United States Patent

[11] 3,587,012

[72] Inventor **Leonard Piekarski**
Pomona, Calif.

[21] Appl. No. **6,038**
[22] Filed **Jan. 26, 1970**
[45] Patented **June 22, 1971**

[73] Assignee **Smyth, Roston & Pavitt**
Los Angeles, Calif.

[54] **MAGNETICALLY ACTUATED DETECTING AND SWITCHING DEVICE**
10 Claims, 10 Drawing Figs.

[52] **U.S. Cl.** **335/205,** 335/207
[51] **Int. Cl.** **H01h 36/00**
[50] **Field of Search** 335/205, 206, 207

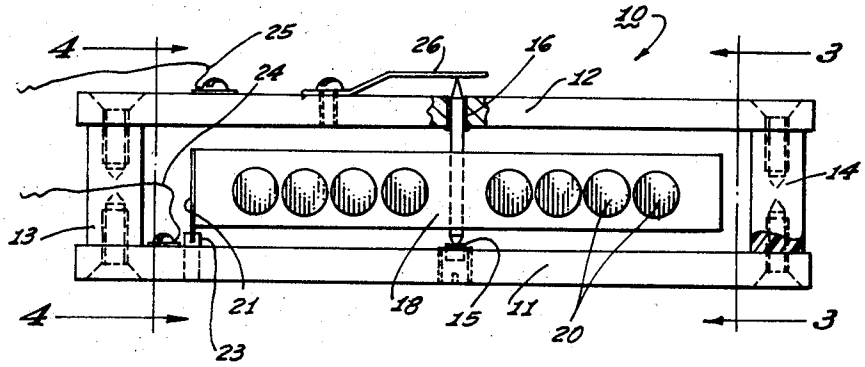
[56] **References Cited**

UNITED STATES PATENTS

2,240,891	5/1941	Marchant	335/205
2,681,960	6/1954	Ellison	335/205 X

Primary Examiner—Bernard A. Gilheany
Assistant Examiner—Roy N. Envall, Jr.
Attorney—Ralf H. Siegemund

ABSTRACT: A car-detecting device is suggested in which a plurality of permanent magnets are symmetrically mounted on a support member to define a common magnetic axis. A shaft on the support member has a vertical axis intersecting transversely the magnetic axis. The lower end of the axis of the shaft is journaled in a needle bearing. The upper end of the shaft traverses a feedthrough bearing inhibiting pivoting of the support member around a horizontal axis. Electric current is fed to the support member through a contact engaging the upper end of the shaft. The support member is provided with a contact cooperating with a stationary contact or a pair of stationary contacts positioned in the angular deflection path of the contact on the support member to serve also as stop for limiting rotation and angle of deflection of the support member with the permanent magnets. This system is preferably used in that normally the magnets align themselves with earth's magnetic field without contact making as between the two contacts. The contacts operate on circuit means responding when a car deflects the permanent magnets from their alignment with the earth magnetic field.



PATENTED JUN 22 1971

3,587,012

SHEET 1 OF 2

Fig. 1

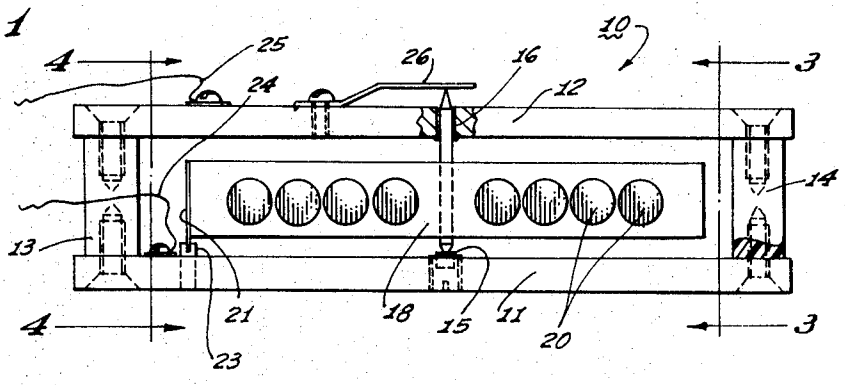


Fig. 2

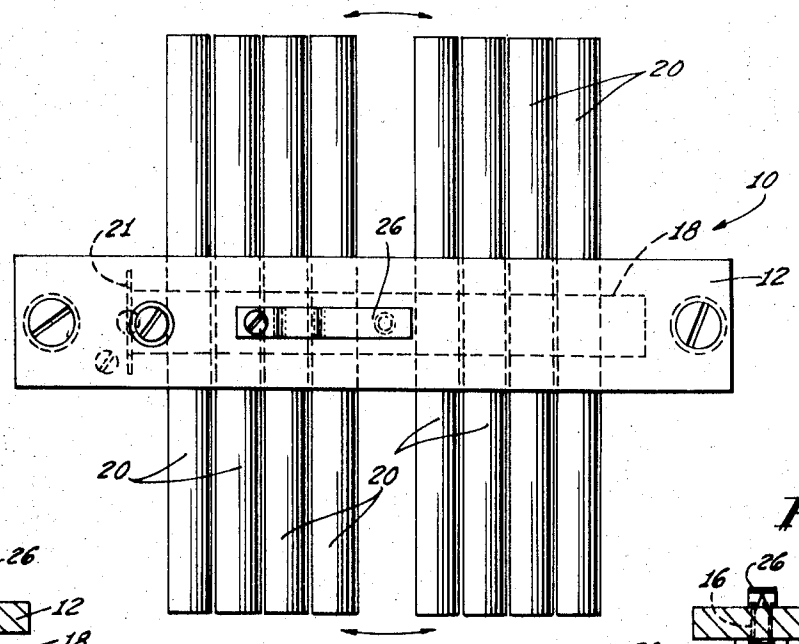


Fig. 4

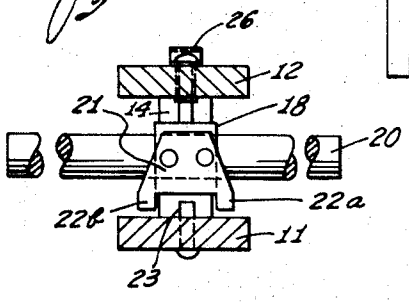


Fig. 3

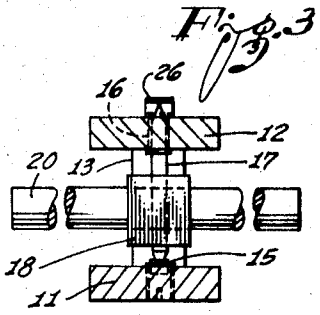


Fig. 10

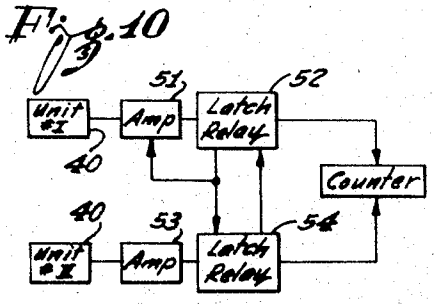
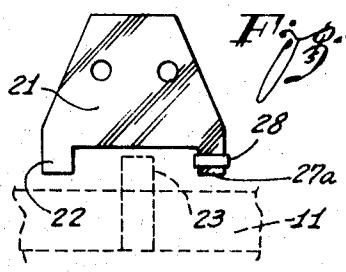


Fig. 5



INVENTOR:
Leonard Piekarski

By Smyth, Roston & Pavitt
Attorneys

Fig. 6

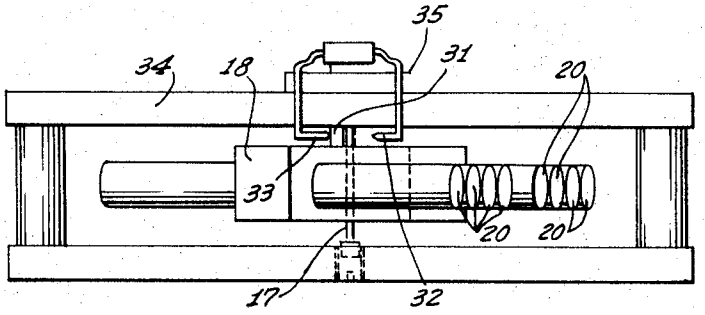


Fig. 7

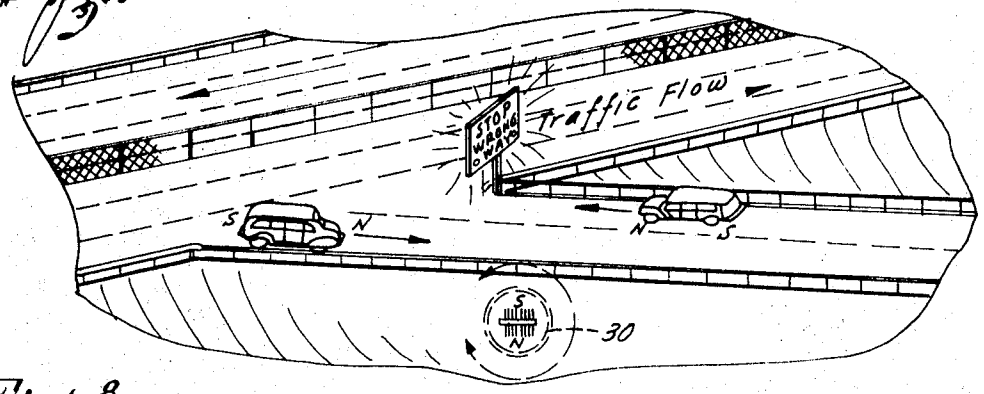


Fig. 8

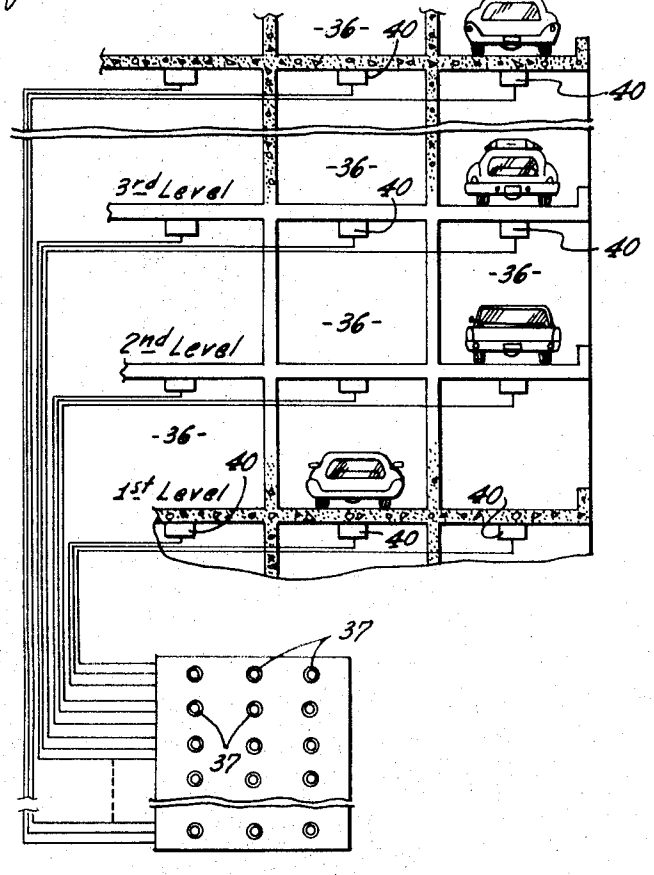
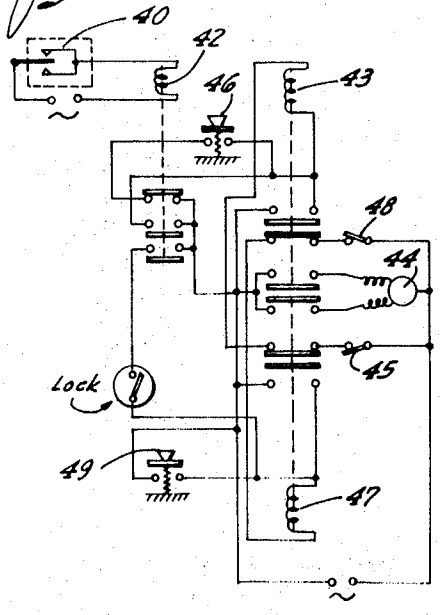


Fig. 9



INVENTOR:
Leonard Piekarski

By Smyth, Roston & Pavitt
Attorneys

MAGNETICALLY ACTUATED DETECTING AND SWITCHING DEVICE

The present invention relates to a magnetically actuated detecting and switching device.

It is a primary object of the present invention to provide a new magnetically actuated switching system which responds to objects emanating a magnetic field which permits their detection over comparatively large distances.

It is another primary object of the present invention to provide a new detection, signalling or control system which responds to automobiles only without responding to attempts, willful or accidental to tamper with such system.

It is another object of the present invention to provide a new and improved system for detecting the presence of automobiles and to signal and initiate control functions such as garage door control, wrong-way warning in highways, counting operations, etc.

It is another object of the present invention to provide a magnetically actuated switching device in which the switching action suffices to enable signalling without requiring current or voltage amplification.

It is a further object of the present invention to provide a magnetically actuated switching device having a directional feature in that it can distinguish between different directions of approach of an object which causes the switching device to respond.

The principle drawback of conventional and widely used automobile detection systems is their susceptibility to easy tampering, resulting from the fact that such detector systems do not respond to automobiles alone. For example, photoelectric barriers or pressure sensitive detector switches will respond to any object actuating them. The present invention overcomes these drawbacks in that a car detecting and control system is equipped with a detector which can be shielded completely so that tampering is made practically impossible, first for reasons of the invisibility of the detector and, second, for reasons that the detector will respond to cars only. Use is being made of the basic fact, that each car, particularly the frame thereof has a permanent magnetization. The magnetic field lines resulting therefrom are easily recognizable over distances comparable with the dimension of the car.

According to one aspect of the present invention in the preferred embodiment thereof, it is suggested to provide a detector system which includes a frame made of electrically conductive but preferably magnetically insulated frame bars which are assembled by means of insulated spacers to define the frame. There is thus defined a top frame bar and a bottom frame bar. The bottom frame bar is provided with a needle bearing, while the top bar is provided with an aperture aligned with the needle bearing and being itself lined with a feedthrough bearing. A shaft is provided with needle points on either end and one of its needle points thereof engage the needle bearing while the other needle projects through the aperture of the second or top frame bar thereby being guided in the feedthrough bearing. The shaft serves for journaling a supporting member which has the form of a more or less elongated bar, but it is capable of clearing the frame. The member supports a plurality of preferably cylindrically shaped permanent magnets in such a manner that rotation is freely permissible around the axis of the shaft, while no torque is imparted by the shaft upon the frame, so that friction between the through bearing and the shaft is not increased by any load.

The supporting member of the magnets preferably is also made of electrically conductive but magnetically insulating material, such as aluminum, so as to permit electric current flow therethrough. Also, there is no insulation provided between the shaft and the magnet-supporting member. A leaf-spring-type contact is mounted with one end on top of the top frame bar, and this spring contact resiliently engages the other needle point of the shaft at a light contact pressure thereby permitting the flow of current from the top frame bar into the

shaft and the magnet-supporting member. Preferably switching contacts are provided by means of contact pieces which are movable relative to each other. One contact piece is, for example, a stationary contact pin mounted on the bottom frame bar, while a countercontact piece is disposed on the magnet-supporting member moving therewith to selectively make or break contact with the stationary contact pin. Additionally, the movable contact piece can be provided to serve as a stop member restricting angular movement of the magnetic assembly.

The frame with magnetic assembly is positioned so that rotation of the magnetic assembly is permitted in the horizontal plane. A zero or neutral position of the switching device is defined by a compass action, and the frame, therefore, is positioned so that, for example, an open contact situation occurs when the magnets align themselves with the earth's magnetic field. When an object, for example, a car, the frame of which always being permanently magnetized, approaches this magnetic switching device, a magnetic disturbance is created causing the detector to respond. The direction of rotation of the magnetic assembly due to magnetic interaction between it and the magnetic field of the car, is indicative of the direction from which the car approaches the magnetic switch. This fact may or may not be used as a direction-sensitive indicator which will be described more fully below.

Other objects, including even motorcycles, bicycles, people, etc. will not cause the detector to respond. Experiments have shown, that the detector can be mounted within a casing which may be submerged in or even under the pavement of a road or driveway, floor of a parking building, etc. The detector though invisible will still respond. Thus, tampering is possible only willfully and by a person who is equipped with a permanent magnet, but even this danger can be avoided almost completely by hiding the detector underneath the pavement. The possibility of tampering with the known devices results from the necessity of conspicuous placement thereof to define the detector range. The detector of the present invention is inconspicuously placeable, thus ensuring actuation only when desired.

While the specification concludes with claims particularly pointing out and distinctly claiming the subject matter which is regarded as the invention, it is believed that the invention, the objects and features of the invention, and further objects, features and advantages thereof will be better understood from the following description taken in connection with the accompanying drawing, in which:

FIG. 1 illustrates a side elevation of the magnetic switching device to be used in a system constituting the preferred embodiment of the invention;

FIG. 2 illustrates a top view of the same magnetic switching device;

FIG. 3 and 4 respectively illustrate cross-sectional views through plane III and IV as defined in FIG. 1;

FIG. 5 illustrates an alternative contact arrangement for the device shown in FIGS. 1 through 4;

FIG. 6 illustrates front elevation of a modified magnetic switching device in accordance with the invention;

FIG. 7 illustrates how the inventive switching device can be used as a direction sensitive signaling means to detect wrong-way traffic;

FIG. 8 illustrates schematically an inventive system for supervising a public lot building;

FIG. 9 illustrates schematically a system, including a circuit wiring diagram for a garage door opener; and

FIG. 10 illustrates schematically a two-unit counting system.

Proceeding now to a detailed description of the drawings in FIGS. 1 and 2 thereof there is shown a switching device used as a detector in the preferred embodiment of the present invention. The magnetic switching device is comprised of a frame 10 which includes flat bottom and top bars 11 and 12 respectively made of electrically conductive but preferably magnetically insulating or shielding material such as, for ex-

ample, aluminum. The two bars are kept apart by insulating spacers **13** and **14** screwed to the top and bottom bars to complete the supporting frame.

The bottom bar **11** carries a flat, waferlike element **15** supporting a jewel bearing such as a sapphire. A central bore in top bar **12** is aligned in vertical direction with the jewel of the bearing. The bore is lined with a sapphire, feedthrough bearing **16**. A double-pointed needle shaft **17** is seated with its lower needle point on the jewel bearing on wafer **15**, and the shaft projects through the bore and the sapphire feedthrough bearing **16**, so that the top needle point of shaft **17** projects beyond the top surface of frame bar **12**.

The needle shaft **17** serves as a pivot shaft for a support block **18**, which is also made of nonmagnetizable but electrically conductive material, such as aluminum. The support block **18** is provided with a plurality of parallel, cylindrical bores preferably having their respective center axes positioned in a common plane which extends transversely to the axis of the shaft **17**.

Each of these bores in member **18** receives a permanent magnet **20**. These permanent magnets **20** are cylindrical rods having a diameter of about one-quarter of an inch and a length of about 4 inches each. There are altogether eight such rods received by the supporting member **18**, four on each side of the pivot shaft **17**. The permanent magnets **20** have their respective magnetic axis positioned in a common plane and define common magnetic north and south pole regions.

The magnets **20** together with the supporting member **18** are preferably assembled in such a manner, that upon placing very accurately the frame **10** in a horizontal position, the pivot shaft **17** has a very accurately defined vertical position, and no torque is exerted upon this shaft **17** about any horizontal axis. Therefore, the bearing **16** receiving the shaft **17** is not subjected to any torque perpendicular to the plane of rotation of shaft **17**.

A contact piece **21** is screwed to one front end of supporting member **18**. Contact piece **21** has two downwardly projecting contact lugs **22***a* and **22***b*. These two contact lugs cooperate for contact making with a contact pin **23** which is mounted, for example, screwed or riveted, on the lower frame bar **11**. The pin **23** when abutting either one of the two contact lugs **22** and **22***b*, also serves as a stop to prevent the pivoting magnetic arrangement from deflecting by too large an angle out of the resting or normal, zero adjusting position which will be described more fully below. The contact pin **23** is in electrical conductive relationship with the lower frame bar **11**, and an electrical connecting wire **24** is connected electrically to bar **11** to apply electrical potential thereto.

The top frame bar **12** is provided with a fastener for another electrical connector **25**. Additionally, a leaf spring **26** is mounted on top of the frame bar **12** resiliently engaging the upper tip of the needle shaft **17** when the latter projects through the bearing **17**. The contact pressure exerted by leaf spring **26** upon the tip of needle shaft **17** is adjusted so that, on one hand, the rotation of shaft **17** is not retarded. On the other hand, the contact pressure is sufficiently strong to provide a sure and safe, arc-free current path into shaft **17** and capable of conducting an electric current sufficient to energize small relays, glow discharge lamps or the like.

Electric current is, therefore, permitted to flow from the connecting wire **24** into the frame bar **11** and the contact pin **23**, and from there into one of the contact lugs **22***a* or **22***b*, whatever lug abuts pin **23**. The current flows from the contact piece **21** into the supporting member **18**, through the shaft **17**, into the leaf spring **26**, and from there into the top frame bar **12** and into the cable **25**.

The magnetic detecting and searching device in accordance with the invention is primarily destined to govern this particular electric circuit. The circuit is interrupted when neither one of the lugs **22***a* or **22***b* engages the pin **23**. This disengaging position is the open contact or zero position of the inventive detector, and this position is attained by placing the switching device into a horizontal plane and by adjusting the direction of extension of the frame so that the permanent magnets **20** become aligned with the field lines of the earth's magnetic field.

As was briefly stated above, it has been found that a car and particularly the frame of the car, carries a permanent magnetization, providing the front of the car with a magnetic north pole, and the rear of the car with a magnetic south pole. The interaction of this field with the magnetic detector system of the invention disturbs the adjusted zero position of the detector when a car is in proximity of the detector. This interaction between magnets is stronger by far than any interaction between the permanent magnets and the unmagnetized steel body of the car. Furthermore, the interaction between the permanent magnets **20** of the detector and the permanent magnetization of the car's frame is not impeded by a magnetic shielding provided by a magnetizable environment such as, for example, the steel structure of a building or the like.

Whenever a car approaches the magnetic switching device or is in the vicinity thereof, up to several yards, the south poles of the permanent magnets are all attracted by the north pole of the front of the car, and thereby a rotary movement is imparted upon the magnetic switching device to connect either one of the lugs **22***a* or **22***b* with contact pin **23**. As long as the car is in the vicinity of this magnetic switching device, the contacts will remain closed as an indication of the presence of a car. The magnets are selected in such a manner that, on one hand, there is sufficient sensitivity over a relatively large distance as far as approaching or passing cars is concerned. On the other hand, the mass of the entire magnetic switching device is not large enough to require strong acceleration for firm and positive contact making as between either one of the lugs **22***a* and the contact pin **23**.

The magnetic switching devices as outlined above operates on the principle that the switch is actuated by magnetic interaction between a magnetic field such as set up by a car and the permanent magnets **20**. Of course interaction will also occur with steel masses, provided they are sufficiently close. However, the sensitivity can be adjusted to make this effect rather negligible. For example, by shielding and proper positioning of the switching device such undesired effects can readily be suppressed, whereby the device is made tamperproof.

The magnetic interaction between the magnetic field of a car and the magnets **20** causes a physical movement of the magnetic assembly including magnets **20** and the supporting member **18** as it is rotatably mounted about the shaft **17**. As was described above, this physical movement results from a magnetic disturbance exerted by an approaching magnetic field upon the north-south aligned permanent magnets, and this movement is used directly for purposes of contact making or breaking as desired.

Alternatively one could use this member **18** as a control element for moving a fan-type mask in and out of a light barrier, set up by a small light source and monitored by a photoelectric cell. Normally, light is permitted to reach the photoelectric cell, but when the magnetic assembly if deflected, the fan is being moved into the light path of the light barrier. It will be appreciated, that this does not negate the tamperproofness of the inventive system as the entire arrangement may be encapsuled, so that no influence other than from an active magnetic field may cause a response of the detector switch.

Alternatively one could use the supporting member **18** as a carrier for a capacitor plate cooperating with a second stationary capacitor plate, so that upon deflection by magnetic attraction as aforedescribed the capacitance set up by these two capacitor plates is varied to detune, for example, a tuned amplifier circuit as an indication of an approaching car. However, it should be mentioned that the switching device described with reference to FIGS. **1** through **5** is the preferred embodiment, because it has been found that the magnetic assembly as outlined above suffices to directly close the energizing circuit for a warning relay or the like, i.e., the electric current path running from a cable or wire **24** into the frame and

magnetic assembly and to the wire **25** is susceptible of direct utilization without electronic or other, more costly current amplification means.

The above-described zero position of the magnetic switching device as attained by placing the frame **10** in such a position that no contact is being made as between either one of the lugs **22***a* or **22***b* and the contact pin **23** when the magnets align themselves with the earth's magnetic field. However, it is also possible to have the magnetic switching device operate in a vertical plane, and adjustment can be made very simply by finding in a vertical plane the proper direction into which the frame **10** can be made to extend, so that the magnets **20** permit normal disengagement of the lugs **22***a* and **22***b* from the contact pin **23**.

The bearings **15** and **16** were described above as sapphire bearings. This selection is preferred but not essential as far as a particular material is concerned. It is important, however, that the bearings are sufficiently hard, and preferably a material of the Mhos scale of 9 and harder is selected. The shaft **17**, particularly the lower needle point thereof as well as the region where it engages the bearing **16**, should have a hardness which, in the Rockwell scale, is 63 and higher.

The permanent magnets **20** are preferably made of the Alnico type No. 5 having the dimensions outlined above. The utilization of permanent magnets is preferred. However, it is in the realm of possibilities to employ electromagnets, and cores with coils being supplied with a suitable current can be used. In this case, however, it is advisable not to use the bearings as a current path for the switching current, because one of the important features of sensitivity of the inventive switching device is the absence of any retarding force which prevents the magnetic assembly from oscillating freely about the adjusted neutral position.

Other forms of permanent magnets than the one illustrated in FIGS. **1** and **2** can also be used, but experiments have shown that cylindrical rods of dimensions as outlined above are preferred. The sensitivity decreases if, for example, permanent magnets of the same material but with square-shaped cross section are used, or if in lieu of the plurality of separated rods, one uses a single permanent magnetic plate. It has been found also, that a small spacing should be provided in between each of the permanent magnet rods, i.e., they should not engage directly, even though they have magnetically aligned axes.

FIG. **5** illustrates a modification of the contact-making device associated with the rotary magnetic assembly outlined above. In this case, the lug **27***a* is provided or covered with a sleeve **28** which is made of insulating material, so that no contact making is possible when the sleeve **28** abuts the contact pin **23**. In this way the magnetic switching device is rendered direction sensitive, but the lug **22***a* still stops excessive rotation.

If a car approaches the magnetic switching device from one direction the magnetic assembly will swing also in a particular direction, while a car approaching the switching device in the opposite direction will cause a rotation of the magnetic assembly in opposite direction. With the aid of the insulating sleeve **28** the switching device is adjusted so that contact making occurs only when a car approaches the switching device from one particular direction, and no contact is made when a car comes from the other direction.

This suggests the utilization of the magnetic switching device for example as a permanent installation in a freeway ramp. If a car drives along the ramp and approaches a suitably installed magnetic switching device from the correct direction, no contact making occurs because the pin **23** than abuts insulating sleeve **28**. Should, however, a car enter the ramp in the wrong direction the contact is established by the car lug **22***b*, and the pin **23** at a rather early moment enables an alarming device, audible or visible or the like, and triggered as a warning that a car travels in the ramp in the wrong direction.

FIG. **7** illustrates schematically how the invention can be used to detect such wrong-way traffic on a highway ramp or the like or any other one-way road. Reference numeral **30** denotes a switching device, in general, of the type outlined with reference to FIGS. **1** etc. and particularly showing the orientation of the magnetic poles of the permanent magnets in a resting and normal position. It is important to note, that the orientation in the normal position follows the earth's magnetic field. It is then decisive on which side of the road the magnetic switching device is being installed, because the desired magnetic switching action as resulting from a car entering the road the wrong way determines the polarity of the permanent magnets **20** to face towards such wrong-way traffic direction. On the other hand, from the description of the switching device it will be apparent that the directional sensitivity is attainable rather easily, because the magnetic switching device as such is strictly symmetrical. Thus, by putting the sleeve **28** on the appropriate contact lug, it can be determined which switching action, i.e., which direction of deflection of the magnetic assembly is to be suppressed and which sense of rotation is to be used for signalling purposes.

In FIG. **7** one can see that the top of the drawing is the northern direction so that the combined south poles of the switching device are normally pointing toward the northern direction. The road illustrated may be of the type in which the eastbound traffic is correct, i.e., this is an exit ramp, whereas any westbound car travels incorrectly. Therefore, it will be apparent that the magnetic north pole of a car when travelling in the wrong direction causes a deflecting motion of the magnetic switching device in the direction of the solid arrow. The switching device is provided so that this particular direction of deflection of the magnetic switching device is in fact registered and signalled.

An eastbound car, however, will not cause such a deflection, but will cause a magnetic attraction so that the magnetic assembly rotates in the direction of the dashed arrow, and the resulting switching action is inhibited.

It will be observed that after a car has passed next to the switching device, the south pole in the rear of the receding car continues the inducement of rotation of the switching device as initiated by the north pole of the car when it approached the switching device.

FIG. **6** illustrates a modification of the switching device described above, but it can also be used in the system shown in FIG. **7**. The frame structure is substantially similar to the one outlined above. However, the contact and switching arrangement is somewhat different. Also, in this embodiment the supporting member **18** when in normal position extends transversely to the plane of extension of the frame **10** (and of the drawing). The permanent magnets **20** when properly aligned for zero position run parallel to the extension of frame **10**. In other words, the suspension of the magnetic assembly is reversed by 90° in comparison with the suspension of the magnetic assembly shown in FIGS. **1** through **4**.

In the embodiment of FIG. **6**, the top portion of the supporting member **18** bears a contact pin **31** at a considerable distance from the axis of rotation. This contact pin **31** is capable of engaging either one of stationarily positioned prong-type contacts **32** and **33** extending from the top of the top frame bar **34**. The contact prongs **32** and **33** serve also as stop members to restrict the pivot motion of the supporting member **18** whenever pin **31** abuts either one of the two prong ends.

The lower frame bar **11** does not participate here in the current conduction and, therefore, no insulation is required as between the top and bottom frame bars. However, the prongs **32** and **33** are not mounted directly on the top frame bar **34**, but there is an insulating piece **35** interposed to separate the prongs from the frame bar **34**. The electric contact making as between the shaft pivoting the supporting member **18** and the frame bar **34** can be made similar to the one outlined with reference to FIG. **1**, so that prongs are maintained at one electrical potential and the bar **34** with shaft **17** etc. is maintained

at opposite potential. Also, either one of the prongs 32 and 33 can be deactivated electrically in placing an insulating cap over the prong point, thereby this prong with cap retains its function as deflection stopper for the magnetic assembly without making electrical contact.

FIG. 8 illustrates a second example of the present invention, there is shown schematically a garage building comprised of several parking floors, each floor being subdivided in a plurality of stalls 36. Beneath the floor of each stall, there is positioned one of the detector units 40 as shown in the figures described above. Each one of these detector units directly governs a glow discharge lamp 37 without requiring an amplifier. The power exerted by each of the detector units upon closing the respectively governed circuit contacts is sufficient for governing a circuit driving such glow-discharge-type lamp.

The detector units are shown to be mounted under or in the floor, i.e., they are invisible for each particular floor. It is a specific advantage of the present invention that a concrete floor or any other material may be provided in between the car to be detected. The detector unit is protected thereby against undesired response, but such shielding does not prevent response to the magnetic field of a car when in the respectively associated stall. The magnetic polarization of a car when entering the stall and when being therein is sufficient to maintain the detector unit in an activated position for as long as a car is parked in the stall. The stalls are usually wide enough so that cars in neighboring stalls will not influence the detector unit of the particular stall. The indicator lamps 37 are arranged at the ground floor near the entrance in a display panel 38 conveniently showing at a glance the location of filled and empty parking spaces in the building.

FIG. 9 illustrates a car detector circuit as it can be used as a garage door opener. Again, a detector unit such as 40 is positioned conveniently in the driveway underneath the concrete or at least in such a manner that the top of the units container is flush with the driveway surface. The position is selected that a car when in the garage, or when sufficiently remote from the driveway will not energize the detector.

The unit activates a small, low power relay 42, which in turn governs two relays 43 and 47. The energizing circuits for relays 43 and 47 are respectively governed by limit switches 45 and 48. Limit switch 45 is open only when the garage door is completely open, otherwise switch 45 is closed. Limit switch 48 is open only, when the garage door is completely closed, otherwise switch 48 is closed. When a car enters the driveway, unit 40 and relay 42 respond to energize relay 43 which in turn causes energization of a reversible motor 44 to run in such a direction that the garage door opens. Relay 47 cannot respond because switch 48 is open, but the limit switch 45 is closed as long as the garage door is not open, and only when the door is completely open, limit switch 45 opens, thereby deenergizing the relay 43, and the motor 44 comes to a stop. Of course allowance for a time lag may be made so that switch 45 may actually respond shortly before the door is completely open. The connection is made so that as long as the door is open, any response of relay 42 does not energize door open control relay 43. Door opening is possible additionally by temporarily operating a manually operable pushbutton switch 46.

When the car is in the garage, the magnetic detector unit 40 and, therefore, the relay 42 are not energized; since the door is still open, limit switch 45 is likewise open. For closing the garage door, the operator pushes a button switch 49 thereby causing the door close control relay 47 to energize. Relay 47 governs the circuit of motor 44 for reverse rotation. Thus, the door is now being closed. Relay 47 can be energized for as long as the garage door is open. When the garage door is completely closed, a limit switch 48 opens, thereby interrupting the energization for door close control relay 47. Relay 47 cannot be reenergized as long as switch 48 is open. The motor 44 when governed by relay 47 for reverse rotation is stopped when switch 48 opens.

Relays 43 and 47 are interlocked and it is being avoided that they energize concurrently and ruin the motor 44. Actuation of the unit 40 and energization of relay 42 is effective in the circuits of the two relays 43 and 47, but response is restricted to the one having its series connected limit switch closed.

As long as the car is in the garage, unit 40 and relay 42 are not energized. The door closed limit switch 45 is closed because the garage door now is closed and door-open-control relay 43 does not energize as long as pushbutton switch 46 is in open position.

When at any time thereafter the driver wants to take the car out of the garage, he pushes the switch 46 thereby energizing door-open-control relay 43 which holds over its own circuit, and motor 44 is energized to cause the garage door to open. Door close limit switch 48 closes as soon as the door leaves the completely close position. When the garage door is completely open, the holding circuit of relay 43 is interrupted due to the opening of door close limit switch 45. Now the driver removes car and the car enters thereby again the range of the detector unit 40, relay 42 energizes. Since limit switch 45 is open, relay 43 cannot respond when relay 42 is now energized, but relay 47 will be energized because switch 48 is closed and motor 44 will run in such a manner that the garage door is being closed.

In the meantime, the car will have moved out of the range of the detector 40, and relay 42 deenergizes, but closing control relay 47 holds over its own circuit until the door is closed. Limit switch 48 opens thereafter so that closing control relay 47 cannot be energized again via unit 40. When the car again enters the range of unit 40, the limit switch 45 is closed, so that in this case a response of unit 40 causes energization of door-open-control relay 43 and motor 44 opens the garage door.

It can be seen that energization of unit 40 and relay 42 by a car opens the door when closed, and closes the door when open. If a car is removed from the garage but stays in the driveway, and if it is desired to then have the door open, then prior to removal of the car, a locking switch 47′ must be opened to prevent energization of relay 47 by unit 40 and relay 42 as long as the car is in the driveway.

The advantage of this system is imminent if one considers that only an object such as a car having a magnetic field, is capable to energize unit 40, and no wireless transmission is necessary. Bicycles, motorcycles or persons in the driveway are not able to cause opening and closing of the garage door. The switches 46 and 49 can be suitably placed to prevent tampering, for example, inside of the house.

FIG. 10 illustrates an automobile counting system which is directionally sensitive. Two units 40, I and II of the type described above are positioned along the road in spaced apart relationship and at such a distance from each other, that a passing car will influence only one unit at a time. Each unit feeds an amplifier, which may be transistor-relay combination, there are thus two amplifiers 51 and 53. Amplifier 51 may be of the gated type and can be disabled and enabled. Amplifier 51 feeds a latch relay 52 which latches upon energization and disables amplifier 51 for preventing further response. Additionally, relay 52 when responding enables relay 54. Amplifier 53 when responding energizes relay 54 provided it was enabled previously by relay 52, and thereupon relay 54 unlatches relay 52. Relays 52 and 54 each furnish a signal to a two-step counter.

A car travelling in the desired direction will first energize unit I and amplifier 51 energizes relay 52 which latches, enables relay 54 and prevents amplifier 51 temporarily from further response. Relay 52 also furnishes the first counting step. Subsequently the car passes unit II, amplifier 53 responds and relay 54 unlatches relay 52 while providing the second step for counting this car. Should the car back up after having reached unit I but before being detected by unit II, then this car is not counted, and the circuit stays with the count half completed. The next car though influencing unit I, is not effective for relay 52, but when passing unit II this car will complete the count correctly. A car travelling the opposite direction will not be counted since relay 54 cannot respond unless unit I has responded first.

The invention is not limited to the embodiments described above, but all changes and modifications thereof not constituting departures from the spirit and scope of the invention are intended to be covered by the following claims.

I claim:

1. A car-detecting device, comprising:
a frame for positioning adjacent an area into which a car may enter, without physically contacting said frame, the frame having an upper and a lower member;
a supporting member including a shaft;
means on the frame journaling the shaft for rotation about a vertical axis, including a needle bearing on the lower member of the frame on which one end of the shaft rests, the upper member being provided with a through bearing traversed by the shaft and serving as means for inhibiting rotation of the shaft about a horizontal axis;
a spring-type element on the upper member resiliently engaging the other end of the shaft for making electrical contact with the other end of said shaft at a region thereof closely limited to the point where the axis of said shaft traverses said one end of said shaft;
permanent magnet means supported by said member and symmetrically disposed relative to said shaft; and
means on the frame and on the support member for limiting the angular deflection of the supporting member relative to the frame about the axis of the shaft and including first and second contact means respectively mounted on said frame and on said supporting member and in such a relation to each other that engagement of the first and second contact means limits the angular deflection of the support member, disengagement of the first and second contact means permits rotation of the support member moving the first and second contact means in relation to each other, said first contact means being insulated from said connection means, said second contact means being in electric connection with the support member and displaced from the magnet means.

2. A control system as set forth in claim 1, said frame being positioned in a driveway in front of a garage, and including circuit means connected to said first and second contact means and being energized when the position relation between the first and second contact means changes due to deflection of the permanent magnet by a car in the driveway, said electric circuit means including an electrical control means for operating a garage door.

3. In a device as set forth in claim 2, the magnet means comprising:
a plurality of substantially similar-shaped permanent magnets mounted on said supporting member and defining common magnetic north pole and south pole regions, there being a resulting magnetic axis;
the means journaling said supporting member with said magnets about an axis extending transversely to said magnetic axis;
electric circuit means; and
means on said supporting member for governing said electric circuit means.

4. In a device as set forth in claim 2, the magnet means comprising:
an even plurality of cylindrically shaped permanent magnets disposed on said supporting member at such magnetic orientation that the magnetical axis extend in parallel and substantially defining a common plane, the poles of said magnets are being similarly oriented.

5. A device as set forth in claim 1, the means including the first and second contact means comprising:
a pin on the supporting member serving as the second contact means, and a contact piece having two extensions mounted to the frame as the first contact means, the two extensions extending in the path of the pin upon rotation of the supporting member about said axis of the shaft for limiting the range of angular positions of the supporting member;
at least one of the extensions when engaging the pin providing closed contact relation of the first and second contact means.

6. A device as set forth in claim 5, the frame with the two extensions being positioned so that the pin is disengaged from both extensions when the permanent magnet means is aligned with the car's magnetic field.

7. A device as set forth in claim 6, the frame with the pin being positioned so that the two extensions are disengaged from the pin when the permanent magnet means is aligned with the earth's magnetic field.

8. A device as set forth in claim 1, the means including the first and second contact means comprising a pin on the frame as the first contact means, further comprising a contact piece having two extensions mounted to the supporting member as the second contact means, the two extensions extending in the path of the pin upon rotation of the supporting member about said axis of the shaft for limiting the range of angular positions of the supporting member;
at least one of the extensions when engaging the pin providing closed contact relation of the first and second contact means.

9. A magnetic switching device, comprising:
a frame including electrically conductive first and second frame bars, and further including insulating spacing members assembled with said frame bars to complete the frame, said second frame bar having an aperture, there being a feedthrough bearing in said aperture aligned with said needle bearing;
an electrical contact pin on said first frame bar;
a hard needle bearing on said first frame bar;
a shaft having upper and lower needle points and being received in said feedthrough bearing while one of said needle points rest on said needle bearing of said first frame bar;
a contact spring mounted on top of said second frame bar and engaging the other needle point of said shaft when projecting through said feed through bearing, and making contact with said other needle point;
a supporting member mounted on said shaft for rotation therewith;
a plurality of similarly shaped permanent magnets symmetrically supported by said support member to permit free rotary motion in a plane extending transversely to the axis of said shaft;
and a contact on said supporting member capable of engaging said contact pin for contact making thereby impeding further rotation of said supporting member and permitting disengagement from said pin, said pin and contact governing the flow of electric current from said first member through said supporting member and said shaft, said contact spring and said second frame bar.

10. A magnetic switching device comprising:
a supporting member having a shaft rotatably supporting said supporting member, said shaft having upper and lower needle points;
a first means providing a needle bearing to receive said lower needle pin permitting rotary movement of said member with said shaft;
second means providing a feedthrough bearing for said shaft;
means making electrical contact with said upper needle point;
permanent magnet means substantially symmetrically disposed in said supporting member relative to said shaft and having at least one magnetic axis extending transversely to the axis of said shaft;
first, stationary contact means positioned relative to said supporting member; and
second contact means on said supporting member moving therewith for relative contact making and breaking with said first contact means.