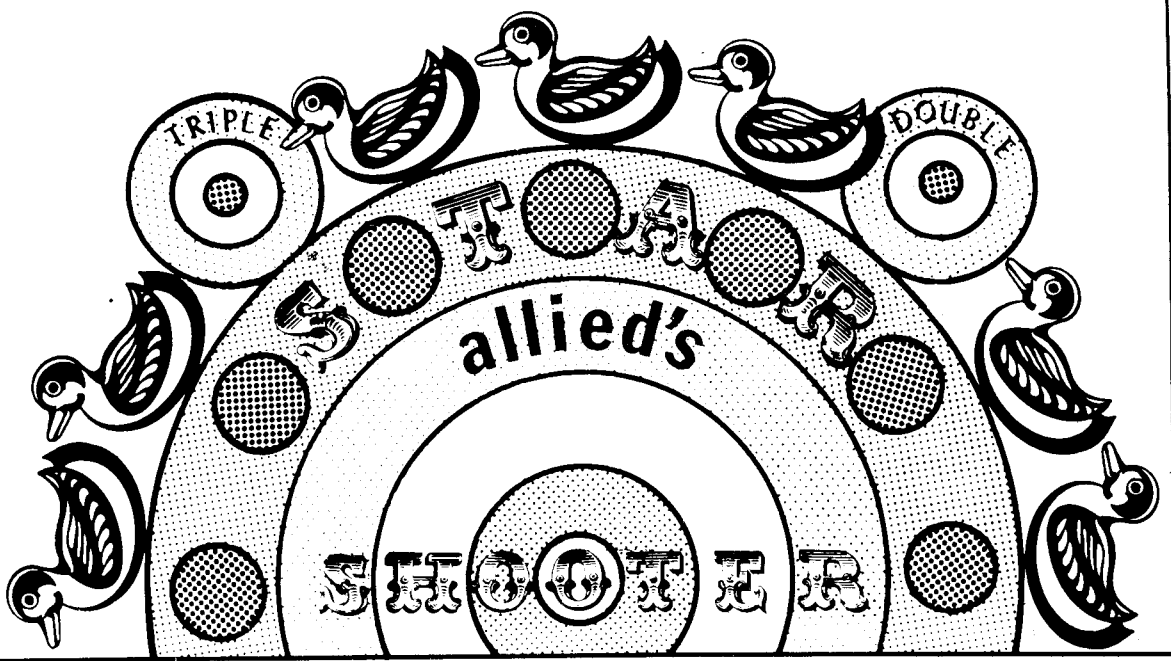
OWNERS MANUAL
GAME NO. 336

allied's

"4" PLAYER



allied leisure industries, inc.
245 west 74 place
hialeah, florida, 33014. U.S.A
TOLL FREE (800) 327-5830

(1979)

PERSONAL SAFETY PRECAUTIONS

This machine must be connected to a grounded power outlet. The power cord has a long, cylindrical ground pin to prevent electrical shock. DO NOT DEFEAT ITS PURPOSE by removing that pin!

If you must use an extension cord to plug the game into a suitable electrical outlet, the plug MUST HAVE WITHOUT EXCEPTION three prongs, and the cord itself must be MEDIUM to HEAVY GAUGE! (14 to 16 gauge).

Thin-wire "household" extensions are not adequate because they are not able to handle the amount of power required by the machine. Additionally, inadequate grounding may affect the operation of the game.

If your skin is wet or moist, do NOT touch this machine while it is connected to power.

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A. INSTALLATION

1. Parts Package

Two balls and 4 leg-levellers with nuts are located inside the CASH BOX. One ball should be placed inside the ROLL-TILT bracket as indicated. The second ball should be put into the OUT-HOLE KICKER, which is in a hole at the lower end of the Playfield.

2. Levelling the Game

Lay the game on the left or right side to expose the holes at the bottoms of the legs. (Protect the game against scratching with a small rug.)

The 4 nuts should be screwed on to the respective leg-levellers, then rotate each nut down one inch from the top of the leveller bolt. Each leveller will then be inserted into the threaded hole at the bottom of each leg. When this has been done, return the game to its upright position.

To properly balance the machine, extend or retract if necessary the leg-levellers causing any imbalance. To accomplish this, loosen nut "A" and, with a wrench or pliers, turn nut "B" to the balance point. Then tighten nut "A". The game must stand level!

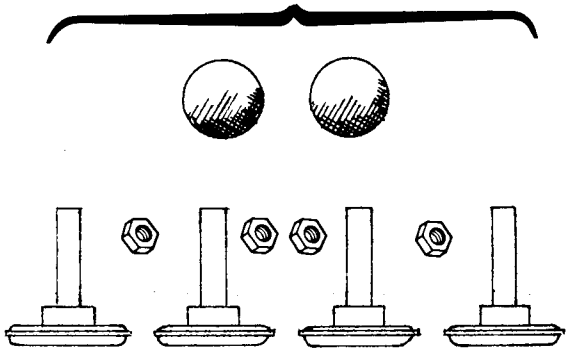
HOWEVER, it should be noted that

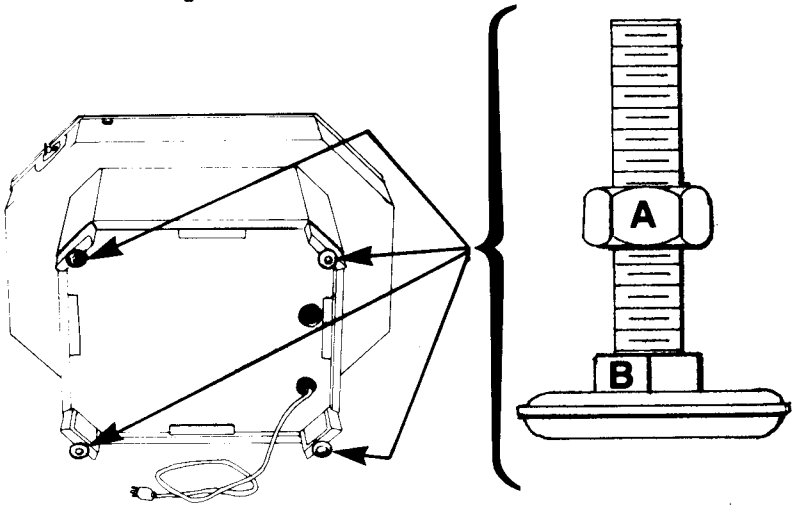
a. Raising rear legs will increase ball speed and will decrease scores.

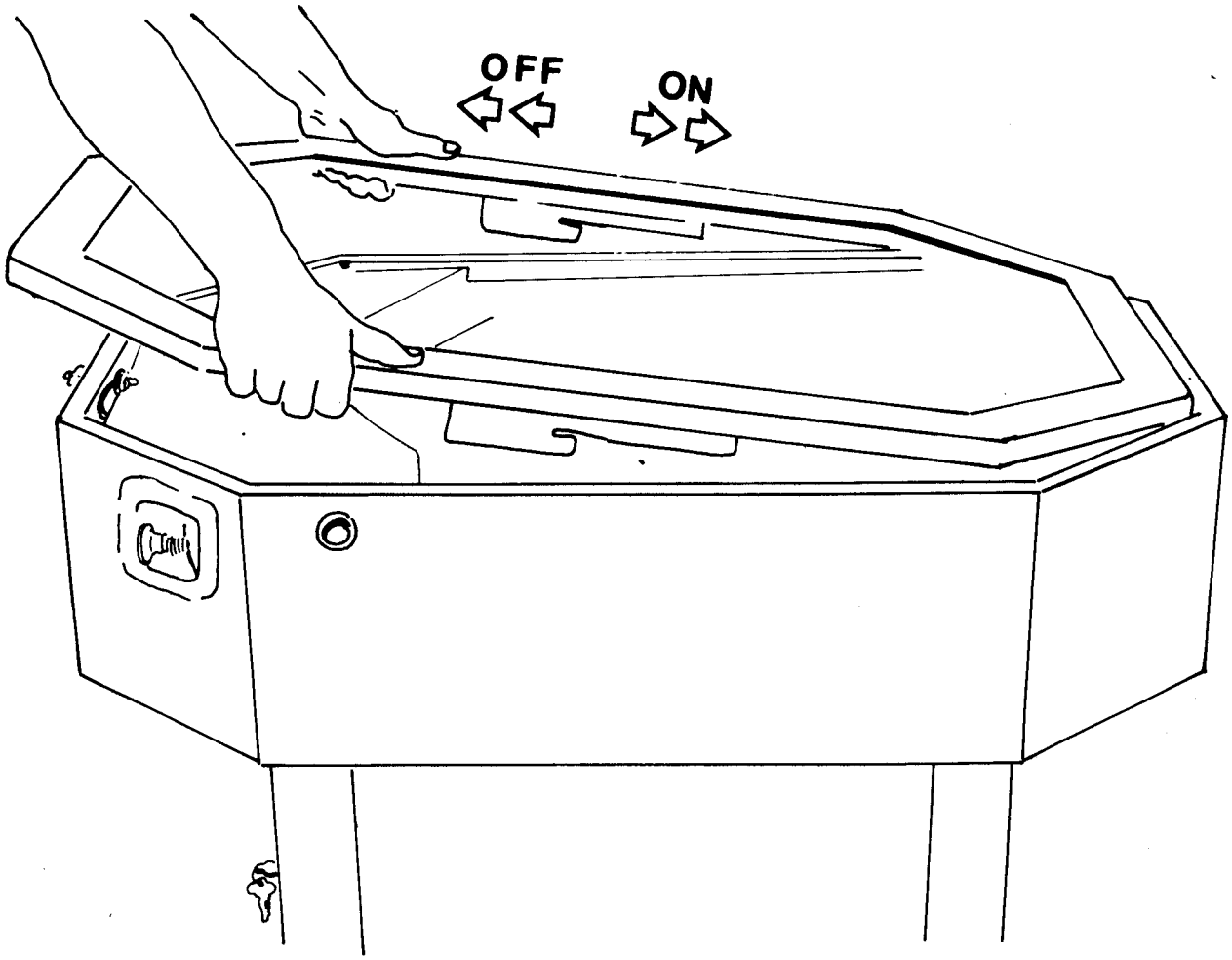
b. Lowering rear legs will decrease ball speed and will increase scores.

NOTE: Be sure to adjust ROLL and PENDULUM TILTS after raising the rear legs. See description of the TILT mechanisms on page 25.

PARTS PACKAGE







3. Set-Up Procedures

Three keys to the game are tied to the plunger. Two of them are identical and fit the lock on the COIN DOOR.

The third key (#8013) fits the lock on the front of the UPPER CABINET, which unlocks the top glass assembly.

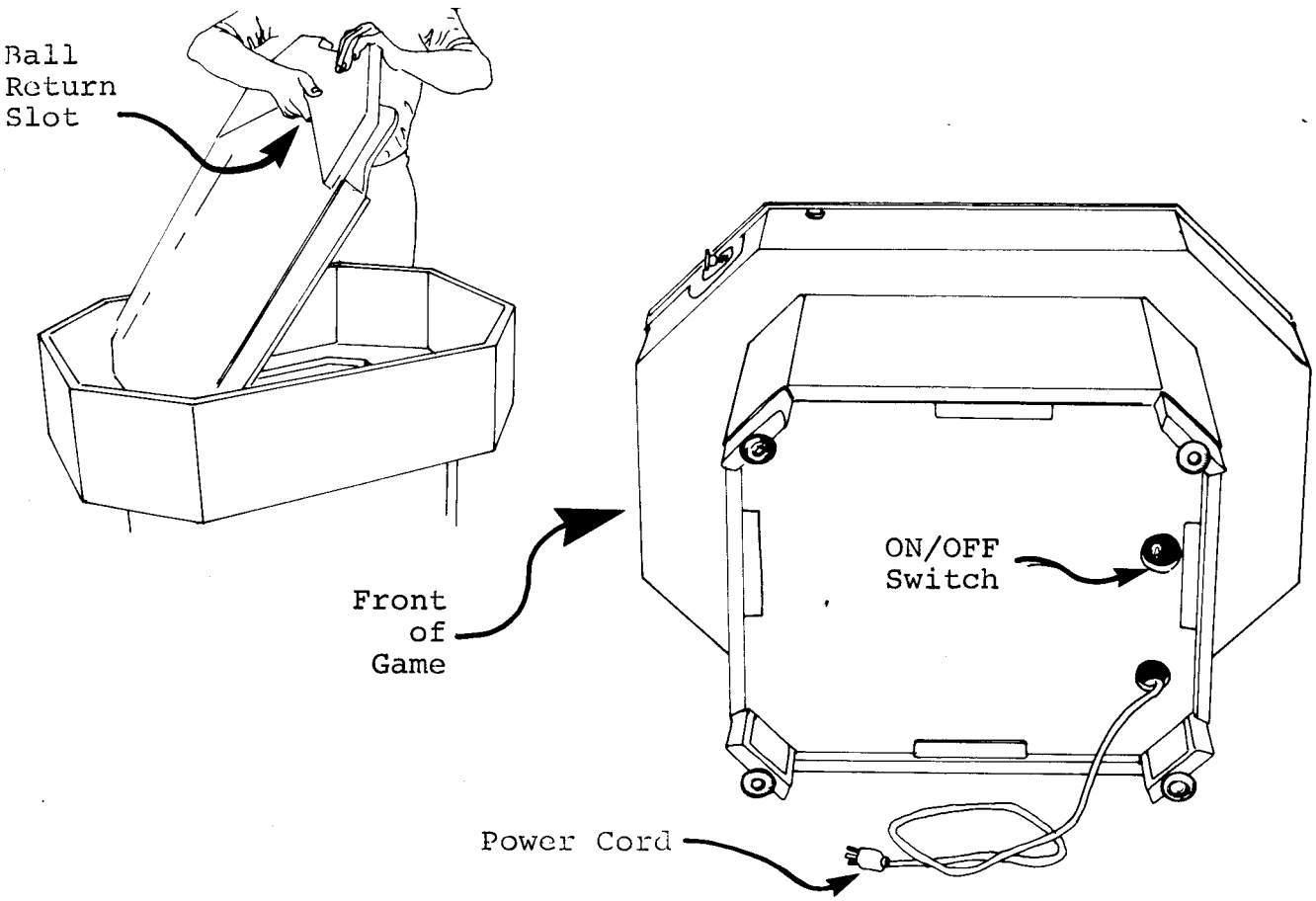
To remove the top glass assembly:

a. Insert the key and turn it clockwise.

b. Lift the front of the top glass slightly.

c. Slide the glass forward, making sure that the glass frame does not slam against the tongue portion of the Top Glass Lock.

4. What to Do before Applying Power



To open the Playfield, grasp the middle of the Shadow Box at the Ball Return slot. Lift the front of the Playfield a few inches, then insert the other hand under the Shadow Box. Gently swing the Playfield upward and to the rear until the bracket locks in the upright position.

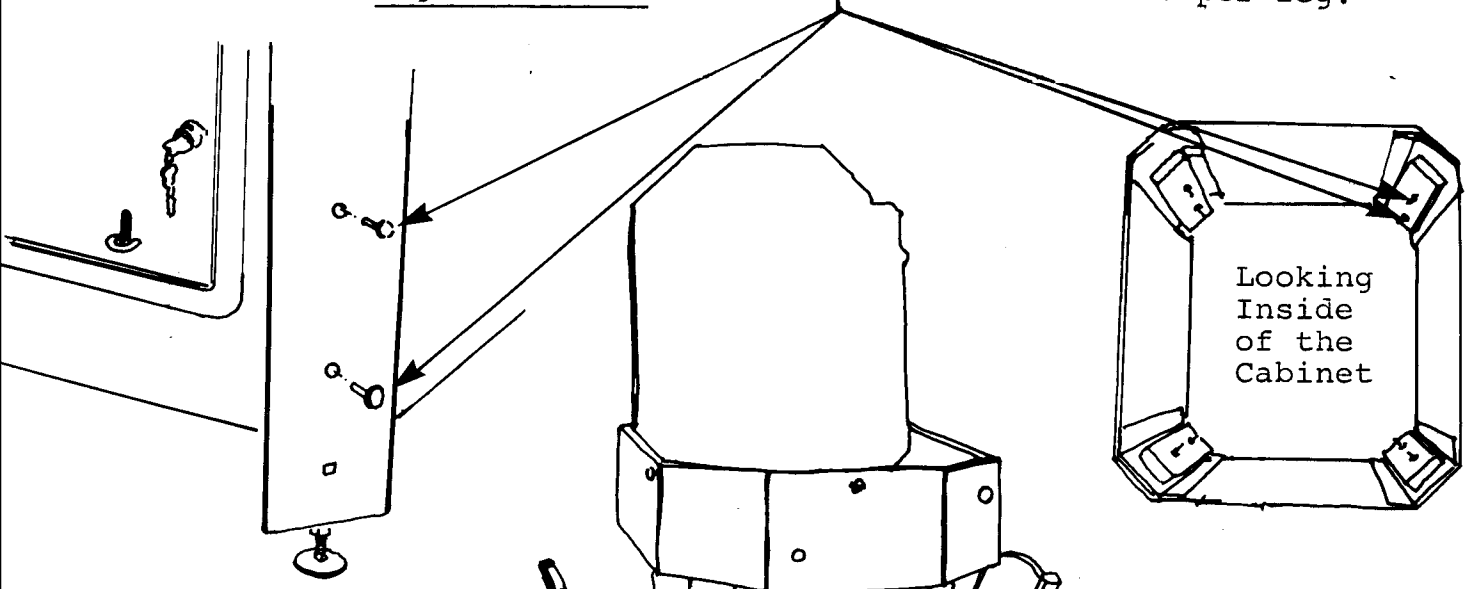
The power cord is tied inside the machine. Cut the tie, then pass the cord through the hole at the bottom left. The ON/OFF switch is located at the rear of the Lower Cabinet below the Power Supply. Do NOT connect the cord to AC power at this time.

BEFORE plugging the power cord into the electrical outlet, the following items should be visually checked for possible troubles caused by handling during shipment:

a. Fuses should be firm and make good contact.
b. All connectors should be completely seated.
c. Wires should be clear of all moving parts.
d. No wires or foreign objects of any kind should be lying loose inside the game.

5. Leg Extensions

Remove 2 nuts per leg.



Legs can be extended to any position shown.

To adjust:

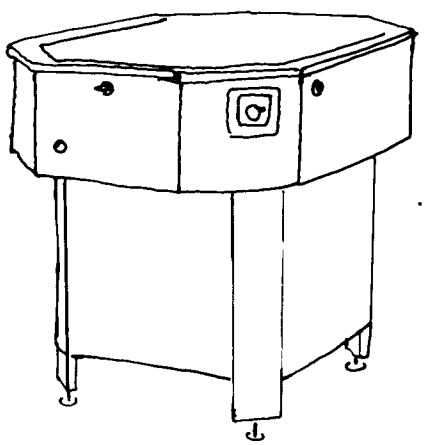
a. Elevate game to height of at least 12". (For example, use two chairs as shown.)

b. Remove nuts from inside of cabinet (two nuts for each leg).

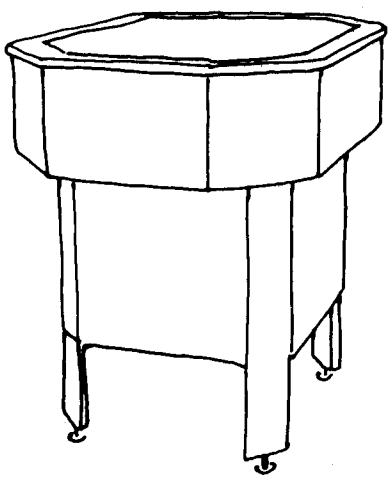
c. Remove each bolt, adjust the leg height as desired, then re-insert bolt into appropriate hole and secure with nut.



Legs Fully Retracted (Factory Standard)

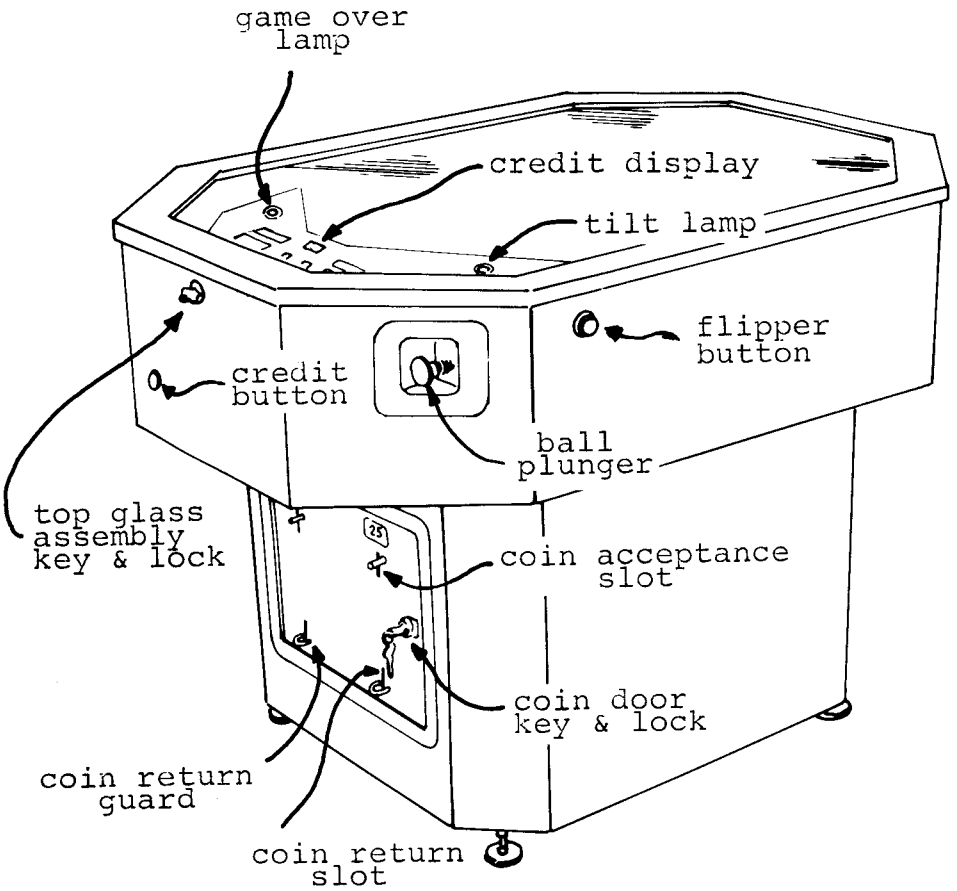


Legs Half-way Extended



Legs Fully Extended

B. GAME OPERATION



1. Coining the Game

The coin is inserted into the Coin Acceptance slot located on the front face of the Coin Door. Acceptance of the coin is acknowledged by a knocking sound from the Game Knocker and by advancement of the Total Play Counter.

The Credit Display advances once if the game is adjusted for "one coin--one credit". If coin is not accepted, it is returned when the Rejector button is pressed. Each subsequent coin insertion will advance the Credit Display once. Pressing the Credit button on the front of the cabinet will cause the Out-Hole Kicker to deliver one ball to the Shooter Alley.

The Game Over lamp goes OFF, and the first player's score display flashes. This indicates that the game is ready to play. Then shooting the ball initiates play by closing the Game Start Rollover switch in the middle of the Shooter Alley.

2. Playfield Scoring Devices

If the Thumper Bumper, the Rebound Kicker, the Spinning Flag or certain Amber Rollover switches stick closed, any coil energized by that switch will remain energized. (NOTE: Only those Amber Rollover Button switches which score 100 points change Alley Value.)

If the switch is still stuck after 2 seconds, the computer will ignore that switch and turn off the associated coil. That feature will then remain inactive until the game ends. At the start of each new game thereafter, this effect will be repeated unless the problem is corrected.

If the Out-Hole Kicker switch sticks in the closed position, the computer will not turn off this coil, but the fuse protecting that series of coils should open within 3 seconds, de-energizing that coil-group of devices.

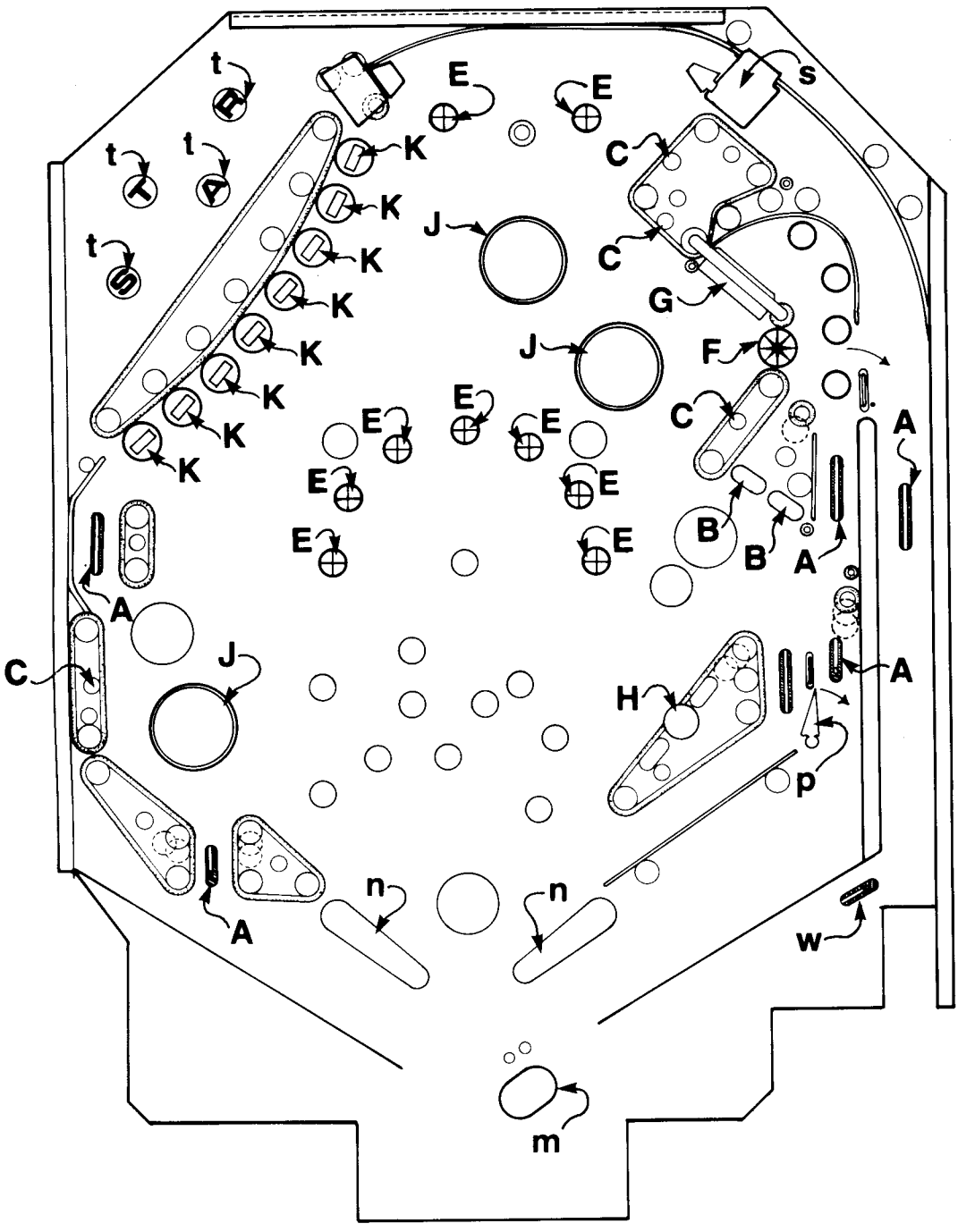
If any other switches on the Playfield (except the open-blade switches on the Drop Targets) stick in the closed position, the computer will lock out all features on the Playfield, and the game will not operate. A stuck-switch condition can be caused by a bad switch, a short in the wiring, or a faulty integrated circuit on the Main Logic Board.

The game has a total of 34 scoring switch devices:

Quantity	Description	Location
5	WIRE ROLLOVERS	A
2	ROUND BULL'S-EYE TARGETS	B
4	RAIL SWITCHES	C
9	AMBER ROLLOVER BUTTONS	E
1	STAR ROLLOVER BUTTON	F
1	SPINNING TARGET ASSEMBLY	G
1	REBOUND KICKER	H
3	THUMPER BUMPERS	J
8	DROP TARGETS	K
1	out-hole kicker *	m
2	flippers *	n
1	flag gate *	p
1	ball entrance gate *	s
4	lamp shields *	t
1	dummy one-way wire rollover * (not electrically connected)	w

*These are not scoring devices. Shown here for convenience and reference only.

a. Playfield


t
R
t
T
t
A
t
S
E
E
s
K
K
K
K
K
K
K
K
J
C
C
G
J
F
C
E
E
E
E
E
E
E
E
A
A
B
B
A
C
J
H
A
A
p
n
n
A
w
m

b. Wire Rollovers

Located throughout the Playfield are several Wire Rollover switches. Note that 2 of them are two-way Wire Rollovers while the other 3 are one-way Rollovers.

The 3 one-way Rollovers are located near the Left Exit, above the Flag Gate Assembly, and under the Shadow Box Assembly near the Ball Entrance Shooter Alley.

NOTE: Only the Wire Rollover located under the Shadow Box has no electrical connection and scores no point value. This wire's function is to provide pressure for the wire protruding through the Playfield, thus preventing the ball from bouncing back into the Out-Hole Kicker.

c. Round Bull's-Eye Targets

The game includes 2 of these, located side by side, about half-way down the Playfield. Each of these targets scores values as described in a later section. (See page 19, examples 1 and 2.)

d. Rail Switches

There are 4 of these on the Playfield, each being located directly behind a length of bumper rubber. Be sure that adjustments for these switches are checked periodically for the correct gap.

e. Amber Rollover Buttons

There are 9 of these on the Playfield. Note the heavy backing blade located below the switch. This is easily adjustable by bending with needle-nose pliers slightly upward or downward.

If the button falls too low when actuated, push the backing blade upward slightly.

If the button does not go down deep enough when actuated, pull the blade downward slightly.

f. Star Rollover Button

There is only one of these on the Playfield. The White Star insert should be free at all times and should not stick when activated. When waxing the Playfield, be careful not to put wax into the grooves where the insert rides.

Should wax get into this area, open up the prongs holding the insert by pushing them gently outward to pop the insert out. Then press them gently inward before pushing the insert back in.

g. Spinning Target Assembly

This is located on the right-hand side of the Playfield. Be sure that the switch is OPEN when the flag is in the REST position. If, while spinning, the flag should stick, check that the housing and the activator arms are not deformed. Be sure that the switch is not binding on the activator arm and is properly adjusted.

NOTE: When servicing the game, lifting the Playfield can cause the flag to swing far enough so as to allow the switch to close. The computer will then lock out this switch for the rest of the game (if the game is not tilted or in the Game Over mode).

h. Rebound Kicker

This assembly is located behind the triangular-shaped rubber above the right Flipper. Should the switches become bent out of adjustment, the Rebound Kicker might double-kick each time it is activated. Be sure that the switch gap is correct, and that the rubber tension is even all around.

i. Thumper Bumpers

There are 3 of these on the Playfield. Since they can be activated from any direction, it is important that there are no "dead" spots. Periodically check all around the bumpers ... should "dead" spots occur, clean and adjust the switches. Be sure that the screws which mount the switches are fully tightened before making adjustments.

j. Drop Targets

Each Drop Target combines two scoring switches: one is a microswitch mounted on the Drop Target housing ... the other is an open-bladed switch which notifies the computer that the Drop Target is down and scores additional values as described on page 15.

When a certain combination of Drop Targets have been struck, the DOUBLE or TRIPLE BONUS lamps will light ... then all Drop Targets are re-set. This BONUS MULTIPLIER action will be explained first.

j-1. Drop Target Groups

Eight Drop Targets are used in four groups of two. Ahead of each Drop Target on the Playfield is a star or a circle in one of four colors indicating one of the four groups. The brown star and the brown circle indicate one group ... the blue star and the blue circle indicate another, etc.

When one target of each color group is knocked down (one brown, one blue, one white and one yellow), the DOUBLE BONUS lamp will light ... then all targets are re-set. If one target of each color is again knocked down during the same Ball-in-Play, the TRIPLE BONUS lamp will light, and all targets will again re-set. Thus a minimum of four and a maximum of eight Drop Targets must be DOWN at the same time in order for the BONUS MULTIPLIER lamps to come ON.

The two coils of each group are wired together so that both are re-set at the same time. This may be when the BONUS is multiplied and at the beginning of each Ball-in-Play, OR when that particular group is re-set while the ball is in play (when a "raise" device is activated).

When all targets re-set, the target groups are raised in reverse order (group 4, group 3, group 2, group 1). The target groups and their colors are arranged as follows:

Group #1	Brown star & circle	Targets 1 and 5
Group #2	Yellow star & circle	Targets 2 and 8
Group #3	Blue star & circle	Targets 3 and 6
Group #4	White star & circle	Targets 4 and 7

The switch within the Drop Target mechanism which pertains to this action is the open-blade switch. This switch remains closed the entire time that the target is DOWN. Thus, at least one open-blade switch from each group must be closed at the same time for the BONUS to be multiplied.

The design of this eight-target feature requires that the first target of each color group to be knocked down will score 500 points, while the second target of the same group to be knocked down will not score in that same action.

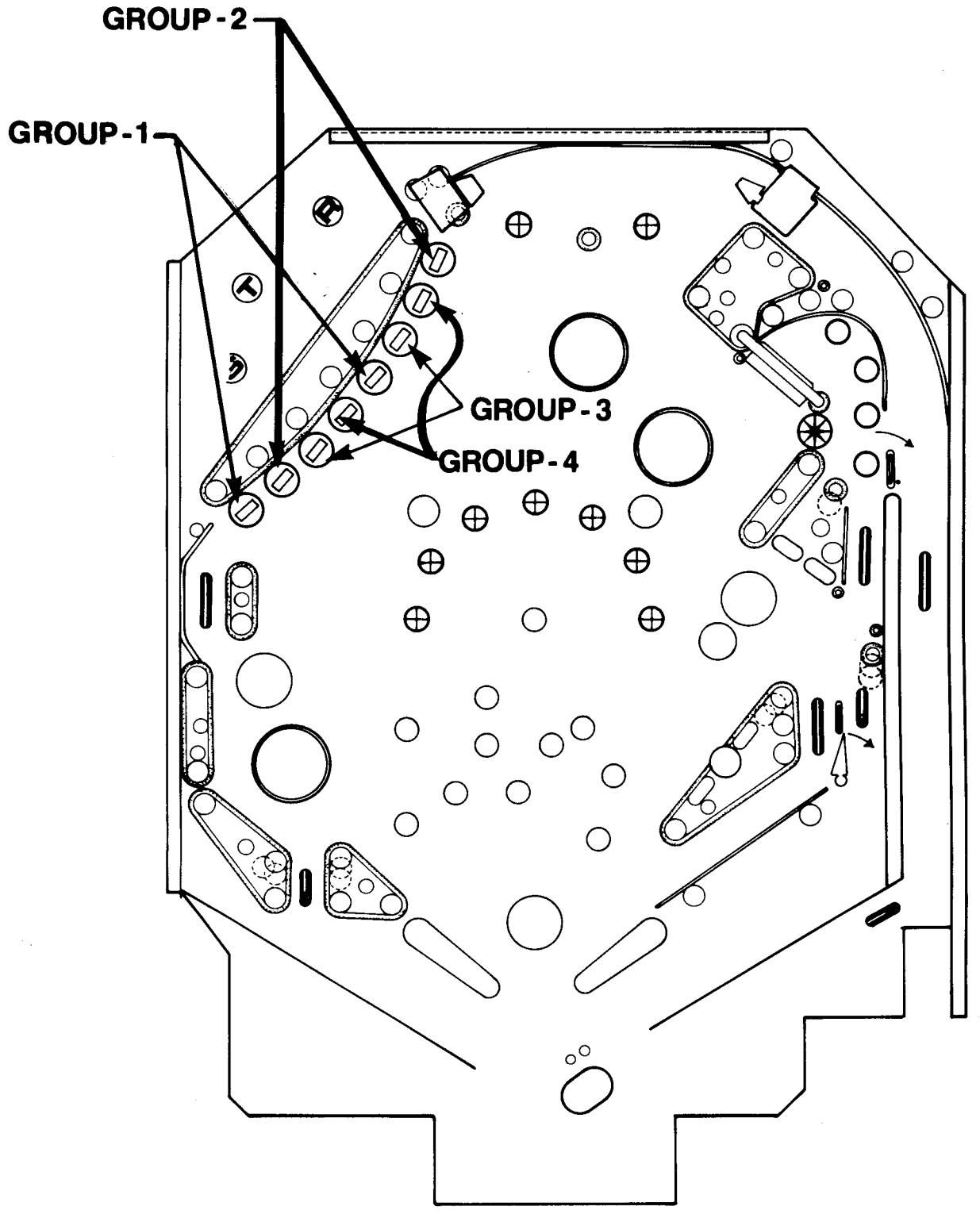
NOTE: It must be remembered that the point values discussed in this section pertain to the OPEN-BLADE switch only, and that the scoring values and actions of the microswitch are separate from this and will be discussed later in this section.

Aside from re-setting all Drop Targets at the beginning of each ball, or after one of the BONUS MULTIPLIER lamps are lit, various features on the Playfield will re-set individual groups of Drop Targets. These features are indicated on the Playfield by the word "RAISE" followed by a small star and circle of the color of the group to be re-set.

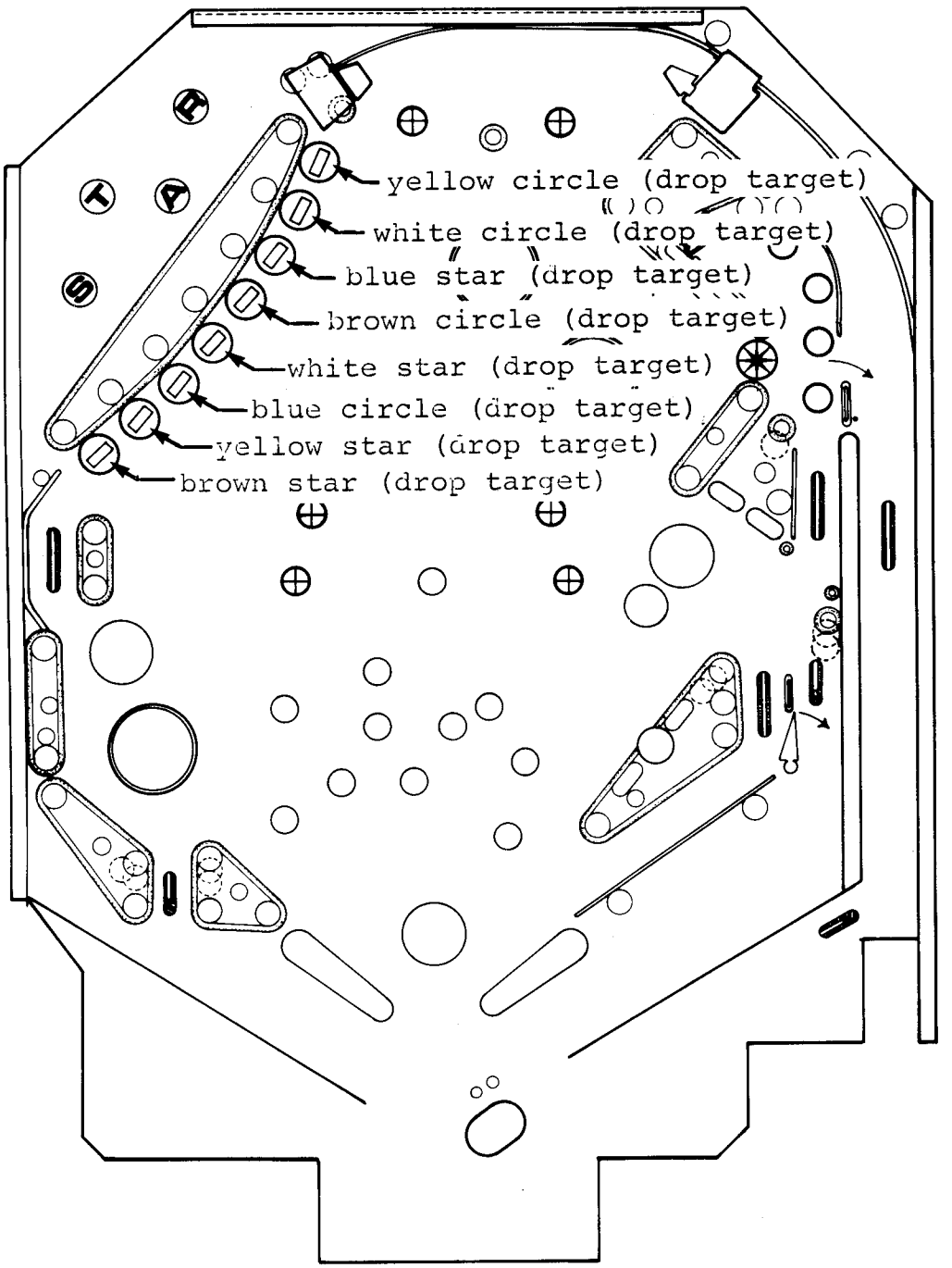
When any group or groups of targets are re-set, the above score or no-score action will be repeated. The test diagnostics number each open-blade switch runs as follows:

Targets 1 and 5	Switch No. 250
Targets 2 and 8	Switch No. 270
Targets 3 and 6	Switch No. 260
Targets 4 and 7	Switch No. 280

DROP TARGET GROUPS



DROP TARGETS



The other switch in each Drop Target mechanism is a MICROSWITCH. These are normally open switches which make contact while the target is 1/4 to 1/2-way down, and then open again as the target comes to rest flush with the Playfield.

The score values of these switches are indicated by labels on the face of each Drop Target. From bottom left to upper right, the microswitches score as follows:

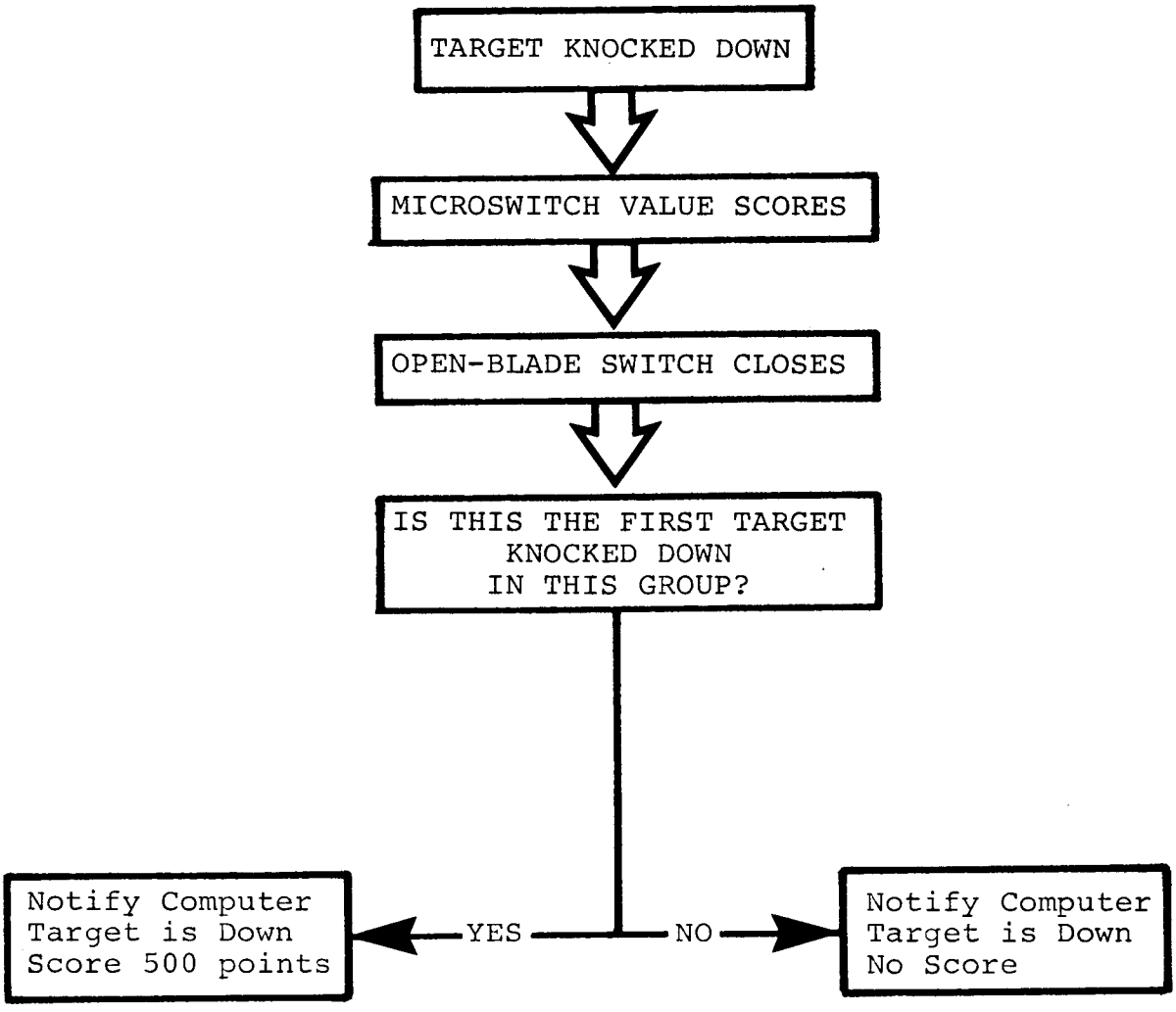
TARGET	TEST DIAGNOSTICS NUMBER	VALUE
First	190	Scores 10 points and closes FREE BALL GATE.
Second	210	Scores 500 points.
Third	170	Scores 500 points, advances BONUS, opens FREE BALL GATE, and raises Drop Targets 1 and 5.
Fourth	40	Advances BONUS and collects S-T-A-R value.
Fifth	50	Advances BONUS and collects ALLEY value.
Sixth	180	Scores 500 points, advances BONUS and raises Drop Targets 4 and 7.
Seventh	210	Scores 500 points.
Eighth	40	Advances BONUS and collects S-T-A-R value.

NOTE: In some cases, several targets can be knocked down simultaneously by the ball.

In such cases the LOGIC will only score the point values associated with the first switch activated.

When testing these switches, always knock the targets down ONE-AT-A-TIME.

j-2. Drop Target Scoring Sequence



k. Special Features

k-1. Alley Value and S-T-A-R Value

There is a set of 4 inserts, numbered "1" through "4", at the right side of the Playfield. These are the ALLEY VALUE lamps, and their location is named SPINNER ALLEY.

At the beginning of play of each ball, the insert numbered "1" is lit. Each time the Spinning Target switch closes, or an Amber Rollover button (marked "Change Alley Value") switch is activated, the lighted insert goes OUT, and the next insert in line lights.

When insert "4" is reached, the series starts over. When any Collect Alley Value switch is contacted, the player is awarded 1000, 2000, 3000 or 4000 points.

On the left side of the Playfield, behind the row of Drop Targets, are 4 plastic lamp shields which protrude through holes in the plastic. These are marked with the letters S-T-A-R ... one letter to each lamp shield. These relate to the Alley Value inserts on the right, with "S" being worth 1000, etc., up to "R" being worth 4000. These lamps change each time the lower left Thumper Bumper switch is contacted.

Whenever any "Collect S-T-A-R Value" switch is contacted, the player is awarded 1000, 2000, 3000 or 4000 points, and the "S" lamp comes ON to repeat the series.

k-2. Special Scoring

While the ball is in play, if BOTH the "4" Alley Value lamp and the "R" S-T-A-R Value lamp are ON at the same time, the SPECIAL WHEN LIT lamp comes ON.

If the target indicated by that lamp is hit while the lamp is ON, the player is awarded either one free game or one extra ball, depending on how the operator has set that adjustment on the Main Logic Board, and the two values return to "1" and "S".

k-3. Extra Ball When Lit

On each player's last ball (3rd or 5th depending on game adjustments), the EXTRA BALL WHEN LIT insert comes ON. This insert is located just above the lower left Thumper Bumper and indicates the 2-way Wire Rollover just above it.

If that switch is contacted while the Extra Ball When Lit insert is ON, the SAME PLAYER SHOOTS AGAIN lamp comes ON, and the player is awarded an extra ball (which he will receive immediately after the ball he was playing).

NOTE: Although the EXTRA BALL WHEN LIT insert stays lit after the extra ball is awarded, the player receives one extra ball per ball in play. The Logic does NOT accumulate extra balls.

k-4. Free Ball Gate

Play is extended by re-issue of a ball passed through the FREE BALL gate while the gate is open.

When any OPEN-GATE feature is contacted, the GATE OPEN WHEN LIT lamp comes ON, and the gate swings OPEN to guide any ball traveling down the right BALL EXIT ALLEY back to the Flipper.

When any CLOSE-GATE feature is contacted, and at the beginning of each ball, the gate returns to its upright (closed) position.

A diode in one lead of the GATE OPEN WHEN LIT lamp is switched to ground each time the gate coil is energized.

The lamp is not directly driven by the Computer Logic.

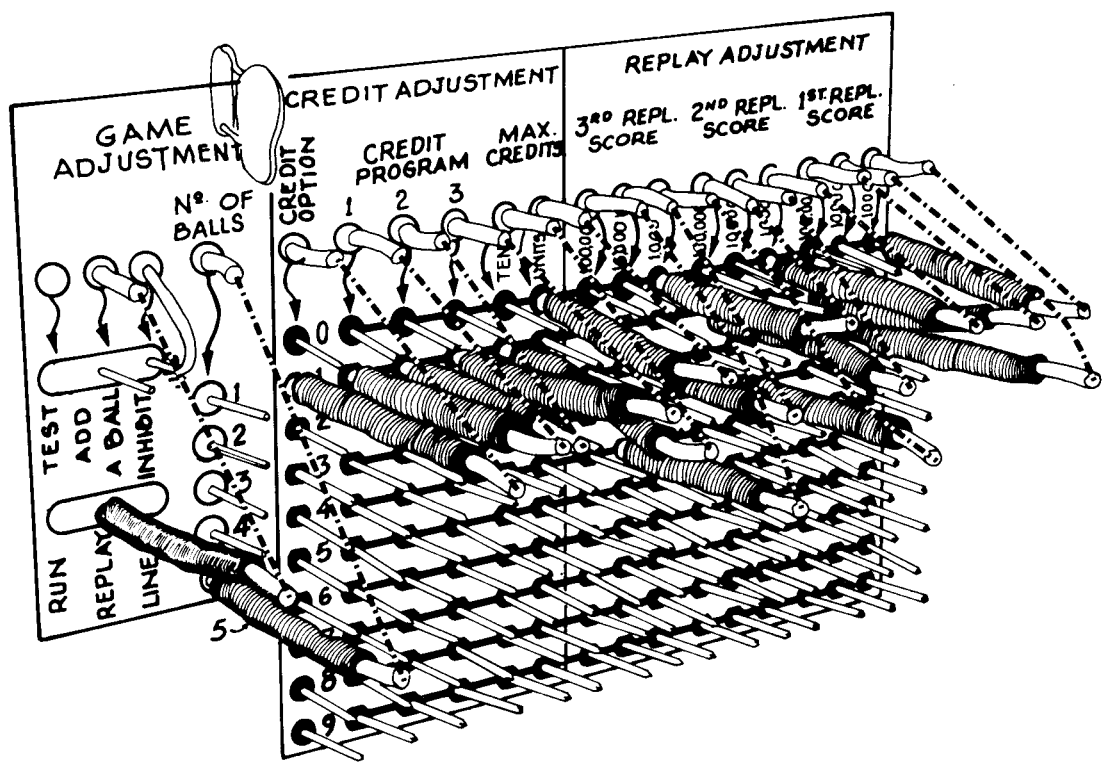
C. GAME ADJUSTMENTS AND OPTIONS

1. Standard Factory Adjustments

Several game adjustments and options are performed by moving jumpers on the Main Computer Board, including the number of balls per game.

IMPORTANT: Jumpers should never be handled by the wires. They should be grasped by the plastic housings and pulled gently from the pin.

(1) Run Test--No Jumper
(2) Replay/Add-A-Ball--Lower Pin
(3) Line-up Inhibit--No Jumper or Inhibit
(4) Number of Balls--5
(5) Credit Option--1
(6) Credit Program 1--1/coin switch #1 (left)
(7) Credit Program 2--1/coin switch #2 (right)
(8) Credit Program 3--1/coin switch #3 (middle)
(9) Max Credits Tens--1
(10) Max Credits Units--0
(11) 3rd Replay Score 100,000--1
(12) 3rd Replay Score 10,000--7
(13) 3rd Replay Score 1,000--4
(14) 2nd Replay Score 100,000--1
(15) 2nd Replay Score 10,000--6
(16) 2nd Replay Score 1,000--2
(17) 1st Replay Score 100,000--1
(18) 1st Replay Score 10,000--3
(19) 1st Replay Score 1,000--9



2. Main Computer Adjustment

Items 11-19: This example shows pin locations if Replay Scores were

139,000
162,000
174,000.

Actual pin locations will be set for replay scores noted on Shadow Box Top.

3. P. C. Board Adjustments

a. Replay/Add-A-Ball Selective

Prior to removing the Main Computer Board for game adjustments and options, the game MUST BE DISCONNECTED from electric power!

There is a jumper on the Main Computer Board for winning "Replay" or "Add-A-Ball". This option is programmed on the Main Computer Board by placing the jumper on the proper pin as indicated on the Computer Board. This jumper determines whether a Score Replay or Special gives an extra ball or a free game.

Example 1: With the jumper on lower pin labelled REPLAY, and with sufficient score, or by hitting the SPECIAL WHEN LIT Bull's-Eye Target while the lamp is ON, the player can win free games.

Example 2: With the jumper on the upper pin labelled ADD-A-BALL, no free games can be won. However, when the player hits the SPECIAL WHEN LIT Bull's-Eye Target while the lamp is ON, or with sufficient scores, extra balls can be won.

Example 3: If no extra balls are to be awarded on sufficient scores, put the ADD-A-BALL jumper on the upper pin. Then put all 9 jumpers on 0's on REPLAY adjustments, which automatically prevents the winning of free games.

(LINE-UP INHIBIT: This feature is not included on cocktail table games.)

b. Number of Balls Adjustment

This jumper determines the number of balls to be played per game. One to 5 balls can be selected by moving jumper to the correspondingly numbered pin.

c. Credit Options and Credit Programs

There are several credit options which determine the number of credits given by various combinations of the COIN SWITCH. Please note that the top pin of each row is a "0". Credit Option "0" is not used.

Example 1: With Credit Option on pin 1 and Credit Program 3 on pin 1, the coin activating switch #3 will give one game.

Example 2: With Credit Option on pin 1 and Credit Program 2 on pin 2, the coin-activating switch #2 will give 2 games, etc.

For 2 coins per credit, set the Credit Option jumper pin on "2". Also set all 3 Credit Programs on the same number. Each time 2 coins are inserted in succession, the computer will place on the credit display the number of credits as set by the Credit Program jumper pins.

Example 3: With Credit Option on pin 2 and Credit Programs 1, 2 and 3 on pin "3", each time 2 coins are inserted in succession, 3 credits will be placed on the credit display.

Credit Options 3 through 9 are not used.

> NOTE: Each time the coin switch is activated, one of the BONUS lamps on the Playfield will momentarily light indicating how many credits the computer is programmed to put up on the Credit Display.

d. Maximum Credits

These jumpers determine the maximum number of games that can be stored in the credit section. There is a "tens" program jumper and a "units" program jumper. Please note that the top of each column starts with a "0" pin.

Example 1: If the left jumper is on left row pin 1 and right jumper is on right row pin 0, then the credit section can store a maximum of ten free or paid games, or combination thereof.

Example 2: If the left jumper is on left row pin 0 and right jumper is on right row pin 5, then the credit section can store a maximum of 5 free or paid games, or combination thereof.

e. Replay Adjustment

There are 3 programmable winning score values. Each value has 100,000-, 10,000- and 1,000-point settings. Please note that the top pin in each column is a "0".

Example: If a value of 76,000 was desired as one of the replays, the 100,000 jumper would be on pin 0 ... the 10,000 jumper would be on pin 7 ... and the 1,000 jumper would be on pin 6.

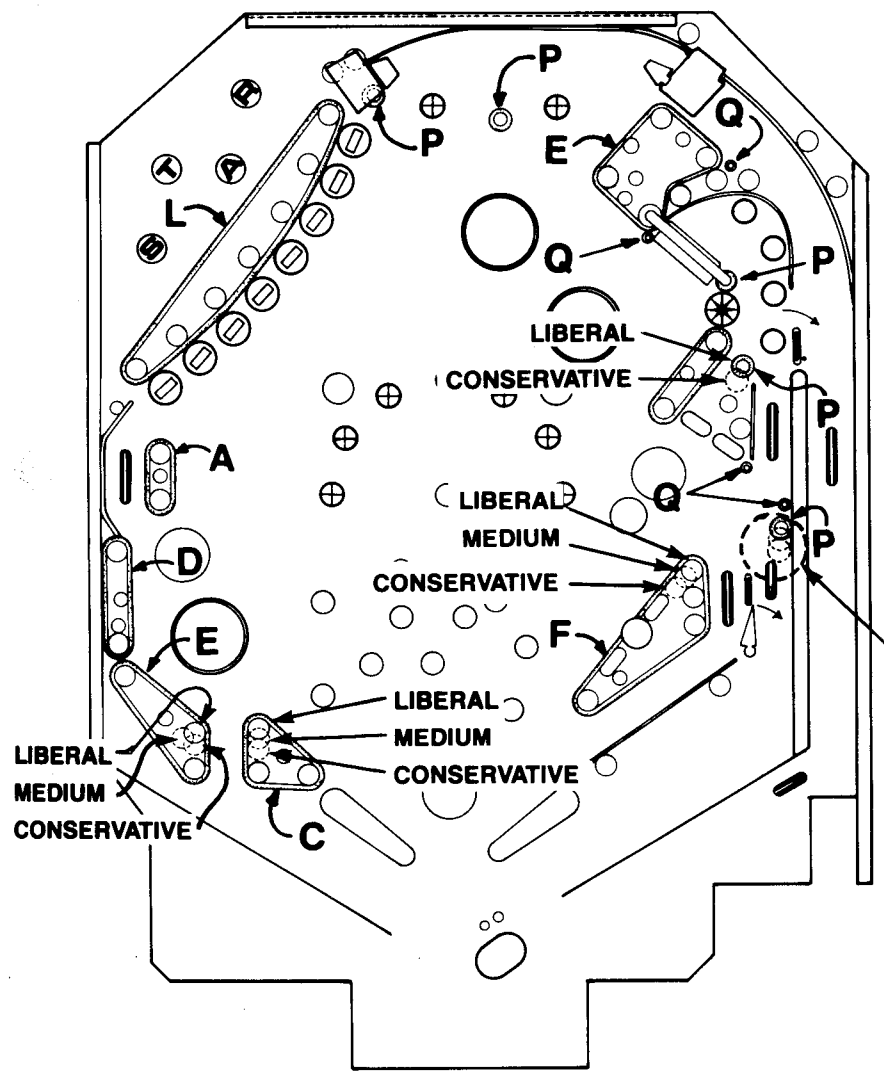
NOTE: Scores will average lower for 3-ball games.

The second replay score must be set higher than the first, and the third replay score must be set higher than the second. Differences of scores should be at least 20,000 in accordance with example, and might be even greater, depending on abilities of players to win free games. ONLY THREE FREE GAMES can be won with sufficient scores.

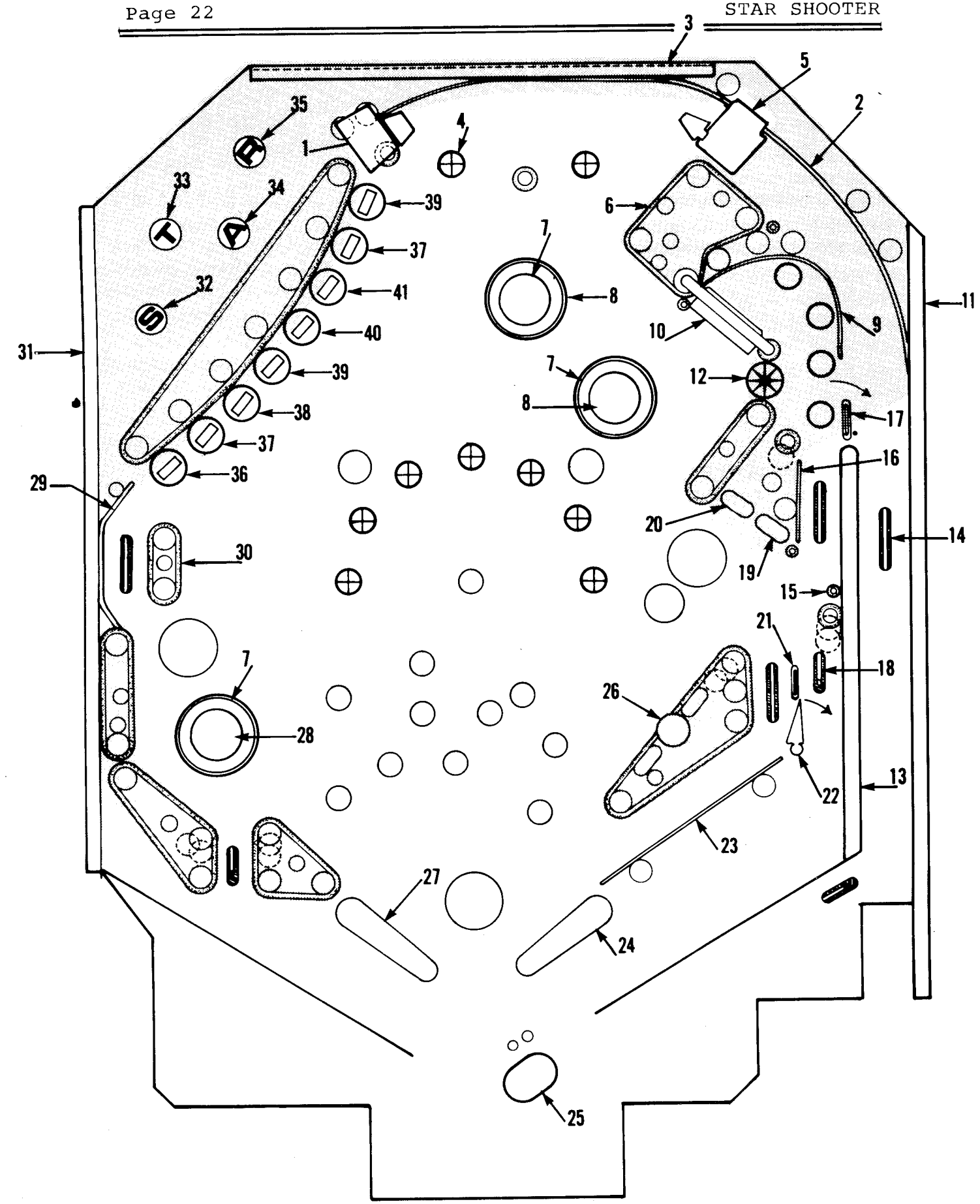
NOTE: If free games are allowed, the rule of thumb is that 20% free games will invite more play. If the game counter indicates that 500 games have been played since the last collection of coins, and there are approximately 400 coins in cash box, players are winning approximately 20% of total games played.

If there are too many or too few free games based on this count, adjust the REPLAY ADJUSTMENT jumpers accordingly. An OPTIONAL REPLAY COUNTER is available with complete installation procedure.

f. Adjustable Posts and Rubber Ring Sizes



Code	Size	Part Number
A	1"	264-8-29
C	1½"	264-8-103
D	2"	264-8-104
E	2½"	264-8-31
F	3"	264-8-32
L	6"	264-8-36
P	3/8"	264-8-100
Q	#33 mini post	264-8-101



4. Playfield Parts List Locations

Parts List:

Location	Description	Part Number
1	Ball Entrance Gate, Left (short)	292-1-6
2	Wireform, #13 3/16" diameter	336-08-1700
3	Playfield End Bracket	336-03-0200
4	Amber Rollover Button Assembly	324-70-0100
5	Ball Entrance Gate, Right	336-08-1200
6	Rail Switch Assembly #1	336-01-3500
7	Thumper Bumper Assembly (w/o cap)	336-10-1300
8	Bumper Cap #1 (red)	336-06-3200
9	Wireform #8	324-08-0100
10	Spinning Flag Assembly with decal	336-08-0800
11	Side Rail #9	336-04-0400
12	Star Button Insert	315-8-6
13	Side Rail #7	336-04-0200
14	Wire Rollover Switch with bracket	235-1-49
15	Mini-post Screw	10430001
16	Wireform #7	292-8-2
17	Ball Guide Rail 1½" long with pins	336-01-2800
18	1-way Wire Rollover Assembly	336-01-1000
19	Round Bull's-Eye Target Assembly with Golden Yellow Face	336-01-0800
20	Round Bull's-Eye Target Assembly with Cardinal Red Face	336-01-0900
21	Ball Guide Rail 1" long with pins	336-01-2900
22	Flag Gate Assembly with Flag	336-10-1500
23	Wireform #12	336-08-1600

(Continued--)

Parts List (continued):

Location	Description	Part Number
24	Flipper Assembly, Right with decal	336-01-2000
25	Out-Hole Kicker Assembly with 18 ohm coil	336-01-3300
26	Rebound Kicker Assembly #2	336-01-1900
27	Flipper Assembly, Left with decal	336-01-2000
28	Bumper Cap #1 (yellow)	336-06-3300
29	Ball Guide Bracket #5	336-03-0100
30	Single Flange, 1½" (red)	264-8-2005
31	Side Rail #3 with Ball Guide #5 mounted	336-01-1100
32	Lamp Shield, "S"	336-06-2900
33	Lamp Shield, "T"	336-06-2800
34	Lamp Shield, "A"	336-06-2700
35	Lamp Shield, "R"	336-06-2600
36	Drop Target Assembly with decal "10-Close Gate"	336-10-0100
37	Drop Target Assembly with decal "500 Points"	336-10-0200
38	Drop Target Assembly (yellow paddle with decal "Raise (star + circle) Open Gate"	336-10-2100
39	Drop Target Assembly with decal "S-T-A-R VALUE"	336-10-0400
40	Drop Target Assembly with decal "ALLEY VALUE"	336-10-2500
41	Drop Target Assembly (yellow paddle) "Raise (star + circle)"	336-10-2200
42	Standoff	247-2-76

5. Slam Switch and Tilt Mechanisms

a. The SLAM SWITCH, which is located on the inside of the COIN DOOR, is designed to discourage unnecessary abuse to the game. Slamming the machine results in loss of game or games. The machine simply goes DEAD! A short delay occurs, after which the GAME OVER lamp flashes indicating the end of game or games, whichever is being played.

The Slam Switch is factory adjusted to approximately 1/16" gap between contacts. Decreasing the gap will make the switch more sensitive. Opening the gap will reduce sensitivity. The customer will adjust the weighted blade to attain the desired sensitivity.

b. The TILT mechanism is designed to discourage the player from jolting or lifting the machine in an attempt to prolong play. Tilting the game causes the Flippers to go dead. The Thumper Bumper and the Rebound Kicker lights go OUT. The Flipper switches cannot be activated. The TILT lamp, located on the Score Glass assembly, flashes. If one person is playing, the ball in play will advance. If two persons are playing, it will move to the next player. The Out-Hole Kicker will propel the ball into the Shooter Alley, then the game returns to NORMAL. (The net effect of tilting the game is loss of a ball to the player who did the tilting.) The game will not tilt until the ball rolls over the BALL-IN-PLAY switch.

b-1. The TILT mechanism consists of one electrical circuit which can be activated by either of two mechanical assemblies. The first assembly is called the ROLL-TILT, and is activated when the front of the machine is lifted, allowing the ball to roll down the bracket until it touches the ROLL-TILT switch. It can be adjusted by loosening the appropriate screws in the Roll-Tilt bracket. Then slide the end of the bracket, which is closest to the switch, UP to decrease sensitivity, and DOWN to increase sensitivity.

b-2. The other TILT assembly is called the PENDULUM TILT, and is activated when the machine is jolted, thereby causing the weight to touch the Pendulum bracket. Sensitivity can be decreased by sliding the weight and the clip UPWARD on the Pendulum Rod. Similarly, sensitivity can be increased by sliding the weight and the clip DOWNWARD on the Pendulum Rod.

Make sure that the Pendulum Rod and the Pendulum Weight are ALWAYS centered. If necessary, adjust the Pendulum bracket by loosening screws that attach the Pendulum bracket.

6. Drop Target Microswitch Adjustments

NOTE: Under normal working conditions, the Drop Target microswitch should never need to be adjusted. Procedures are provided here for those special cases where adjustment might become necessary.

Each Drop Target assembly has a microswitch mounted on its main bracket so that in its travel downward the Drop Target guide pin pushes the switch activator closed, and then allows the switch to open again. The microswitch is delicate at the point where the activator arm is attached. Should this switch fail to close when the target falls, or remain closed, it will be necessary to adjust the switch activator arm. The procedure is as follows:

a. Remove the Drop Target assembly from the Playfield.

b. Provide support to the housing by grasping the plastic with your fingers. (This will prevent the arm from breaking the housing where the arm mounts on the switch.)

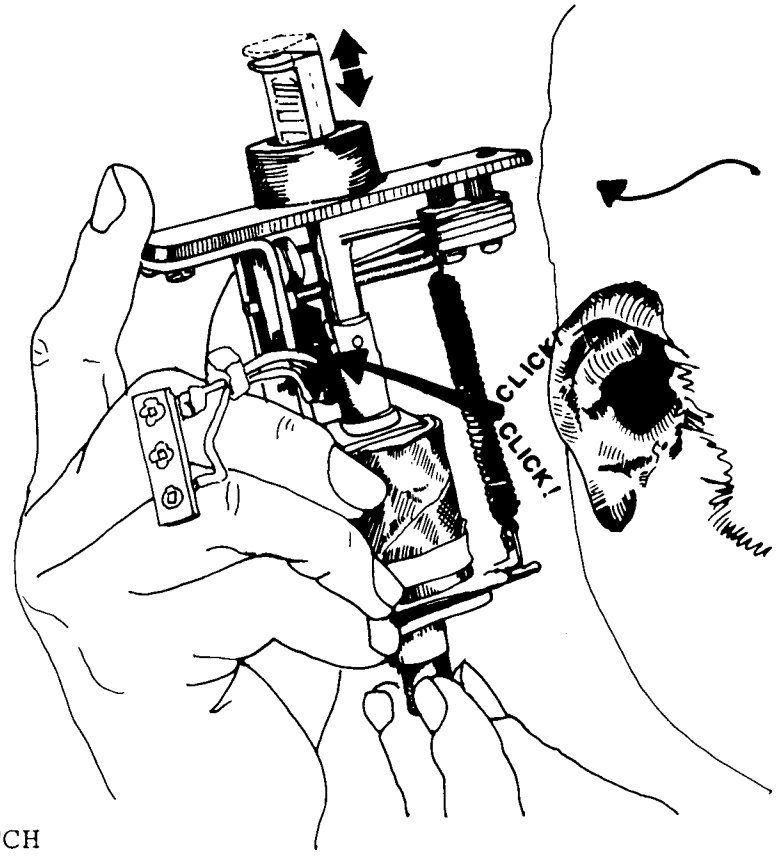
c. If the switch fails to close, bend the activator arm OUTWARD slightly. Check this action by manually raising and lowering the target paddle.

d. If the switch fails to open, bend the activator arm INWARD slightly. Check this action by manually raising and lowering the target paddle.

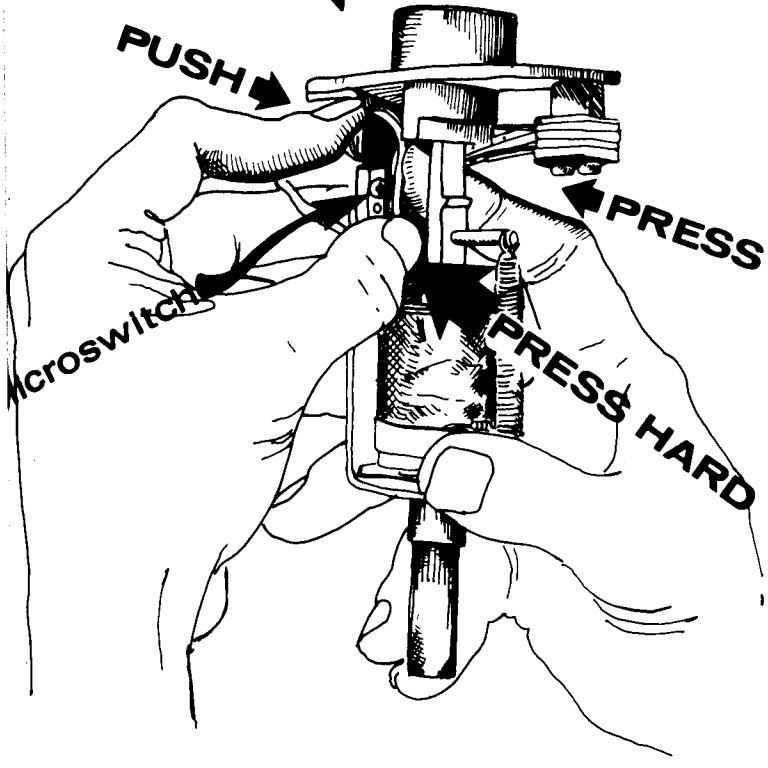
Retard the solenoid plunger so that the paddle retracts very slowly. Two "clicks" will be heard from the microswitch. The first will occur before the paddle is half-way down, caused by the switch making contact. The second will be heard after the paddle is past the half-way point, caused by the switch breaking contact.

(This switch action can also be tested with the Drop Target assembly in place by placing the game in TEST MODE TWO, or by using a continuity tester at the switch terminals.)

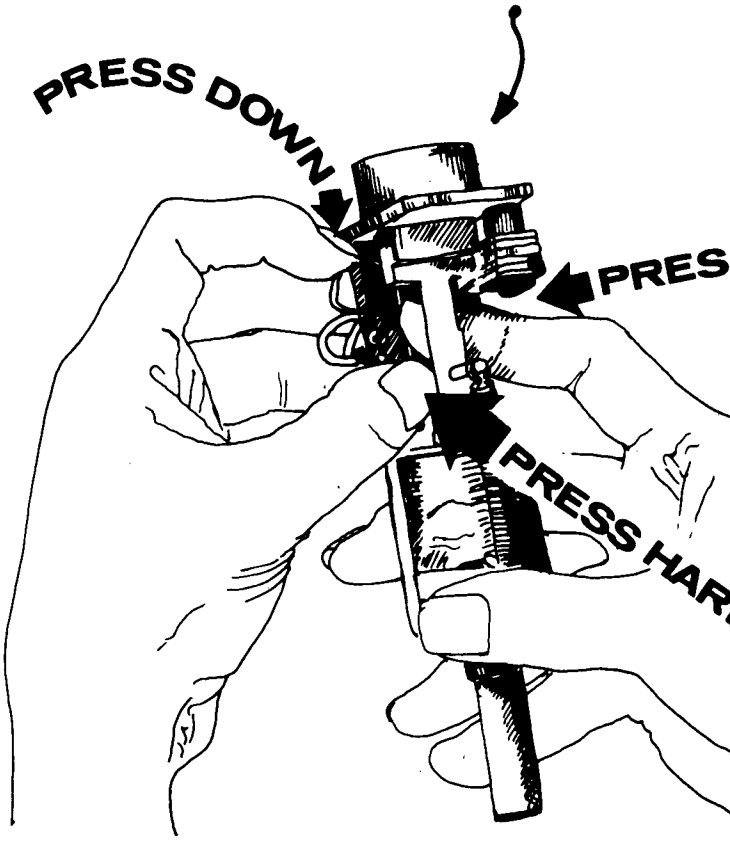
e. Replace the Drop Target assembly on the Playfield, being careful to return all wires to their correct connections and tightening all mounting screws snugly.



IF THE SWITCH
FAILS TO
CLOSE



IF THE SWITCH
FAILS TO OPEN

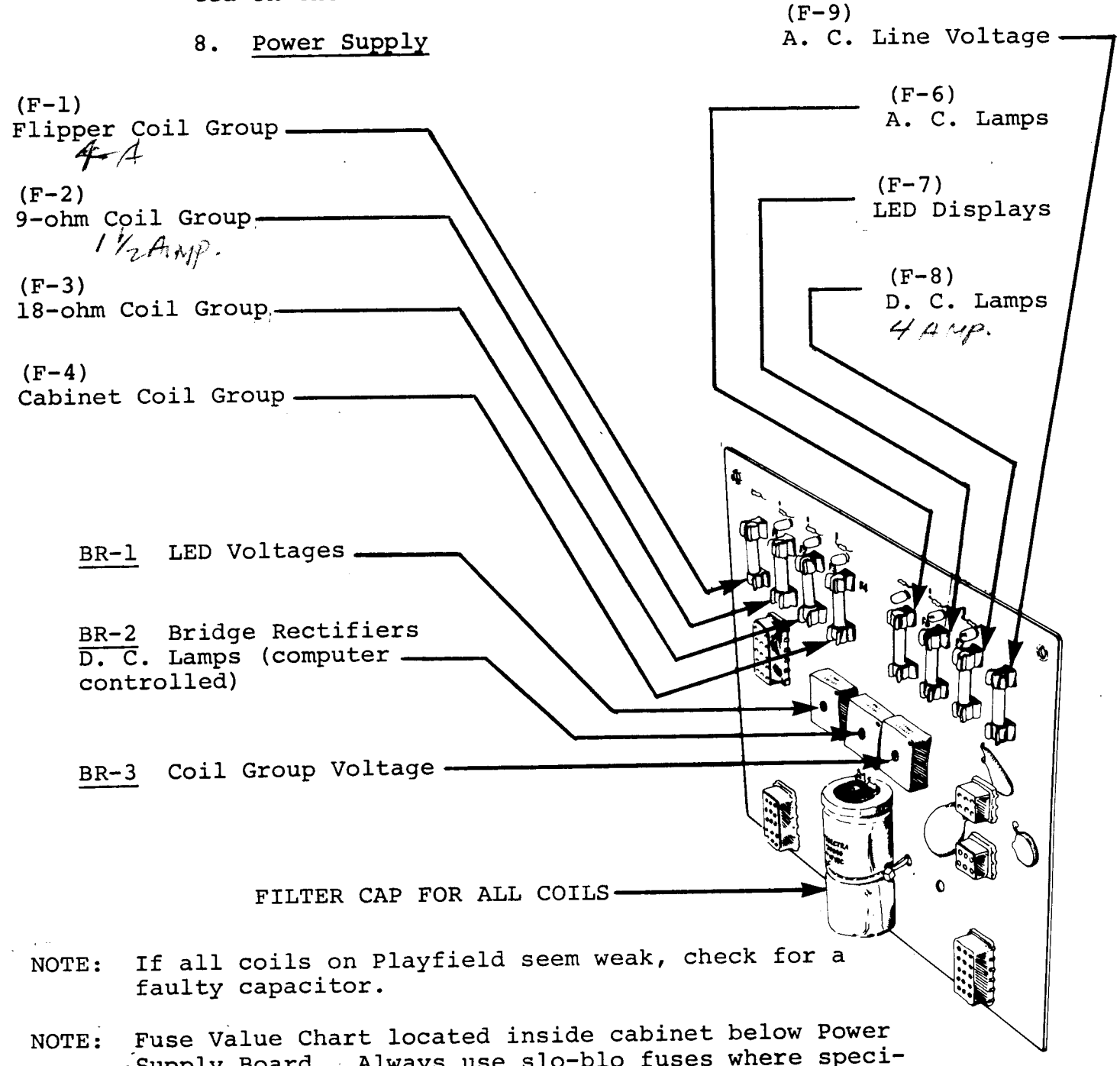


7. Solid State Sound

The STAR SHOOTER game includes a versatile solid state soundboard which will produce a variety of sounds for each 1000, 100 or 10 points scored.

This board is located below the Tilt assembly. The loudness is adjustable by turning the potentiometer located on the board itself.

8. Power Supply



NOTE: If all coils on Playfield seem weak, check for a faulty capacitor.

NOTE: Fuse Value Chart located inside cabinet below Power Supply Board. Always use slo-blo fuses where specified. (Fast-blows used as a substitute will blow prematurely.)

D. ROUTINE MAINTENANCE ON LOCATION

1. Re-Set Signal Test

The Re-Set Circuit guarantees that the system will start up in a known state upon the application of power or during an intense static discharge lightning.

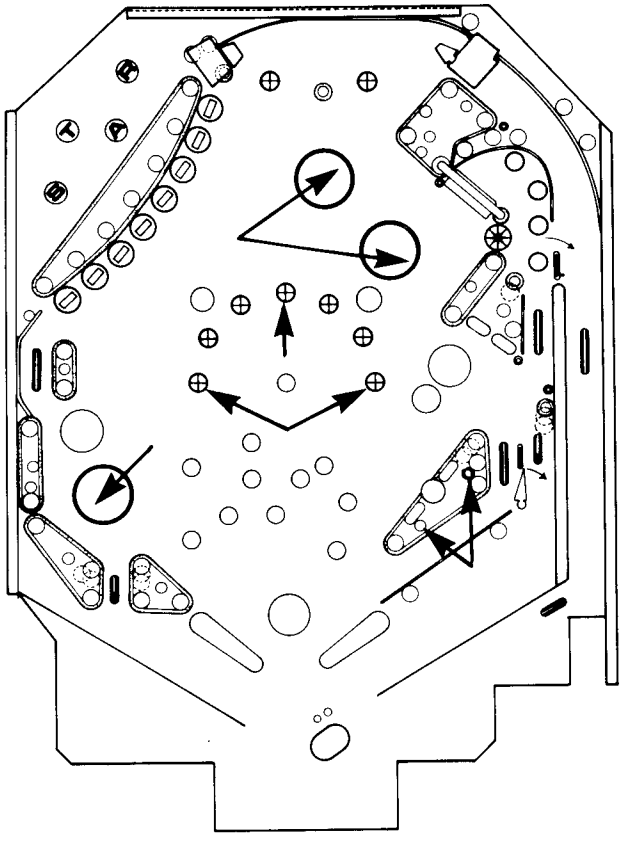
Turn the power OFF, then ON. Until 2 seconds after power is re-applied, observe the following:

a. Score displays are extinguished.
b. FREE GAME credit display may show erroneous data.
c. All D. C. flasher lamps are OFF.
d. SAME PLAYER SHOOTS AGAIN lamp is ON.
e. GAME OVER lamp is OFF.

After the 2 seconds have expired, observe the following:

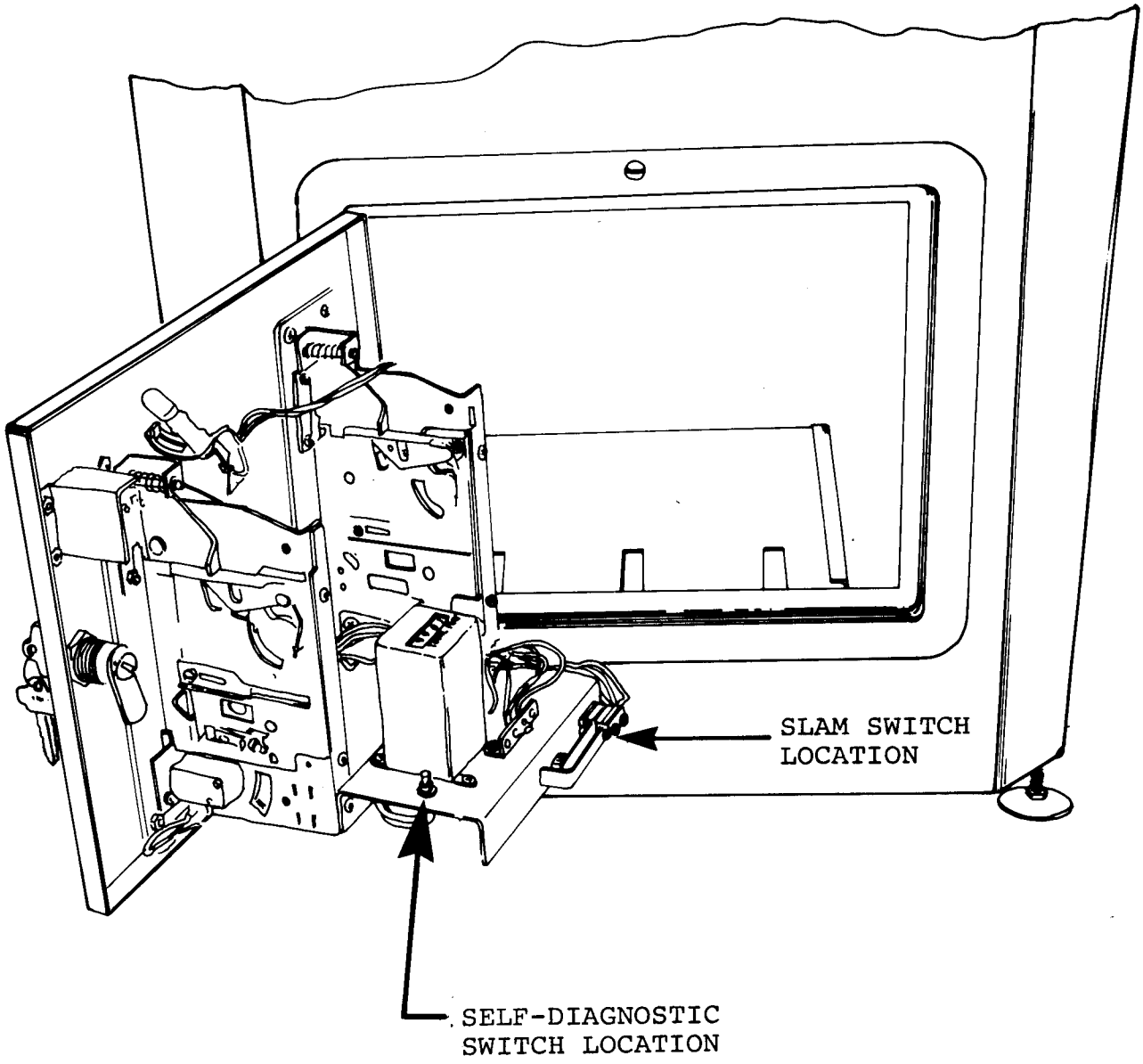
a. SCORE displays light and re-set to all zeroes.
b. FREE GAME credit display lamps light and re-set to double zero.
c. GAME OVER lamp flashes.
d. D. C. flasher lamps are ON.
e. SAME PLAYER SHOOTS AGAIN lamp goes OFF.
f. No COILS (solenoids) will energize at this time.

2. D. C. Flasher Lamps



These are the computer-controlled lamps, which flash while the BONUS is counting, but will go OUT if the game is tilted.

3. Self-Diagnostic Switch

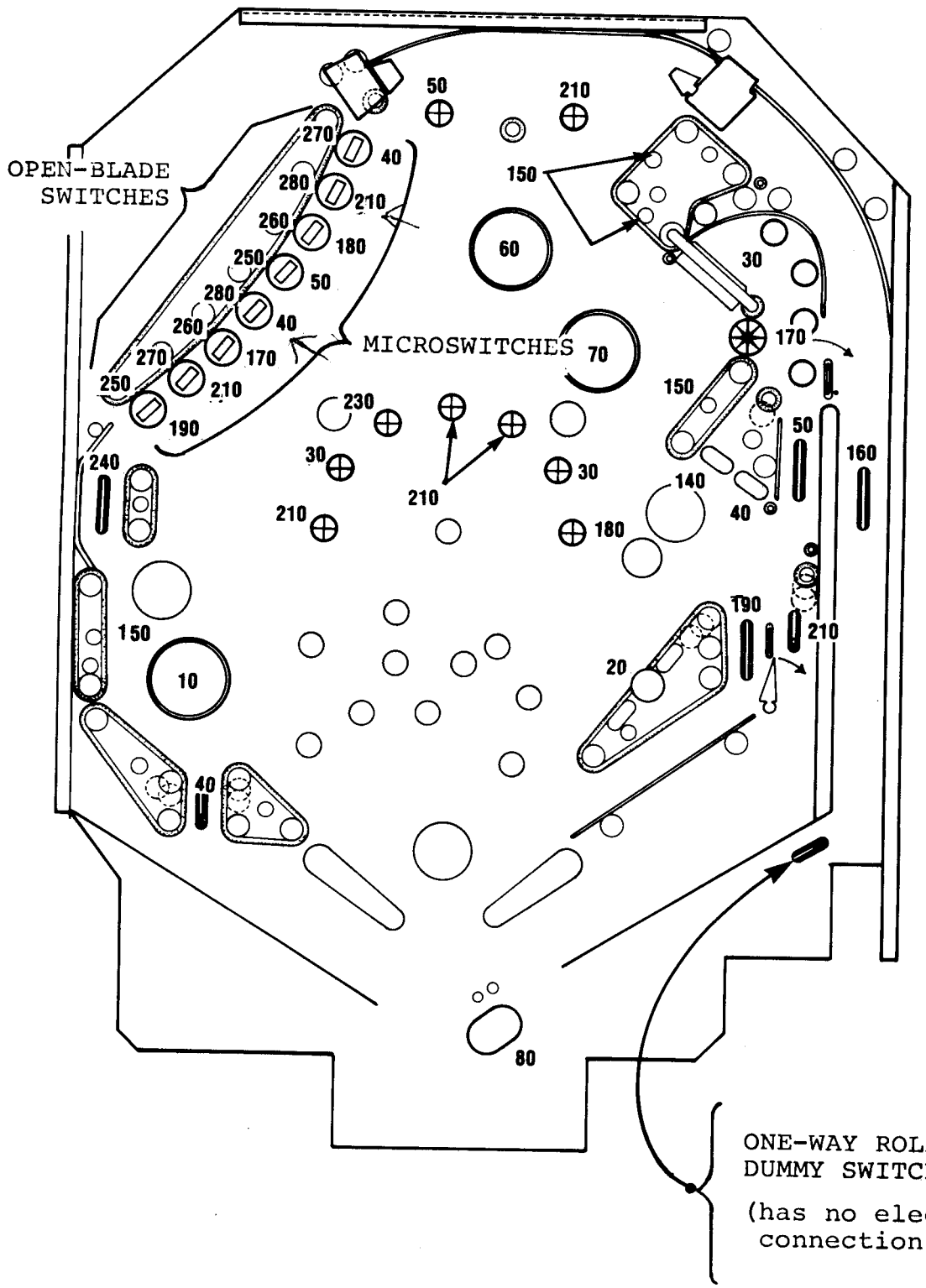


a. Switch Identification Numbers

Switch No.	Value	Number of Times Used
10	Thumper Bumper (100 points), change S-T-A-R value	1
20	Rebound Kicker (100 points)	1
30	Change Alley Value (100 points)	3
40	Collect S-T-A-R value, advance BONUS	4
50	Collect Alley Value, advance BONUS	3
60	Thumper Bumper (10 points)	1
70	Thumper Bumper (10 points)	1
80	Out-Hole Kicker, collect BONUS Value	1
140	Special When Lit (500 points) advance BONUS	1
150	Rail Switches (10 points)	4
160	Ball-in-Play switch (no point value)	1
170	Raise Drop Targets 1 and 5 (500 points), advance BONUS, open Gate	2
180	Raise Drop Targets 4 and 7 (500 points), advance BONUS	2
190	Close Gate (10 points)	2
210	(500 points)	6
230	Raise Drop Targets 3 and 6 (500 points)	1
240	Extra Ball When Lit (1000 points) advance BONUS	1
250	Drop Target DOWN switch for Targets 1 and 5 (500 points)	2

(Continued--)

Switch No.	Value	Number of Times Used
260	Drop Target DOWN switch for Targets 2 and 8 (500 points)	2
270	Drop Target DOWN switch for Targets 3 and 6 (500 points)	2
280	Drop Target Down switch for Targets 4 and 7 (500 points)	2
310	Tilt Switches (Pendulum and Roll Tilts)	2
320	Credit Switch	1
330	Slam Switch (on Coin Door)	1
340	Coin Switch #1 (left)	1
350	Coin Switch #2 (right)	1
360	Coin Switch #3 (optional)	1


OPEN-BLADE SWITCHES
MICROSWITCHES
50
210
270
40
280
210
150
260
180
60
250
50
30
280
260
40
170
270
170
250
210
70
150
230
190
50
160
30
30
240
140
210
210
180
40
T90
150
210
10
20
40
80
ONE-WAY ROLLOVER DUMMY SWITCH
(has no electrical connection)

b. TEST MODE ONE (Credit & Score LED's)

To initiate this test, remove the ball from the Out-Hole, raise all Drop Targets, then press the Self-Diagnostic switch. Both SCORE and CREDIT displays should sequence from 0 through 9, then repeat. The first digit on the right side of all SCORE displays will always be zero.

c. TEST MODE TWO (Stuck Switch & Switch Verification Test)

Press CREDIT button for 5 seconds, then observe:

(1) Game credit display shows "02".
(2) Left side score display will show the number of switch that is closed.

Then momentarily press each switch to verify recognition by the computer. The switch number will be displayed on Score Display #1. The game will not progress to the next test mode if the SCORE display shows that any switch is stuck in the closed position.

d. TEST MODE THREE (Vibration Test)

Press the test switch for 2 seconds. The game credit display should then show "03".

Tap very lightly the surface of the Playfield. If there are any switches not adjusted correctly (gap too close), the number of such switch will be displayed and latched in Score Unit #1. Make the necessary switch adjustments. To unlatch the number from the score display, press the GAME START button.

e. TEST MODE FOUR (Lamps Test "A")

Press the test switch for 2 seconds. The CREDIT display will show "04". Ignore any numbers on the SCORE display. The D. C. flasher lamps will remain lit through this test. The following lamps also should be lit:

(a) EXTRA BALL WHEN LIT.
(b) Alley Value 1, 2, 3 and 4.
(c) Star Value #1.
(d) SPECIAL WHEN LIT.
(e) EXTRA BALL WHEN LIT.

Ignore the GAME OVER lamp.

f. TEST MODE FIVE (Lamps Test "B")

Press the GAME START button for 2 seconds. The CREDIT display will show "05". Then observe that these lamps are lit:

(a) S-T-A-R value 1, 2, 3 and 4.
(b) 10,000 BONUS lamp, DOUBLE BONUS lamp and TRIPLE BONUS lamp.

The D. C. flasher lamps are out during this test.

g. TEST MODE SIX (D. C. Flasher Lamps)

Press the CREDIT button for 2 seconds. The CREDIT display will show "06". SAME PLAYER SHOOTS AGAIN lamp will be lit. The D. C. flasher lamps come on at this time.

h. TEST MODE SEVEN (Score Displays)

Press the CREDIT button for 2 seconds. The CREDIT display will show "07" and all score displays go dark.

i. TEST MODE EIGHT (Lamps Test "C")

Press the CREDIT button for 2 seconds. The CREDIT display will show "08" ... then observe:

(a) The BONUS lamps count down from 9,000 to 1,000. (The 10,000 lamp was tested in MODE FIVE.)
(b) The GAME OVER lamp flashes after the 1,000 BONUS lamp.

NOTE: There are two GAME OVER lamps: one on the Shadow Box, and the other on the Playfield below the two Bull's-Eye Targets. This one serves as an attraction feature only.

j. TEST MODE NINE (Coils and Sound Test)

Press the CREDIT button for 5 seconds. The CREDIT display will show "09". Ignore the score displays during this test. The coils (solenoids) should energize in the following sequence:

(a) Bottom left Thumper Bumper and Drop Targets 1 and 5.
(b) Rebound Kicker and Drop Targets 2 and 8.
(c) Drop Targets 3 and 6.
(d) Drop Targets 4 and 7.
(e) Left Thumper Bumper.
(f) Right Thumper Bumper.
(g) Out-Hole Kicker.
(h) 1,000-point sound (low tone).
(i) 100-point sound (middle tone).
(j) 10-point sound (high tone).
(k) Replay Knocker.
(l) Free Ball (Flag) Gate and GATE OPEN WHEN LIT lamp lights.

(The Flipper buttons must be held IN for Flipper coils to energize immediately after Replay Knocker.)

k. TEST MODE TEN (Combination Test)

This test can be used as a method of testing a newly installed Logic Board.

Press the CREDIT button for 10 seconds. The CREDIT display should show "Oc".

E. TROUBLE SHOOTING GUIDE

1. General

Do not EXPERIMENT with any of the game mechanisms. Improper adjustment or makeshift repair will cause serious damage to other parts of the machine or repeated failure of the part. To properly service this machine in a minimum time, it is necessary to isolate any problem to a specific circuit. A system of logical elimination will reduce the number of possible trouble spots. The self-diagnostic tests built into this game are designed to locate and define common failures.

Attempting to play the game and observing the results will be helpful. Careful reasoning with reference to the schematic diagram usually reveals the cause of the problem. A visual inspection of the components in a suspected area will save time. Look for a possible loose wire, a bad connection at a plug or socket, or a broken or unhooked spring.

2. Re-Set Circuit

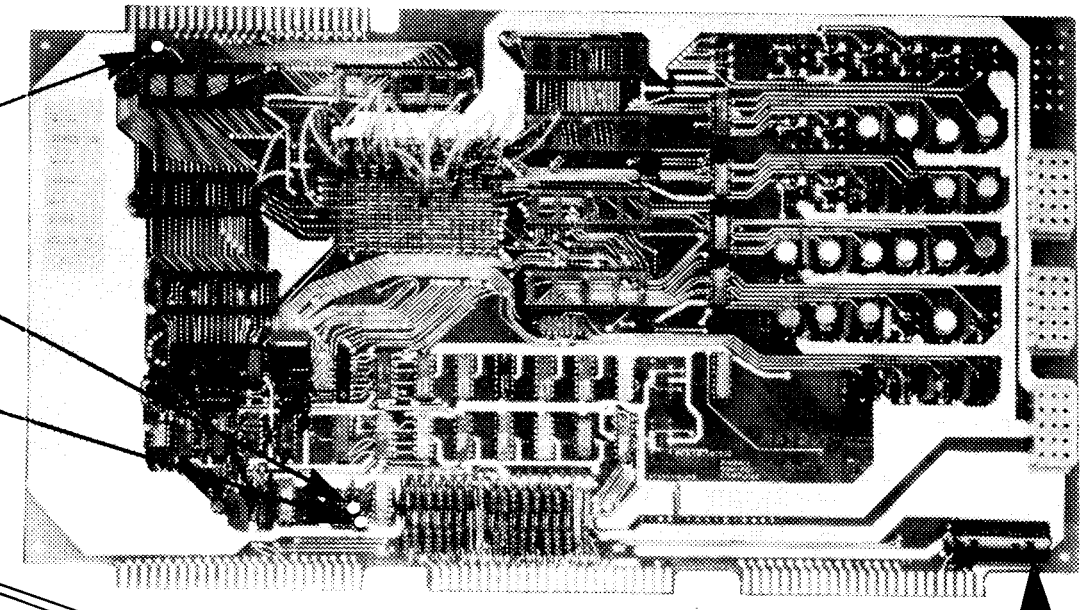
Upon application of power to the game, LED #1 on the Main Computer Board will light for approximately 2 seconds, then extinguish, thereby indicating a proper re-set condition.

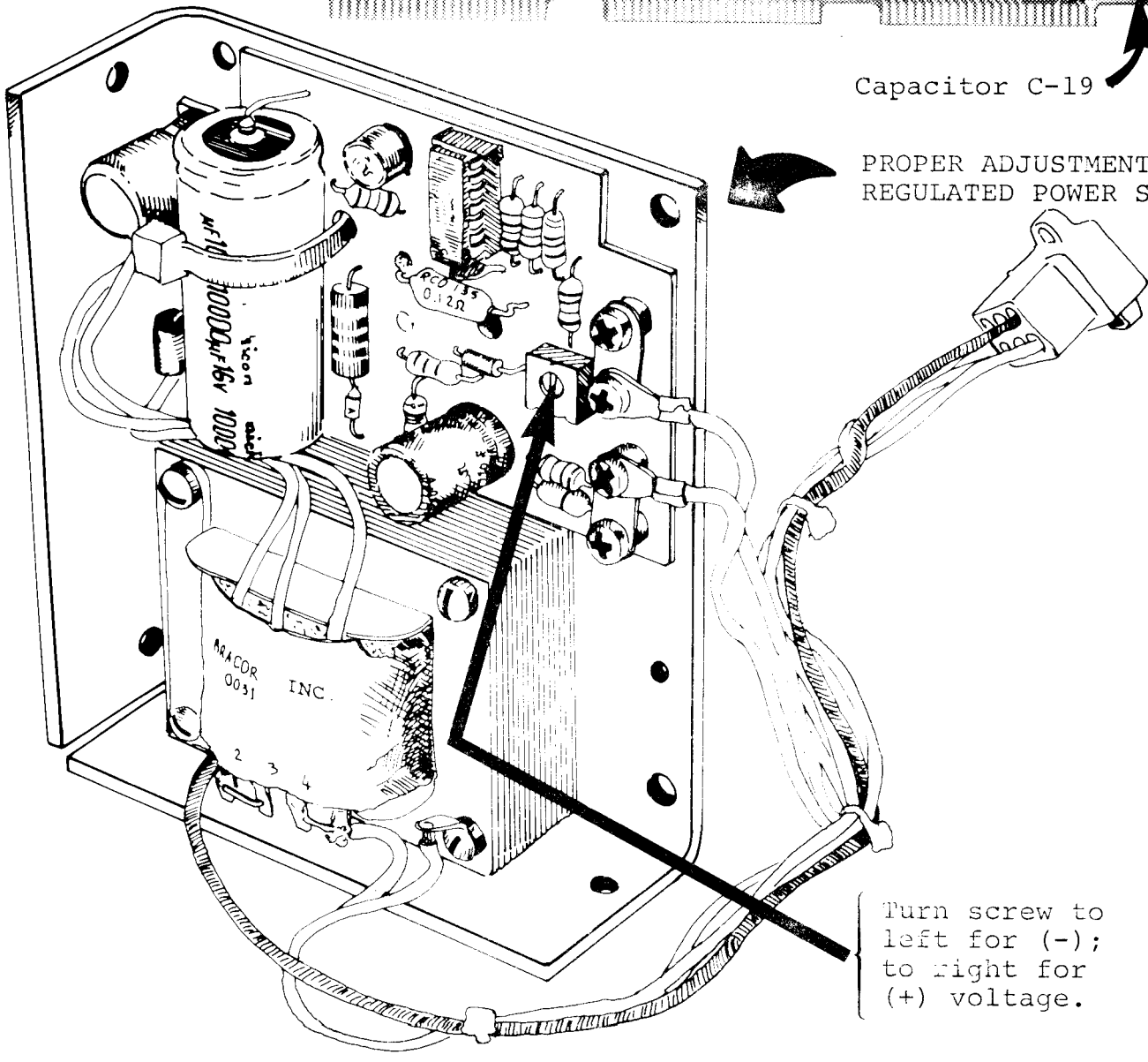
If this LED does not come ON, or remains ON, check the 5-V power supply. If the computer board has 5-V across C-19 (the large capacitor in the lower right-hand corner) and LED #1 is not functioning properly, then the malfunction is the re-set circuitry on the Main Board.

The 5-V power supply is used to supply regulated 5-V power to the computer board and the peripheral display boards. This circuit should regulate between 4.8 VDC and 5.2 VDC.

The 5-V should be measured across C-19, the 2200 mfd capacitor on the computer board.

3. Computer Control Logic Board Assembly No. 307-1-17





4. Displays

Disconnect power before removing or replacing any printed circuit board.

5. Score Display

Test for the proper score unit function using the Self-Diagnostic Test procedure. If failure of a score unit is suspected, it can be interchanged with another unit known to be good. The following signals are necessary to light the score display:

a. 4.8-5.2 VDC.
b. 7.8 VDC.
c. Proper score blanking (LED #4 on the Main Computer Board should be momentarily flashing).
d. Proper data from the Computer Board (LED #3 should be momentarily flashing).
e. Proper score clock signal.

A quick way to check for score blanking is to check LED #4 on the Main Computer Board. LED #4 should be ON during power re-set, and should momentarily blink whenever score unit #1 is updated or blanked out. If you are uncertain about whether the problem of the score units being continually extinguished is due to a bad blanking signal, perform the following:

a. Remove game power.
b. Complete remove the Computer Board.
c. Re-apply game power. If the Score Unit now lights, then the faulty blanking signal is due to a bad Computer Board.

6. Credit Display

The operation of the Credit Display Board is identical to that of the SCORE unit with the exception that the CREDIT unit does not require a blanking signal.

7. Lamps

The background lamps, such as ENTRANCE GATE lamps, with the exception of the D. C. flasher lamps, are in normal circuit operation on 5.8 VAC as shown on the schematic.

All lamps tested in the self-diagnostic mode are driven from the Main Computer Board. All of these lamps have one side tied to +7.8 VDC. The other side of each lamp is switched by the Computer Board to System Ground.

If, during the self-diagnostics, a lamp malfunctions, the socket should be checked with a lamp known to be good. If none of the lamps light during the self-diagnostics test, then trouble-shoot the +7.8 VDC power supply.

If the Main Computer Board is suspected, a quick test to check the continuity of a lamp circuit is as follows:

a. Remove game power.
b. Completely remove the Main Computer Board.
c. Re-apply game power.

IMPORTANT: The function which the Computer Board performs when turning on a lamp is to supply system ground. Thus, if you take a jumper from system ground to the output pin from the Computer Board which connects to the lamp, the lamp should light if the harness and power supply are working properly.

CAUTION: Do NOT do this with the Computer Board connected!

Refer to the game schematic to get proper pin connections. If the suspected circuit functions properly, then the fault is on the Computer Board. The GAME OVER, TILT and D. C. flasher lamps all have one side tied to +7.8 VDC. The other side of the lamp is switched to system ground through a circuit similar to that which drives the coils. If suspected, these lamps can be tested in the same manner as above.

8. Coils

All of the coils in the game (including the Flipper power relay located on the ROLL-TILT assembly) have one side tied to +32 VDC. The computer board switches these coils to system ground to complete the circuit, thus energizing the coil.

If a coil driver on the Computer Board is suspected, a quick test of the remaining circuitry is performed as follows:

a. Remove system power.
b. Completely remove Main Computer Board.
c. Re-apply power.

REMEMBER: The only function the Computer Board performs when turning on a coil is to supply system ground. Thus, if you take a jumper from system ground to the output pin from the Computer Board which connects to the coil, the coil should energize if the circuit is working properly.

CAUTION: Do NOT do this unless the Computer Board has been completely removed from the game!

9. Switch Adjustments

Before cleaning or adjusting switch assemblies, remove POWER from the game.

All switch assemblies on the game contain basically the following: leaf springs, contacts, spacers and insulators. Some leaf springs have contacts and others do not. The leaf springs without contacts are the ones used for adjusting the separation between those that do, for which the SPECIAL CONTACT ADJUSTER must be used.

Before attempting to adjust a switch assembly, make sure that the screws used to hold the assembly to the mounting surface are tight. If not, tighten the screw closer to the contact first. This will prevent the assembly from being secured in a manner that would cause the leaf springs to fan out.

Unless instructed otherwise in this manual, contacts should be adjusted for approximately 1/16" in the OPEN position and 1/64" follow-through in the CLOSED position. The contacts are plated to resist corrosion, and, except for the Flipper Activator switches, should not be filed or sanded. Such action would damage the finish, thereby causing corrosion. The contacts should be dry and free of dust and dirt. The proper way to clean the contacts is by placing an absorbent piece of paper between them, close them, and then gently slide out the paper. This may

(Continued--)

be repeated if necessary until the contacts are clean. Tarnish on the Flipper Activator switches can be removèd with a contact file followed by a burnishing tool.

All contacts should be cleaned or adjusted ONLY when they are found to be the source of game malfunction. If a switch is suspected of not performing its function, please refer to SELF-DIAGNOSTIC TEST MODE TWO to verify switch recognition by the Computer Board.

10. Contact Adjustment

The Contact Adjuster is vital for proper switch adjustment. However, improper or over-use of the tool can cause fatigue or eventual breakage of switch blades. Before attempting to adjust a switch, make sure that such adjustment is necessary by first going to SELF-DIAGNOSTIC TEST MODE TWO to determine whether or not the switch is being recognized by the Computer Board.

If the switch is NOT being recognized, clean the contacts and then repeat SELF-DIAGNOSTIC TEST MODE TWO. If the switch is still not recognized, then insert the Contact Adjuster. Apply only a small amount of pressure. It is very important not to over-bend the switch blade in the attempt to adjust it properly.

After the adjustment has been made, use SELF-DIAGNOSTIC TEST MODE TWO. When you are satisfied that the switch is recognized, proceed to SELF-DIAGNOSTIC TEST MODE THREE to verify that the contacts are not too close.

11. Flipper Switch Contact Adjustments

NOTE: Check the switch adjustments by energizing the Flipper push button on cabinet. Do not operate the Flipper by hand. FAILURE TO PROPERLY ADJUST THIS SWITCH MAY CAUSE THE COIL TO BURN OUT!

a. Open Position

Adjustment is proper when these contacts on the blades have a MINIMUM GAP of .035" and a MAXIMUM GAP of .065".

b. Closed Position

Adjustment is proper when the backer blade (thicker shorter blade with no contact) is vertical, and there is a MINIMUM GAP of .010" between the backer blade and the closer long blade having a contact.

F. SYMPTOMS AND SOLUTIONS

1. Reference Chart

PROBLEM DESCRIPTION	NO POWER FROM AC OUTLET	BLOWN FUSE	ELECTRICAL CONNECTION	SWITCH CONTACT ADJUSTMENT	MECHANICAL ADJUSTMENT	HARDWARE LOOSE OR BROKEN	FAILED ELECTRICAL PART	FAILED MECHANICAL PART	FAILED MAIN LOGIC	FAILED 5-V POWER SUPPLY
All lights out/nothing works	6	7	8							
One Push Button fails to operate Flippers			9,10	5						
Both Push Buttons fail to operate Flippers		7		5			12,11	9		
Lights on but machine does not operate		7							14	26
Flippers work poorly				5	24	17		25		
Rebound Kicker does not work		7	1	13			12			
Rebound Kicker works poorly				13	24	17		25		
Rollovers do not work			1	13					14	
Ball Out-Hole Kicker does not work		7	1	13			12		14	
Ball Out-Hole Kicker not strong enough					18	17			14	
Single Lamp out (Computer Control Lights)			1				15,16		14	
One Flipper weak				4				24		
Energizing Flipper blows fuse			1	4			3			
Energizing Thumper, Rebound Kicker, Out-Hole Kicker, Replay Knocker, etc. blows fuse							2,12			
Drop Target does not score			1	13						
1 Drop Target does not return			1	13	24	17	12			
"No Double Bonus" All Drop Targets do not return			1	13						
Thumper Bumper does not score			1	13						
Thumper Bumper action slow				13	24	17		25		
Thumper Bumper stays on and then shuts off for the rest of the game				13						

PROBLEM DESCRIPTION (Continued)	NO POWER FROM AC OUTLET	BLOWN FUSE	ELECTRICAL CONNECTION	SWITCH CONTACT ADJUSTMENT	MECHANICAL ADJUSTMENT	HARDWARE LOOSE OR BROKEN	FAILED ELECTRICAL PART	FAILED MECHANICAL PART	FAILED MAIN LOGIC	FAILED 5-V POWER SUPPLY
Thumper Bumper does not energize but scores			1				12		14	
Gate does not open				13					14	
Gate does not close			1	13			12			
500 & 1000 Pt. Targets do not work			1	13					14	
Replay Knocker does not sound			21				12	24	14	
Score does not stop flashing			1	13					14	
Does not give replay for high score			19		19				14	
Does not accept coin								17	14	
Credits do not count down to start new game			1	13					23	26
Gives wrong number of credits			19		19					26
Accepts coin but does not give credit			1		20		20		14	26
Credit display not lit		7								
Score Unit will not score			21				22			
Score Unit changes score intermittently			21				22			
Score Unit Display not lit			21						14	26
All Score Units not lit		7	21						14	26

2. Reference Numbered Solutions

1 When trouble-shooting a switch contact or electrical connection problem, begin by using TEST MODE TWO. In this way the machine itself will tell if it is seeing a switch closure. Check solder joints at each switch or lamp socket. Check each connector in a harness, making sure that it is firmly connected. Remove P. C. Board from game, and check for corrosion at each contact edge, especially that contact in series with the problem area.

If a switch gets stuck during game play, it may impair any or all other functions of the game. Do NOT mistake this for a bad connection in the other switches, but identify the stuck switch by using TEST MODE TWO.

2 A diode is located on each solenoid. If the diode is shorted, a fuse will blow when the solenoid is activated. Be careful to observe polarity when replacing the diode. Also check the computer board for a possible blown transistor.

3 Two diodes are located on each flipper coil. If either diode is shorted, a fuse will blow upon actuating the flipper. Replace both diodes, and be careful to observe polarity.

4 Located on each flipper assembly is a switch which should be CLOSED until the end of the flipper stroke. When the flipper reaches the top of its stroke, this switch opens to approximately 1/32". Clean contacts if necessary. Check all solder joints on flippers and terminal strip.

5 Flipper button should close contacts firmly. Clean and adjust the contacts.

6 The AC cord should be firmly inserted in the wall. Verify that wall outlet is good by connecting another appliance in its place.

7 Verify that all fuses in the power supply are good.

8 All connectors on the power supply should be firmly connected.

9 All connectors in harness should be firmly connected.

10 Check all solder connections on switch.

11 Check flipper power relay by using TEST MODE NINE. The relay should energize periodically. If it does not, and is good, the problem is in relay #1 or #12.

(Continued--)

PROBLEM DESCRIPTION (Continued)	NO POWER FROM AC OUTLET	BLOWN FUSE	ELECTRICAL CONNECTION	SWITCH CONTACT ADJUSTMENT	MECHANICAL ADJUSTMENT	HARDWARE LOOSE OR BROKEN	FAILED ELECTRICAL PART	FAILED MECHANICAL PART	FAILED MAIN LOGIC	FAILED 5-V POWER SUPPLY
Thumper Bumper does not energize but scores			1				12		14	
Gate does not open				13					14	
Gate does not close			1	13			12			
500 & 1000 Pt. Targets do not work			1	13					14	
Replay Knocker does not sound			21				12	24	14	
Score does not stop flashing			1	13					14	
Does not give replay for high score			19		19				14	
Does not accept coin								17	14	
Credits do not count down to start new game			1	13					23	26
Gives wrong number of credits			19		19					26
Accepts coin but does not give credit			1		20		20		14	26
Credit display not lit		7								
Score Unit will not score			21				22			
Score Unit changes score intermittently			21				22			
Score Unit Display not lit			21						14	26
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3 Two diodes are located on each flipper coil. If either diode is shorted, a fuse will blow upon actuating the flipper. Replace both diodes, and be careful to observe polarity.

4 Located on each flipper assembly is a switch which should be CLOSED until the end of the flipper stroke. When the flipper reaches the top of its stroke, this switch opens to approximately 1/32". Clean contacts if necessary. Check all solder joints on flippers and terminal strip.

5 Flipper button should close contacts firmly. Clean and adjust the contacts.

6 The AC cord should be firmly inserted in the wall. Verify that wall outlet is good by connecting another appliance in its place.

7 Verify that all fuses in the power supply are good.

8 All connectors on the power supply should be firmly connected.

9 All connectors in harness should be firmly connected.

10 Check all solder connections on switch.

11 Check flipper power relay by using TEST MODE NINE. The relay should energize periodically. If it does not, and is good, the problem is in relay #1 or #12.

(Continued--)

12 Located on the Main Logic Board is a group of coil drivers. All solenoids (except Flippers), flipper power relays, coin counter and one set of 4 DC lamps are activated by one of these drivers. Each driver is turned on as follows:

One line of an output port on an MOS IC connects to an inverter. When the line goes low, the inverter output goes high and turns on a small transistor (6531 or 4400) through a 270-ohm resistor. This transistor drives a larger transistor (TIP 3055). When this transistor turns on, the voltage at its collector changes from approximately 32-VDC to .6-VDC, and thus provides virtual ground for its load (solenoid).

NOTE: When a TIP 3055 fails, the reason is often a shorted diode. The diode should always be replaced first. Always replace both 6531 and TIP 3055 transistors when one fails.

13 Switch contacts should be normally open and set at approximately 1/32". Contacts should be cleaned and adjusted.

14 Go to discussion on RE-SET CIRCUITRY.

15 Go to discussion on LAMPS.

16 Check to see if the lamp bulb is good by trying it in a known-good location.

17 After heavy or prolonged use, screws may work loose. Tighten where necessary.

18 Solenoid (coil) mounting bracket should form a 90-degree angle with the Playfield. Adjust the bracket if bent. Spring tension on the plunger should be only enough to hold the plunger UP. (Too much tension will result in the ball not reaching the shooter.) The connector should be aligned so that each ball rolls straight up the alley to the shooter.

19 Check the jumpers in the program section of the Computer Board.

20 The coin switch should be activated fully by each coin. Verify by using TEST MODE THREE, and then feed a coin through the mechanism several times.

21 Check each connector in the harness, making sure that it is connected firmly. Remove the P. C. Board from the game. Check for possible corrosion at each board-edge contact, especially the contact which connects to the problem area. Remove corrosion with a pencil eraser.

(Continued--)

22 Exchange with a good score unit to determine if one is bad. Replace as necessary.

23 On the back of the P. C. Board are jumper wires that directly control the performance of the credit switch. The jumpers should be checked carefully to be sure that they are not shorted to other connections. Also be sure that the jumpers are firmly connected.

24 Each solenoid has a plunger, sleeve and spring. The plunger should be free from dust, dirt or anything that might inhibit free movement.

25 The plunger and sleeve should be checked carefully for wear. After prolonged use, it may be necessary to replace one or both.

26 Check the 5-V supply for proper voltage. It should read at least 4.8-V. If not, locate the small potentiometer (trim pot) on the power supply board by which voltage can be adjusted. If the problem still exists, it could be caused by a defective component within the power supply, allowing an AC ripple to occur. Check for this by disconnecting the score displays, then check for proper operation of the game.

G. HOW TO KEEP YOUR MACHINE LOOKING NEW

The Playboard has a hardened finish with excellent wearing qualities.

CAUTION: Do NOT clean the board with water, water-and-soap solutions, or abrasive-containing cleaners. Water will weaken the adherence of the paint to the board, and abrasives will shorten the life of the board by many thousands of plays. A wax-based cleaner (such as a liquid car wax) used very lightly will extend the life of the board to its full capabilities.

NOTE: When waxing the Playfield, avoid getting wax into the "Star Rollovers". Wax build-up will cause the Rollover button to stick.

The SCORE GLASS is made from plexiglass, which is softer than glass, thereby easier to mar or damage. The image is PAINTED on the surface. DO NOT USE ANY ALCOHOL-BASED WINDOW CLEANER on this surface! We recommend a soft water-dampened cloth used lightly only when necessary.

The CABINET is covered almost entirely with formica. Do NOT use any furniture polish that contains OIL. Such polish will cause a "build-up", which will detract from the appearance of this machine.

You may use any good glass cleaner to take care of the glass which covers the Playfield.

Do NOT use silicone spray or similar lubricants except as recommended in this manual for specific areas.