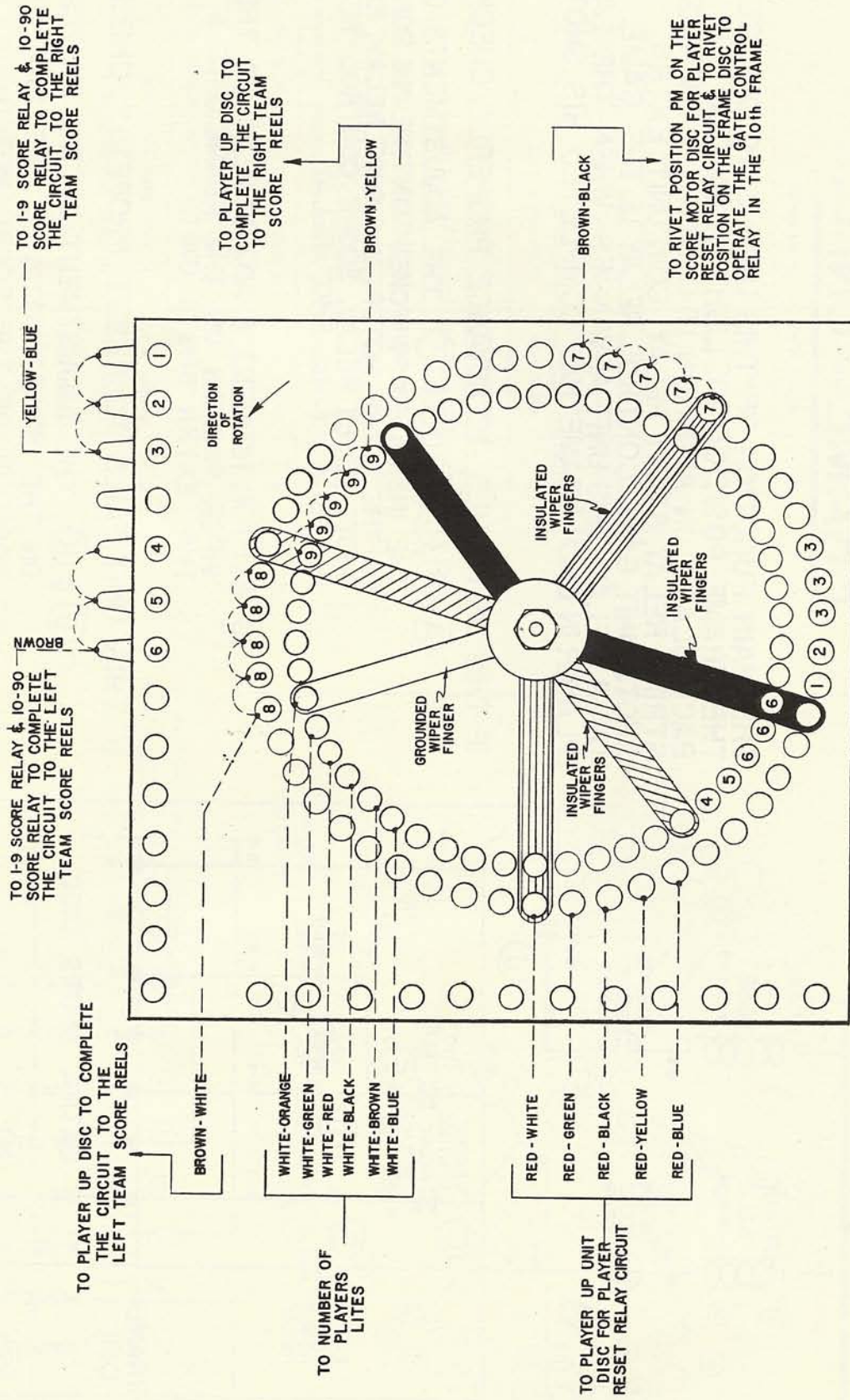
IF THIS UNIT FAILS TO RESET PROPERLY, CHECK:

(J) & (K) THE ADJUSTMENT OF THE SWITCHES ON THE START RELAY & THE 2nd POSITION OF THE SCORE MOTOR.



COIN S.U. DISC

RESETS WITH 1st COIN AND ADVANCES WITH THE 2nd COIN



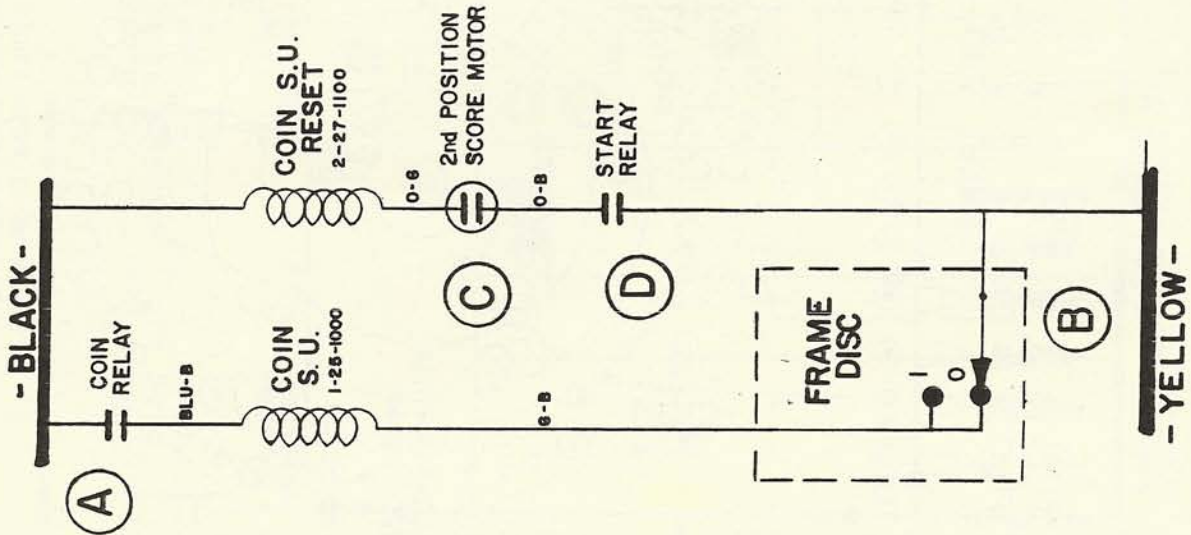
VIEW LOOKING AT WIPER FINGER SIDE AND WITH WIPER IN RESET POSITION

COIN UNIT

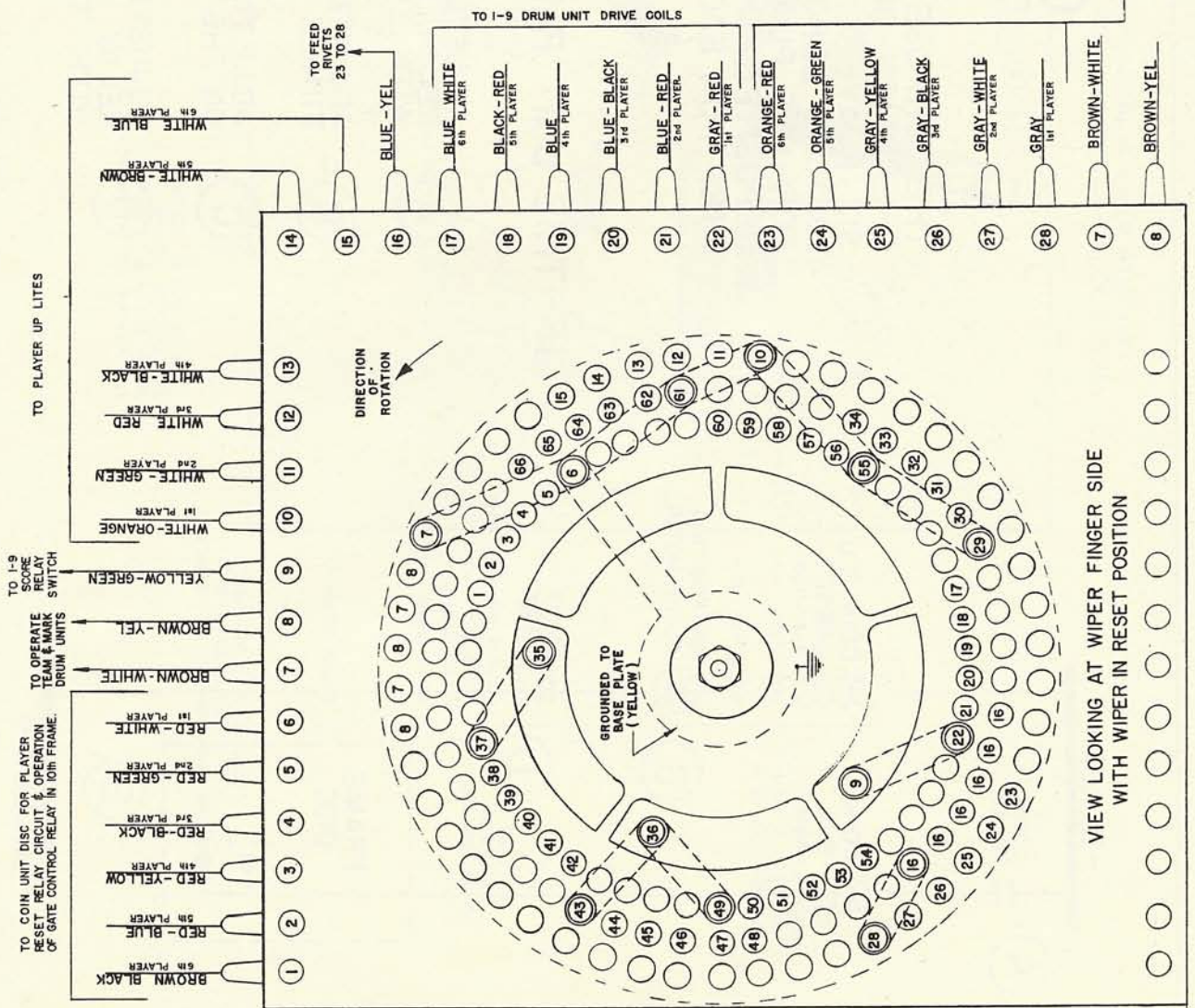
THE PURPOSE OF THIS UNIT IS TO PERMIT OPERATION OF THE GAME FROM ONE TO SIX PLAYERS. THE FIRST COIN RESETS THE UNIT TO ZERO WHERE IT WOULD REMAIN FOR ONE PLAYER; IF EXTRA COINS ARE DEPOSITED THE UNIT WOULD ADVANCE ONE STEP FOR EACH COIN.

IF THIS UNIT FAILS TO ADVANCE PROPERLY, CHECK:

- (A) ADJUSTMENT OF THE SWITCH ON THE COIN RELAY. THE COIN RELAY SHOULD IMPULSE WITH EVERY COIN DROPPED.
- (B) ADJUSTMENT & ALIGNMENT OF THE WIPER FINGER ON THE FRAME UNIT.
- (C) ADJUSTMENT OF THE 2nd POSITION SWITCH ON THE SCORE MOTOR.
- (D) ADJUSTMENT OF THE SWITCH ON THE START RELAY THE START RELAY IS ENERGIZED WITH THE DROP OF THE FIRST COIN.



PLAYER UP S.U. DISC



VIEW LOOKING AT WIPER FINGER SIDE
WITH WIPER IN RESET POSITION

RIVET NUMBERS	WIRE COLORS	FUNCTION OF RIVETS
29	GREEN-WHITE	STRIKE SPARE STEP UP
30	-GRAY-	
31	GREEN-YELLOW	
32	GREEN-BLACK	
33	ORANGE-WHITE	
34	ORANGE-RED	
35	GREEN-RED	FEED TO RIVETS 35,36,37,38,39 & 40
36	WHITE-GREEN	TO 10-90 SCORE RELAY SWITCH
37	BROWN-WHITE	TO 1st PLAYER
38	BROWN-RED	TO 2nd PLAYER
39	BROWN-YELLOW	TO 3rd PLAYER
40	BROWN-BLACK	TO 4th PLAYER
41	BLACK-WHITE	TO 5th PLAYER
42	BLACK-GREEN	TO 6th PLAYER
43	-GREEN-	1st PLAYER
44	GREEN-WHITE	2nd PLAYER
45	GREEN-RED	3rd PLAYER
46	GREEN-YELLOW	4th PLAYER
47	GREEN-BLACK	5th PLAYER
48	BLUE-YELLOW	6th PLAYER
49	BLACK-GREEN	1st PLAYER
50	BLACK-YELLOW	2nd PLAYER
51	BLUE-RED	3rd PLAYER
52	-BLUE-	4th PLAYER
53	ORANGE-BLACK	5th PLAYER
54	-ORANGE-	6th PLAYER
55	BLACK-YELLOW	1st PLAYER
56	-BLUE-	2nd PLAYER
57	BLUE-WHITE	3rd PLAYER
58	BLUE-RED	4th PLAYER
59	BLUE-YELLOW	5th PLAYER
60	BLUE-BLACK	6th PLAYER
61	BLACK-RED	TO 1st PLAYER
62	RED-WHITE	TO 2nd PLAYER
63	RED-GREEN	TO 3rd PLAYER
64	RED-YELLOW	TO 4th PLAYER
65	RED-BLUE	TO 5th PLAYER
66	RED-BLACK	TO 6th PLAYER

TO 9th POSITION SWITCH
ON THE 1-9 DRUM UNITS
TO OPERATE 10-90 DRUM
UNITS AT 9th POSITION.

PLAYER-UP UNIT

THE PURPOSE OF THIS UNIT IS TO SHOW WHAT PLAYER IS UP AND GIVE THE SCORE TO THE PROPER PLAYER. AS A ONE PLAYER GAME THE UNIT NEVER ADVANCES. IF OPERATED AS A FOUR PLAYER GAME THE UNIT ADVANCES UNTIL THE 4th PLAYER HAS COMPLETED HIS SHOTS, AFTER WHICH THE UNIT SHOULD RESET

IF THIS UNIT FAILS TO ADVANCE PROPERLY, CHECK:

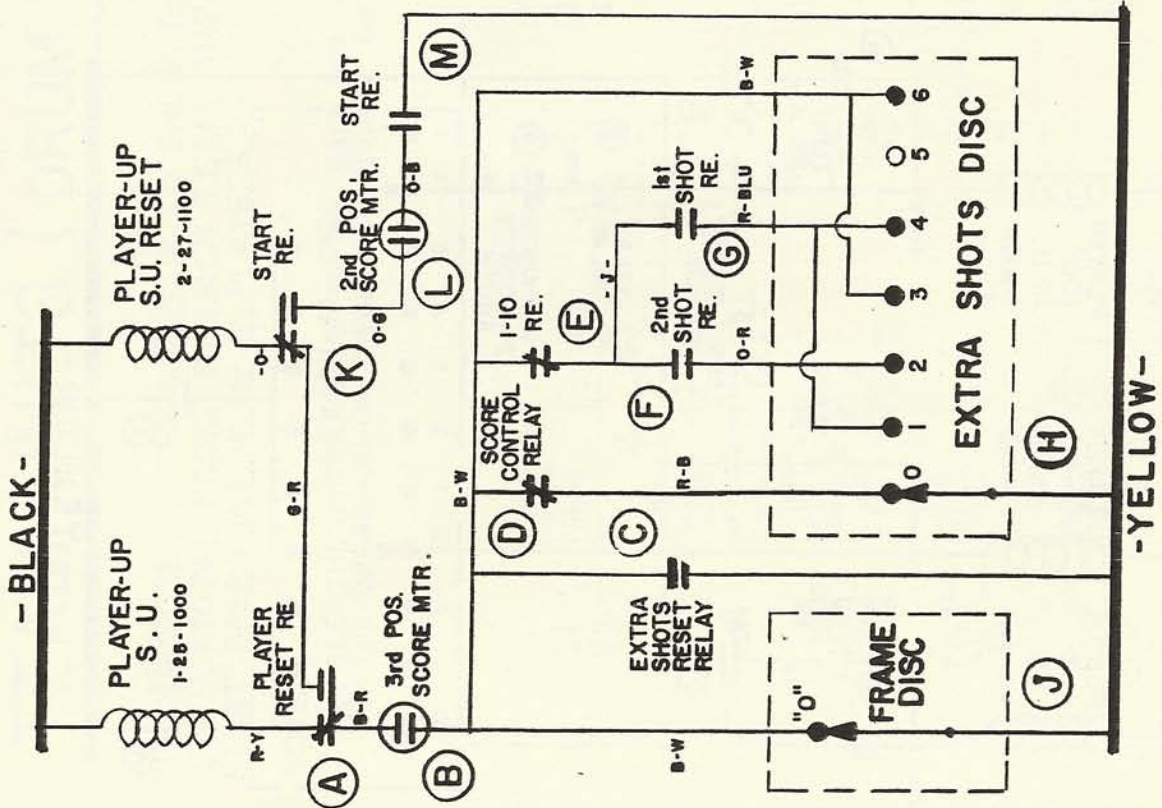
- (A), (B), (C), (D), (E), (F) & (G) THE ADJUSTMENTS OF THE INDICATED SWITCHES ON THE PLAYER RESET RELAY, 3rd POSITION ON THE SCORE MOTOR, EXTRA SHOTS RESET RELAY, SCORE CONTROL RELAY, 1-10 RELAY, 2nd SHOT RELAY & 1st SHOT RELAY.

- (H) & (J) ALIGNMENT & ADJUSTMENT OF THE WIPER FINGERS ON THE FRAME UNIT & THE EXTRA SHOTS UNIT.

IF THIS UNIT FAILS TO RESET PROPERLY, CHECK:
(K) THE ADJUSTMENT OF THE SWITCH ON THE START RELAY.

IF THIS UNIT FAILS AT THE START OF A GAME, CHECK:

- (L), (M) & (N) THE ADJUSTMENTS OF THE 2nd POSITION SWITCH ON SCORE MOTOR & THE (2) INDICATED SWITCHES ON THE START RELAY.



SCORE UNITS (DRUM TYPE)

THE PURPOSE OF THE UNITS ARE TO SHOW THE PROGRESS OF THE SCORE BY EACH PLAYER.

The 1-9 Drum Unit is operated by the 1-9 Score Relay through the Player Disc.

If the Unit fails to advance, check:-

- A. The adjustment or the Switch on the 1-9 Score Relay.
- B. Alignment and Adjustment of the Wiper Finger on the Player Up Unit.

If the Unit fails to Advance to Zero at the start of the Game, check:-

- C & D. The adjustment of the Switches on the 1st and 2nd Player Reset Relay and Zero Switch on the 1-9 Reel.

The 10-90 Drum Unit and the 1000 Drum Unit is operated by the 10-90 Score Relay through the Player Up Disc. If the Units fail to advance properly, check:-

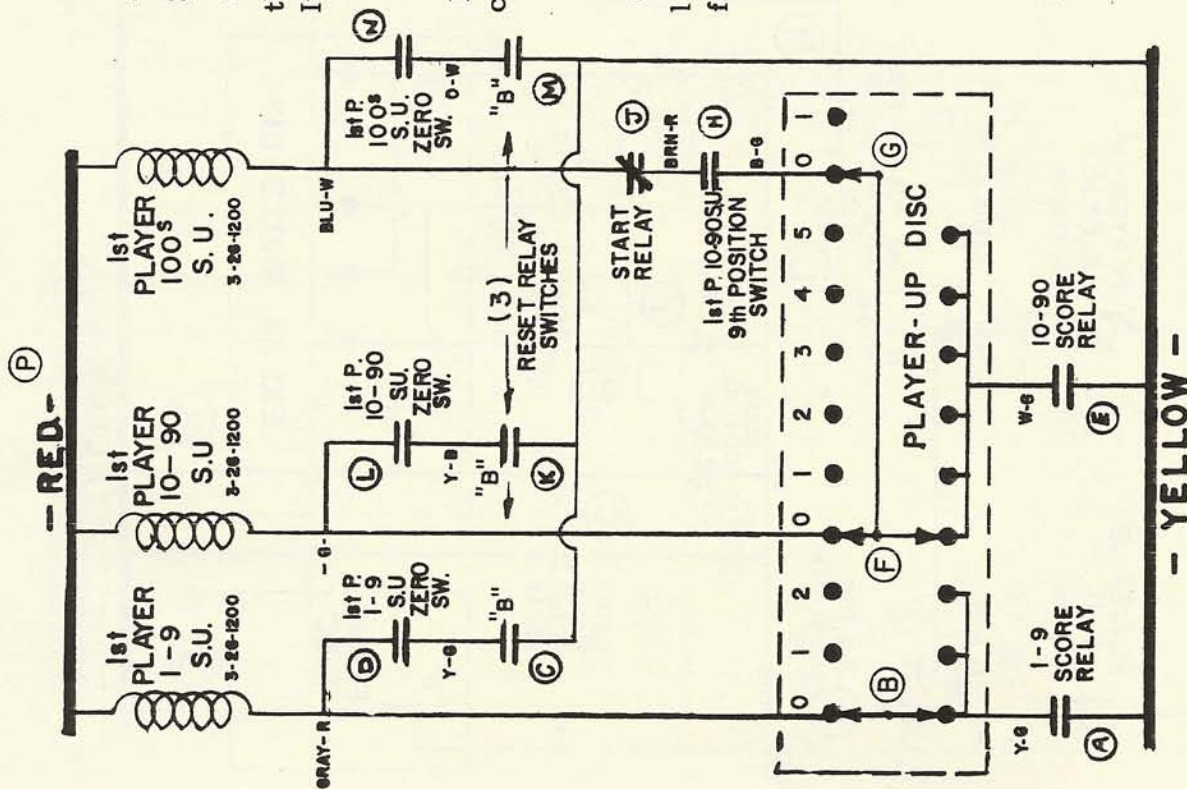
- E. Adjustment of the Switch on the 10-90 Score Relay.

F & G. Alignment of the Wiper Fingers on the Player Up Unit.
H & J. Failure of the 100 Reel, check the 10-90 S. U. 9th Position Switch and the Switch on the Start Relay.

K, L, M, & N. The Switches on the 1st and 2nd Player Reset Relay, 10-90 S. U. Zero Switch and the 100 S. U. Zero Switch.

If none of the Drum Units operate, check:-

- P. The Drum Unit Fuse. (Red Wire)

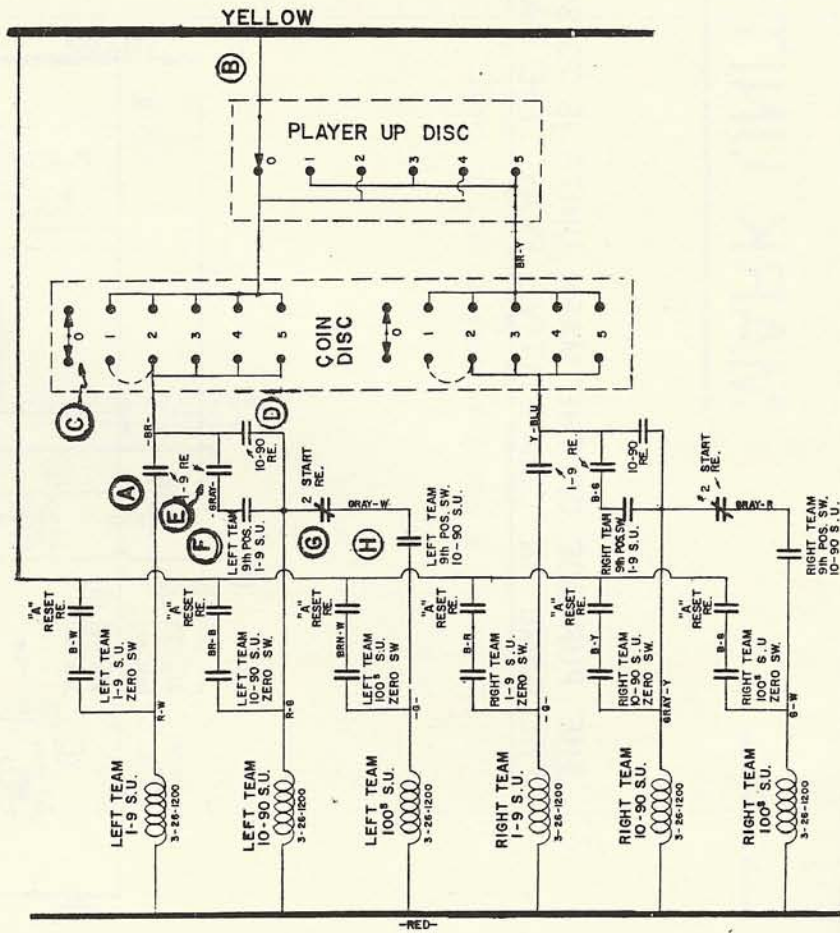


TEAM UNITS (DRUM TYPE)

THE PURPOSE OF THE UNITS IS TO SHOW THE PROGRESS OF THE TOTAL SCORE BY EACH TEAM. THE TEAM UNITS START OPERATING WITH 3 PLAYERS.

NOTE:

SEE THE INSTRUCTIONS IN THE BACK BOX TO CHANGE THE OPERATION OF THESE UNITS FOR 2 OR 4 PLAYERS.



THE 1-9 DRUM UNIT IS OPERATED BY THE 1-9 SCORE RELAY THROUGH THE COIN DISC AND THE PLAYER UP DISC.

IF THIS FAILS TO ADVANCE, CHECK:-

A. THE ADJUSTMENT OF THE SWITCH ON THE 1-9 SCORE RELAY.

B AND C. THE ALIGNMENT AND ADJUSTMENT OF THE WIPERS ON THE COIN UNIT AND THE PLAYER UP UNIT.

THE 10-90 DRUM UNIT IS OPERATED BY THE 10-90 SCORE RELAY. THE UNIT IS ALSO OPERATED BY THE 1-9 SCORE RELAY WHEN THE 1-9 DRUM UNIT IS IN THE 9TH POSITION.

IF THIS UNIT FAILS TO ADVANCE, CHECK:-

D, E, AND F. THE SWITCHES ON THE 10-90 SCORE RELAY, 1-9 SCORE RELAY AND THE 9TH POSITION ON SWITCH ON THE 1-9 DRUM UNIT.

THE 100 DRUM UNIT IS OPERATED BY THE 10-90 SCORE RELAY WHEN THE 10-90 DRUM UNIT IS IN THE 9TH POSITION.

IF THIS UNIT FAILS TO ADVANCE, CHECK:-

G AND H. THE ADJUSTMENT OF THE SWITCHES ON THE #2 START RELAY AND THE 9TH POSITION SWITCH ON THE 10-90 DRUM UNIT.

IF THE 1-9, 10-90 OR 100 DRUM UNITS FAIL TO ADVANCE TO ZERO AT THE START OF THE GAME, CHECK:-

THE ADJUSTMENT OF THE SWITCHES ON THE #A# RESET RELAY AND THE ZERO SWITCH ON THE FALLING UNIT.

MARK UNITS (DRUM TYPE)

THE PURPOSE OF THE MARK UNITS IS TO SHOW THE APPROXIMATE PROGRESS OF THE GAME IN COMPETITIVE PLAY, THE MARKS INDICATE WHICH TEAM IS LEADING.

THE 1-9 DRUM UNIT IS OPERATED BY THE MARK RELAY THROUGH THE PLAYER UP DISC.

IF THE UNIT FAILS TO ADVANCE, CHECK:-

- A. ADJUSTMENT OF THE SWITCH ON THE MARK RELAY.
- B. THE ALIGNMENT AND ADJUSTMENT OF THE WIPER FINGER ON THE PLAYER UP DISC.

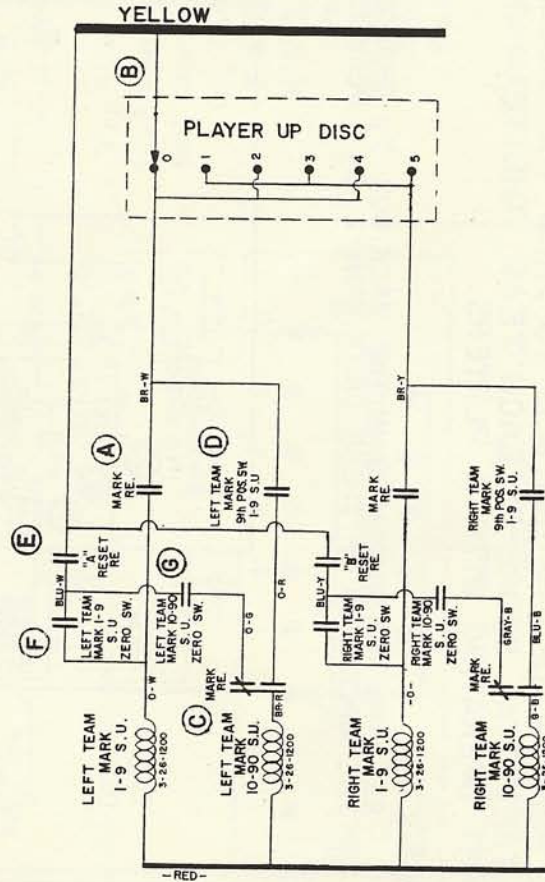
THE 10-90 DRUM UNIT IS OPERATED BY THE MARK RELAY WHEN THE 1-9 DRUM UNIT IS IN THE 9TH POSITION.

IF THE UNIT FAILS TO OPERATE, CHECK:-

- C AND D. THE ADJUSTMENT OF THE SWITCHES ON THE MARK RELAY AND THE 9TH POSITION SWITCH ON THE 1-9 DRUM UNIT.

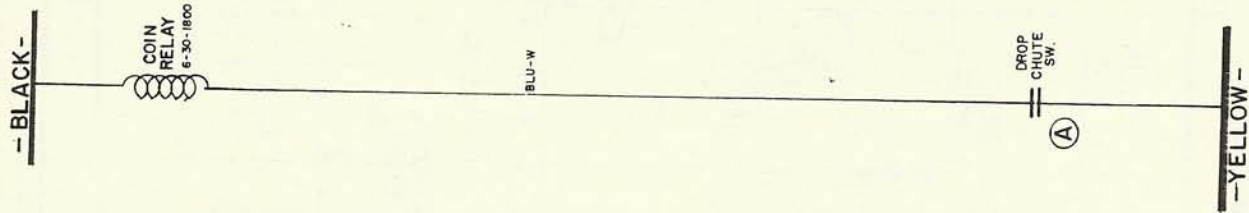
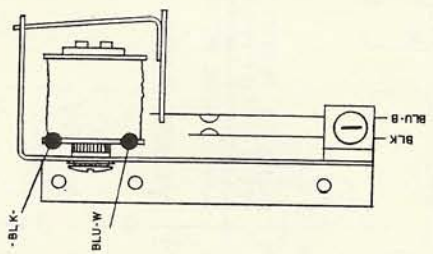
IF THE 1-9 OR 10-90 DRUM UNITS FAIL TO ADVANCE TO ZERO AT THE START OF THE GAME, CHECK:-

- E, F, AND G. THE ADJUSTMENT OF THE SWITCHES ON THE "A" RESET RELAY AND THE ZERO SWITCH ON THE FAILING UNIT.



COIN RELAY

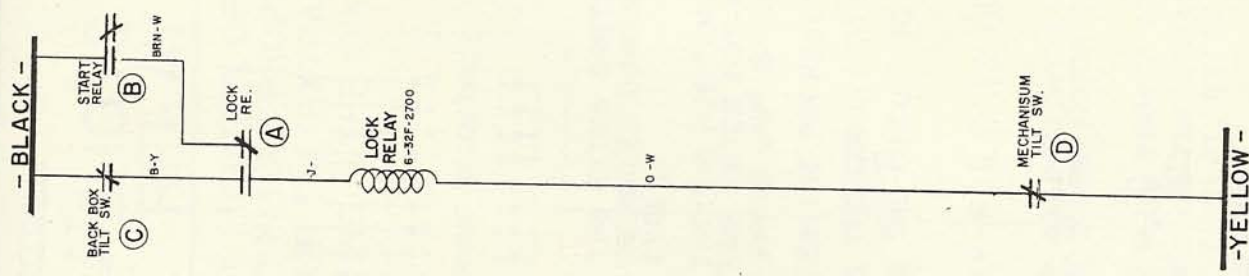
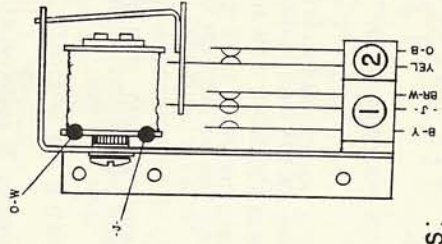
THIS RELAY IS OPERATED DIRECTLY BY THE DROP CHUTE SWITCH. THIS RELAY WHEN ENERGIZED BY THE 1ST COIN OPERATES THE START RELAY AND THE ADDITIONAL COINS ADVANCE THE COIN UNIT.



IF THIS RELAY FAILS TO OPERATE, CHECK:
 (A) THE DROP CHUTE SWITCH

LOCK RELAY

THIS RELAY IS ENERGIZED AT THE START OF THE GAME & STAYS ENERGIZED UNTIL THE 115 VOLT POWER IS REMOVED FROM THE GAME OR IF THE GAME IS TILTED.

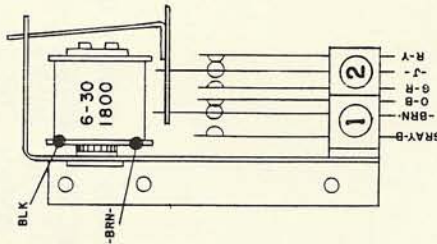


SWITCHES:
 (1) HOLDS CIRCUIT FOR THE LOCK RELAY THROUGH TILTS, ENERGIZES LOCK RELAY & OPENS CIRCUIT FROM THE START RELAY
 (2) OPERATES GAME OVER RELAY.

IF THIS RELAY FAILS TO OPERATE, CHECK:
 (A) THE ADJUSTMENT OF SWITCH (1) IT SHOULD MAKE BEFORE IT BREAKS.
 (B) THE ADJUSTMENT OF THE SWITCH ON THE START RELAY.
 (C) THE ADJUSTMENT OF THE BACK BOX TILT SWITCH.
 (D) THE ADJUSTMENT OF THE MECHANISM TILT SWITCH.

PLAYER RESET RELAY

THE FUNCTION OF THIS RELAY IS TO EITHER ADVANCE OR RESET THE PLAYER UP UNIT, IN ADDITION IT PERMITS THE FRAME UNIT TO ADVANCE TO THE NEXT FRAME WHEN THE LAST PLAYER HAS COMPLETED HIS SHOT



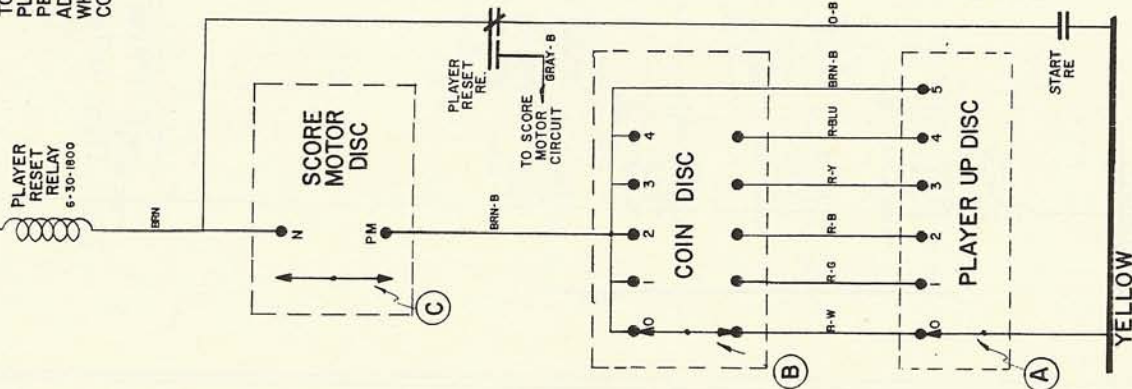
SWITCHES :

- ① ENERGIZES PLAYER RESET RELAY & OPENS CIRCUIT FROM THE START RELAY, HOLD CIRCUIT FOR PLAYER RESET RELAY DURING SCORE MOTOR CYCLE.
- ② OPERATES PLAYER UP & FRAME UNITS.

IF RELAY FAILS TO OPERATE, CHECK :

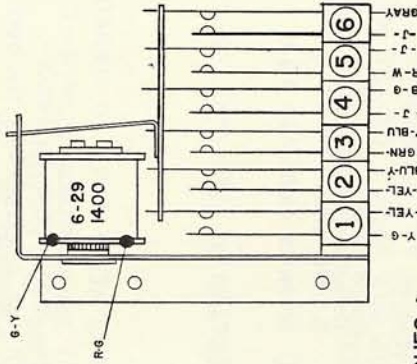
- (A) & (C) WIPER FINGERS FOR PROPER PRESSURE & ALIGNMENT ON THE PLAYER UP UNIT, COIN UNIT & ON THE SCORE MOTOR.
- SWITCH ① TO MAKE BEFORE IT BREAKS.

BLACK



I-9 SCORE RELAY

OPERATES WHEN LESS THAN TEN PINS ARE MADE ON TWO SHOTS, OR ON THE FIRST SHOT WHEN PLAYER IS HOLDING A SPARE OR A DOUBLE STRIKE.



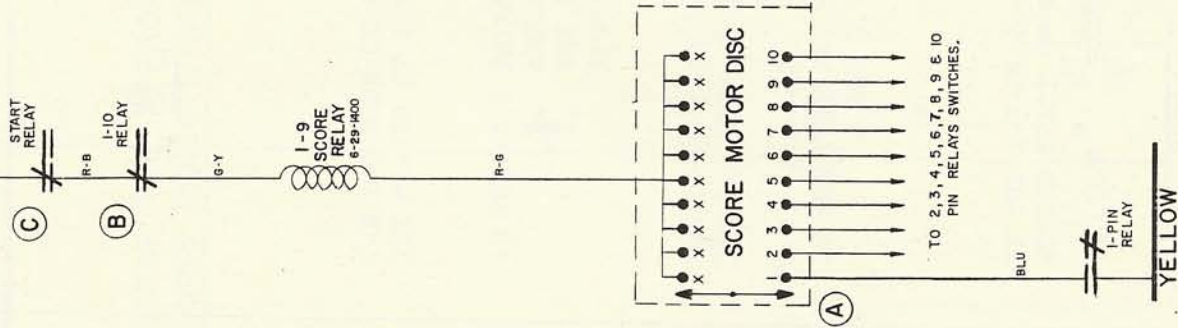
SWITCHES :

- ① OPERATES I-9 DRUM UNITS THROUGH PLAYER UP UNIT.
- ② OPERATES 10-90 DRUM UNITS THROUGH 9th POSITION SWITCH ON I-9 DRUM UNITS
- ③ OPERATES THE RIGHT TEAM I-9 DRUM UNIT
- ④ OPERATES THE RIGHT TEAM 10-90 DRUM UNIT, THROUGH THE 9th POSITION SWITCH ON THE RIGHT TEAM I-9 DRUM UNIT.
- ⑤ OPERATES THE LEFT TEAM I-9 DRUM UNIT
- ⑥ OPERATES THE LEFT TEAM 10-90 DRUM UNIT, THROUGH THE 9th POSITION SWITCH ON THE LEFT TEAM I-9 DRUM UNIT.

IF RELAY FAILS TO OPERATE, CHECK :

- (A) ALIGNMENT & ADJUSTMENT ON THE SCORE MOTOR WIPER.
- (B) ADJUSTMENT OF SWITCH ON THE I-10 RELAY.
- (C) ADJUSTMENT OF SWITCH ON THE START RELAY.

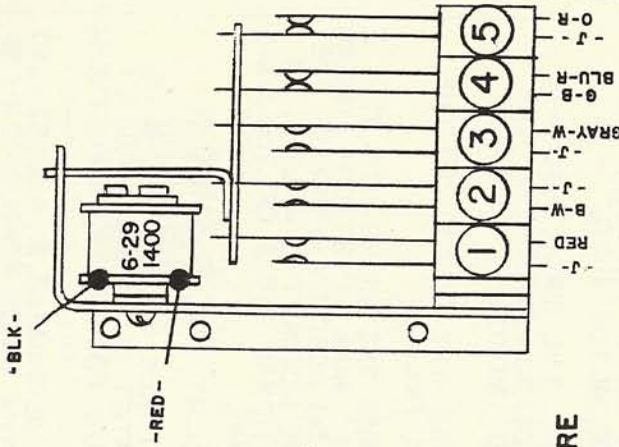
BLACK



YELLOW

EXTRA SHOTS RESET RELAY

THE PRIMARY FUNCTION OF THIS RELAY IS TO INSURE PROPER OPERATION OF THE EXTRA SHOTS UNIT RESETTING IN THE 10th FRAME.

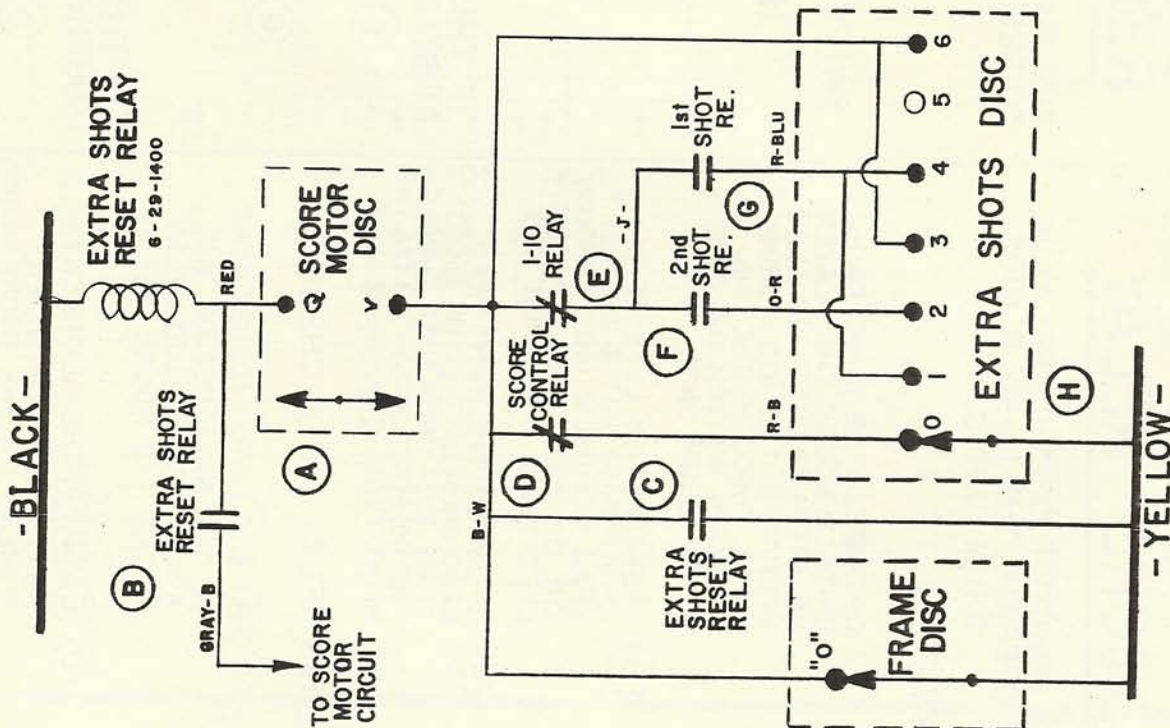


SWITCHES:

- ①— HOLDS THE EXTRA SHOTS RESET RELAY ENERGIZED DURING THE SCORE MOTOR CYCLE.
- ②— KEEPS THE 3rd POSITION SWITCH ON THE SCORE MOTOR HOT WHEN THE EXTRA SHOTS UNIT IS BEING RESET.
- ③— OPERATES THE PIN RESET RELAY.
- ④— BREAKS THE CIRCUIT TO THE SCORE CONTROL RELAY.
- ⑤— BREAKS THE CIRCUIT TO THE GATE COIL IN THE 10th FRAME.

IF THIS RELAY FAILS TO OPERATE PROPERLY, CHECK:

- Ⓐ & Ⓗ PROPER ADJUSTMENT & ALIGNMENT OF THE WIPER FINGERS ON THE SCORE MOTOR. & ON THE EXTRA SHOTS UNIT.
- Ⓑ, Ⓒ, Ⓓ, Ⓔ, Ⓕ & Ⓖ PROPER ADJUSTMENT OF THE INDICATED SWITCHES ON THE SCORE CONTROL RELAY, 1-10 RELAY, 2nd SHOT RELAY, EXTRA SHOTS RESET RELAY & THE 1st SHOT RELAY.



10-90 SCORE RELAY

THE FUNCTION OF THIS RELAY IS TO OPERATE THE 10-90 & 100s DRUM UNITS.

SWITCH:

- ① OPERATES THE 10-90 DRUM UNITS THROUGH THE PLAYER UP STEP-UP DISC. IT ALSO OPERATES THE 100 DRUM UNITS THROUGH THE 9th POSITION SWITCH ON THE 10-90 DRUM UNIT.
- ② OPERATES THE LEFT TEAM 10-90 DRUM UNIT & THE LEFT TEAM 100s DRUM UNIT THROUGH THE 9th POSITION SWITCH ON THE LEFT TEAM 10-90 DRUM UNIT.
- ③ OPERATES THE RIGHT TEAM 10-90 DRUM UNIT & THE RIGHT TEAM 100s DRUM UNIT THROUGH THE 9th POSITION SWITCH ON THE RIGHT TEAM 10-90 DRUM UNIT.

IF THIS RELAY FAILS, CHECK:

- ①, ② & ③ THE ADJUSTMENT OF THE SWITCHES ON THE START RELAY, 1-10 RELAY & THE 1-9 SCORE RELAY.
- ④, ⑤ & ⑥ THE ALIGNMENT & ADJUSTMENT OF WIPER FINGERS ON THE SCORE MOTOR, PLAYER UP UNIT & THE PROPER STRIKE SPARE UNIT.

STRIKE-SPARE RESET RELAY

THE FUNCTION OF THIS RELAY IS TO RESET THE STRIKE SPARE UNITS

SWITCHES:

- ① & ② ARE WIRED IN PARALLEL THE SWITCHES RESET ALL (6) OF THE STRIKE SPARE UNITS AT THE START OF A NEW GAME, AND RESETS ONE OF THE UNITS (DEPENDENT UPON THE POSITION OF THE PLAYER UP UNIT) DURING THE PLAY OF THE GAME.

IF THIS RELAY FAILS TO OPERATE AT START OF A NEW GAME, CHECK:

- ③ THE ALIGNMENT & ADJUSTMENT OF THE WIPER FINGER ON THE SCORE MOTOR.
- ④ THE ADJUSTMENT OF THE SWITCH ON THE #2 START RELAY. THE #2 START RELAY SHOULD BE ENERGIZED DURING THE SCORE MOTOR CYCLE.

IF THIS RELAY FAILS TO OPERATE DURING PLAY OF GAME CHECK:

- ⑤, ⑥ & ⑦ WIPER FINGERS
- ⑧ & ⑨ ADJUSTMENT OF THESE TWO SWITCHES.

SCORE CONTROL RELAY

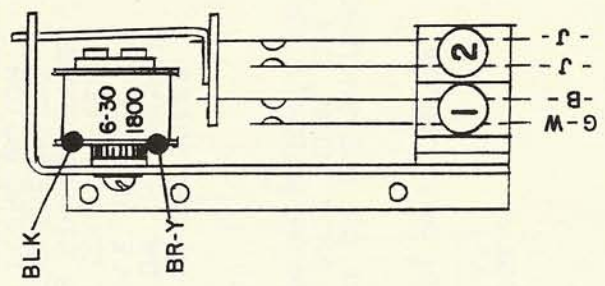
THE FUNCTION OF THIS RELAY IS TO OPEN THE CIRCUITS TO THE 3rd POSITION SWITCHES ON THE SCORE MOTOR, ALLOWING AN ADDITIONAL REVOLUTION OF THE SCORE MOTOR. THIS OCCURS ON THE 1st SHOT WHILE HOLDING A SPARE OR A DOUBLE STRIKE SWITCHES:

- ① IS THE HOLDING CIRCUIT FOR THE SCORE CONTROL RELAY AND ALSO OPERATES THE PIN RESET RELAY THROUGH THE SCORE MOTOR DISC.
- ② BREAKS THE CIRCUIT TO THE 3rd POSITION SWITCH ON THE SCORE MOTOR.
- ③ BREAKS THE CIRCUIT TO THE MARK RELAY.
- ④ BREAKS THE CIRCUIT TO THE RELAY BANK RESET COIL THROUGH THE 3rd POSITION SWITCH ON THE SCORE MOTOR. THIS ALLOWS AN ADDITIONAL CYCLE OF THE SCORE MOTOR.

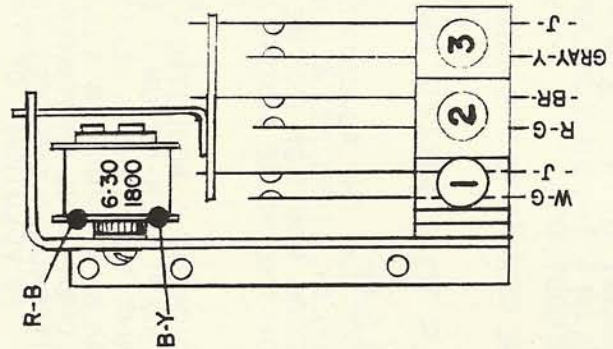
IF THIS RELAY FAILS, CHECK:

- SWITCHES ①, ②, ③, ④ & ⑤ LOCATED ON WIRING DIAGRAM BELOW, FOR PROPER ADJUSTMENT.
- THE ALIGNMENT & ADJUSTMENT OF THE WIPER FINGERS ON THE SCORE MOTOR, PLAYER-UP UNIT & THE PROPER STRIKE-SPARE UNIT.

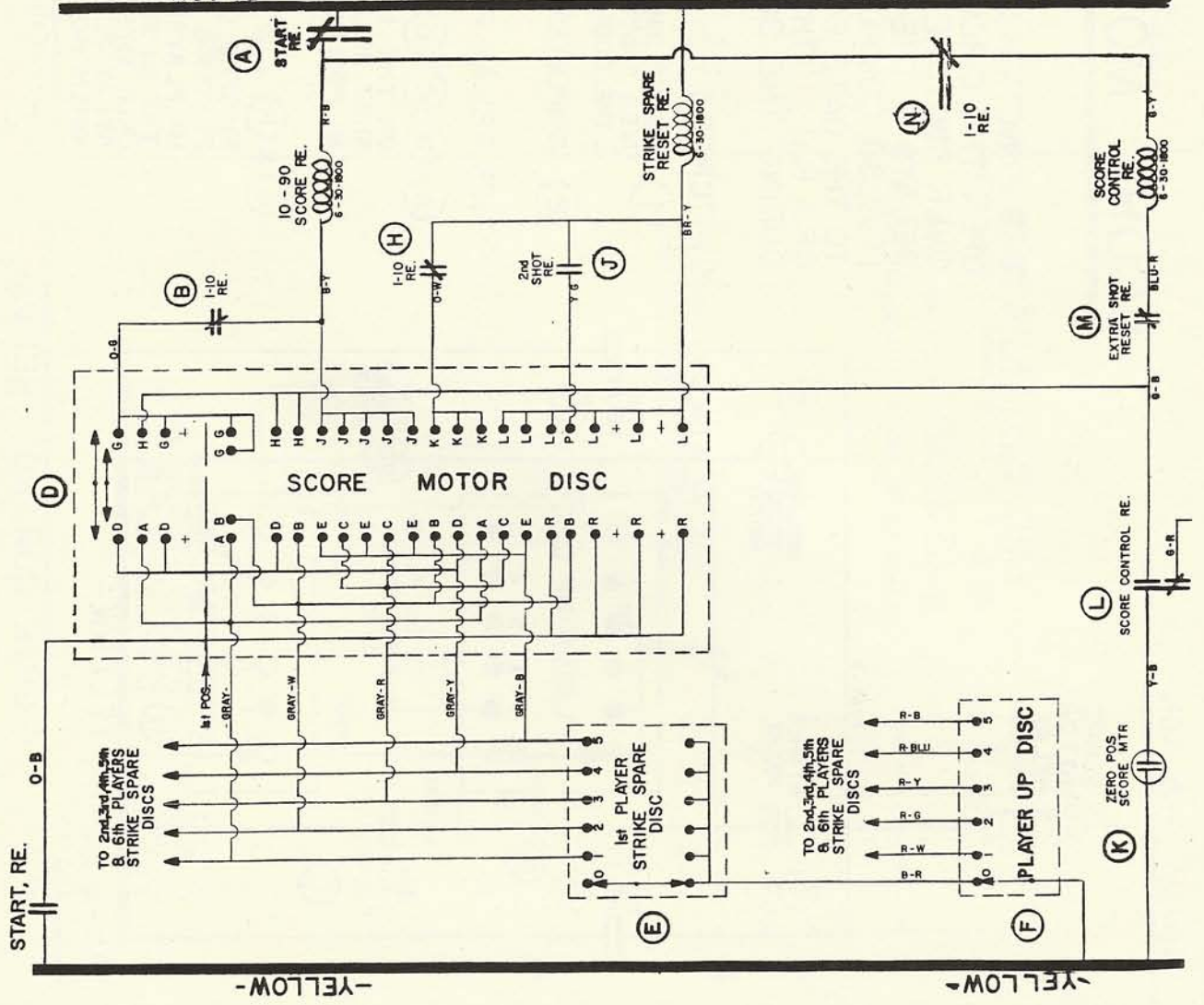
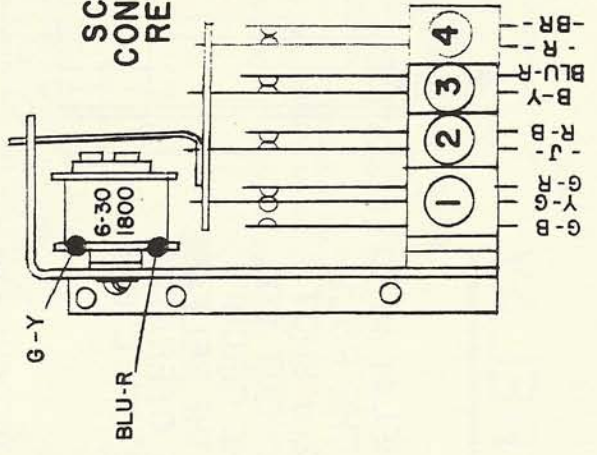
**STRIKE-SPARE
RESET RELAY**



**10-90
SCORE RELAY**



**SCORE CONTROL
RELAY**



-BLACK-

-BLACK-

-YELLOW-

-YELLOW-

SCORE MOTOR RELAY

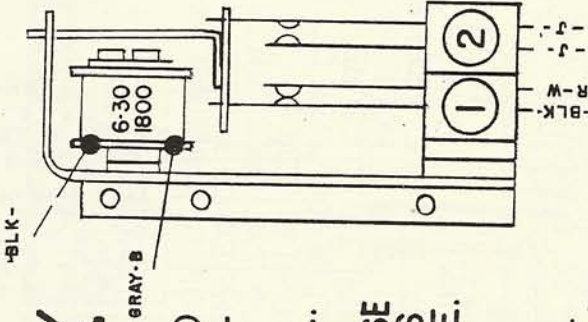
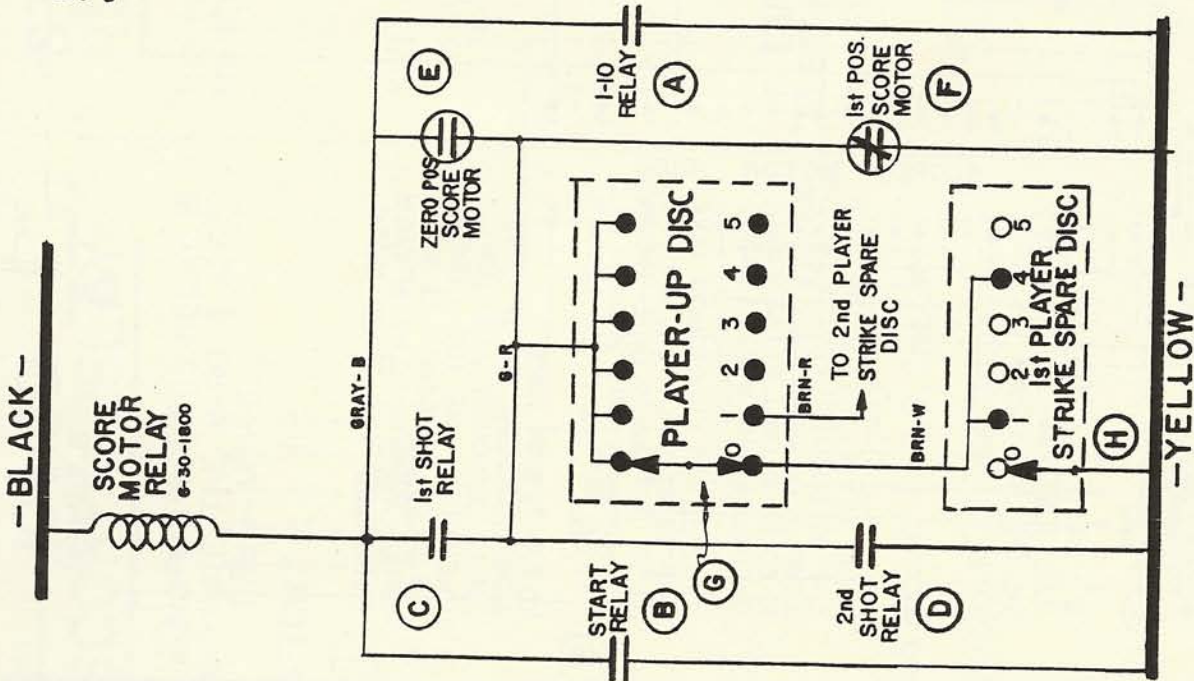
THE FUNCTION OF THIS RELAY IS TO OPEN THE CIRCUITS TO THE ROLL-OVER SWITCHES 1st & 2nd SHOT RELAYS & THE COIN LOCKOUT COIL. IT ALSO COMPLETES THE CIRCUIT TO THE GATE COIL FOR THE RELEASE OF A BALL. THIS RELAY OPERATES DURING THE SCORE MOTOR CYCLE.

SWITCHES:

- ① BREAKS THE CIRCUIT TO THE ROLL-OVER SWITCHES, 1st & 2nd SHOT RELAYS, & THE COIN LOCKOUT COIL.
- ② COMPLETES THE CIRCUIT TO THE GATE COIL.

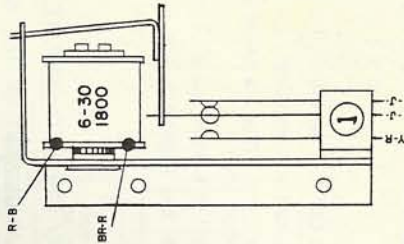
IF THIS RELAY FAILS TO OPERATE PROPERLY, CHECK:

- Ⓐ, Ⓑ, Ⓒ, Ⓓ, Ⓔ & Ⓕ THE ADJUSTMENT OF THE SWITCHES ON THE 1-10 RELAY, START RELAY, 1st SHOT RELAY, 2nd SHOT RELAY, ZERO POSITION ON THE SCORE MOTOR & THE 1st POSITION ON THE SCORE MOTOR.
- Ⓖ & Ⓕ THE ALIGNMENT & ADJUSTMENT OF THE WIPER FINGERS ON THE PLAYER-UP UNIT, & ON THE PROPER PLAYER'S STRIKE SPARE UNIT. (EXAMPLE, IF ONLY THE 1st PLAYER FAILS TO REGISTER A UNIT COUNT AFTER THE 1st SHOT, CHECK THE 1st PLAYER'S STRIKE-SPARE UNIT. THIS UNIT SHOULD OPERATE THE SCORE MOTOR RELAY FOR 1 REVOLUTION OF THE SCORE MOTOR WHEN HOLDING A SPARE OR A DOUBLE STRIKE.)



GATE CONTROL RELAY

THE FUNCTION OF THIS RELAY IS TO ALLOW ONLY THE REQUIRED NUMBER OF BALLS TO BE PUT IN PLAY AND TO LOCK THE BALLS AT THE END OF THE GAME.



SWITCHES:

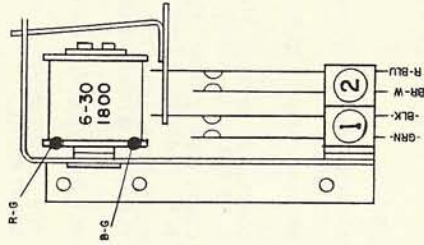
- 1- THE SWITCH COMPLETES THE CIRCUIT TO CONTROL THE OPERATION OF THE GATE COIL IN THE 10th FRAME.

IF THIS RELAY FAILS TO OPERATE, CHECK:

- A- THE ADJUSTMENT OF THE SWITCH ON THE START RELAY.
- B & D- THE ALIGNMENT & ADJUSTMENT OF THE WIPER FINGERS ON THE FRAME UNIT, COIN UNIT & PLAYER-UP UNIT.

STRIKE SPARE S.U. RELAY

THE PRIMARY FUNCTION OF THIS RELAY IS TO ADVANCE THE STRIKE SPARE UNITS & THE EXTRA SHOTS UNIT.

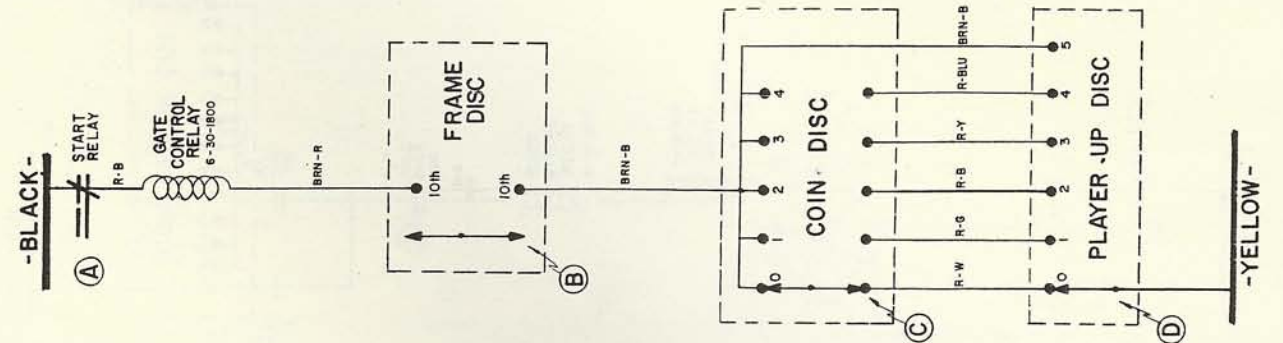
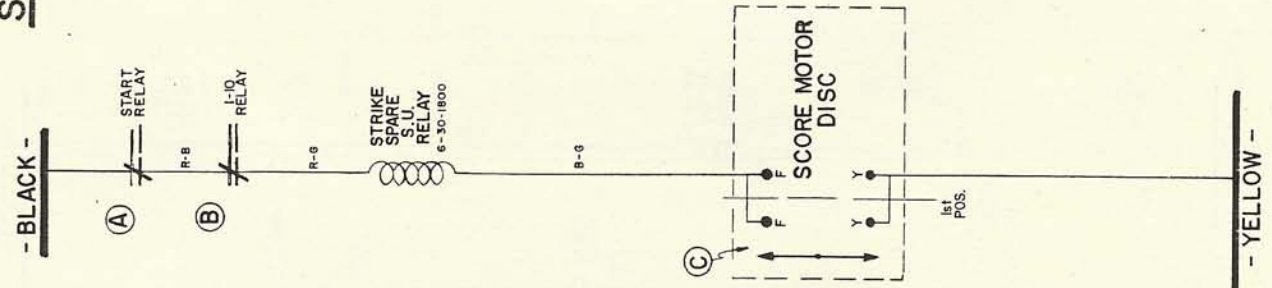


SWITCHES:

- 1- COMPLETES THE CIRCUIT FOR THE ADVANCE OF THE PROPER PLAYER'S STRIKE - SPARE UNIT THROUGH THE PLAYER UP DISC. TWO PULSES FOR A STRIKE, ONE FOR A SPARE.
- 2- ADVANCES THE EXTRA SHOTS UNIT IN THE 10th FRAME.

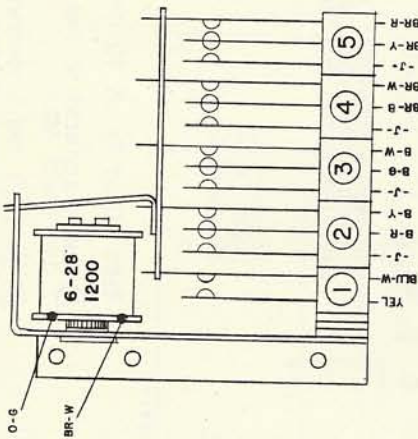
IF THIS RELAY FAILS TO OPERATE, CHECK:

- A & B- THE ADJUSTMENT OF THE SWITCHES ON THE START RELAY & THE 1-10 RELAY.
- C- THE ALIGNMENT & ADJUSTMENT OF THE WIPER FINGERS ON THE SCORE MOTOR.



"A" RESET RELAY

THE FUNCTION OF THIS RELAY IS TO RESET THE 10 DRUM UNITS TO ZERO AT THE START OF A GAME. THIS IS THE ONLY TIME IT OPERATES.



SWITCHES:

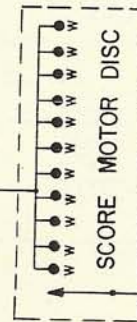
- ① RESETS LEFT TEAM MARK, 1-9 & 10-90 DRUM UNITS.
- ② RESETS RIGHT TEAM MARK, 1-9 & 10-90 DRUM UNITS.
- ③ RESETS LEFT TEAM 1-9 DRUM UNIT & RIGHT TEAM 100^s DRUM UNIT
- ④ RESETS LEFT TEAM 10-90 & 100^s DRUM UNITS.
- ⑤ RESETS 2nd PLAYER'S 1-9 & 10-90 DRUM UNITS

IF THIS RELAY FAILS TO OPERATE, CHECK:

- Ⓐ THE ADJUSTMENT OF THE SWITCH ON THE START RELAY.
- Ⓑ THE ALIGNMENT & ADJUSTMENT OF THE LONG WIPER FINGER ON THE SCORE MOTOR.

NOTE:

THE "B" & "C" RESET RELAYS ARE SIMILIAR IN OPERATION.

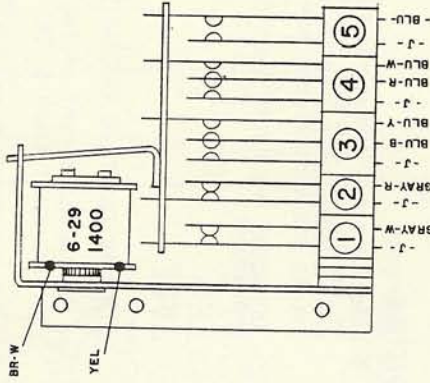


Ⓑ

- YELLOW -

* 2 START RELAY

THE FUNCTION OF THIS RELAY IS TO RESET THE STRIKE-SPARE UNITS AT THE START OF EACH NEW GAME.



SWITCHES:

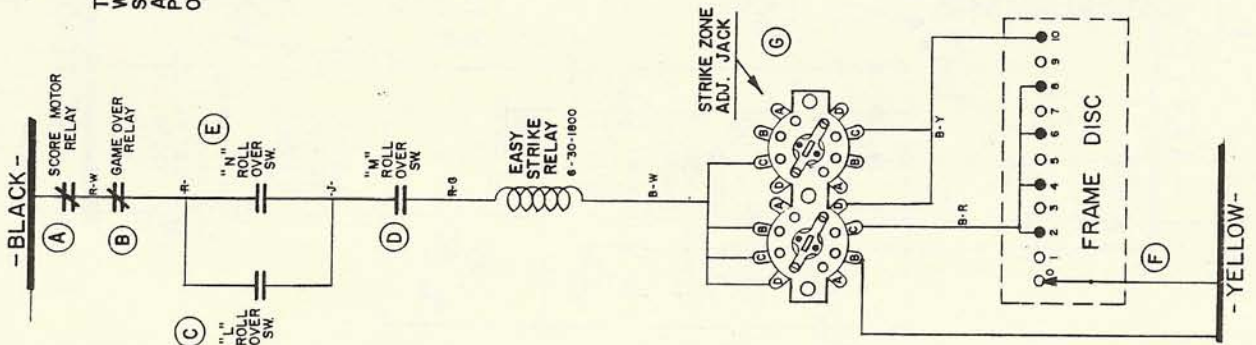
- ① BREAKS CIRCUIT TO THE LEFT TEAM 100^s DRUM.
- ② BREAKS CIRCUIT TO THE RIGHT TEAM 100^s DRUM.
- ③ COMPLETES CIRCUIT TO RESET THE 5th & 6th PLAYERS' STRIKE SPARE UNITS.
- ④ COMPLETES CIRCUIT TO RESET THE 3rd & 4th PLAYERS' STRIKE SPARE UNITS.
- ⑤ COMPLETES CIRCUIT TO RESET THE 2nd PLAYER'S STRIKE SPARE UNIT.

IF THIS RELAY FAILS TO OPERATE, CHECK:

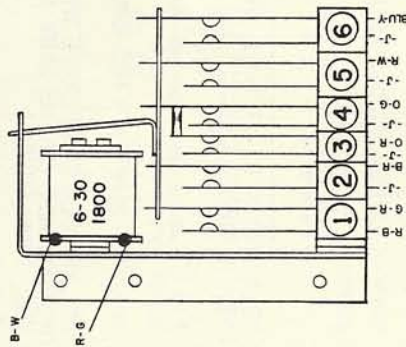
- Ⓐ THE ADJUSTMENT OF THE SWITCH ON THE START RELAY.

- YELLOW -

EASY STRIKE RELAY



THE EASY STRIKE RELAY OPERATES ONLY WHEN THE "N" OR "L" & "M" ROLL OVER SWITCHES ARE HIT TOGETHER & THE ADJUSTMENT JACK IS IN THE PROPER POSITION. THE RELAY SWITCHES OPERATE ONLY ON THE SHOT THAT TRIPS THE #1 RELAY.



SWITCHES:

- ①— TRIPS THE #2 RELAY.
- ②— TRIPS THE #3 RELAY.
- ③— TRIPS THE #4 RELAY.
- ④— TRIPS THE #6 RELAY.
- ⑤— TRIPS THE #7 RELAY.
- ⑥— TRIPS THE #10 RELAY.

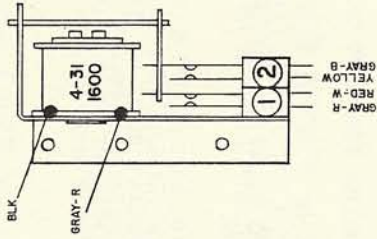
IF THE RELAY FAILS TO OPERATE, CHECK:

- A & B— THE ADJUSTMENT OF THE SWITCHES ON THE SCORE MOTOR & GAME OVER RELAYS.
- C, D & E— THE ADJUSTMENT OF THE "L," "M" & "N" ROLL OVER SWITCHES.
- F— THE ALIGNMENT & ADJUSTMENT OF THE WIPER FINGERS ON THE FRAME UNIT.
- G— THE POSITION OF THE STRIKE ZONE ADJ. JACK.

- A — NORMAL STRIKES. EASY STRIKE RELAY NEVER OPERATES.
- B — ALL FRAMES ARE EASY STRIKES.
- C — ALL EVEN FRAMES ARE EASY STRIKES.
- D — EASY STRIKE IN TENTH FRAME ONLY.

PIN RESET RELAY

THE FUNCTION OF THE PIN RESET RELAY IS TO INSURE PROPER OPERATION OF THE PIN RESET MOTOR.



SWITCHES:

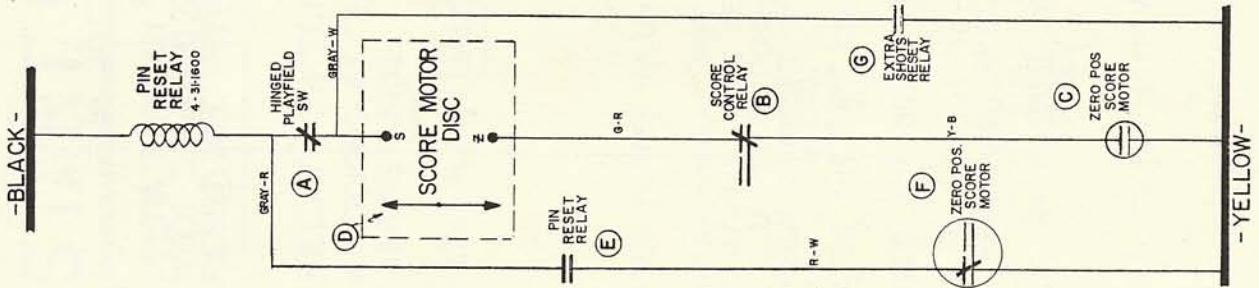
- ①— HOLDS THE CIRCUIT OF THE PIN RESET RELAY UNTIL THE PIN RESET MOTOR MOVES OUT OF THE ZERO POSITION.
- ②— ENERGIZES THE PIN RESET MOTOR WHILE THE MOTOR IS IN THE ZERO POSITION.

IF THE RELAY FAILS TO OPERATE AFTER ANY STRIKE OR 2nd SHOT, CHECK:

- A & C— THE ADJUSTMENT OF THE SWITCHES ON THE SCORE CONTROL RELAY, THE HINGED PLAYFIELD & THE ZERO POSITION OF THE SCORE MOTOR.
- D— THE ALIGNMENT & ADJUSTMENT OF THE WIPER FINGERS ON THE SCORE MOTOR.

IF THE RELAY DOES NOT STAY ENERGIZED UNTIL THE PIN RESET MOTOR MOVES OUT OF THE ZERO POSITION, CHECK:

- E— THE HOLD CIRCUIT SWITCH ON THE PIN RESET RELAY FOR PROPER ADJUSTMENT.
- F— THE SWITCH ON THE PIN RESET MOTOR SHOULD BE ADJUSTED TO MAKE BEFORE IT BREAKS.
- G— THE ADJUSTMENT OF THE EXTRA SHOTS RESET RELAY SWITCH, WHICH SUPPLIES ADDITIONAL CURRENT TO THE PIN RESET RELAY.



*1 THRU *10 (TRIP) RELAYS

THE FUNCTIONS OF THE 1, 2, 3, 4, 5, 6, 7, 8, 9, & 10 RELAYS ARE ALL SIMILAR IN OPERATION. THE PRIMARY FUNCTION OF THESE RELAYS IS TO TRIP THE CORRESPONDING PIN & COMPLETE A CIRCUIT THROUGH THE SCORE MOTOR DISC FOR THE OPERATION OF THE 1-9 SCORE RELAY. THE SECONDARY FUNCTIONS ARE TO TRIP OTHER RELAYS DIRECTLY, COMPLETE CIRCUITS FOR THE STRIKE ZONE SHOT & TO OPEN CIRCUITS ON SPARE COMBINATIONS. REFER TO THE SWITCHES DIAGRAM LOCATED IN THE CABINET FOR A DETAILED EXPLANATION OF THE ROLL-OVER SWITCHES.

*4 RELAY SWITCH BUILD-UP (VIEW LOOKING AT THE SOLDERING SIDE)

—	5M
2M & B	4M
1B	3B

SWITCH

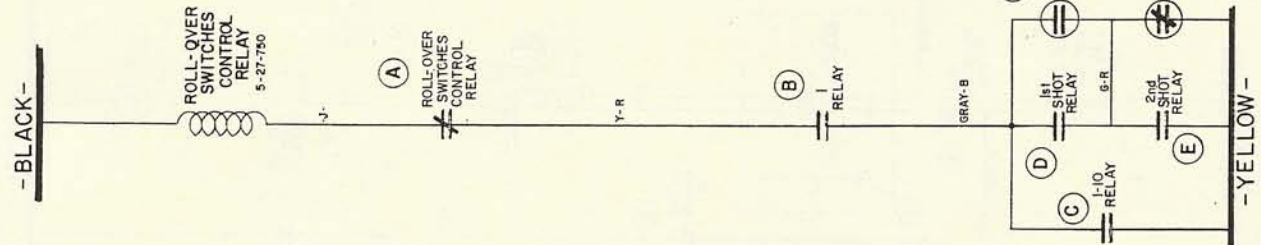
- OPENS THE CIRCUIT TO THE "P" ROLL-OVER ON THE 2nd SHOT.
- TRANSFERS THE CIRCUIT FROM THE #4 RELAY COIL TO THE 4 PIN RELAY & THE #4 RIVET ON THE SCORE MOTOR DISC FOR A 1-9 SCORE RELAY IMPULSE.
- OPENS THE CIRCUIT TO THE "B" ROLL-OVER SWITCH ON THE 2nd SHOT.
- CONTINUITY CIRCUIT FOR THE OPERATION OF THE 1-10 RELAY.
- ENERGIZES THE #8 RELAY.

IF THE RELAY FAILS TO OPERATE WHEN THE "K" ROLL-OVER IS MADE, CHECK:

- & (C) ADJUSTMENT OF THE SWITCHES ON THE SCORE MOTOR RELAY, GAME OVER RELAY & #4 RELAY
- ADJUSTMENT OF THE "K" ROLL-OVER SWITCH.

IF THE RELAY FAILS TO OPERATE WHEN THE "C" ROLL-OVER IS MADE ON THE SAME SHOT THAT TRIPS THE 1 PIN, CHECK:

- & (G) ADJUSTMENT OF THE SWITCHES ON THE ROLL-OVER SWITCHES CONTROL RELAY, THE "1" RELAY & THE "C" ROLL-OVER.
- RELAY FAILURE ON EASY STRIKES CHECK THE SWITCH ON THE EASY STRIKE RELAY.
- IF THE RELAY FAILS TO OPERATE WHEN "B" ROLL-OVER IS MADE CHECK THE #2 RELAY, #4 RELAY & THE "B" ROLL-OVER SWITCHES FOR PROPER ADJUSTMENTS.



ROLL-OVER SWITCHES CONTROL RELAY

THIS RELAY OPERATES ON THE FIRST SHOT PROVIDING THE 1 RELAY HAS BEEN TRIPPED. THIS RELAY IN TURN CONTROLS THE OPERATION OF THE "C" & "S" ROLL-OVER SWITCHES ON THE PLAYFIELD & THE EASY STRIKE RELAY SWITCHES.

ROLL-OVER SWITCHES CONTROL RELAY SWITCH BUILD-UP (VIEW LOOKING AT THE SOLDERING SIDE)

—	3M
—	2B
—	1B

SWITCH

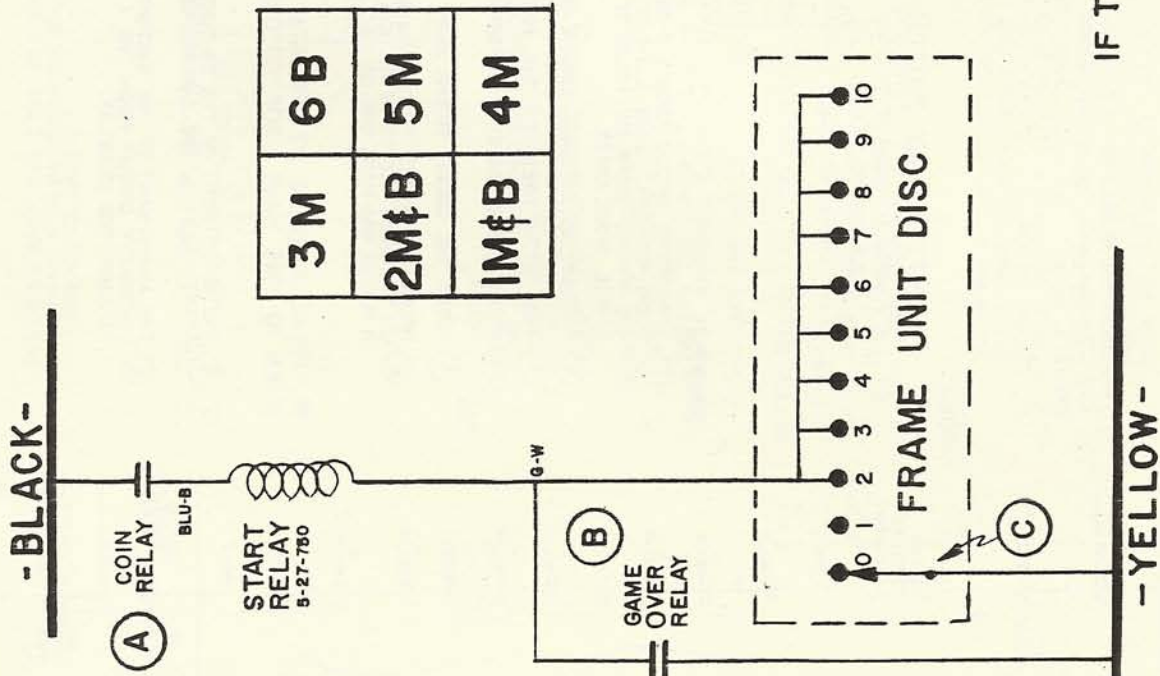
- OPENS CIRCUIT TO THE "C" & "S" ROLL-OVER SWITCHES & THE EASY STRIKE RELAY SWITCHES.
- OPENS THE CIRCUIT TO THE ROLL-OVER SWITCHES CONTROL RELAY.
- CLOSES CIRCUIT TO THE 7-10 PICKUP

IF THIS RELAY FAILS TO OPERATE PROPERLY, CHECK:

- (B), (C), (D), (E), (F) & (G) THE ADJUSTMENT OF THE ROLL-OVER SWITCHES CONTROL RELAY, 1 RELAY, 1-10 RELAY, THE 1st SHOT & 2nd SHOT RELAYS, ZERO POSITION SWITCH ON THE SCORE MOTOR & THE 1st POSITION SWITCH ON THE SCORE MOTOR.

START (TRIP) RELAY

OPERATES ONLY AT THE START OF A NEW GAME, WITH THE 1st COIN ONLY. ITS FUNCTION IS TO RESET ALL THE UNITS TO A ZERO POSITION.



START RELAY SWITCH BUILD-UP

(VIEW LOOKING AT THE)
(SOLDERING SIDE)

3 M	6 B
2M & B	5 M
1M & B	4 M

A SWITCH EXAMPLE : **1M & B** REFERS TO SWITCH NUMBER 1 AND ALSO INDICATES THAT THE SWITCH IS A MAKE & A BREAK.

SWITCH

- ① OPERATES PLAYER UP UNIT RESET.
- ② TRANSFERS CIRCUIT FOR THE SCORE CONTROL RELAY, BELL, I-10 RELAY, I-9 SCORE RELAY, 10-90 SCORE RELAY & STRIKE SPARE S. U. RELAY DURING OPERATION OF THE GAME TO THE LOCK RELAY & RESET RELAYS AT THE START OF THE GAME.
- ③ OPERATES THE GATE COIL RELEASING THE 1st BALL TO A PLAYER.
- ④ OPERATES THE SCORE MOTOR.
- ⑤ COMPLETES CIRCUIT TO THE PLAYER RESET RELAY COIN UNIT RESET FRAME UNIT RESET & PLAYER UP UNIT RESET.
- ⑥ BREAKS THE CIRCUIT TO THE 1st PLAYER'S 100^S REEL.

IF THIS RELAY FAILS TO OPERATE WITH THE 1st COIN DEPOSITED CHECK :

(A) & (B) SWITCH ADJUSTMENTS ON THE COIN RELAY & THE GAME OVER RE. UNIT.

(C) THE ALIGNMENT & ADJUSTMENT OF THE WIPER FINGERS OF FRAME UNIT.

I-10 RELAY

THIS RELAY OPERATES WHENEVER ALL TEN PINS ARE TRIPPED AND THE SCORE MOTOR STARTS TO OPERATE.

I-10 RELAY SWITCH BUILD-UP
(VIEW LOOKING AT THE SOLDERING SIDE)

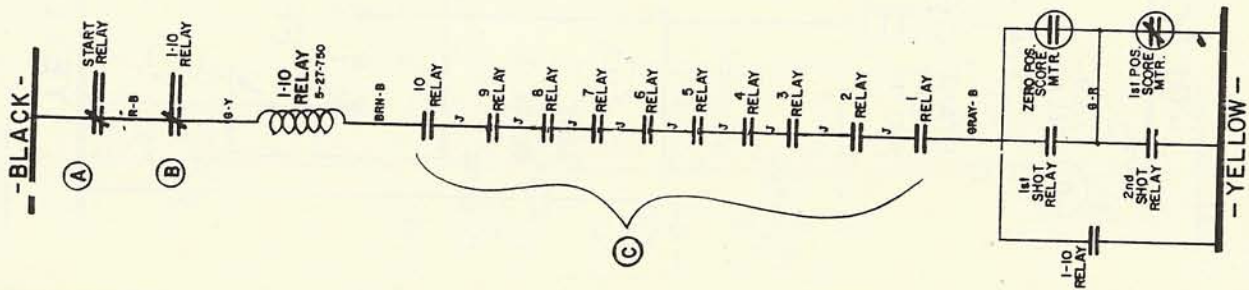
3M	6B
2M & 5B	
1M & 4B	

SWITCH

- 1- TRANSFERS CIRCUIT FROM THE BELL, I-10 RELAY, SCORE CONTROL RELAY & I-9 SCORE RELAY TO THE STRIKE-SPARE S.U. RELAY TO ADVANCE THE STRIKE SPARE UNITS.
- 2- PART OF THE GATE COIL CIRCUIT IN THE 10th FRAME.
- 3- THIS SWITCH OPERATES THE SCORE MOTOR.
- 4- OPENS THE CIRCUIT TO THE STRIKE SPARE RESET RELAY.
- 5- OPENS THE CIRCUIT TO THE I0-90 SCORE RELAY.
- 6- OPENS THE CIRCUIT TO THE 3rd POSITION SWITCH ON THE SCORE MOTOR IN THE 10th FRAME WHEN A PLAYER HAS MADE ONE OR TWO STRIKES.

IF THIS RELAY FAILS TO OPERATE PROPERLY WHEN 10 PINS HAVE DROPPED, CHECK:

- A) THE ADJUSTMENT OF THE SWITCHES ON THE START RELAY & THE I-10 RELAY.
- B) THE ADJUSTMENT OF THE SWITCHES IN THE CONTINUITY CIRCUIT FROM THE I RELAY THROUGH THE I0 RELAY.



1st SHOT RELAY

THIS RELAY ALWAYS OPERATES ON THE 1st SHOT.

1st SHOT RELAY SWITCH BUILD-UP
(VIEW LOOKING AT THE SOLDERING SIDE)

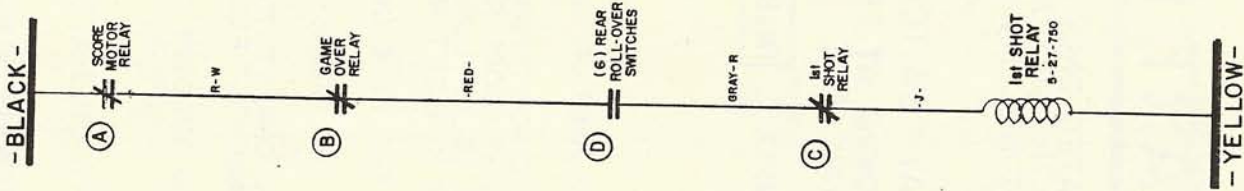
2M	4B
1M	3M

SWITCH

- 1- COMPLETES THE CIRCUIT TO THE GATE COIL IN THE 10th FRAME.
- 2- COMPLETES THE CIRCUIT TO THE SCORE MOTOR.
- 3- AFTER MAKING A SPARE OR TWO STRIKES IN THE 10th FRAME THIS SWITCH COMPLETES THE CIRCUIT TO THE 3rd POSITION SWITCH ON THE SCORE MOTOR, WHEN LESS THAN 10 PINS ARE MADE.
- 4- OPENS THE CIRCUIT TO THE 1st SHOT RELAY.

IF THIS RELAY FAILS TO OPERATE ON THE 1st SHOT BY EACH PLAYER CHECK:

- A) & B) THE ADJUSTMENT OF THE SWITCHES ON THE SCORE MOTOR RELAY, THE GAME OVER RELAY & THE 1st SHOT RELAY.
- C) THE ADJUSTMENT OF THE SWITCHES ON THE (6) REAR ROLL-OVER SWITCHES.
- D) THE (6) REAR ROLL-OVER SWITCHES ON THE PLAYFIELD BOARD FOR PROPER ADJUSTMENT.



GAME OVER RELAY

OPERATES WHEN THE LAST PLAYER COMPLETES HIS SHOTS; IT ALSO OPERATES WHEN THE GAME IS POUNDED OR DROPPED.

GAME OVER RELAY SWITCH BUILD-UP
(VIEW LOOKING AT THE
SOLDERING SIDE)

—	5B
2M & B	4B
1M	3B

SWITCH

1. ALLOWS THE RESET OF THE START RELAY IF THE GAME IS TILTED IN THE 1st FRAME.
2. TRANSFERS GROUND FOR THE 6-VOLT LITES TO COMPLETE THE CIRCUIT FOR THE GAME OVER LITE.
3. BREAKS THE CIRCUIT TO THE GATE COIL AND THE GAME OVER RELAY.
4. BREAKS THE CIRCUIT TO ALL OF THE ROLL-OVER SWITCHES & THE 1st & 2nd SHOT RELAYS.
5. BREAKS THE CIRCUIT TO THE BALL LIFT MOTOR.

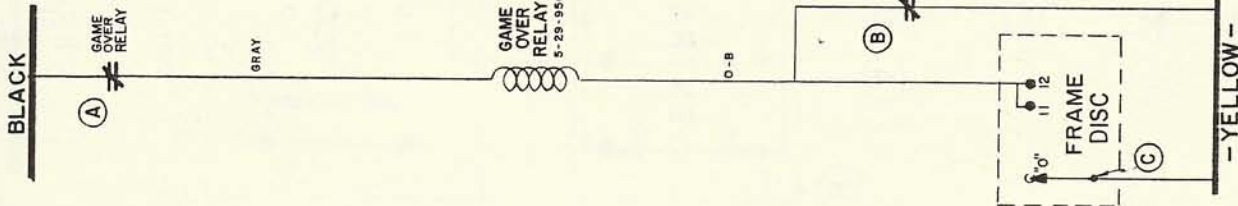
IF THIS RELAY FAILS TO OPERATE, CHECK:

- A & B THE ADJUSTMENT OF THE SWITCHES ON THE GAME OVER RELAY AND THE LOCK RELAY
- C THE ALIGNMENT & THE ADJUSTMENT OF THE WIPER FINGERS ON THE FRAME UNIT.

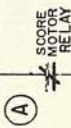
NOTE:

IF THIS RELAY OPERATES IN THE 10th FRAME; THE WIPER FINGERS ON THE FRAME UNIT ARE OVER-RIDING MOMENTARILY & ARE HITTING THE 11th FRAME BUTTON. ROTATE BAKELITE DISC SLIGHTLY IN A COUNTER-CLOCKWISE DIRECTION WHEN LOOKING AT THE WIPER FINGERS.

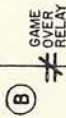
IF THIS RELAY OPERATES TOO SOON, CHECK THE VIBRATION TILT SWITCHES. ONE IS LOCATED IN THE BACK BOX, THE OTHER ON THE MECHANISM BOARD.



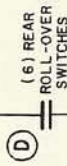
BLACK



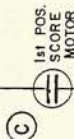
R-W



RED



GRAY-R



BRN-W



-YELLOW-

2nd SHOT RELAY

ALWAYS OPERATES ON THE 2nd SHOT.

2nd SHOT RELAY SWITCH BUILD-UP
(VIEW LOOKING AT THE
SOLDERING SIDE)

2 M	4 M
1 M	3 M & B

SWITCH

1. COMPLETES THE CIRCUIT TO THE 3rd POSITION SWITCH ON THE SCORE MOTOR FOR THE CONDITION OF A STRIKE AND A BLOW IN THE 10th FRAME ONLY.
2. COMPLETES THE CIRCUIT TO THE SCORE MOTOR ON A BLOW.
3. TRANSFERS GATE COIL CIRCUIT FROM THE ZERO RIVET POSITION TO THE 1st RIVET POSITION ON THE EXTRA SHOTS DISC IN THE 10th FRAME & LAST PLAYER ONLY.
4. COMPLETES CIRCUIT TO ONE RIVET ON THE SCORE MOTOR DISC FOR THE STRIKE SPARE RESET RELAY.

IF THIS RELAY FAILS TO OPERATE, CHECK:

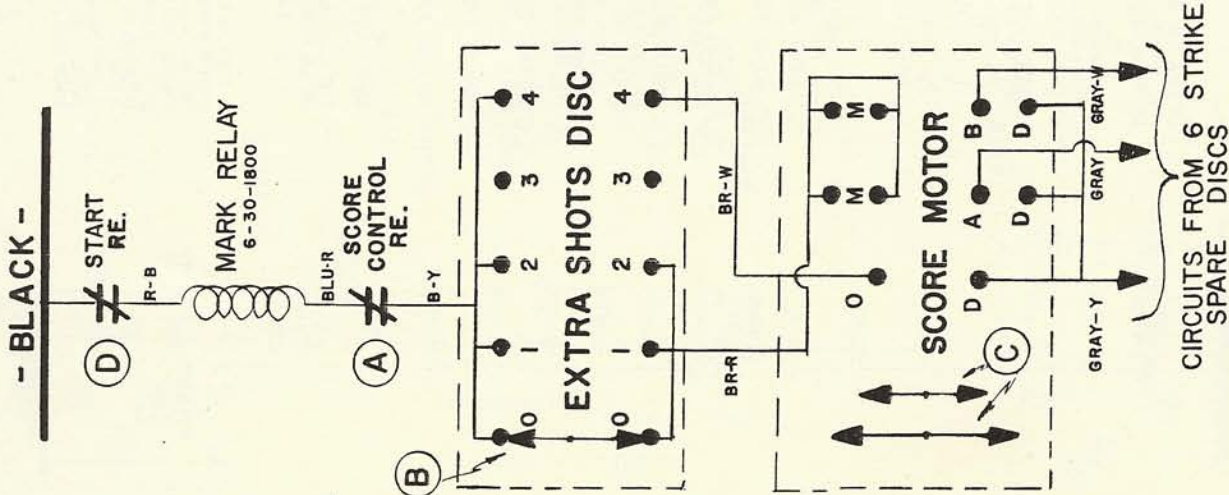
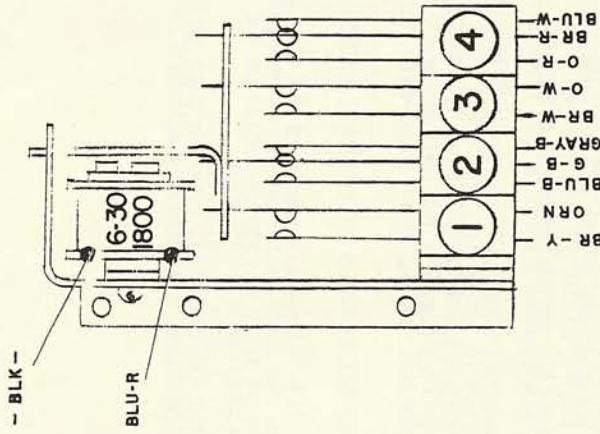
- A, B & C THE ADJUSTMENT OF THE SWITCHES ON THE SCORE MOTOR RELAY, THE GAME OVER RELAY & THE 1st POSITION SWITCH ON THE SCORE MOTOR.
- D THE (6) REAR ROLL-OVER SWITCHES ON THE PLAYBOARD FOR PROPER ADJUSTMENT.

MARK RELAY

THE FUNCTION OF THE MARK RELAY IS TO COMPLETE A CIRCUIT TO IMPULSE THE TEAM MARK UNITS. THE RELAY IMPULSES ONCE FOR EACH STRIKE OR SPARE & TWICE FOR DOUBLE STRIKES.

SWITCHES:

- ① COMPLETES THE CIRCUIT TO THE RIGHT TEAM MARK 1-9 UNIT.
- ② COMPLETES THE CIRCUIT TO THE RIGHT TEAM MARK 10-90 UNIT.
- ③ COMPLETES THE CIRCUIT TO THE LEFT TEAM MARK 1-9 UNIT.
- ④ COMPLETES THE CIRCUIT TO THE LEFT TEAM MARK 10-90 UNIT.



- YELLOW -

IF THIS RELAY FAILS TO OPERATE PROPERLY, CHECK:

- Ⓐ THE ADJUSTMENT OF THE BREAK SWITCH ON THE SCORE CONTROL RELAY.
- Ⓑ, Ⓒ THE ADJUSTMENT & ALIGNMENT OF THE WIPER FINGERS ON THE EXTRA SHOTS UNIT & THE SCORE MOTOR.
- Ⓓ THE ADJUSTMENT OF THE BREAK SWITCH ON THE START RELAY.

NOTE: THE ADJUSTMENT OF THIS RELAY REQUIRES THAT THE SWITCHES BREAK BEFORE ANY SWITCH HAS BEEN MADE.