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

Indicates Number of Turns.

Indicates Size of Magnet Wire

Indicates Size of Coil

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, reliving 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**

- Insulated wire leads soldered to lug of socket and bottom of battery.
- Lead wire soldered to bottom of battery.
- Alligator clips.
- Flashlight Bulb.
- Lug type Socket.
- One lug soldered to core of battery.

**Use approximately \( \frac{1}{6} \) inch diameter rod or wire, covered with insulation tubing, or wrapped with tape.**

**45 ohm 10 watts Resistor.**

**Solder resistor between prod and socket. Attach lead wire to center contact of socket.**

For 6 Volt tests, solder a wire to socket side of resistor. Fasten an alligator clip to other end and clip to prod, thus shorting out resistor.

**ALTERNATE METHOD**

**Wire (2) *458 Bulbs in Series for 50 Volts Only**

- Use approximately \( \frac{1}{4} \) inch diameter rod or wire, covered with insulation tubing or wrapped with tape.

- Insulated Wire.

- Alligator Clip.

- (2) No. 458 Bulbs.
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 a 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.

To energize the Coin Relay Coil we must apply a voltage across the Coin Relay Coil. Black is already at one terminal of the coil and we must bring yellow to the other terminal. This is accomplished by closing the Drop Chute Switch with a Coin dropped through the Coin Rejector.

We found when we dropped a Coin we energized the Coin Relay. This closes the Switch at (A) and allows Black at both the Start Relay Coil (B) and the Coin S. U. Coil (C). Since the Frame Unit is not in position 0 or 1, for the operation of the first coin, the Coin S. U. Coil cannot be energized. Since the Game Over Relay Trips at the end of a Game the Switch at (D) is closed.

When the Coin Relay Switch closes the start Relay becomes energized and resets all of the Units and Relays. With additional coins the Coin S. U. advances because the frame unit has reset to a position closing the circuit to the Coin S. U. and opening the circuit to the start relay.

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.
<table>
<thead>
<tr>
<th>SERVICE CALL</th>
<th>CAUSE</th>
<th>CORRECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Game completely dead.</td>
<td>1. Line cord not making contact in outlet.</td>
<td>1. Repair or replace plug or outlet.</td>
</tr>
<tr>
<td>2. Drum units fail to score properly.</td>
<td>2a. Wires to drum unit coils and switches are hitting reels.</td>
<td>2a. Rearrange wires.</td>
</tr>
<tr>
<td></td>
<td>2b. Tape from coils rubbing reels.</td>
<td>2b. Remove Tape</td>
</tr>
<tr>
<td></td>
<td>2c. 1-9 or 10-90 Score Relay Switches not adjusted properly.</td>
<td>2c. Make proper adjustment</td>
</tr>
<tr>
<td></td>
<td>2d. Only one particular 10-90 unit fails to advance properly.</td>
<td>2d. Check 9th position switch on the 1-9 unit.</td>
</tr>
<tr>
<td></td>
<td>2e. Wiper fingers on Score Motor not adjusted with sufficient pressure.</td>
<td>2e. Make proper adjustment</td>
</tr>
<tr>
<td>3. Drum units fail to reset to Zero at start of game.</td>
<td>3a. Poorly adjusted Zero Switch on failing unit.</td>
<td>3a. Adjust Zero switch to open at the zero position, and &quot;make&quot; at the 1st position with adequate contact pressure.</td>
</tr>
<tr>
<td></td>
<td>3b. Reset relays not operating properly.</td>
<td>3b. Adjust switches on Reset relays.</td>
</tr>
<tr>
<td></td>
<td>3c. Check #2</td>
<td></td>
</tr>
<tr>
<td>SERVICE CALL</td>
<td>CAUSE</td>
<td>CORRECTION</td>
</tr>
<tr>
<td>---------------------------------------------------------------------------</td>
<td>-----------------------------------------------------</td>
<td>---------------------------------------------------------------------------</td>
</tr>
<tr>
<td>4. Spare does not register and game scores 10 points.</td>
<td>4. 1-10 Relay is not dropping</td>
<td>4. a. Adjust the 10 switches which trip the 1-10 Relay, starting from the #1 Relay and continuing to the #10 Relay</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4. b. Check the 1-10 Relay for tripping properly mechanically. This is generally caused by too much tension by the top switches.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4. c. Apply lubrication to the tip of the Armature.</td>
</tr>
<tr>
<td>5. No 2nd shot for spare; Game scores on 1st shot.</td>
<td>5. a. 2nd shot relay is not being reset properly</td>
<td>5. a. Adjust armature fl ap.</td>
</tr>
<tr>
<td></td>
<td>5. b. Score Motor is over-riding and is not stopping at the 1st Position</td>
<td>5. b. Adjust 1st Position switch (Green-Red Wire). If clutch on motor is not dis-engaging, tap the bearing housing lightly.</td>
</tr>
<tr>
<td></td>
<td>6. b. Pin Reset Relay energizes, but drops out before the Pin Reset motor moves out of the Zero Position.</td>
<td>6. b. Adjust the Zero Position switch on the Pin Reset motor to &quot;make&quot; before it &quot;breaks.&quot;</td>
</tr>
<tr>
<td>SERVICE CALL</td>
<td>CAUSE</td>
<td>CORRECTION</td>
</tr>
<tr>
<td>--------------------------------------------------</td>
<td>---------------------------------------------------------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>7. Score motor operates continuously until &quot;GAME OVER&quot;.</td>
<td>7a. Ball is lying on one of the six back rollover switches.</td>
<td>7a. Level Game</td>
</tr>
<tr>
<td></td>
<td>7b. The Relay Bank fails to reset.</td>
<td>7b. Adjust 3rd Position switch on Score Motor and normally closed switch on Score Control Relay (Brown Wire).</td>
</tr>
<tr>
<td></td>
<td>8b. Relays not tripping on the relay bank due to much friction of armature tip.</td>
<td>8b. Apply lubrication to tip of the armature.</td>
</tr>
<tr>
<td>9. Balls not being returned.</td>
<td>9a. Gate coil not being energized because 1st or 2nd Shot Relays are not being tripped.</td>
<td>9a. Adjust the six rear rollover switches to have a smaller gap. Apply lubrication to the tips of the armatures on the 1st and 2nd Shot Relays.</td>
</tr>
<tr>
<td></td>
<td>9b. Gate coil is being energized but balls hang on steel runway.</td>
<td>9b. Remove steel runway.</td>
</tr>
<tr>
<td>SERVICE CALL</td>
<td>CAUSE</td>
<td>CORRECTION</td>
</tr>
<tr>
<td>--------------</td>
<td>-------</td>
<td>------------</td>
</tr>
<tr>
<td>10. Game shows &quot;GAME OVER&quot; in 1st Frame after depositing coin.</td>
<td>10. Lock Relay does not energize.</td>
<td>10. Adjust the Make and Break switch to &quot;Make before &quot;Break.&quot;</td>
</tr>
<tr>
<td>11. Game shows &quot;GAME OVER&quot; too soon.</td>
<td>11. Tilt switches are improperly adjusted.</td>
<td>11. One tilt switch is located in the cabinet and another one is located in the backbox. Adjust in accordance with instructions.</td>
</tr>
<tr>
<td>12. Lights are dim; all units work sluggishly.</td>
<td>12. Line voltage is too low.</td>
<td>12. Install Voltage control fuse into the &quot;LOW LINE&quot;.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>13b. Relieve some of the switch Tension.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>13c. Bend Bracket away from the Coil.</td>
</tr>
<tr>
<td>LUG POSITION</td>
<td>FUNCTION OF RIVETS CONNECTED TO LUG POSITION</td>
<td>LUG POSITION</td>
</tr>
<tr>
<td>--------------</td>
<td>---------------------------------------------</td>
<td>--------------</td>
</tr>
<tr>
<td>J.</td>
<td>TO 10-90 SOUCRE RELAY (5) RIVETS TO OPERATE 10-90 SOUCRE RELAY.</td>
<td>1.</td>
</tr>
<tr>
<td>K.</td>
<td>TO 1-10 RELAY (3) RIVETS TO OPERATE STRIKE SOUCRE RESET RELAY WITH LESS THAN 10 PINS.</td>
<td>2.</td>
</tr>
<tr>
<td>L.</td>
<td>TO STRIKE SOUCRE RESET RELAY (6) RIVETS TO OPERATE STRIKE SOUCRE RESET RELAY.</td>
<td>3.</td>
</tr>
<tr>
<td>M.</td>
<td>TO EXTRA SHOTS DISC TO FOUR RIVETS TO OPERATE THE MAX RELAY.</td>
<td>4.</td>
</tr>
<tr>
<td>N.</td>
<td>TO PLAYER RESET RELAY OPERATES PLAYER RESET RELAY FROM 10 PIN RELAY.</td>
<td>5.</td>
</tr>
<tr>
<td>O.</td>
<td>TO EXTRA SHOTS DISC TO ONE RIVET TO OPERATE THE MAX RELAY.</td>
<td>6.</td>
</tr>
<tr>
<td>P.</td>
<td>TO END SHOTS RELAY OPERATES STRIKE SOUCRE RESET RELAY AFTER 2 SHOTS WHEN HOLDING A STRIKE.</td>
<td>7.</td>
</tr>
<tr>
<td>Q.</td>
<td>TO COIN UNIT DISC COMPLETE CIRCUIT TO #8 RIVET FOR OPERATION OF THE PLAYER RESET UNIT.</td>
<td>8.</td>
</tr>
<tr>
<td>R.</td>
<td>TO EXTRA SHOTS RESET RELAY OPERATES EXTRA SHOTS RESET RELAY FROM #9 RIVET.</td>
<td>9.</td>
</tr>
<tr>
<td>S.</td>
<td>TO LAUNCH RELAY (11) RIVETS FOR THE OPERATION OF THE STRIKE SOUCRE RESET RELAY AT THE START OF THE GAME.</td>
<td>10.</td>
</tr>
<tr>
<td>T.</td>
<td>TO HIDDEN PLATFIELD SWITCH OPERATES PIN RESET RELAY THROUGH #11 RIVET.</td>
<td>A.</td>
</tr>
<tr>
<td>U.</td>
<td>TO &quot;C&quot; RESSET RELAY (11) RIVETS OPERATE &quot;C&quot; RESET RELAY AT START OF THE GAME.</td>
<td>B.</td>
</tr>
<tr>
<td>V.</td>
<td>TO &quot;B&quot; RESSET RELAY (11) RIVETS OPERATE &quot;B&quot; RESET RELAY AT END OF THE GAME.</td>
<td>C.</td>
</tr>
<tr>
<td>W.</td>
<td>TO &quot;A&quot; RESSET RELAY (11) RIVETS OPERATE &quot;A&quot; RESET RELAY AT START OF THE GAME.</td>
<td>D.</td>
</tr>
<tr>
<td>X.</td>
<td>TO 1-9 SOUCRE RELAY (10) RIVETS OPERATE 1-9 SOUCRE RELAY.</td>
<td>E.</td>
</tr>
<tr>
<td>Y.</td>
<td>TO 50 VOLT POWER (2) RIVETS TO COMPLETE CIRCUIT TO THE &quot;SP&quot; RIVETS FOR THE STRIKE SOUCRE STEP-UP RELAY ON A STRIKE. (11) RIVET ON A SPARE.)</td>
<td>F.</td>
</tr>
<tr>
<td>Z.</td>
<td>TO SCORE CONTROL RELAY COMPLETE CIRCUIT TO THE PIN RESET RELAY THROUGH #9 RIVET.</td>
<td>G.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>H.</td>
</tr>
</tbody>
</table>
EXTRA SHOTS UNIT DISC

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

LOCATED AT TOP OF DISC

16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1

WHITE - ORANGE TO FIRST STRIKE LITE
WHITE - RED TO SECOND STRIKE LITE
WHITE - BLACK TO THIRD STRIKE LITE
WHITE - BLUE TO SPARE LITE
YELLOW - RED TO SHOOT AGAIN LITE
BLACK - WHITE TO 3rd POSITION SWITCH ON THE SCORE MOTOR
RED - BLUE TO 1st SHOT RELAY SWITCH
RED - BLACK TO SCORE CONTROL RELAY SWITCH
ORANGE - RED TO 2nd SHOT RELAY SWITCH
BLACK - GREEN TO 2nd SHOT RELAY SWITCH
BLUE TO 2nd SHOT RELAY SWITCH
BROWN TO 1st SHOT RELAY SWITCH
WHITE - GREEN TO 3rd POSITION ON THE SCORE MOTOR
BLACK - YELLOW TO SCORE CONTROL RELAY SWITCH
BROWN - RED TO THE SCORE MOTOR DISC
BROWN - WHITE TO THE SCORE MOTOR DISC

TO CONTROL POWER TO THE 3rd POSITION SWITCH ON THE SCORE MOTOR
TO CONTROL POWER TO OPERATE GATE COIL
TO CONTROL THE MARK RELAY IN THE 10th FRAME

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

WHITE-ORANGE — TO SPARE LITE
WHITE-RED — TO 2nd STRIKE LITE
WHITE-GREEN — TO N1 STRIKE LITE
WHITE-BLACK — TO 3rd STRIKE LITE
BLACK-RED — TO COMPLETE CIRCUIT FROM THE PLAYER UP DISC, TO OPERATE 10-90 SCORE RELAY, STRIKE & SPARE RESET RELAY & SCORE CONTROL RELAY THROUGH POSITIONS ON THE SCORE MOTOR DISC.
GRAY-BLACK — TO THREE RIVETS ON SCORE MOTOR TO OPERATE 10-90 SCORE RELAY AND ALSO TO ONE RIVET ON THE SCORE MOTOR TO OPERATE THE STRIKE & SPARE RESET RELAY.
GRAY-YELLOW — TO FOUR RIVETS ON THE SCORE MOTOR DISC, TWO RIVETS TO OPERATE 10-90 SCORE RELAY, ONE RIVET TO OPERATE STRIKE & SPARE RESET RELAY & TO ONE RIVET TO OPERATE THE SCORE CONTROL RELAY.
GRAY-RED — TO THREE RIVETS ON THE SCORE MOTOR, TWO RIVETS TO OPERATE THE 10-90 SCORE RELAY & ONE RIVET TO OPERATE THE SCORE CONTROL RELAY.
GRAY-WHITE — TO FOUR RIVETS ON THE SCORE MOTOR, 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.
GRAY — TO THREE RIVETS ON THE SCORE MOTOR, ONE RIVET TO OPERATE THE 10-90 SCORE RELAY, ONE RIVET TO OPERATE THE STRIKE & SPARE RESET RELAY & ONE RIVET TO OPERATE THE SCORE CONTROL RELAY.
BROWN WHITE — TO OPERATE THE SCORE MOTOR ON SPARE-BLOW & DOUBLE STRIKE-BLOW COMBINATIONS.
YELLOW — TO 50-VOLT POWER LINE.

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 SIMILAR.


IF THE UNIT FAILS TO ADVANCE PROPERLY, CHECK:

A. THE ADJUSTMENT OF THE WIPER SPARE S.U. RELAY.
B. THE ADJUSTMENT OF THE WIPER SPARE RESET RELAY.
C. THE ADJUSTMENT OF THE WIPER SPARE FINGER ON THE PLAYER UP UNIT.
D. THE ADJUSTMENT OF THE WIPER SPARE 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.

---

Diagram:

- BLACK
  - 2nd PLAYER SPARE RELAY
  - 2nd PLAYER SPARE S.U. RELAY
- YELLOW
  - PLAYER UP DISC
  - START RELAY
<table>
<thead>
<tr>
<th>RIVET NUMBER</th>
<th>WIRE COLORS</th>
<th>FUNCTION OF RIVET</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>GREEN-BLACK</td>
<td>TO COIN UNIT COIL</td>
</tr>
<tr>
<td>2</td>
<td>GREEN-WHITE</td>
<td>TO START STOP RELAY COIL</td>
</tr>
<tr>
<td>3</td>
<td>ORANGE-BLACK</td>
<td>TO GAME OVER RELAY COIL</td>
</tr>
<tr>
<td>4</td>
<td>BLACK-WHITE</td>
<td>TO OPERATE BIKE RELAY IN 1st FRAME</td>
</tr>
<tr>
<td>5</td>
<td>BROWN-BLACK</td>
<td>TO OPERATE BIKE RELAY IN 2nd FRAME</td>
</tr>
<tr>
<td>6</td>
<td>BROWN-RED</td>
<td>TO OPERATE BIKE RELAY IN 3rd FRAME</td>
</tr>
<tr>
<td>7</td>
<td>BLACK-RED</td>
<td>TO OPERATE BIKE RELAY IN 4th FRAME</td>
</tr>
<tr>
<td>8</td>
<td>WHITE-ORANGE</td>
<td>TO OPERATE BIKE RELAY IN 5th FRAME</td>
</tr>
<tr>
<td>9</td>
<td>WHITE-GREEN</td>
<td>TO OPERATE BIKE RELAY IN 6th FRAME</td>
</tr>
<tr>
<td>10</td>
<td>WHITE-RED</td>
<td>TO OPERATE BIKE RELAY IN 7th FRAME</td>
</tr>
<tr>
<td>11</td>
<td>WHITE-BLACK</td>
<td>TO OPERATE BIKE RELAY IN 8th FRAME</td>
</tr>
<tr>
<td>12</td>
<td>WHITE-BLUE</td>
<td>TO OPERATE BIKE RELAY IN 9th FRAME</td>
</tr>
<tr>
<td>13</td>
<td>YELLOW-GREEN</td>
<td>TO OPERATE BIKE RELAY IN 10th FRAME</td>
</tr>
<tr>
<td>14</td>
<td>YELLOW-RED</td>
<td>TO OPERATE BIKE RELAY IN 11th FRAME</td>
</tr>
<tr>
<td>15</td>
<td>BLACK-YELLOW</td>
<td>TO OPERATE BIKE RELAY IN 12th FRAME</td>
</tr>
</tbody>
</table>

Diagram:
- **Direction of Rotation**: Clockwise
- **Wiper Fingers**: Bounded to base plate
- **Wiper Positions**: 1 to 12

**View Looking at Wiper Fingers Side** and with wiper in reset position.
FRAME UNIT

The main function of this unit is to denote the frame position by light indication on the frame glass. In addition, it controls the easy strike relay, start control relay, extra shots unit gate control relay, and the game over relay. This unit advances when the last player 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 score motor, extra shots reset relay, score control relay.

(G) & (H) alignment of the wiper fingers on the frame unit.

(J) & (K) the adjustment of the switches on the start relay & the 2nd position of the score motor.

If this unit fails to reset properly, check:

Extra shots disc.
COIN S.U. DISC
RESETS WITH 1st COIN AND ADVANCES WITH THE 2nd COIN

TO PLAYER UP DISC TO COMPLETE THE CIRCUIT TO THE LEFT TEAM SCORE REELS

TO NUMBER OF PLAYERS LITES

TO PLAYER UP UNIT DISC FOR PLAYER-RESET RELAY CIRCUIT

TO 1-9 SCORE RELAY & 10-90 SCORE RELAY TO COMPLETE THE CIRCUIT TO THE RIGHT TEAM SCORE REELS

DIRECTION OF ROTATION

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

GROUNDED WIPER FINGER

INSULATED WIPER FINGERS

INSULATED WIPER FINGERS

BROWN-YELLOW

BROWN-BLACK

RED-BLUE

RED-YELLOW

RED-BLACK

RED-GREEN

RED-WHITE

WHITE-BROWN

WHITE-BLACK

WHITE-RED

WHITE-GREEN

WHITE-ORANGE

BROWN-WHITE
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 - Alignment of the wiper finger on the frame unit.
C - Adjustment of the 2nd position switch on the score motor.
D - Adjustment of the start relay with the drop of the first coin.

[Diagram of the coin unit circuit with labels A, B, C, D, and connections marked as black and yellow.]

23
PLAYER UP S.U. DISC

VIEW LOOKING AT WIPER FINGER SIDE
WITH WIPER IN RESET POSITION

TO COIN UNIT DISC FOR PLAYER
RESET RELAY CIRCUIT & OPERATION
OF GATE CONTROL RELAY IN 10TH FRAME
TO OPERATE TEAM & MAV
DRUM UNITS
TO 3-9 RIVET RELAY SWITCH
TO PLAYER UP LITES

RIVET NUMBERS | WIRE COLORS | FUNCTION OF RIVETS
---|---|---
29 | GREEN-WHITE | 1ST PLAYER
30 | GRAY | 2ND PLAYER
31 | GREEN-YELLOW | 3RD PLAYER
32 | GREEN-BLACK | 4TH PLAYER
33 | ORANGE-WHITE | 5TH PLAYER
34 | ORANGE-RED | 6TH PLAYER
35 | GREEN-RED | FEED TO RIVETS 29, 30, 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-BLACK | 2ND PLAYER
45 | GREEN-YELLOW | 3RD PLAYER
46 | GREEN-BLACK | 4TH PLAYER
47 | BLUE-YELLOW | 5TH PLAYER
48 | BLUE-BLACK | 6TH PLAYER
49 | BLACK-BLACK | 1ST PLAYER
50 | BLACK-YELLOW | 2ND PLAYER
51 | BLACK-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-BLACK | 4TH PLAYER
59 | BLUE-YELLOW | 5TH PLAYER
60 | BLUE-BLACK | 6TH PLAYER
61 | BLACK-BLACK | TO 1ST PLAYER
62 | RED-BLACK | TO 2ND PLAYER
63 | RED-RED | TO 3RD PLAYER
64 | RED-YELLOW | TO 4TH PLAYER
65 | RED-BLUE | TO 5TH PLAYER
66 | RED-BLACK | TO 6TH PLAYER

TO 10-90 DRUM UNIT DRIVE COILS
TO 9TH POSITION SWITCH
ON 10-90 DRUM UNIT
TO OPERATE THE 100 DRUM UNIT
AT THE 9TH POSITION

STRIKE SPARE STEP UP
STRIKE & SPARE DISC
TO OPERATE THE SCORE
NOTE ON SPARE-SLOW
DOUBLE STROKE-SLOW
COMBINATIONS

STRIKE & SPARE DISC
TO OPERATE THE 1000
SCORE RELAY, THE STROKE
SPACE DELETION RELAY AND
THE SCORE CONTROL
RELAY THROUGH POSITIONS
ON THE SCORE UNIT

STRIKE SPARE STEP UP RELAY
ON THE 1-9 POSITIONS
TO OPERATE 10-90 DRUM UNITS AT 9TH POSITION.
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.

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 FAILING 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.
LOCK RELAY

Switches:
1. Holds circuit for the lock relay
2. Opens circuit from the lock relay

If this relay fails to operate, check:
A. The adjustment of the switch
B. The adjustment of the back box tilt
C. The adjustment of the mechanism

COIN RELAY

This relay is operated directly by the coin when energized by the start relay. If this relay fails to operate, check:
A. The drop chute switch

29
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, B, & 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.

1-9 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 1-9 drum units through player up unit.
2. Operates 10-90 drum units through 9th position switch on 1-9 drum units.
3. Operates the right team 1-9 drum unit.
4. Operates the right team 10-90 drum unit, through the 9th position switch on the right team 1-9 drum unit.
5. Operates the left team 1-9 drum unit.
6. Operates the left team 10-90 drum unit, through the 9th position switch on the left team 1-9 drum unit.

If relay fails to operate, check:
A. Alignment & adjustment on the score motor wiper.
B. Adjustment of switch on the 1-10 relay.
C. Adjustment of switch on the start relay.
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:

A & H PROPER ADJUSTMENT & ALIGNMENT OF THE WIPER FINGERS ON THE SCORE MOTOR. & ON THE EXTRA SHOTS UNIT.
B, C, D, E, F & G 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 & 100$^\text{th}$ drum units.

Switches:

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 100$^\text{th}$ 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 100$^\text{th}$ drum unit through the 9th position switch on the right team 10-90 drum unit.

If this relay fails, check:

A, B, & C: The adjustment of the switches on the start relay, 1-10 relay & the 1-9 score relay.

D, E, & F: 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 (depending 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:

D: The alignment & adjustment of the wiper finger on the score motor.

G: 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:

D, E, & F: Wiper fingers

H & J: 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 A, N, M, L, & K 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.
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 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:
A. THE ADJUSTMENT OF THE SWITCHES ON THE 1-HO RELAY, START RELAY, ZERO POSITION ON THE SCORE MOTOR.
B. THE START RELAY, 1st SHOT RELAY, ZERO POSITION ON THE SCORE MOTOR.
C. THE ALIGNMENT & ADJUSTMENT OF THE WIPER FINGERS ON THE PLAYER-UP UNIT & ON THE PROPER PLAYERS' STRIKE SPARE UNIT. (EXAMPLE: IF ONLY THE 1st SHOT FAILS TO REGISTER A UNIT COUNT AFTER THE 1st SHOT, CHECK THE 1st PLAYERS STRIKE - SPARE UNIT. THIS UNIT SHOULD OPERATE THE SCORE MOTOR WHEN HOLDING A SPARE OR A DOUBLE STRIKE.)

34
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: 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 WHEN THE GAME IS STARTED. THIS IS THE ONLY TIME IT OPERATES.

SWITCHES:
1. Completes circuit to the left team 1 & 2 drum units.
2. Completes circuit to the right team 1 & 2 drum units.
3. Completes circuit to reset the 3rd & 4th players strike spare units.
4. Completes circuit to reset the 5th & 6th players strike spare units.
5. Completes circuit to reset the 2nd & 3rd players strike spare units.

IF THIS RELAY FAILS TO OPERATE, CHECK:
- THE ADJUSTMENT OF THE SWITCH ON THE START RELAY.
- THE ADJUSTMENT OF THE SWITCH ON THE "A" RELAY.

NOTE: THE "B" & "C" RESET RELAYS ARE SIMILAR IN OPERATION.
EASY STRIKE RELAY

The Easy Strike relay operates only when the "N" or "M" roll over switches are set together & the adjustment jack is in the proper position. The relay switches operate only on the shot that trips the "I" relay.

Switches:
1. Trips the #1 relay.
2. Trips the #2 relay.
3. Trips the #3 relay.
4. Trips the #4 relay.
5. Trips the #5 relay.
6. Trips the #6 relay.
7. Trips the #7 relay.
8. Trips the #8 relay.

If the relay fails to operate, check:
A. The adjustment of the switches on the score motor & game over relays.
B. The adjustment of the "I", "M" & "N" roll over switches.
C. The alignment & adjustment of the wiper fingers on the frame unit.
D. The position of the strike zone adj. jack.

- BLACK -

PIN RESET RELAY

The function of thepin 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, B, & 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. **THRUSH (TRIP) RELAYS**

The functions of the 1, 2, 4, 5, 6, 7, 8, 9, & 0 RELAYS ARE ALL SIMILAR IN OPERATION. THE PRIMARY FUNCTION OF THE 1, 2, 4, 5, 6, 7, 8, 9, & 0 RELAYS IS TO OPEN CIRCUITS ON THE 1ST SHOT (1) OF THE 1ST SHOT, TO OPEN CIRCUITS ON THE 2ND SHOT (2) AND TO OPEN CIRCUITS ON THE 3RD SHOT (3) AND TO OPEN CIRCUITS ON THE 4TH SHOT (4) AND TO OPEN CIRCUITS ON THE 5TH SHOT (5) AND TO OPEN CIRCUITS ON THE 6TH SHOT (6) AND TO OPEN CIRCUITS ON THE 7TH SHOT (7) AND TO OPEN CIRCUITS ON THE 8TH SHOT (8) AND TO OPEN CIRCUITS ON THE 9TH SHOT (9) AND TO OPEN CIRCUITS ON THE 0TH SHOT (0). THE PRIMARY FUNCTION OF THE 1, 2, 4, 5, 6, 7, 8, 9, & 0 RELAYS IS TO OPEN CIRCUITS ON THE 1ST SHOT (1) OF THE 1ST SHOT, TO OPEN CIRCUITS ON THE 2ND SHOT (2) AND TO OPEN CIRCUITS ON THE 3RD SHOT (3) AND TO OPEN CIRCUITS ON THE 4TH SHOT (4) AND TO OPEN CIRCUITS ON THE 5TH SHOT (5) AND TO OPEN CIRCUITS ON THE 6TH SHOT (6) AND TO OPEN CIRCUITS ON THE 7TH SHOT (7) AND TO OPEN CIRCUITS ON THE 8TH SHOT (8) AND TO OPEN CIRCUITS ON THE 9TH SHOT (9) AND TO OPEN CIRCUITS ON THE 0TH SHOT (0).

2. **ROLL-OVER CONTROL RELAY**

This relay operates on the first shot on the 10th position of the score motor relay. The adjustment of the roll-over control relay is done on the 10th position of the score motor relay. The adjustment of the roll-over control relay is done on the 10th position of the score motor relay. The adjustment of the roll-over control relay is done on the 10th position of the score motor relay. The adjustment of the roll-over control relay is done on the 10th position of the score motor relay.

---

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

Switch 1: Opens the circuit to the "K" relay on the 2nd shot.

Switch 2: Transfers the circuit from the "K" relay coil to the "L" relay on the 3rd shot.

Switch 3: Closes the circuit to the "L" relay on the 4th shot.

Switch 4: Energizes the "K" relay on the 5th shot.

Switch 5: The relay fails to operate when the "K" roll-over is made. Check:

- Adjustments of the "K" roll-over switch on the 10th position of the score motor.

Switch 6: The relay fails to operate when the "K" roll-over is made. Check:

- Adjustments of the "K" roll-over switch on the 10th position of the score motor.

Switch 7: The relay fails to operate when the "K" roll-over is made. Check:

- Adjustments of the "K" roll-over switch on the 10th position of the score motor.

Switch 8: The relay fails to operate when the "K" roll-over is made. Check:

- Adjustments of the "K" roll-over switch on the 10th position of the score motor.
START (TRIP) RELAY

OPERATES ONLY AT THE START OF A NEW GAME, WITH THE 1ST COIN ONLY. IT'S FUNCTION IS TO RESET ALL THE UNITS TO A ZERO POSITION.

START RELAY
- Switch Build-Up
- (View looking at the soldering side)
- A switch example: IM&B

<table>
<thead>
<tr>
<th>3M</th>
<th>6B</th>
<th>2M&amp;B</th>
<th>5M</th>
<th>4M</th>
</tr>
</thead>
</table>

1. Operates player up unit reset.
2. Transfers circuit for the score control relay, BELL; 90 RELAY, 10-90 COIN RELAY E, STRIKE.
3. Operates the gate coil releasing the 1st ball to a player.
4. Completes circuit to the player reset relay, E.
5. Reset frame unit reset & player up unit reset.
6. Breaks the circuit to the 1st player's 100§ reel.

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

A. $B Switch adjustments on the coin relay $B. The game over.
B. The alignment & adjustment of the wiper fingers of frame unit.

COIN RELAY BLUE
START RELAY BLUE
GAME OVER RELAY
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)

<table>
<thead>
<tr>
<th>3M</th>
<th>6B</th>
</tr>
</thead>
<tbody>
<tr>
<td>2M</td>
<td>5B</td>
</tr>
<tr>
<td>1M</td>
<td>4B</td>
</tr>
</tbody>
</table>

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 10-90 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:

1. The adjustment of the switches on the start relay & the I-10 relay.
2. The adjustment of the switches in the continuity circuit from the 1 relay through the 10 relay.

1st SHOT RELAY

This relay always operates on the 1st shot.

1st SHOT RELAY SWITCH BUILD-UP
(View looking at the soldering side)

<table>
<thead>
<tr>
<th>2M</th>
<th>4B</th>
</tr>
</thead>
<tbody>
<tr>
<td>1M</td>
<td>3M</td>
</tr>
</tbody>
</table>

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:

1. The adjustment of the switches on the score motor relay, the game over relay & the 1st shot relay.
2. 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)

<table>
<thead>
<tr>
<th>Switch</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Allows the reset of the start relay if the game is tilted in the 1st frame.</td>
</tr>
<tr>
<td>2. Transfers ground for the 6-volt lites to complete the circuit for the game over lite.</td>
</tr>
<tr>
<td>3. Breaks the circuit to the gate coil and the game over relay.</td>
</tr>
<tr>
<td>4. Breaks the circuit to all of the roll-over switches &amp; the 1st &amp; 2nd shot relays.</td>
</tr>
<tr>
<td>5. Breaks the circuit to the ball lift motor.</td>
</tr>
</tbody>
</table>

IF THIS RELAY FAILS TO OPERATE, CHECK:

A) The adjustment of the switches on the game over relay and the lock relay

B) 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.

2nd SHOT RELAY

ALWAYS OPERATES ON THE 2nd SHOT.

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

<table>
<thead>
<tr>
<th>Switch</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Completes the circuit to the 3rd position switch on the score motor relay for the condition of a strike and a blow in the 10th frame only.</td>
</tr>
<tr>
<td>2. Completes the circuit to the score motor on a blow.</td>
</tr>
<tr>
<td>3. Transfers gate coil circuit from the zero pivot position to the 1st pivot position on the extra shots disc in the 10th frame &amp; last player only.</td>
</tr>
<tr>
<td>4. Completes circuit to one pivot on the score motor disc for the strike spare reset relay.</td>
</tr>
</tbody>
</table>

IF THIS RELAY FAILS TO OPERATE, CHECK:

A) B) C) The adjustment of the switches on the score motor relay. The same 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 and 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.

If this relay fails to operate properly, check:

A. The adjustment of the break switch on the score control relay.
B. The adjustment of the extra shots unit.
C. The adjustment of the score motor.
D. 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.