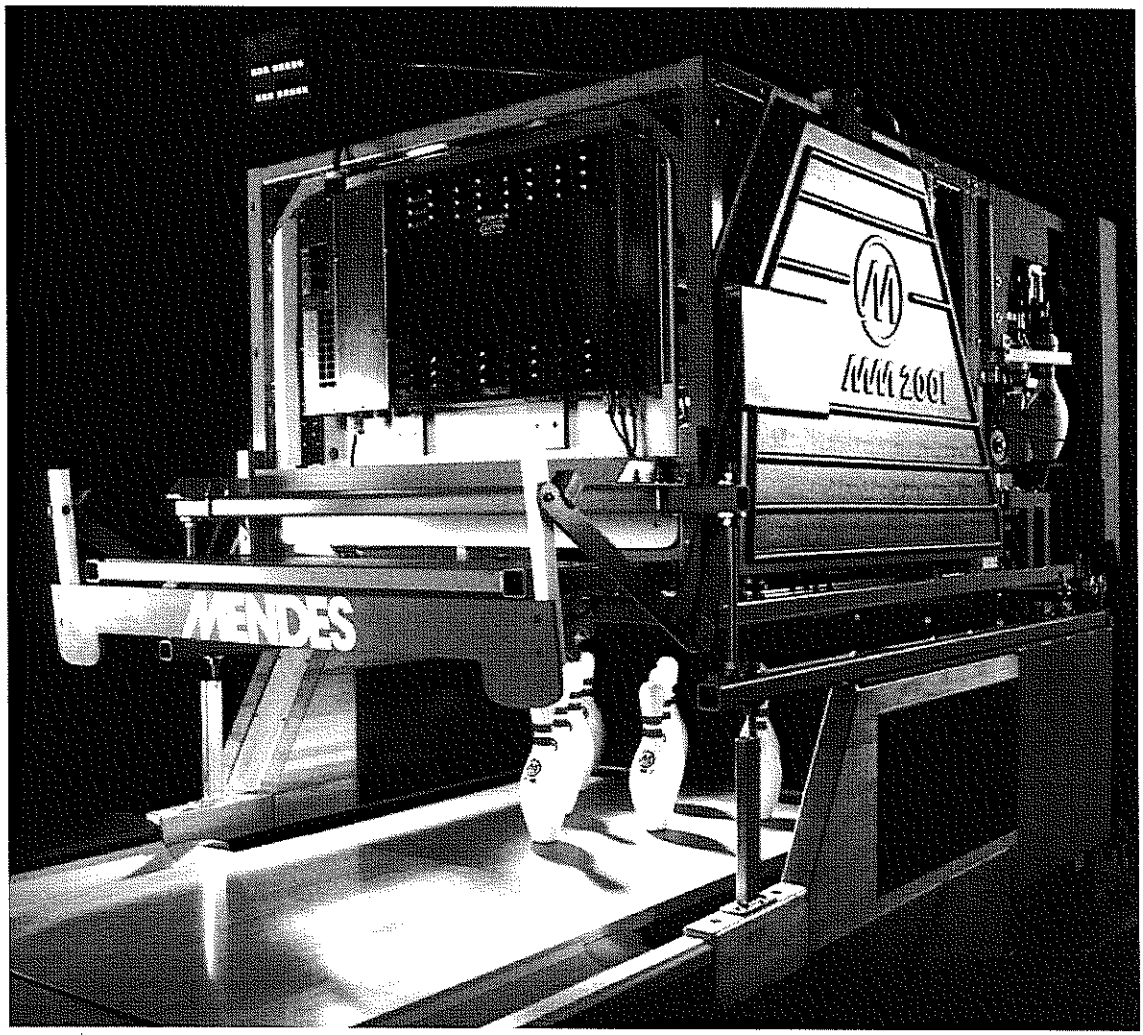
FUNDAMENTALS

1

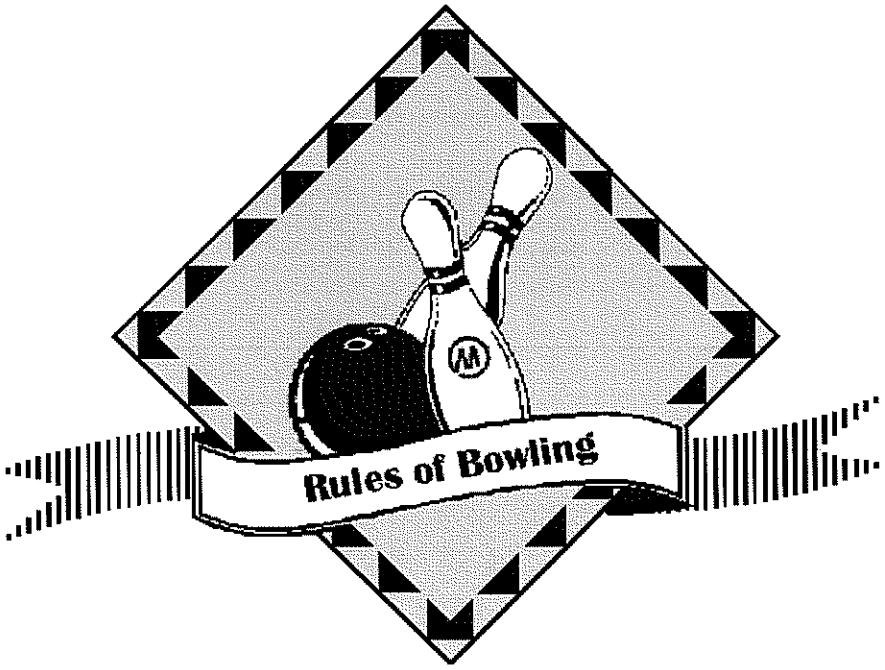


After reading this chapter you should be able to:

Understand the rules of bowling necessary to comprehend the different pinsetter cycles.

Identify the major components of the pinsetter.

Understand the basic principles of the pinsetter's operation.



Before being able to understand the various functions of the pinsetter, you must have a certain knowledge of the rules of bowling. A very brief description of the game of bowling is included in the following paragraphs in order to emphasize the fact that the pinsetter must be able to respond to any condition set up by delivery of the first ball.

A game of bowling is made up of ten frames. At the beginning of each frame ten pins are set in a triangular form at the far end of the bowling lane, and the bowler rolls a maximum of two balls per frame at the pins trying to knock down as many as possible. If all the pins are knocked down with the first ball it is called a strike. The ball is returned to the bowler and ten pins are then set up for the next frame.

If all the pins are not knocked down by the first ball, the ball is returned to the bowler and the standing pins are left as they are for the bowler's second roll of the frame. The deadwood is removed from the playing area so as not to interfere with the game. The bowler then rolls the ball a second time in order to attempt to knock down the remaining pins. Regardless of the number of pins left standing after the delivery of the second ball, the ball is returned to the bowler and ten pins are set up for the next frame.

At the point where the bowler releases the ball to roll down the lane, there is a black line. If the bowler's foot crosses this line while delivering the ball, it is considered a foul. If a foul occurs on the first ball, all of the pins are set up again and the bowler throws a second ball, losing any possible score he made with the first ball. If the foul occurs on the second ball, the bowler loses the points scored with the second ball only and all ten pins are set up for the next frame.

Pinsetter Operation

Each pair of pinsetters has an ***electronic power box*** and a ***Magnet 2001 Controller*** which are used in conjunction with the ***manager's control*** located at the front desk.

When the pinsetter is turned on, ten pins are set on the lane and the pinsetter is placed in a ball one situation. The bowler rolls the ball which passes through the ***ball detector***'s infrared beam of light thus sending a signal to the electronic power box. The ball knocks down some pins which fall into the ***pit***. The floor of the pit is a continuous belt that is angled so that the pins roll to the back and the ball moves toward the ***ball accelerator***. There is a ***baffle stop*** that guides the ball to the ***accelerator port***, while the pins roll under and stage themselves for a ride up the ***pin elevator***.

The ***ball accelerator door*** that covers the port is a unique knife design that allows the ball to exit the pit area while at the same time making it impossible for a pin to enter the ball accelerator. A ***magnetic clutch*** is activated by an ***electronic sensor*** which recognizes that a ball is in position to exit.

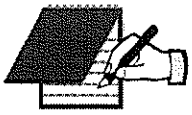
The pins stage themselves at the back of the pit and roll into the ***elevator lifts***. These lifts are made of Delron, a virtually indestructible plastic which is easy on the pin finish. The elevator takes the pins up to the top of the pinsetter and then moves them into the ***carrousel staging*** position. The pins move either left or right depending upon the way they settled into the lifts.

Each bowling pin has a magnet placed in the top of the head. The continuous moving carrousel uses a permanent magnet to pick off the pins from the staging position. They pick up either from the left or the right side depending on where the pin's head is located when exiting the elevator. The carrousel carries the pins around the top of the pinsetter and places them into the ***drawer magazine***. Once the pins are in the magazine, they are released into the ***drawer*** when necessary.

The telescoping drawer receives the pins from the magazine in two straight lines; one of three, and one of seven. The drawer then expands into the familiar triangle ready to be picked up by the ***miracle deck***. When necessary, the deck picks up the ten pins from the drawer and lowers and sets the pins on the lane.

If a bowler does not knock down all the pins with the first ball, the deadwood is removed before the second ball is delivered. This operation is accomplished by the deck and the ***sweep***. The deck utilizes magnets and fluid dynamics to lift the standing pins up out of the way while the sweep pushes the deadwood into the pit, and then the deck re-spots the standing pins in their original positions.

Each pinsetter uses two sets of pins, but only ten pins are ever in play at any given time. The extra set of pins is used to speed up operations so that the bowler doesn't have to wait for the pins to be carried from the pit to the lane.



Whenever any motion or direction is described in the text of this manual such as clockwise, counterclockwise, right, left, forward or rearward, the motion is always as viewed from the front of the pinsetter.

Pinsetter Cycles

The pinsetter must be able to determine the different pinsetter reactions based on the rules of bowling and set up by delivery of the first ball. After the bowler delivers the first ball, the ball detector sends a signal to the electronic power box which in turn sends a signal to the ***camera***. The camera will determine whether the bowler has thrown a strike or whether there are pins standing and returns the information to the electronic power box. This process is called reading and according to all the information which the electronic power box analyzes, the pinsetter will cycle in one of five possible manners.

Full set

The bowler rolls the first ball down the lane knocking down all the pins (strike). The camera takes its reading and finds no standing pins. The sweep is lowered and pushes the deadwood into the pit and then returns to its forward position. The deck picks up the ten pins from the drawer, lowers and sets the pins on the lane. The deck and the sweep raise and the lane is ready for the next frame

Part set

The bowler rolls the first ball down the lane knocking down some pins. The camera takes its reading and finds some pins still standing. The deck lowers and then lifts the standing pins up out of the way while the sweep pushes the deadwood into the pit and then returns to its forward position while the deck re-spots the standing pins in their original positions. The deck and the sweep raise and the lane is ready for the second ball. The deck picks up the ten pins from the drawer and waits in its upper position

Second ball

The bowler rolls the second ball down the lane. Regardless of the number of pins knocked down, the sweep is lowered and pushes the deadwood into the pit and then returns to its forward position. The deck lowers and sets ten new pins on the lane. The deck and the sweep raise and the lane is ready for the next frame.

Foul

If when rolling the ball, the bowler steps across the foul line, all the pins must be replaced on the lane. Depending on whether or not the lanes are equipped with electronic foul detectors, the pinsetter will or will not do this automatically as described below:

With electronic foul lines, a signal is sent to the electronic power box indicating a foul. The sweep is lowered and pushes the deadwood into the pit and then returns to its forward position. The deck picks up the ten pins from the drawer, lowers and sets the pins on the lane. The deck and the sweep raise and the lane is ready for the next ball. The deck picks up the ten pins from the drawer and waits in its upper position.

Without electronic foul lines, if all the pins were knocked down, the pinsetter will go through its normal cycle and set new pins; the bowler just loses the score of the first ball and throws a second ball. However, if standing pins were left, the pinsetter, not knowing that the bowler has fouled, will re-spot the standing pins. As the bowler is penalized by losing the score made on any foul ball, it is necessary for the pinsetter to sweep and set ten new pins for the bowler's second ball, even though there were pins left standing by the first ball. There is a button located at the bowler's end of the ball return which, when pushed, will cause the pinsetter to cycle. This button is called the ***cycle button*** and will satisfactorily handle any foul situation.

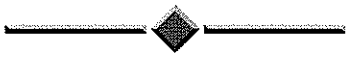
Fouls which occur on second ball are no problem since the pinsetter will automatically sweep and set ten new pins as previously described.

Out of range pin

The one condition which may never be handled completely automatically is when a pin moves but does not fall down. The pin may move far enough to prevent it from being lifted up by the deck while the sweep pushes the deadwood into the pit. To prevent the ***out of range*** pin from being swept into the pit, the deck comes down, detects the out of range pin, and the pinsetter stops while the Magnet 2001 Controller displays a message indicating the out of range and requesting someone to inform it whether or not one or more pins have remained in the deck. Before the bowler may bowl again, it is necessary for someone to remove the deadwood manually and choose the appropriate answer on the Magnet 2001 Controller. After the first answer, the Magnet 2001 Controller will request someone to indicate whether the pinsetter should perform a ***part set*** or a ***full set***, which will restart the pinsetter. There is no problem if an out of range pin occurs on the second ball, since the pinsetter will automatically sweep and set ten new pins.

Safety Procedures

Use of common sense and industry experience are key factors which one should utilize whenever operating a pinsetter. As with all machinery, there is an element of risk working on the pinsetter if the rules of safety are disregarded. Training in the operation of this machine is available. Schools in the pinsetter's use and operation are held periodically. It is the responsibility of the attendant to provide his or her own travel, lodging and school expenses. Anyone interested in attending a factory training school should contact their local Mendes sales or service representative or Mendes directly to make arrangements.



Rule 1 Always open the pinsetter circuit breaker or disconnect the pinsetter power plug from the electrical box before looking for, and clearing, the cause of the jam.

Rule 2 Always reach over and around the machine assemblies, never through or between the components.

Rule 3 Avoid the use of cleaners which are toxic.

Rule 4 Immediately wipe up any oil or liquids that have spilled to prevent slipping.

Rule 5 Store oily rags and any other combustibles in a fireproof container.

Rule 6 The desk person must never turn on a machine from the manager's control without first making sure that no one is working on the machine.

Rule 7 The mechanic must teach all personnel who will work on the pinsetters enough about the machine to prevent accidents through ignorance.

Rule 8 Under no circumstances allow an unqualified person to work on the pinsetter.

Rule 9 Use the right tool for each job to prevent injury to yourself and to the machine. Remove all tools from the machine before turning it on.

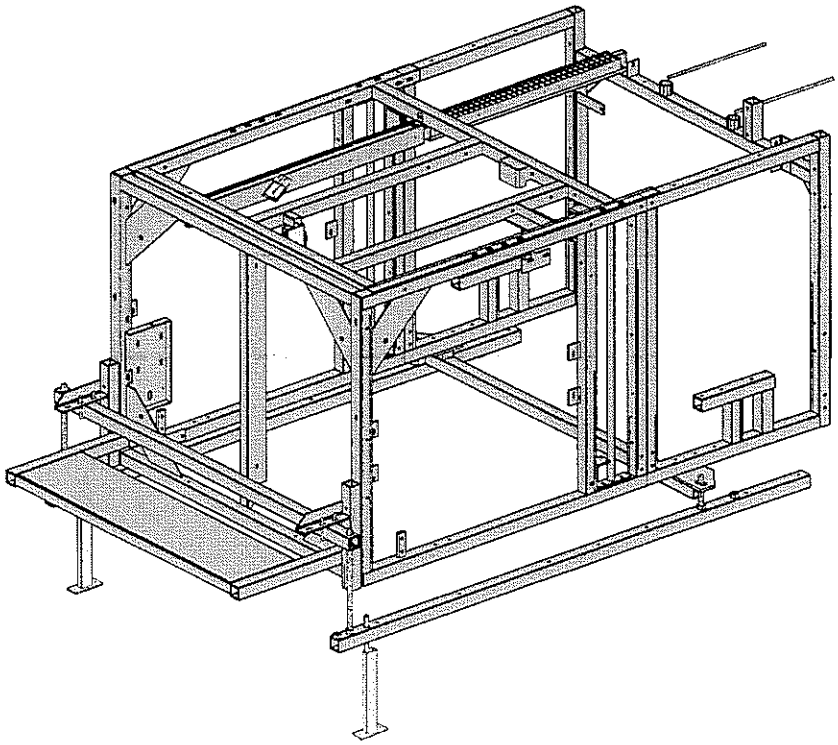
Rule 10 Wear the proper clothing when working on the pinsetter. Do not wear neckties or loose clothing that may be caught by the machine. Wear trousers without cuffs to prevent tripping. Wear shoes with safety, non-slip soles.

Rule 11 When more than one person is working on the machines, never turn on a machine without checking to see if everyone is clear of the machine.

Rule 12 When the safety guards are removed from the pinsetter, be extra cautious when the machine is turned on. Replace the guards immediately when the work is completed.

Major Pinsetter Components

Frame & Support

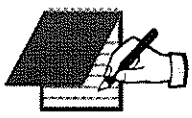


The frame provides the main support in suspending the pinsetter above the lane and pit.

Screwed to the top of each kickback is the kickback tubing. The kickback tubing runs the entire length of the kickback and beyond in order to line up with the front of the pinsetter.

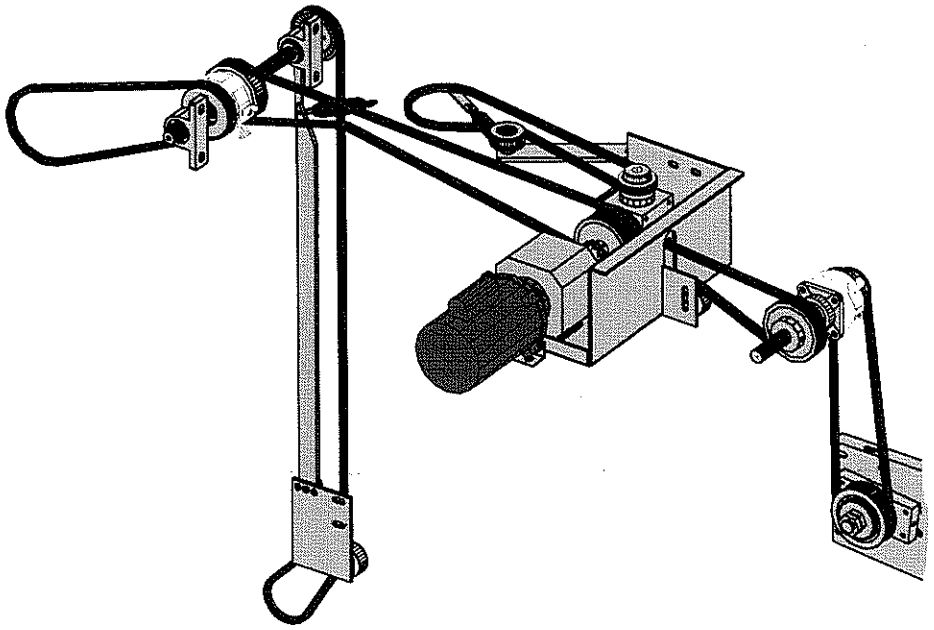
The frame is made up of 6 separate assemblies (each assembly is composed of lengths of tubular steel which are welded together). The 6 assemblies are bolted together to form the frame which is then mounted on the kickback tubing using the front and rear leveling rods. Welded to the kickback tubing are nuts which are used to position the front and rear leveling rods. The leveling rods are used to adjust the pinsetter in relation to the lane surface. Used to raise or lower the frame, the leveling rods set the pinsetter parallel to the lane surface.

Attached to the top of the frame are the front and rear wiring ducts which house the various cabling to and from the different components. Two (2) thread rods are positioned at the rear of the frame in order to secure the pin elevator to the pinsetter.



The front rod supports are only needed if you do not have the 1995 model of Mendes kickbacks.

Drive Train



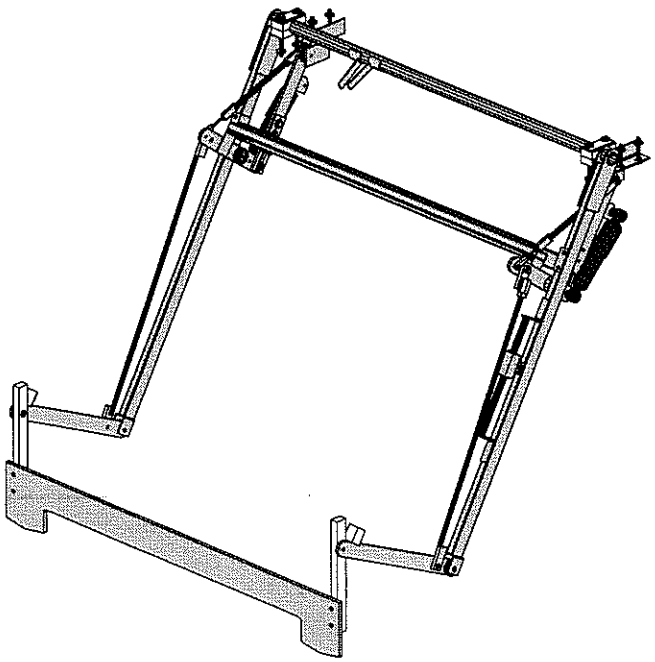
Located on the top of each pinsetter is the ½ hp main motor. Using a series of magnetic clutches, belts and pulleys, the main motor supplies the driving power to the sweep, the carrousel, the pin elevator and the pit.

The parallel shaft gearbox reduces the speed of the main motor. Synthetic lubricants are used in this gearbox due to its wide temperature range. The gearbox is breatherless and lubricated for life thus eliminating maintenance. Internal parts for the parallel shaft gearbox are not available through Mendes, only complete gearboxes. In the event that the gearbox needs to be refilled, check the chart in the Drive Train section of "Chapter 3 - Adjustments & Maintenance" for the recommended lubricants.

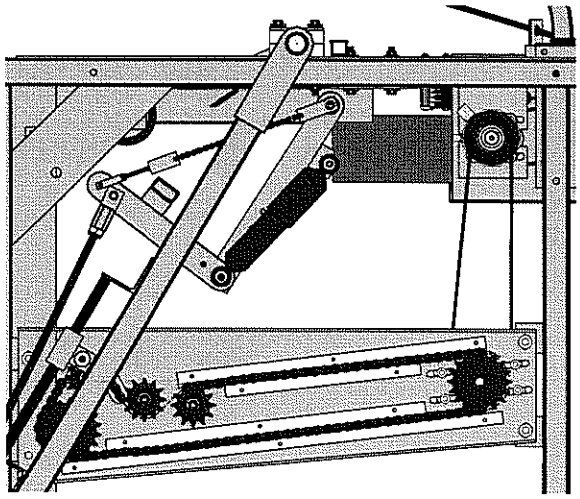
The main motor is controlled through the electronic power box. When the electric power to one or both pinsetters is turned on, the pinsetter(s) will not start until it receives a power on command from the electronics.

Sweep

The sweep frame assembly pivots on the pinsetter frame through two plastic collars. Hinged at the bottom of the sweep frame assembly are two follower arms upon which are mounted the sweep arms and finally the sweep board. When the sweep board is drawn rearward by the sweep frame assembly, it removes deadwood from the pin area and pushes it into the pit.



A series of sprockets located in the sweep drive channel carry the sweep chain between them. The sweep is powered by the main motor. The power generated by the motor is relayed to the sweep chain through the two sweep timing belts, with the second one being activated by a magnetic clutch when necessary.

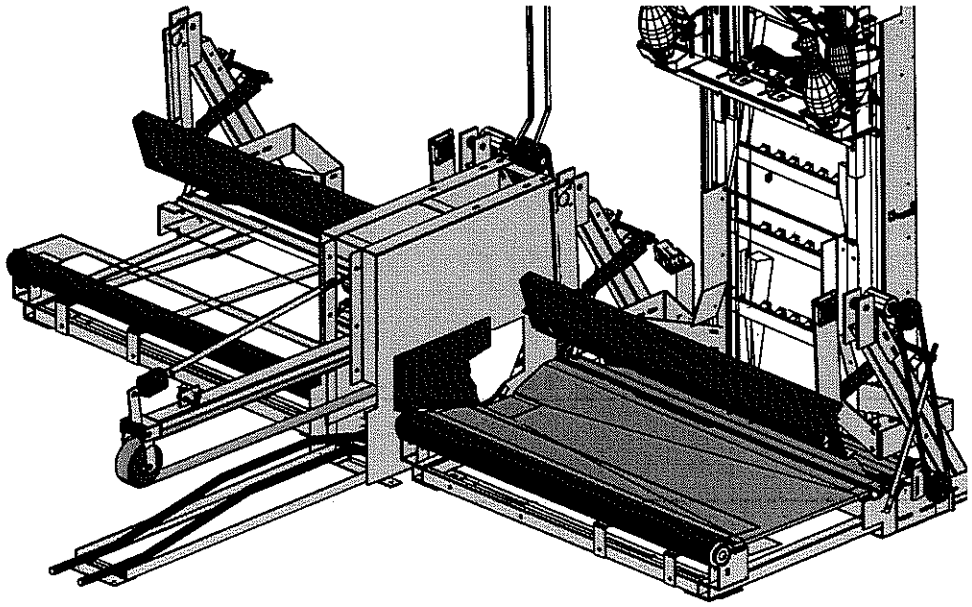


When the sweep's clutch is activated, it results in the sweep chain traveling over its sprockets and carrying with it the sweep chain attachment which pulls the sweep frame assembly through its cycle.

Attached to the top of the sweep frame assembly are two actuators which rotate with the movement of the sweep and activate the sensors attached to the front wiring duct. The left actuator has a single arm and is used to trip the sweep's up position optical sensor ***(SWUP)***. When the sweep is lowered prior to sweeping, the first arm of the V-shaped actuator trips the sweep's forward position optical sensor ***(SWFW)***. After the sweeping movement, the second arm of the V-shaped actuator trips the same sensor, this time signaling its back limit.

The up and down motion is controlled by the sweep lift chains which collapse and extend with the movement of the center sweep bar assembly thus letting go or pulling up the sweep rods. Two (2) shock absorbers, mounted between each sweep bar assembly and the center sweep bar assembly, cushion the sudden, downward motion of the sweep board. As the sweep board moves rearward and forward in its sweeping motion, the left and right adjustment brackets control its height to obtain a horizontal sweep motion.

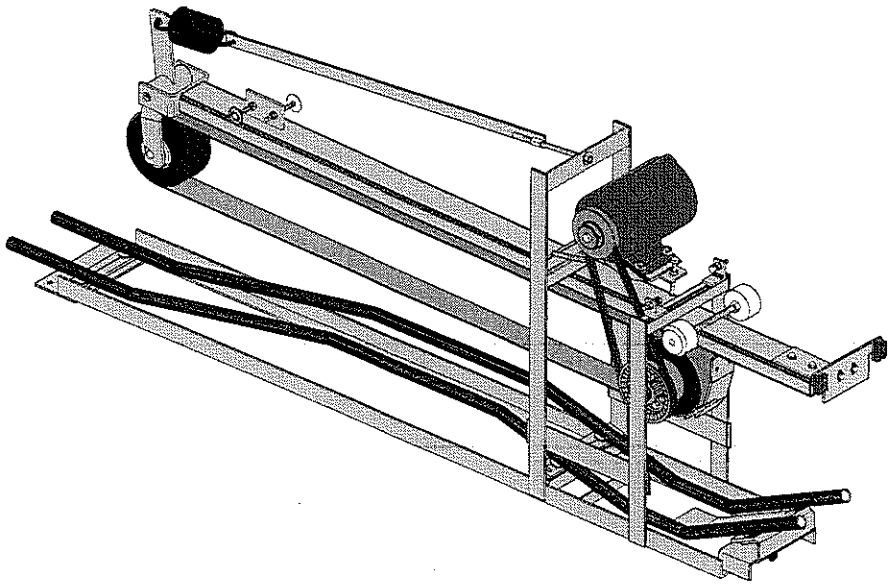
Pit



Located at the rear of each lane's pin deck is the pit which uses a conveyor belt to transport the deadwood to the pin elevator and the ball to the ball accelerator door. The conveyor belt travels on the front roller and the rear roller. The power generated by the main motor is continuously relayed to the rear rollers through the stock timing belt and the pit belt.

Located at the rear of each pit is the ball ready transmitter which emits an infra-red light beam returned to it by the round reflector located in the deflector. When a ball rolls into position behind the deflector block, it cuts the infra-red light beam which in turn activates the ball door's magnetic clutch. When the ball door's clutch is activated, it results in the ball door opening, thus allowing the ball to exit into the ball accelerator.

Ball Accelerator

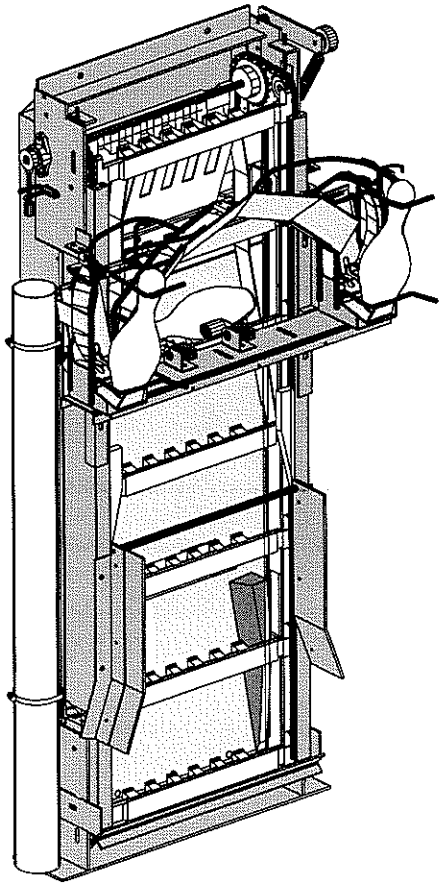


Fastened to the floor between each pair of pinsetters is the ball accelerator assembly which propels the ball to the ball return rack located at the bowler's end of the lane. Mounted on the accelerator's frame are two carriage bolts which exert pressure on both kickbacks in order to keep the accelerator belt and accelerator track parallel to each other.

The drive wheel and the tension wheel carry a long, flat accelerator belt between them. The accelerator is powered by a one-third horsepower, capacitor start electric motor that is mounted on the motor support bracket at the rear end of the accelerator frame. The power generated by the motor is relayed to the accelerator belt through the pulley on the motor shaft, the drive belt, the drive pulley, and the drive wheel. The motor support bracket is adjustable to obtain constant pressure on the drive belt, while the tension rod is used to provide proper tension of the tension wheel on the accelerator belt.

Fastened to the bottom of the frame is the ball accelerator track which from rear to front is sloped down, then up, and finally back down again. As a returning ball enters the accelerator, it rolls down the first slope of the track, contacts the constantly rotating accelerator belt and is moved up the inclined surface of the track, thereby increasing the tension on the accelerator belt. When the ball reaches the highest point on the track, the accelerator belt is under maximum tension, thereby propelling the ball down the curved portion of the track and back to the bowler.

Pin Elevator & Carrousel Staging



The pin elevator receives the pins from the pit conveyor belt and carries them up to the carrousel staging position using the elevator lifts. A series of sprockets located inside the left and right plates carry the elevator chains between them. The elevator is powered by the main motor. The power generated by the motor is relayed to the elevator chain through the stock timing belt and the elevator belt which is activated by a magnetic clutch when necessary.

When the elevator's clutch is activated, it results in the elevator chains traveling over their sprockets and thus revolving the elevator lifts through their endless cycle. The tension on the chains is adjustable through the two adjustment rods located at the top of the elevator.

As the pins ride up the elevator, they are individually counted by the two pin elevator optical sensors located on the carrousel staging channel support. The pin elevator's left side optical sensor ***(PL)*** is used to signal the presence of a pin on the elevator's left side (head to the right) while the pin elevator's right side optical sensor ***(PR)*** is used to signal the presence of a pin on the elevator's right side (head to the left).

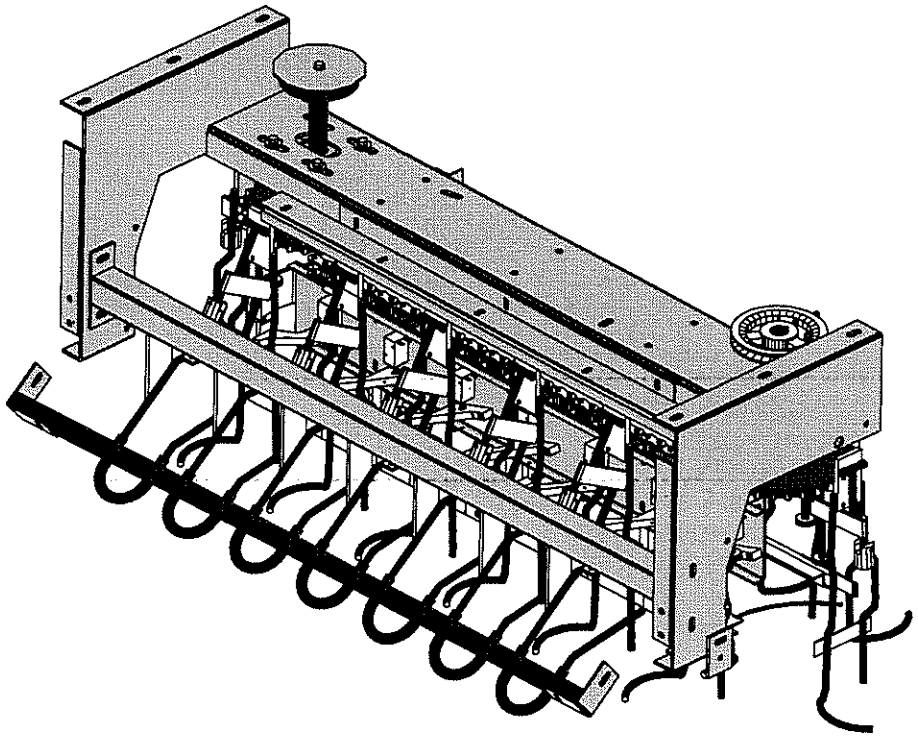
When the pins reach the carrousel staging position located at the top of the elevator, they move either left or right depending on the way they settled into the elevator lifts. As the pins fall into place to be picked up by the carrousel's pin loaders, they are once again individually counted by the two pin loader optical sensors located inside each staging unit. The pin loader's left side optical sensor ***(LL)*** is used to signal the presence of a pin in the carrousel staging left side while the pin loader's right side optical sensor ***(LR)*** is used to signal the presence of a pin in the carrousel staging right side.

All this pin counting is needed in order to control the pin traffic in the elevator. With the pins being accounted for on their way up the elevator and on their way out the carrousel staging, the electronic power box activates and de-activates the pin elevator's magnetic clutch as needed. Without this control, the pin elevator would continuously drop pins into the carrousel staging eventually causing a jam.

The pin elevator's optical sensor ***(ER)***, located on the top right side of the elevator is used to detect the elevator's movement. If the electronic power box sends an ON signal to the elevator's clutch and no elevator movement is detected, the Magnet 2001 Controller will display a troubleshooting message to indicate the fact that there is a physical malfunction with one of the elevator's components.

A manual, low-voltage on-off switch is mounted at the rear of each pin elevator. This switch may be used to open the power circuit to the pin elevator without disrupting the pinsetter's operation in order to clear a pin jam or to perform other quick maintenance to the elevator.

Carrousel



The continuous moving carrousel uses fourteen (14) pin loaders with permanent magnets to pick off the pins from the staging position. Each pin loader may pick up from the left or the right staging position and an empty pin loader will always pick off a pin if one is present in the carrousel staging.

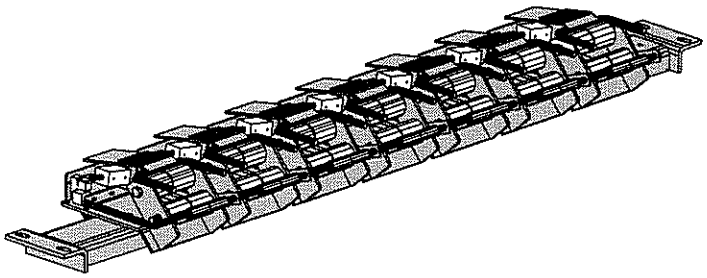
Two (2) sprockets located inside the frame assembly carry the carrousel chain between them. The carrousel is powered by the main motor. The power generated by the motor is relayed to the carrousel chain through the pulley on the motor shaft, the angle drive and pulley, the carrousel belt, the pulley, and the shaft sprocket assembly.

Located on the top of the carrousel frame assembly on its left hand side is the encoder assembly which rotates at the same speed as the carrousel. As it turns, it passes through the carrousel synchronization optical sensor ***(CS)*** which keeps the carrousel in sync with the pinsetter's electronics. The carrousel station synchronization optical sensor ***(SS)*** is located just below the CS on the underside of the frame assembly. One of the fourteen pin loaders has an actuator welded to it which activates the SS as it passes through it. The SS serves as a starting point for the electronics when the pinsetter is started. Once the SS has been detected after startup, the carrousel may begin its job of loading the magazine.

Located inside the detection bar assembly are seven (7) reed switches ***(CS1-CS7)*** which detect the presence of pins in their respective magazine station. After a pin loader has picked off a pin from the carrousel staging position, it travels around the carrousel to the front. On the right side of the carrousel is the pin detector optical sensor ***(PD)***. The PD lets the electronics know that a pin is on its way to the front. If there is at least one magazine station empty, the electronics will activate its solenoid cam in order to push the pin loader to the front, releasing the pin into the magazine station. If all seven magazine stations are full, the pin loaders will simply continue rotating on the carrousel until the pins they are carrying are needed.

Due to the manner in which the magazine will later feed the drawer, the electronics will always give priority to magazine stations number three, four and five. These stations will always be filled prior to filling the remaining stations.

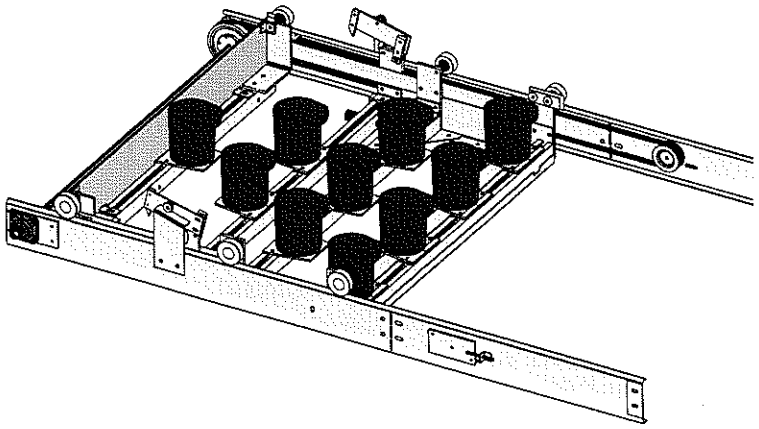
Magazine



The magazine contains seven (7) stations used to load the drawer with its pins. Once the pins have been loaded into the magazine by the carrousel, the electronics loads the drawer in two steps. The first step places pins number one, two and three into the drawer from magazine stations number three, four and five. The second step places pin numbers four to ten into the drawer from all seven magazine stations.

The dumping procedure is quite simple. The electronics activate the necessary stations' solenoids which allow the stations' arms to move freely. The pins fall into the drawer due to their sheer weight and angle.

Drawer

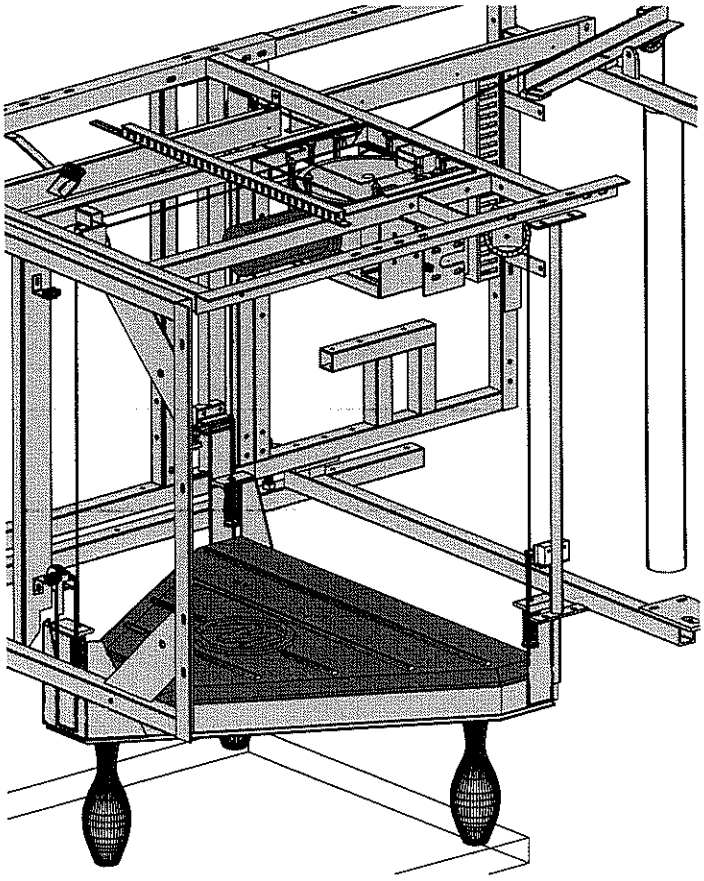


The telescoping drawer receives the pins from the magazine in two straight lines; one of three and one of seven. The drawer then expands in order to position the ten pins in their standard triangular shape ready to be picked up by the deck.

The drawer is powered by a ½ hp, 180VDC motor located at the front of the pinsetter.

The drawer movement control optical sensor and encoder are used to control the drawer's displacement by sixteenths of an inch. The drawer back limit optical sensor (***DWBL***) and the drawer front limit optical sensor (***FRNT***) keep the electronic power box informed on the drawer's position. When the drawer is in its rear position, it may be loaded with pins from the magazine and when it is in its forward position, the magnetic deck may pick up the pins from the drawer. A third detection unit, the drawer obstruction (***DWOB***), using a transmitter and a receiver is used to detect the presence of pins in the drawer as the drawer returns to its rear position. At this point, the drawer should be empty since all ten pins should now be in the magnetic deck. If a pin has remained in the drawer, a problem will occur when the magazine dumps new pins into the drawer. To avoid this problem, the ***DWOB*** signals the fact on the Magnet 2001 Controller and stops the pinsetter.

Deck

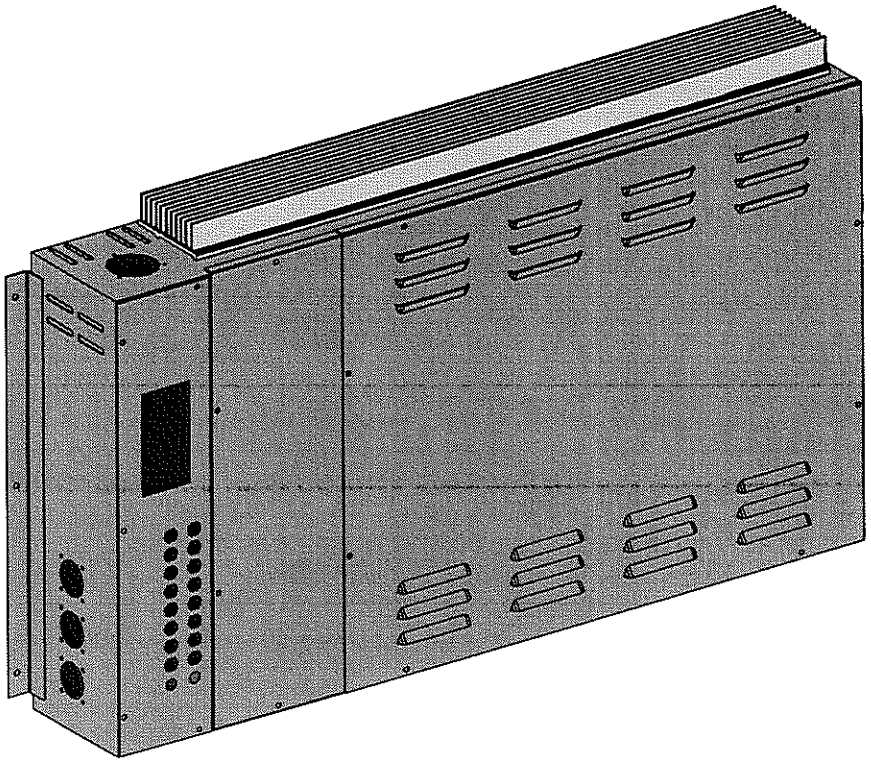


The magnetic deck is a multi-functional component which carries out precision movement commands. When the drawer is expanded, the deck uses fluid dynamics to lift the pins out of the drawer and, after the drawer has receded to its rear position, set the pins on the pin deck. The deck is the principle component used to perform the different pinsetter cycles, full set, part set, second ball, foul, and out of range pin. The out of range pin is actually detected by the deck's out of range plate located on the underside of the deck.

The deck is powered by a ¾ hp, 180VDC motor located at the top of the pinsetter, just above the deck. This motor powers a 14-inch pulley which controls the movement of 4 different wire cables used to move the deck up and down. Deck wire 1, deck wire 2 and deck wire 3 travel over the deck pulleys which are placed at the top of the pinsetter relative to each corner of the deck. As these wires rotate on the 14-inch pulley in one direction, the fourth wire cable, the load wire, rotates in the opposite direction. The load wire also travels through a deck pulley, this one located at the rear of the pinsetter. At the end of the load wire is a load of approximately 70lbs (31.8kg) which is used to control the deck's movement. As the load is pulled up and down, the deck rides up and down along the columns using the column guides to keep it straight.

The deck movement control optical sensor and encoder are used to control the deck's displacement by sixteenths of an inch. The deck upper limit optical sensor ***(DKUP)*** and the deck lower limit optical sensor ***(DOWN)*** keep the electronic power box informed on the deck's position. When the deck is in its upper position, it will lift the pins out of the drawer after the drawer has been loaded and expanded. From its lower limit, the deck will lift pins from the pin deck in order for the sweep to remove the deadwood. A third detection unit, the out of range ***(OORG)*** detection plate, uses a metal plate to close a reed switch circuit when it comes into contact with an out of range pin. At this point, the pinsetter will stop and signal the presence of the out of range to the Magnet 2001 Controller.

Electronic Power Box



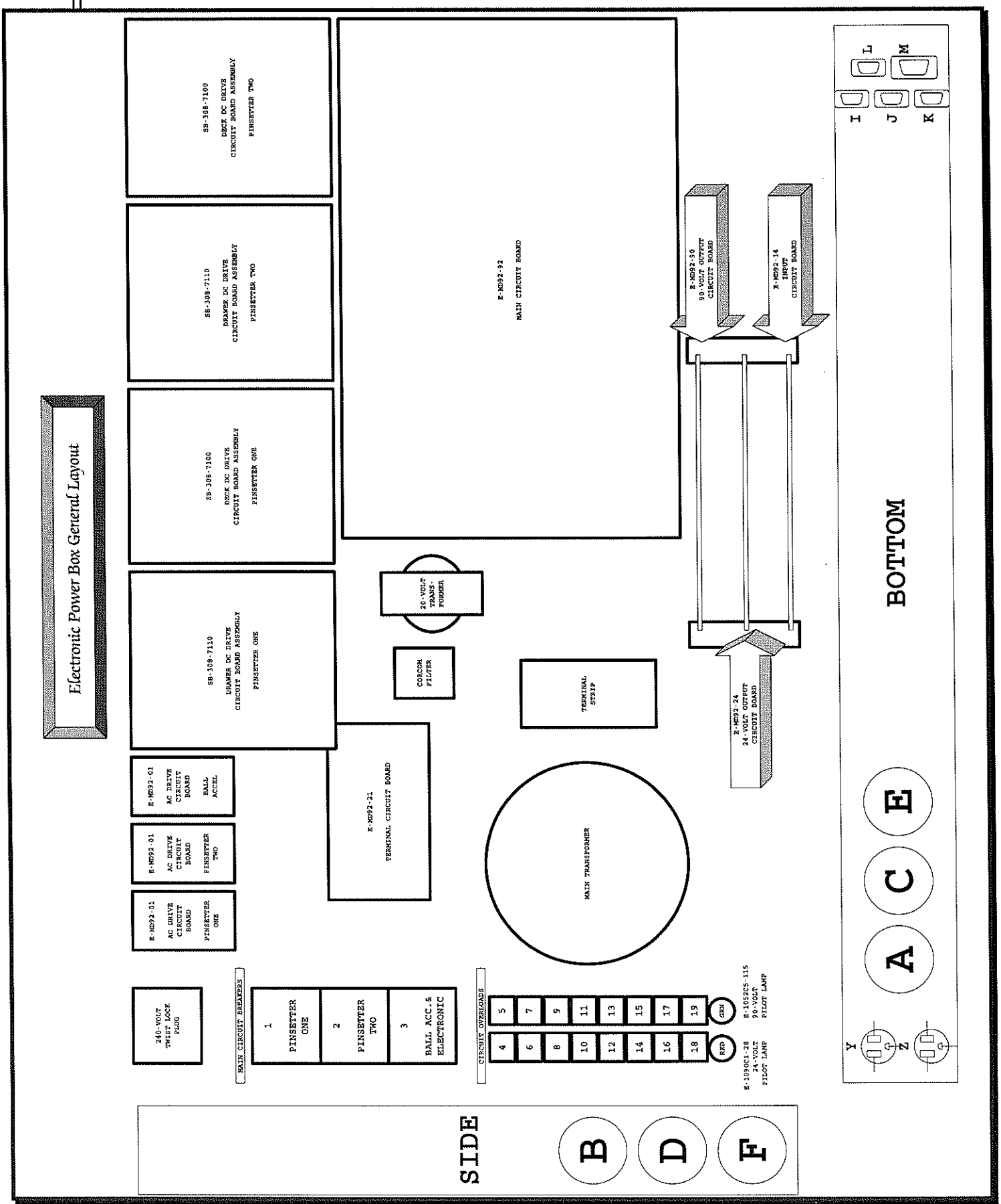
Attached to the front frame of each even numbered pinsetter is the electronic power box used to control both pinsetters. Unlike conventional electrical circuits, which are controlled through a multitude of microswitches, all opening and closing of electrical circuits on the MM-2001 is done through the electronic power box using software and optical reading devices (sensors and transmitters/receivers). The electronic power box receives software commands from the Magnet 2001 Controller and/or the Mendes Manager's Control Computer System / Mendes Automatic Scoring System. Input signals originate from the different optical devices located on the pinsetter. The electronic power box, through its different circuit boards, analyzes the input signals and sends the appropriate output signal (s) to the pinsetter's components. The electronic power box keeps both pinsetters under constant surveillance, turning on and off components as necessary.

Caution: High voltage is present in the electronic power box. The main circuit breakers must always be shut off or the twist lock plug disconnected prior to removing the electronic power box cover.

All wiring to and from the different components is grouped together in six circular plastic connectors, five sub miniature D connectors and two electrical receptacles. Due to the different cable lengths and different connectors used, it is practically impossible to make a mistake in connecting components which have been replaced by the pinsetter maintenance crew.

Three on-off switches are located on the electronic power box and are used to manually open and close the thermal overload circuit breakers. The first switch (top) is used for pinsetter one's electric motors. The second switch (middle) is used for pinsetter two's electric motors. The third switch (bottom) is used for the pair's electronics and the ball accelerator.

In series with the on-off switches located on the electronic power box, are sixteen overload switches. When any of these switches are open, the power to its corresponding component will be shut off. The button on the electronic power box must be manually depressed to restore power to the component. Ample cooling time must be allowed for the overload elements to cool before pressing the button.


Electronic Power Box General Layout
SB-308-7100
DECK DC DRIVE
CIRCUIT BOARD ASSEMBLY
PINSETTER TWO
SB-308-7110
DRAWER DC DRIVE
CIRCUIT BOARD ASSEMBLY
PINSETTER TWO
SB-308-7100
DECK DC DRIVE
CIRCUIT BOARD ASSEMBLY
PINSETTER ONE
SB-308-7110
DRAWER DC DRIVE
CIRCUIT BOARD ASSEMBLY
PINSETTER ONE
E-MD92-92
MAIN CIRCUIT BOARD
E-MD92-90
90-VOLT OUTPUT
CIRCUIT BOARD
E-MD92-14
INPUT
CIRCUIT BOARD
E-MD92-24
24-VOLT OUTPUT
CIRCUIT BOARD
20-VOLT
TRANS-
FORMER
CORCOM
FILTER
TERMINAL
STRIP
E-MD92-21
TERMINAL CIRCUIT BOARD
MAIN TRANSFORMER
E-MD92-01
AC DRIVE
CIRCUIT
BOARD
PINSETTER
ONE
E-MD92-01
AC DRIVE
CIRCUIT
BOARD
PINSETTER
TWO
E-MD92-01
AC DRIVE
CIRCUIT
BOARD
BALL
ACCEL
240-VOLT
TWIST LOCK
PLUG
MAIN CIRCUIT BREAKERS
1
PINSETTER
ONE
2
PINSETTER
TWO
3
BALL ACC. &
ELECTRONIC
CIRCUIT OVERLOADS
4 6 8 10 12 14 16 18 RED
5 7 9 11 13 15 17 19 GRN
E-109CC1-28
24-VOLT
PILOT LAMP
E-105CC5-115
90-VOLT
PILOT LAMP
SIDE
B
D
F
A
C
E
BOTTOM
H
J
K
L
M
Y
Z

Electronic Power Box Legend

Index	Part Number	Overload or Breaker which protects
1	E-QUO215	Pinsetter 1
2	E-QUO215	Pinsetter 2
3	E-QUO210	Ball Accelerator & Electronics
4	E-W28XQ1A-3	Carrousel controllers, Magnet 2001 Controller & Input Circuit Board
5	E-W28XQ1A-1	20-volt Transformer
6	E-W28XQ1A-2	Fluorescent 1
7	E-W28XQ1A-2	Fluorescent 2
8	E-W28XQ1A-3	Main Transformer
9	E-W28XQ1A-4	90-volt Output Circuit Board
10	E-W28XQ1A-5	24-volt Output Circuit Board
11	E-W28XQ1A-7	Ball Accelerator AC Motor
12	E-W28XQ1A-7	Pinsetter 1 AC Motor
13	E-W28XQ1A-7	Pinsetter 2 AC Motor
14	E-W28XQ1A-7	Drawer 1 DC Motor
15	E-W28XQ1A-7	Deck 1 DC Motor
16	E-W28XQ1A-7	Drawer 2 DC Motor
17	E-W28XQ1A-7	Deck 2 DC Motor
18	E-W28XQ1A-10	Carrousel 1 Solenoids
19	E-W28XQ1A-10	Carrousel 2 Solenoids

Index	Part Number	Used to Connect
A	E-211773-1	Pinsetter 1 DC Motor Drives & Clutches
B	E-211773-1	Pinsetter 2 DC Motor Drives & Clutches
C	E-206306-1	Pinsetter 1 Drive Input Signals & 24-Volt Output Signals
D	E-206306-1	Pinsetter 2 Drive Input Signals & 24-Volt Output Signals
E	E-206151-1	Pinsetter 1 Optical Sensor Inputs
F	E-206151-1	Pinsetter 2 Optical Sensor Inputs
I	CPB-71	Magnet 2001 Controller
J	CPB-70	Pinsetter 2 Carrousel controller
K	CPB-70	Pinsetter 1 Carrousel controller
L	CPB-73	Automatic Scoring Player's Console
M	CPB-72	Camera & Ball Detectors
Y	E-5252	Pinsetter 1 Fluorescent Light
Z	E-5252	Pinsetter 2 Fluorescent Light

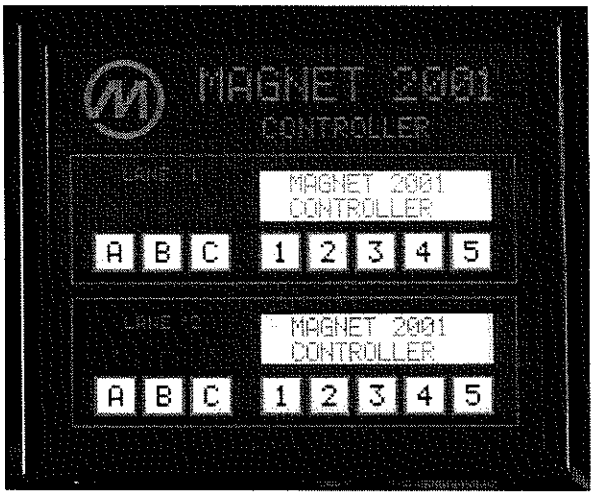
For more information on the electronic power box and its various components along with descriptions of their functions, refer to "Chapter 5 - Wiring Diagrams & Schematics".

Optical Reading Devices

Each pinsetter uses a total of twenty-eight (28) different optical reading devices in order to send signals directly or indirectly to the electronic power box. These devices come in the form of optical sensors, reed switches and transmitters with each one equipped with a partner device such as an actuator, encoder, receiver or reflector. Some of the components used are interchangeable as shown in the table below.

Device	Signal	Partner
Encoder Optical Sensor	Carrousel Synchronization.	Carrousel Encoder
	Deck Motor Synchronization	Motor Encoder
	Drawer Motor Synchronization	Motor Encoder
Optical Sensor	Ball Door Open	Ball Door Actuator
	Carrousel Pin Detector	Pin Detector Actuator
	Carrousel Station Sync.	Carrousel Sync. Actuator
	Deck Lower Limit	Up & Down Actuator
	Deck Upper Limit	Up & Down Actuator
	Drawer Back Limit	Back Limit Actuator
	Drawer Front Limit	Front Limit Actuator
	Pin Elevator Running	Elevator Pulley
	Pin Elevator Left Side	Pin Counter Actuator Assembly
	Pin Elevator Right Side	Pin Counter Actuator Assembly
	Pin Loader Left Side	Pin Loader Actuator Assembly
	Pin Loader Right Side	Pin Loader Actuator Assembly
	Sweep Up	Up Actuator
	Sweep Forward & Rear	Double Actuator
Reed Switch	Carrousel Sensor 1	Pin Magnet
	Carrousel Sensor 2	Pin Magnet
	Carrousel Sensor 3	Pin Magnet
	Carrousel Sensor 4	Pin Magnet
	Carrousel Sensor 5	Pin Magnet
	Carrousel Sensor 6	Pin Magnet
	Carrousel Sensor 7	Pin Magnet
Modular Box	Out of Range Pin(s	Out Of Range Plate
Ball Ready Transmitter	Ball Ready to Exit Pit	Ball Ready Reflector
Drawer Obstruction Transmitter	Pin in Drawer	Drawer Obstruction Receiver
Ball Detector Transmitter	Ball Detection on Lane	Ball Detector Reflector

Magnet 2001 Controller



There is one Magnet 2001 Controller assembly for each pair of MM-2001 pinsetters. The controller is located on a pivotal arm which is attached to the even numbered pinsetter's frame. The pivotal arm allows the user to place the display unit in the most comfortable position desired.

Connected to the electronic power box through connector DB-S09I, the Magnet 2001 Controller uses the metaphor of a dashboard which is constantly displaying information on the status of your pinsetters and their activities. It will display messages if there is a physical malfunction with a pinsetter and more importantly what to do in order to correct the malfunction.

The Magnet 2001 Controller is a very important component of your MM-2001 pinsetters. Use it wisely and treat it respectfully in order for the controller to give you years of trouble free service.

Learn to read the digital display before attempting any type of intervention. The digital display gives you precise information in order to help you. By reading the digital display, you will save time and effort during your daily duties.

With the Magnet 2001 Controller you can:

- Verify each pinsetter's components individually by sending on/off signals to check output signals or simple commands in order to verify input signals;
- Troubleshoot your pinsetters if a problem arises;
- Turn pinsetters on and off or perform different types of pinsetter cycles after mechanical maintenance has been performed.

For information on how to use the Magnet 2001 Controller, refer to "Chapter 2 - Using the Magnet 2001 Controller".

Camera

For each pair of pinsetters, one camera pin detection assembly is installed on the ball return's capping. Refer to the Camera Service Manual (part number Z-CSM-6400-95) for more information.

Ball Detectors

The ball detector is a simple, very reliable stand alone device which is mounted on the 10½-inch capping between the camera assembly and the kickback. An infrared light beam is constantly emitted from the ball detector. A reflector placed on the opposite side of the lane returns the beam to the unit. The minimum reaction time is 1.7 milli-seconds or 40MPH. When the signal is cut (ball is detected) the ball detector communicates the information to the electronic power box, which in turn has the camera take a reading of the pins still standing. The ball detector's signal allows for an automatic operation of the pinsetter which means that it is not necessary to use a reset button during play. The ball detector must be operational in order for the electronic power box and pinsetter to function. All commands to and from the pinsetter start with the detection of a ball.

pages 31 through 36 reserved for future publications...