April 18, 1961 C. J. ZAANDER 2,980,425

CONTROL MECHANISM FOR BOWLING PIN SPOTTING MACHINES

Filed Oct. 18, 1957

3 Sheets-Sheet 1

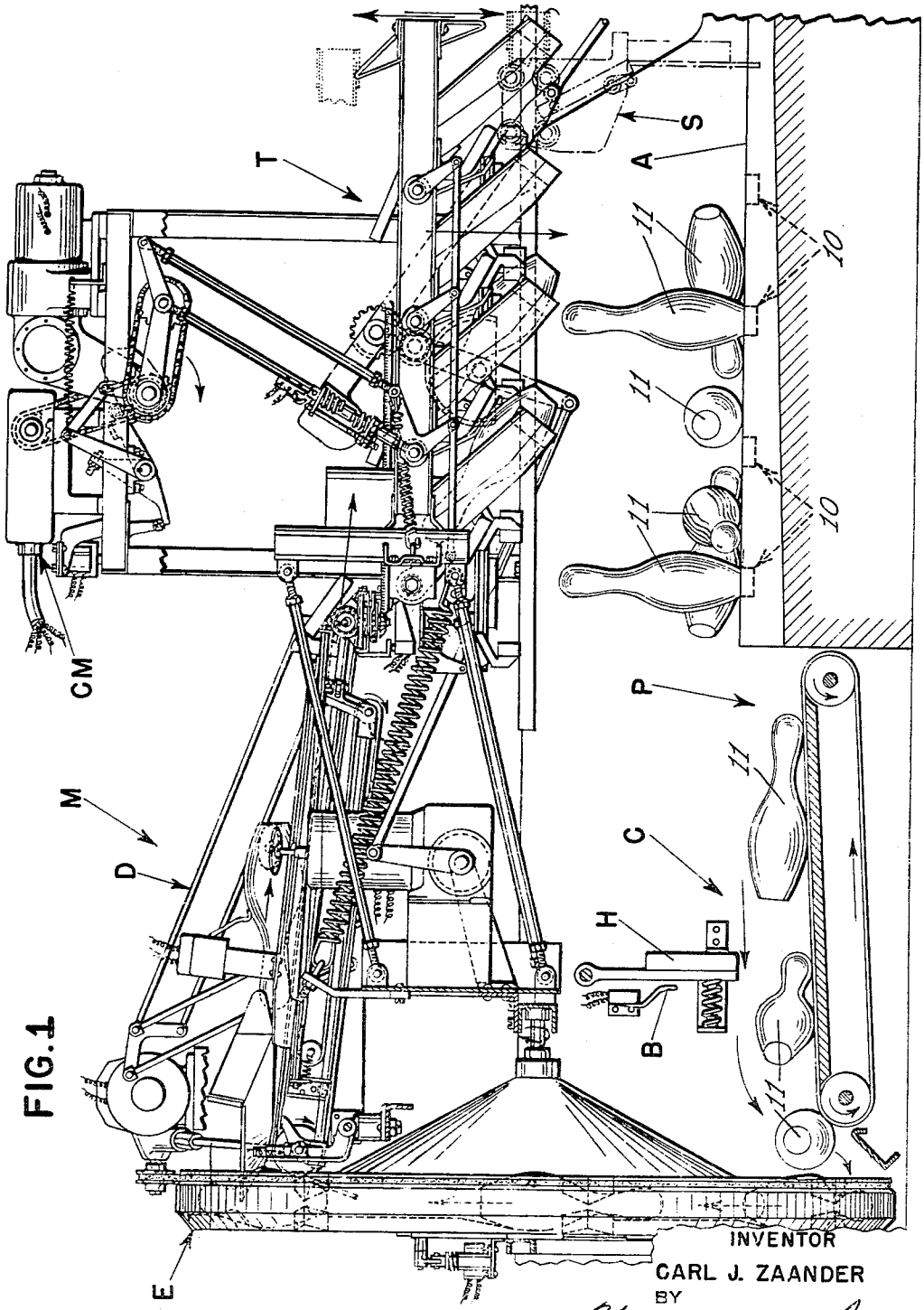


FIG. 1

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FIG. 2

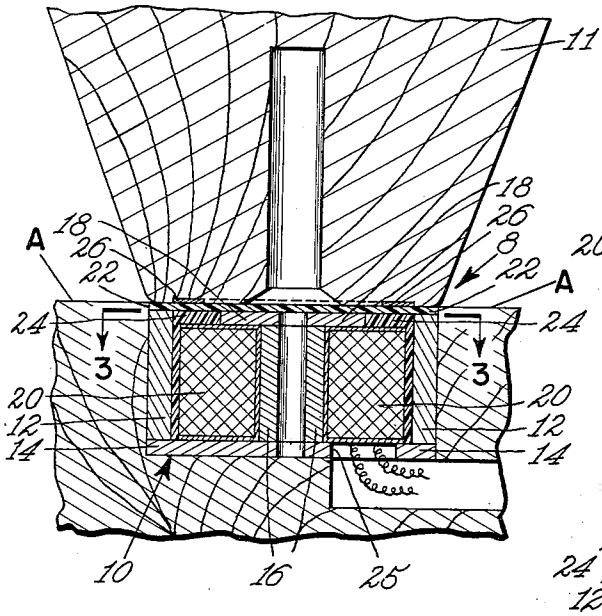


FIG. 3

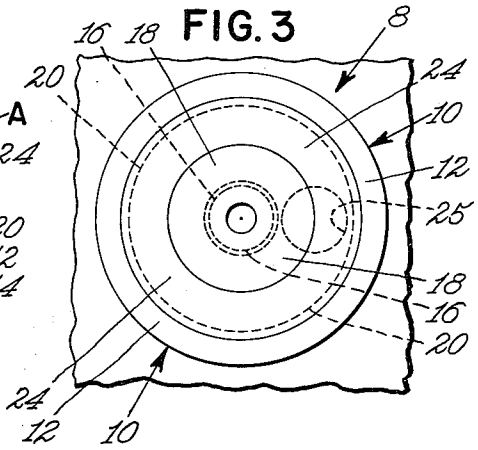


FIG. 7

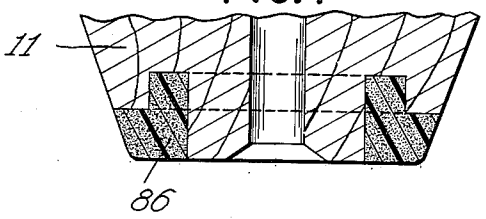


FIG. 4

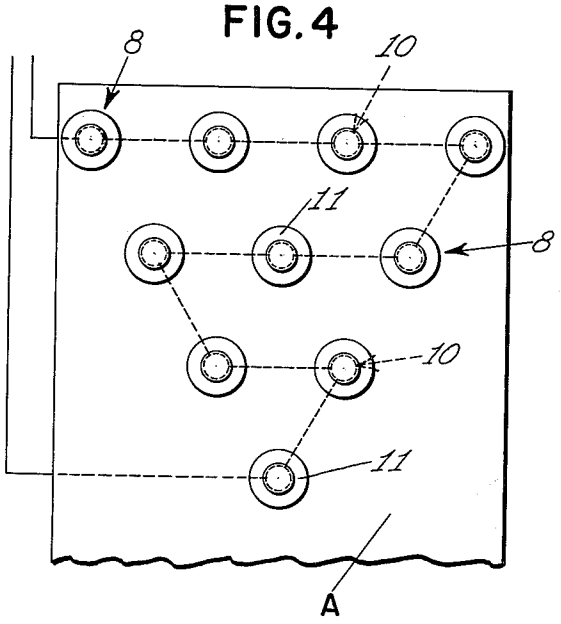
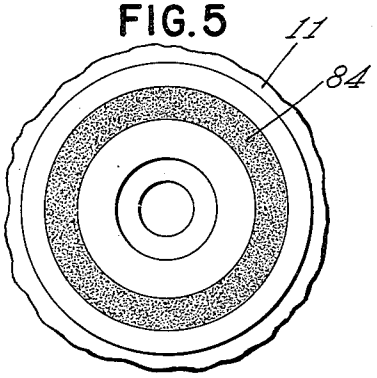


FIG. 5



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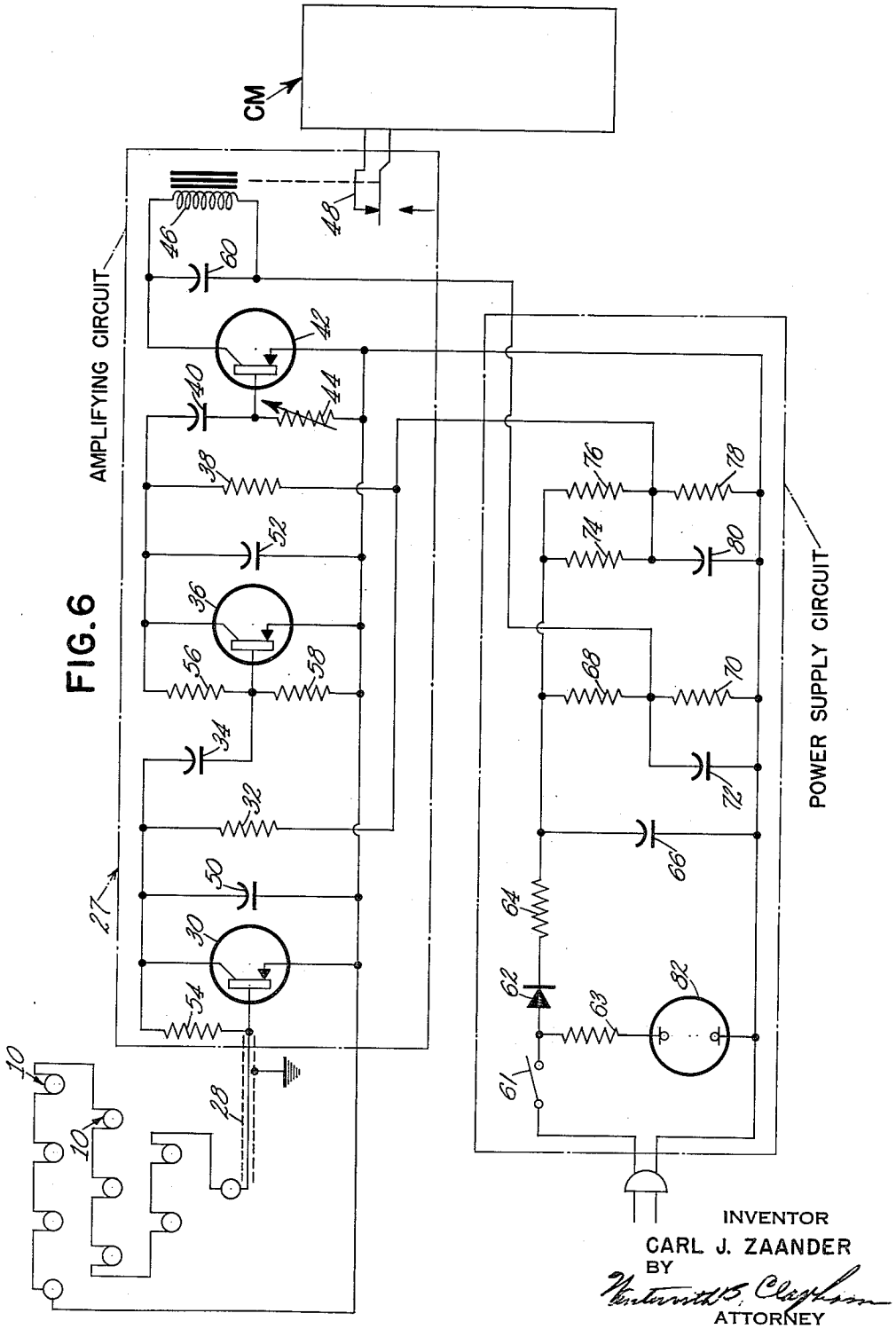


FIG. 6

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2,980,425

CONTROL MECHANISM FOR BOWLING PIN SPOTTING MACHINES

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Filed Oct. 18, 1957, Ser. No. 690,981

10 Claims. (Cl. 273—43)

This invention relates to automatic bowling pin spotting machines and more particularly to a mechanism for selectively controlling the operation of the sweep and the spotting and respotting mechanism associated with the machine in response to pin motion or "wobble."

In the play of the game of bowling, all pins knocked down from a standing position on the playing surface of a bowling alley by a player, either directly by the thrown ball or indirectly by other pins, are counted as part of the score. However, bowling pins due to their general shape and characteristics, have a tendency to rock or "wobble" from side to side when struck or grazed by the ball or another pin. Since the bowler is entitled under the rules of the game to count the wobbling pin if it eventually falls, in automatic bowling pin spotting machines heretofore available, it has been found desirable to incorporate mechanism in the pin spotting machine control circuit which delays, for a predetermined short period of time, the sweep, and spotting and respotting operations of the associated machine, so as to allow any wobbling pins to either fall or return to a stationary standing position on the alley. Further, the delay prevents the spotting and respotting mechanism of the machine from itself causing a wobbling pin to fall, contrary to the rules of the game. However, since wobbling pins do not occur on every roll of a bowling ball, and as the time of wobble varies depending on how vigorously a pin is grazed or struck it will be evident that unnecessary delay in the play of the game may result from employing a set time delay which is operative on every sweep and spotting and respotting operation of a bowling pin spotting machine.

The present invention is characterized by the provision of mechanism which is selectively operative to delay the sweep and spotting and respotting cycles of the bowling machine only when wobbling pins do actually occur and then to delay the operation of the sweep, and the spotting and respotting mechanism only long enough to insure that a wobbling pin has fallen or has remained in its standing position on the alley. This is accomplished by the incorporation of sensors including magnetic detector units into each of the pin spots on the playing surface of the bowling alley to co-act with each pin such that when pin wobble occurs, a signal is transmitted to the pin spotting machine control circuit, delaying the sweep and spotting and respotting operation thereof until the pin wobble ceases, either by the pin falling or returning to a substantially stationary standing position on the alley.

It is therefore an object of the present invention to provide mechanism operative in response to the wobble of a pin to selectively control the operation of an automatic bowling pin spotting machine.

It is a further object of this invention to provide a control system to selectively delay the sweep and spotting and respotting operations of an automatic bowling pin spotting machine until all pin movement on an alley caused by the rolling of a ball has ceased.

An added object of this invention is to provide magnetic means located in the pin spots of a bowling alley which co-act with each bowling pin upon movement thereof to control the operation of an automatic bowling pin spotting machine after the rolling of each ball of a frame.

A further object of the present invention is to provide magnetic sensors in the bowling alley to co-act with each bowling pin upon the movement thereof to generate a signal current to control the operation of an automatic bowling pin spotting machine.

Another object of this invention is to provide magnetic sensors located in the pin spots of a bowling alley and connected in an operating circuit whereby the sensors co-act with each pin upon the movement thereof to detect the reluctance of the circuit thus caused and to control the operation of an automatic bowling pin spotting machine and particularly the operation of the sweep and the movement of table after the rolling of each ball of a frame during the course of play of the game of bowling.

With these and other objects not specifically mentioned in view, the invention consists in certain combinations and constructions which will be hereinafter fully described and then specifically set forth in the claims hereunto appended.

In the accompanying drawings which form a part of this specification, and in which like characters of reference indicate the same or like parts:

Figure 1 is a side elevation of a bowling pin spotting machine provided with a preferred embodiment of the invention.

Figure 2 is a detail view of the invention.

Figure 3 is a view taken along line 3—3, Figure 2.

Figure 4 is a schematic plan view illustrating a suitable arrangement of the invention in the playing surface of a bowling alley.

Figure 5 is a bottom view of a bowling pin employing a modified form of the invention.

Figure 6 is a schematic diagram for a suitable control circuit for use with the invention.

Figure 7 is a partial sectional view of a bowling pin employing a modified form of the invention.

A preferred embodiment of the invention is associated with and forms an operative part of a bowling spotting machine designated generally M, provided with mechanisms for removing standing or unwanted pins from the playing surface of a bowling alley into the pit thereof and elevating them from the pit and delivering them in succession to a distributor associated therewith from which pins are delivered in succession and conveyed one by one to a pin spotting device having means for supporting and spotting pins and also for respotting pins during the course of play, when such is desired.

Fallen or unwanted standing pins are removed from the playing surface of alley A into the pit P thereof by a sweep device S which may be similar in construction and operation to that disclosed in co-pending Zuercher application, S.N. 575,548, filed April 2, 1956, now Patent 2,878,019, for Bowling Alley Sweep Mechanism. The mechanism C illustrated for removing pins from pit P of a bowling alley A is similar in construction and operation to that disclosed in Holloway et al. Patent 2,767,983 for Bowling Pin Elevating Mechanism. Pins delivered by the device E which removes or elevates them from the pit of the alley are discharged therefrom into a distributing device D operatively associated therewith, and which may be similar in construction and operation to that disclosed and described in Zuercher Patent 2,767,984 for Pin Handling Mechanism for Bowling Pin Spotting Machines. Operatively associated with the distributing mechanism is a bowling pin spotting and respotting device T, which may be similar in construction and operation to that illustrated and described in Holloway et al.

Patent 2,781,195 for Bowling Pin Spotting and Respotting Mechanism. The operation of these mechanisms which form co-acting and selectively actuated parts of the bowling pin spotting machine M is controlled by mechanism such that all sequential and cyclical operations of the machine take place in proper time order in spotting and respotting pins upon the playing bed of alley A during the entire course of play of a game. This control mechanism, CM with which a wobble detector mechanism embodying the invention is operatively connected, may be similar in construction and operation to that illustrated and described in Dumas Patent 2,821,395 for Control Mechanism for Bowling Pin Spotting Machine or the control mechanism disclosed in Broekhuysen Patent 2,559,274 for a Bowling Pin Setting Machine. While reference is made to the above cited patents and co-pending application, the present invention may be used with other types of automatic bowling pin spotting machines with which it is adaptable and therefore is not to be considered as limited in use with the structure shown in the above referred to patents and application.

In the preferred embodiment, illustrated in detail in Figures 2 and 3, a sensor mechanism **10** is shown imbedded in the playing surface of alley A at each of the pin spots **8** thereof. Alley A is generally provided with ten pin spots **8** arranged in a substantially triangular configuration thereon and upon which pins **11** are placed in standing position by table T during the spotting and respotting cycles of the associated bowling pin spotting machine. A sensor mechanism **10** is provided for each pin spot **8**, the construction and operation of each being identical. Therefore in the interest of brevity, only one is described in detail herein below.

Sensor mechanism **10** comprises a cylindrical magnet **12**, made of any suitable permanent magnet material, such as "Alnico," magnetized along its major axis such that the ends thereof will be of opposite polarity. Magnet **12** is mounted on base plate **14** which conforms generally to the outer circumference of magnet **12**. Core **16** is attached to base plate **14** concentrically with magnet **12** and is likewise substantially cylindrical in shape but of a smaller diameter than magnet **12**. A substantially circular top plate **18** is mounted on the end of core **16** remote from base plate **14** and is of smaller diameter than magnet **12**. Base plate **14**, core **16**, and top plate **18**, are preferably constructed of a metal which will offer a ready path to the magnetic field of magnet **12**. Cold rolled steel has been found to be satisfactory for this purpose.

Coil **20** is mounted inside magnet **12** and around core **16**, as shown in Figure 2. A cover **22**, preferably of plastic or other non-magnetic material such as Bakelite, is mounted on the top of detector mechanism **10** and is flush with the playing surface of alley A to support a pin **11** spotted thereon by the associated bowling pin spotting machine, and provide an unbroken smooth alley playing surface.

The various components of sensor **10** are so sized and mounted that a gap **24** is established between the underside of cover **22** and the inner periphery of magnet **12** and coil **20** for purposes to be disclosed in detail hereinbelow.

As shown in Figure 2, each bowling pin **11** is provided with a substantially circular plate or ring **26** imbedded in its base. Ring **26** is preferably constructed of the same metal as that of base plate **14**, core **16** and top plate **18** hereinabove. Ring **26** is so positioned in the base of pin **11** that, when pin **11** is spotted on its associated pin spot **8** by table T, ring **26** will be directly over gap **24** of sensor **10**.

When during the play of the game, a pin wobble occurs, as the result of the rocking or wobbling of a pin ring **26** thereon is oscillated from side to side over gap **24**. This oscillation of metal over the gap **24** of the sensor **10** beneath the wobbling pin affects the distribution of the magnetic lines of force therethrough from magnet **12** and thus induces a signal into coil **20**. It has been found desirable to use a suitable non-magnetic material such as, epoxy resin, to fill gap **24** to prevent shifting of the sensor elements.

Figure 6 illustrates a suitable pin wobble control circuit. The coil **20** of each sensor **10** is connected through opening **25** in base plate **14** in series (see Figure 4) across the input of a suitable signal amplifier, designated generally **27**.

A series connection is employed for coils **20** since a greater electrical output is obtained directly across the input from a pin wobble signal than would be possible if coils **20** were connected in parallel thereacross. Any wobbling pin **11** over its associated sensor will be of an alternating current type. This signal from any pin **11** is imposed on amplifier **27** through the shielded cable **28** connecting sensors **10** as shown in Figure 6, the first stage of amplifier **27**. This first stage comprises a suitable electronic device; such as a semiconductor or transsistor **30** which amplifies the signal thus imposed on it and through the resistance-capacitance coupling of resistor **32** and capacitor **34**, passes the amplified signal onto the second stage of amplifier **27**. This second stage comprises a second semi-conductor or transistor **36** which again amplifies the signal imposed on it and through the second resistance-capacitance coupling of resistor **38** and capacitor **40** passes the amplified signal onto the third stage of amplifier **27**. This third stage comprises a third semi-conductor or transistor **42** and a suitable variable resistor **44** connected between the base and emitter of transistor **42** for the purpose of more gain. In the absence of an input signal the current through relay **46** and transistor **42** is small and relay opening will be prevented; when a signal of a suitable magnitude is impressed on transistor **42** from transistors **30** and **36**, the current through relay **46** increases and it will be energized. Variable resistor **44** effectively changes the amplification of the amplifier and hence determines the input signal amplitude necessary for relay opening. The signal thus transmitted to relay **46** energizes relay **46** opening its normally closed contacts **48** which are connected to the pinspotter control mechanism CM.

The operation of bowling pin spotting machine M, occurs after each ball of a frame is rolled. The ball contacts cushion H swingably mounted in pit P, actuating start switch B on control mechanism M. In the sequence of operations of machine M, sweep S thereof is moved down to a guard position adjacent the playing surface of alley A, as shown in dotted lines in Figure 1 before table T moves downward toward alley A. When sweep S is in guard position, if relay **46** is energized and contacts **48** are open as described hereinabove due to a pin wobble, further operation of the machine is interrupted by the open contacts **48** and remains in that state as long as the wobble signal is transmitted from transistor **42** to relay **46**. When the amplitude of this signal decreases below a predetermined level to over come the bias set on transistor **42** by potentiometer **44**, relay **46** will be de-energized, closing contacts **48** and allowing the cyclic operation of the machine to resume.

Capacitors **50** and **52** connected across transistors **30** and **36** respectively, operate to by-pass the high frequency signals produced by a pin **11** wobbling with an extremely short cycle of movement; such as, when the pin **11** is coming to rest after a severe wobble. Since these high frequency signals indicate that the wobbling pin is coming to rest the filter system comprising capacitators **50** and **52** is set at a pre-determined frequency to absorb these signals and prevent them from being interpreted by the amplifier and thereby unduly continuing the interruption of the cyclic operation of the pin spottting machine M.

Resistors **54**, **56** and **58** are used to set the transistors **30** and **36** to their correct operating conditions. Since the signal generated by pin wobble is of the alternating cur-

rent type, capacitor 60 is connected across relay 46 to absorb a charge during the electron flow energizing relay 46 and transmit its stored charge to relay 46 when the signal alternates, thereby continuously energizing relay 46 during the entire electron flow of the induced signal assuring that the operation of the associated bowling pin spotting machine will be completely incapacitated during this period.

Transistors 30 and 36 are operated as voltage amplifiers and transistor 42 is operated as a current amplifier. This novel three-stage design for amplifier 27 is dictated by the necessity of amplifying a very weak signal through the first two stages and then using this amplified signal to cause relatively large current variations in the third stage to operate relay 46. To accomplish this, the first two stages are operated with low collector voltages and the third stage is operated with a higher collector voltage.

Figure 6 also illustrates diagrammatically a suitable power supply circuit to obtain the desired collector voltages in the three stages of amplifier 27. This power supply circuit uses the standard 110 volts, 60 cycle, line supply generally available. This line supply controlled by switch 61, is passed through a conventional type of current rectifier 62 and the output filtered by resistor 64 and capacitor 66. This output is next fed to a filtered voltage divider circuit consisting of resistors 68 and 70 and capacitor 72 for the supply to the first two stages of the amplifier and resistors 74, 76, and 78 and capacitor 80 for the third stage voltage supply. Also, the power supply circuit is provided with a resistor 63 and suitable pilot light 82; such as a neon tube, to indicate that amplifier 27 is energized.

A modified form of bowling pin which has been used satisfactorily is illustrated in Figure 5. Ring 26 in pin 11 in the preferred embodiment has been eliminated and replaced by a paint layer 84 applied to the base of pin 11. All other parts of this modification are identical in construction and operation to like parts heretofore described in the preferred embodiment.

Paint layer 84 is applied, preferably by spraying, to the base of pin 11 such that it will be in contact with cover 22 and directly over gap 24. The paint comprising paint layer 84 contains ferromagnetic materials which permits paint layer 84 to function in like manner to ring 26 in the preferred embodiment to produce a pin wobble signal in its associated coil 20. It has been found preferable to use a paint consisting of an epoxy resin containing polyiron for this purpose.

A third modified form of the invention shown in Figure 7 is to incorporate the ferromagnetic material into the construction of the base ring 86 of a bowling pin 11. Base ring 86 of the pin 11 may be similar in construction and operation to that disclosed in Downey Patent 2,739,814 for a Bowling Pin. A ferromagnetic substance, preferably polyiron powder, is added to the liquid plastic which is then cast as the base ring 86 of the pin 11. With the addition of the ferromagnetic substance to its construction, base ring 86 will function in like manner to ring 26 in the preferred embodiment to produce a pin wobble signal in its associated coil 20. However, since in this case the ferromagnetic material is of larger diameter, the diameter of the sensor is increased so that its gap lies directly under the ring and is concentric with it when the pin is spotted.

It will be noted that the plate or ring 26, Figure 2, the paint layer 84, Figure 5, and the base ring 86, Figure 7, all constitute magnetic means carried by the bowling pin and operative to co-act with the inductive sensor mechanisms 10 to generate signals upon occurrence of wobbling of the pins. While these magnetic means have been chosen to illustrate the invention, and are particularly advantageous, it will be apparent to those skilled in the art that the bowling pins can be provided with various other types of magnetic means capable of co-acting with the inductive sensors to generate signals upon occurrence of pin wobble and that the use of such other types of magnetic means constitutes no departure from the scope of the present invention.

I claim:

1. In a bowling alley installation of the type comprising an alley bed and a spotting machine for spotting and re-spotting on the alley bed a set of bowling pins each equipped with magnetic means, a pin wobble detector comprising the combination of a plurality of electrical inductance elements mounted in the alley bed and each located in a different one of the pin spot positions thereof, each of said inductance elements including a permanent magnet and a coil; an operating circuit, said coils being connected in said operating circuit in series, the magnetic means of the bowling pins each co-acting with one of said inductance elements to generate a signal in the corresponding one of said coils in response to wobbling of any individual pin on the alley bed; means connected in said operating circuit to amplify such signals; and control means in said operating circuit selectively operative in response to a predetermined signal amplitude to prevent the spotting machine from operating after the rolling of a ball until the wobbling pin has returned to a condition of stable equilibrium on the alley bed.

2. The invention as defined in claim 1 wherein said control means includes a variable resistor connected to said amplifying means, a relay, means connecting said relay to said amplifying means, the contacts of said relay being connected in the control circuit of the bowling pin machine, said variable resistor being operative to regulate the signal delivered by said amplifying means to said relay in such fashion that only signals of a pre-determined amplitude will be transmitted to said relay whereby said relay is selectively energized and said contacts thereof opened, interrupting the control circuit of the machine stopping the operation thereof.

3. In a bowling alley installation, the combination of an alley bed; a bowling pin spotting machine including an electrical control circuit; a set of bowling pins, said spotting machine being operative to spot and respot said pins on said alley bed in response to the condition of said control circuit; a plurality of permanent magnets mounted in said alley bed each at a different one of the pin spot positions thereof; a plurality of induction coils mounted each within a different one of said permanent magnets; an operating circuit, said coils being connected in said operating circuit in series; means carried by each of said pins and operative to co-act with said magnets to generate a signal in the corresponding one of said coils in response to wobbling of a pin on said alley bed; an amplifier connected in said operating circuit to amplify such signals; and relay means connected in said operating circuit to respond to amplified signals from said amplifier, said relay means being connected to said control circuit of said spotting machine and being operative in response to a predetermined amplified signal amplitude to condition said control circuit to prevent said spotting machine from operating after the rolling of a ball until the wobbling pin causing such signal has returned to a condition of stable equilibrium on said alley bed.

4. The invention as defined in claim 3 wherein said means carried by each of said pins comprises a disk of magnetically permeable metal imbedded in the base of each of said pins.

5. The invention as defined in claim 3 wherein said means carried by each of said pins comprises a paint containing ferromagnetic particles applied to the base of each of said pins.

6. The invention as defined in claim 3 wherein said means carried by each of said pins comprises a base plate for each of said pins containing ferromagnetic particles.

7. The invention as defined in claim 3 and further comprising a variable resistor, and means connecting said variable resistor to said amplifier whereby said vari-

able resistor is operative to regulate the signals supplied from said amplifier to said relay in such fashion that only signals of pre-determined amplitude will be transmitted from said amplifier to energize said relay.

8. In a pin wobble detector for use with an automatic bowling pin spotting machine for spotting on the bed of a bowling alley a set of bowling pins each equipped with magnetic means, the combination of a plurality of voltage generating elements each including a permanent magnet and a coil and each adapted to be mounted in the playing surface of the alley bed under a different one of the pin spot positions thereof; an operating circuit, said coils being connected in series directly in said operating circuit, the magnetic means of the bowling pins co-acting with said voltage generating elements, upon wobbling of a pin, to generate a signal in the coil of the one of said voltage generating elements above which the wobbling pin is located; means connected in said operating circuit to amplify such signal; and control means connected in said operating circuit and adapted for connection to the control circuit of the spotting machine, said control means being selectively operative in response to a predetermined amplified signal amplitude to interrupt the operation of the spotting machine until the amplified signal amplitude has decreased to within limits indicating that the wobbling pin has returned to a condition of stable equilibrium on the alley bed.

9. In a pin wobble detector for use with an automatic bowling pin spotting machine for spotting on the bed of a bowling alley a set of bowling pins each equipped with a ferromagnetic element, the combination of a plurality of permanent magnets adapted to be mounted in the playing surface of the alley bed each under a different one of the pin spot positions thereof; a plurality of induction coils each mounted within a different one of said magnets; an operating circuit, said coils being connected in series directly in said operating circuit, the ferromagnetic elements of the bowling pins each co-acting with one of said magnets to generate a signal in the corresponding one of said coils in response to wobbling of the respective pin on the alley bed; amplifying means connected in said operating circuit to amplify such signals; a relay connected in said operating circuit to respond to signals from said amplifier and having contacts adapted to be connected into the control circuit of the spotting machine, said relay being operative, in response to a predetermined amplified signal amplitude which is representative of the wobbling of a pin, to open said contacts, thereby interrupting the control circuit of the spotting machine, and to maintain said contacts open until the amplified signal amplitude decreases to a level indicating that the pin has returned to a condition of stable equilibrium on the alley bed, and to thereafter close said contacts to permit operation of the spotting machine.

10. A bowling alley installation comprising means providing a playing surface, a pin spotting machine for spotting and re-spotting bowling pins on said playing surface, a set of bowling pins, a plurality of electrical inductance elements located each in a different one of the pin spot positions of said playing surface and each including a permanent magnet and a coil, an operating circuit, said coils being connected in said operating circuit in series, means in each of said pins to co-act with each of said inductive elements to generate a signal in said coils in response to the wobbling of any individual pin, means connected in said circuit to amplify such signals, and control means in said circuit selectively operative in response to a predetermined signal amplitude to prevent the movement of said spotter toward said playing surface after rolling of a ball until the wobbling pin has returned to a position of stable equilibrium on said playing surface.

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