Oct. 4, 1949. P. W. ZACEK 2,483,717

MAGNETICALLY OPERATED SWITCH

Filed July 15, 1944

Fig-4

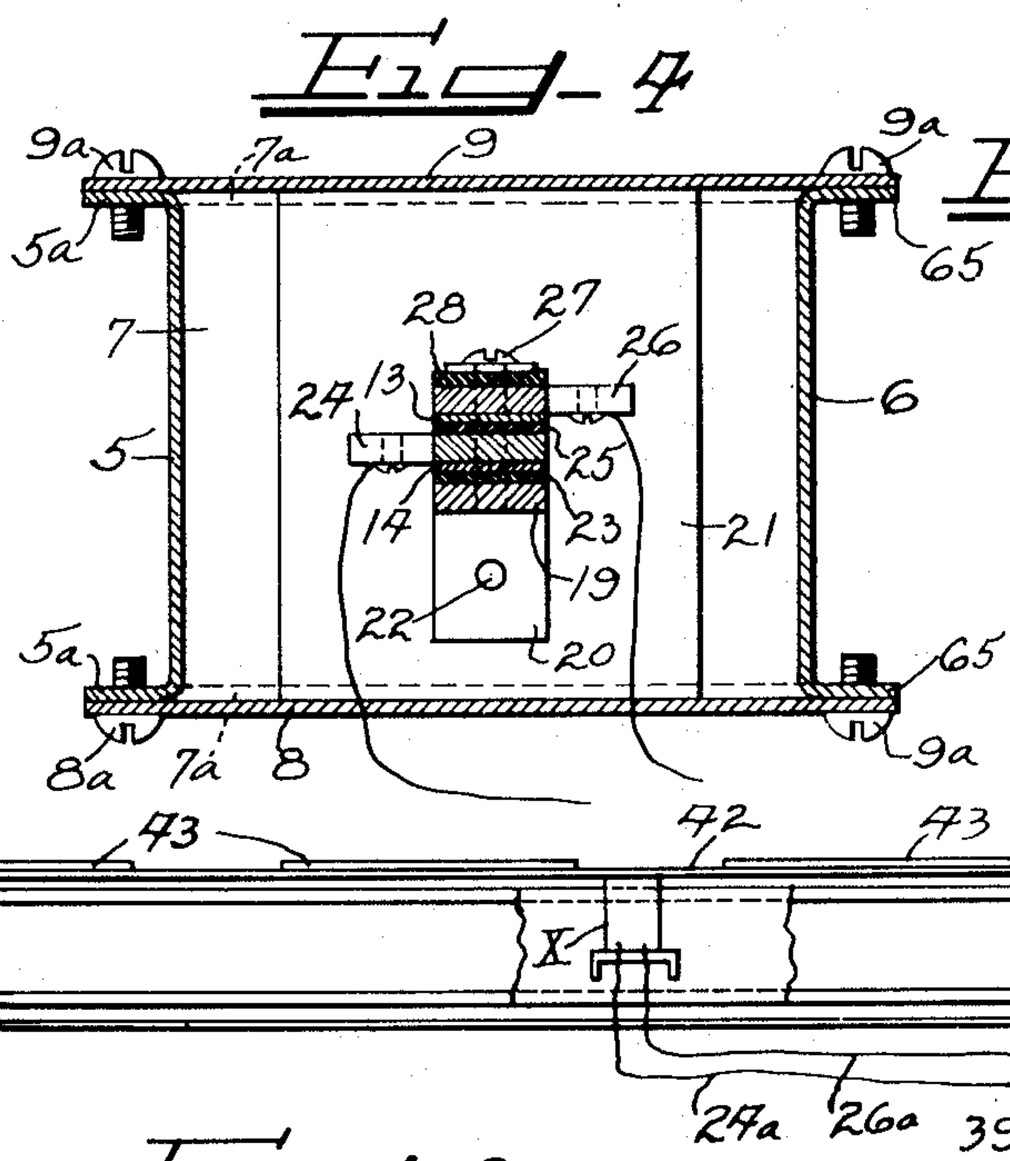


Fig-1

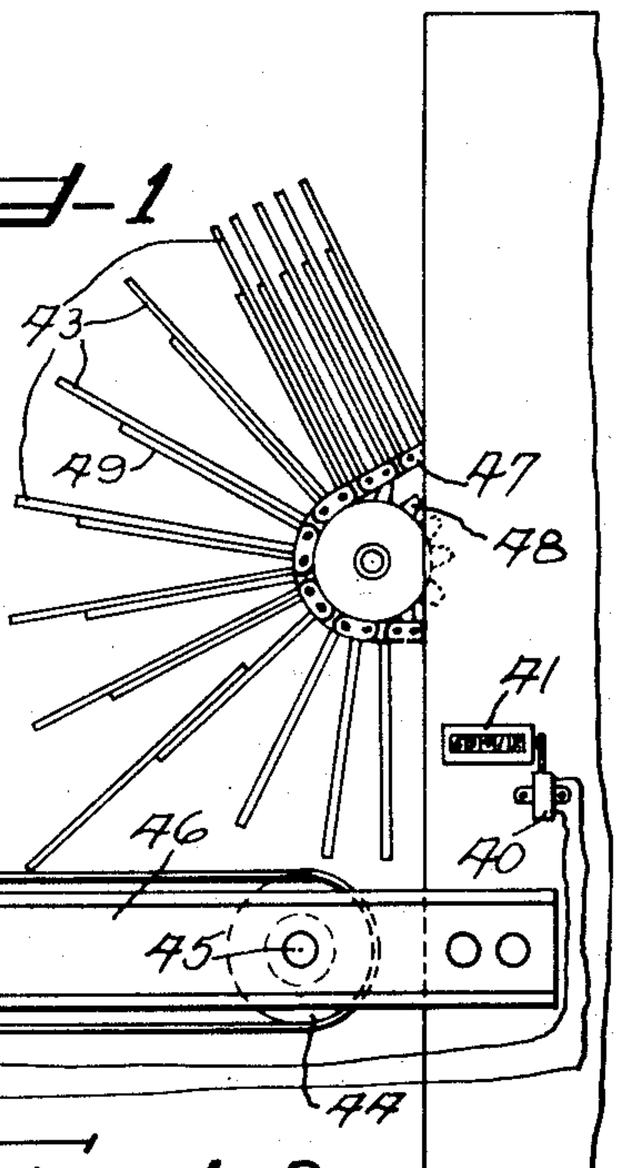


Fig-2

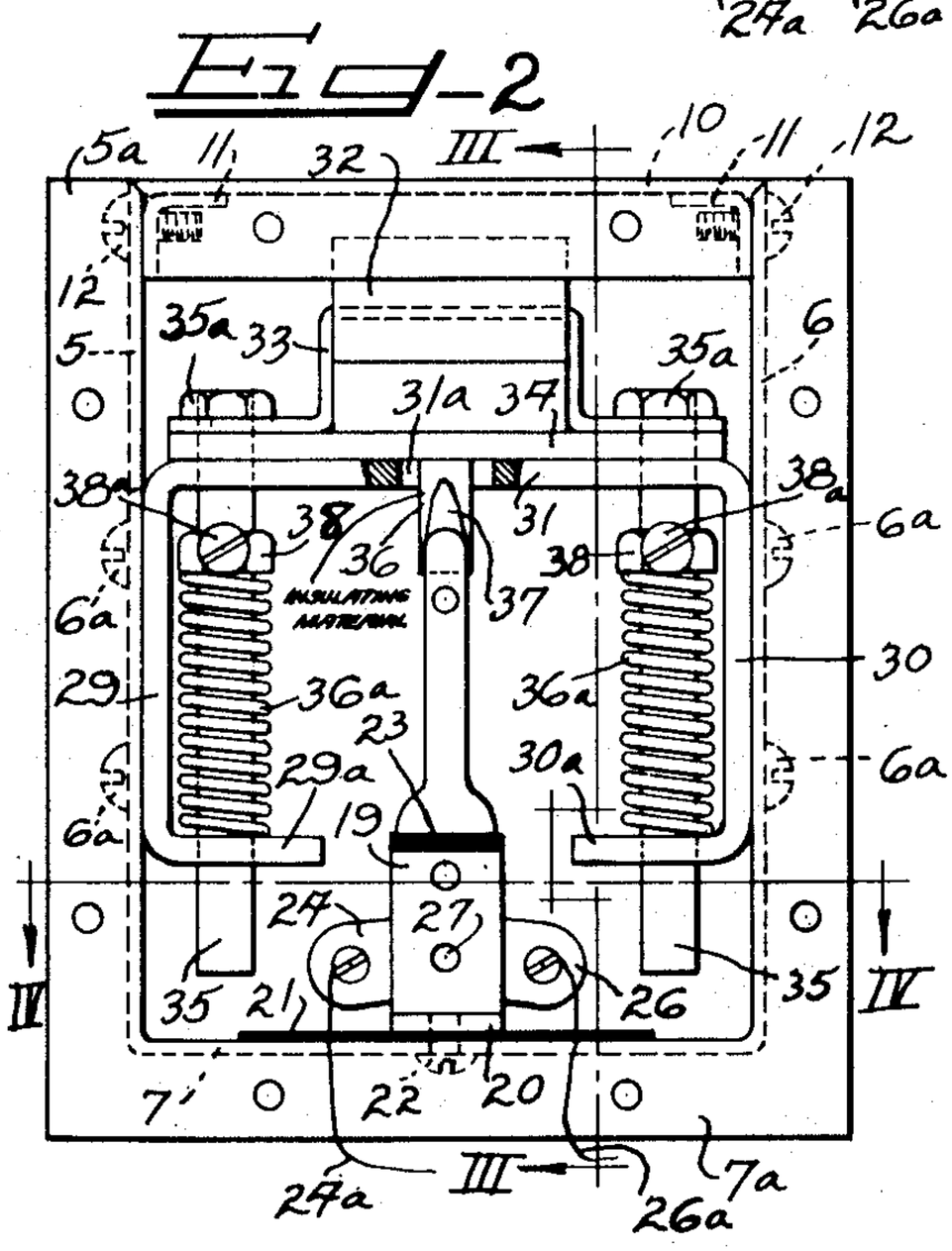
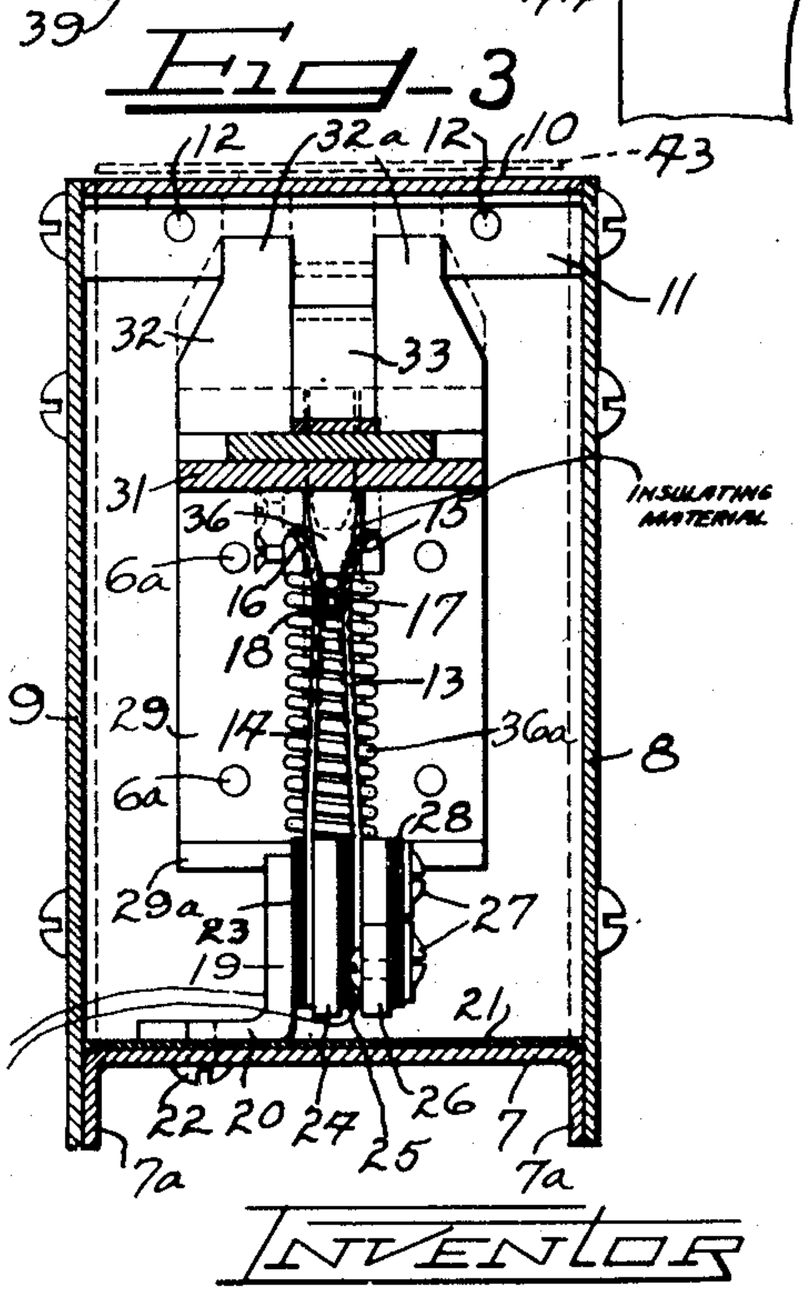


Fig-3



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MAGNETICALLY OPERATED SWITCH

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The present invention relates to a magnetically operated switch, and it has particular reference to a switch that is actuated by the movement of a magnet when it is attracted towards a ferro-magnetic member moved into its field.

It is one of the principal objects of this invention to simplify the construction of a magnetically operated switch such as contemplated herein, and to improve the efficiency, operation and dependability of such switch.

It is also a principal object of this invention to provide a switch that is actuated by the attraction of a permanent magnet toward a metal object moved into its magnetic field.

It is a further principal object of this invention to provide a switch that is actuated intermittently by a series of metal articles passing successively through the field of a permanent magnet.

It is also an object of this invention to provide a switch that is actuated by the lifting of a permanent magnet from a seat, and wherein the weight of the magnet is, to a large extent, somewhat counterbalanced, thereby requiring less effort to lift the magnet for operating the switch.

A still further object of this invention resides in providing a magnetically operated switch wherein the magnet is lifted or moved from a normal position to carry with it means that normally hold the members of the switch in one position and when the magnet has been displaced out of its normal position, such means will be withdrawn from the switch to close a circuit through said switch.

A magnetically operated switch of the character above suggested is especially effective where it is desired to count a plurality or series of metal articles that may be moved into and out of the field of the magnet, thereby operating this switch to electrically actuate a counter device.

Additional objects, aims and advantages of the invention contemplated herein will be apparent to persons skilled in the art after the construction and operation of the magnetically operated switch is understood from the within description.

It is preferred to accomplish the numerous objects of this invention and to practice the same in substantially the manner hereinafter fully described and as more particularly pointed out in the claims.

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Reference is now made to the accompanying drawings that form a part of this specification.

In the drawings:

Figure 1 is a longitudinal side elevation of a structure that is adapted to count metal objects by means of the instrumentalities of the present invention, the same being a magnetically operated electric switch for opening and closing a circuit in which the actuator for a counting device is interposed;

Figure 2 is a vertical elevation of a magnetically operated switch such as contemplated herein, the front closure plate having been removed from the casing;

Figure 3 is a vertical transverse section taken along the plane of line III—III on Figure 2 looking to the left in the direction of the arrows; and

Figure 4 is a horizontal transverse section taken along the plane of line IV—IV on Figure 2, looking in a downward direction.

The drawings are to be understood as being more or less of a schematic character for the purpose of disclosing a typical or preferred form of the improvements contemplated herein. In these drawings like reference characters identify the same parts in the different views.

As shown, the magnetically operated switch is enclosed within a suitable housing or casing that comprises parallel vertical side walls **5** and **6** and a bottom horizontal wall **7**. These walls are preferably integral and are formed in substantially U-shape as shown in Figure 2. Both margins of the vertical wall **5** are provided with outwardly extending lateral flanges **5***a*, and similarly the other vertical wall **6** is provided with outwardly extending lateral flanges **65**. Lateral downwardly extending flanges **7***a* extend along the edges or margins of the bottom wall **7**. All of these flanges on each side of the housing are preferably integral as seen in Figures 2 and 3, and are in the same plane, as shown in Figure 4, to receive the cover plates **8** and **9** respectively that lie against the respective flanges and are secured thereto by screws **8***a* and **9***a* respectively. The spaced upper margins of the vertical walls **5** and **6** are adapted to receive the top closure plate **10** having angle metal strips **11** along opposite edges. The vertical flanges of said strips are engaged with the upper portions of walls **5** and **6** to which they are secured by screws **12** the shanks of which pass through these walls **5** and **6** and through the adjacent flanges of the angle strips **11** as seen in Figure 2.

The switch comprises a pair of opposing switch arms **13** and **14** that are preferably formed of

pieces of spring metal and are arranged in a manner to normally urge them towards each other. At their upper ends these arms have outwardly bowed portions 15 and 16 respectively that flare away from each other as shown in Figurs 3. Adjacent the outwardly flared end portions, these arms 13 and 14 are provided with opposing contact blocks 17 and 18 respectively that are normally out of engagement with each other as shown in Figure 3, for maintaining the electric circuit normally open.

The lower portions of the flexible switch arms 13 and 14 are spaced from each other and are anchored to the upstanding member 19 of a mounting bracket of angle shape, the horizontal member 20 of which rests upon an insulating plate 21 on the bottom wall 7 of the housing and is anchored to said bottom wall by screws 22. The arm 14 is maintained out of contact with the bracket member 19 by an insulating spacer 23 and upon its face opposite the bracket member it is in electrical contact with a metal terminal piece 24. An insulating spacer 25 is interposed between this terminal piece 24 and the adjacent lower portion of the other switch arm 13 that is in electrical contact with its terminal piece 26. Thus the arms 13 and 14, the insulating spacers 23 and 25, and the terminal pieces 24 and 26 provide a laminated assembly as shown in Figures 3 and 4. This assembly is secured to the upstanding member 19 of the mounting bracket by means of flanged head bolts 27 that pass through an insulating spacer 28 on the outer face of the terminal 26 and then through holes in the other members of the switch and are screwed into the upstanding member 19 of the supporting bracket as seen in Figure 3.

The means for operating the hereinbefore described switch are mounted upon an inverted substantially U-shaped frame that comprises vertically disposed spaced side members 29 and 30 and a connecting or top member 31 that is horizontally disposed in the manner shown in Figure 2. The side members 29 and 30 of this mounting frame are engaged against the inside surfaces of the housing walls 5 and 6 respectively to which they are secured by bolts or screws 6*a*. The lower portions of the side members 29 and 30 are bent laterally towards each other to provide inwardly projecting horizontal flanges 29*a* and 30*a* respectively with their ends in spaced relation.

The magnet 32, which is of the permanent type, is secured by means of a U-shaped strap 33 to the upper surface of a carrier plate 34. As seen in Figure 3 the intermediate portion of this strap 33 is seated in the channel between the spaced poles 32*a* of the magnet. The carrier plate 34 normally rests upon the horizontal connecting member 31 of the mounting bracket or frame, and said carrier plate is adapted to be lifted by the magnet wherever an article containing ferromagnetic material is placed in the field of the magnet to attract the latter and move it in an upward direction.

In order to guide the magnet and its carrier plate 34 elongated studs or guide rods 35 are secured to the end portions of the carrier plate 34 by nuts 35*a* screwed on the threaded upper ends of said guide rods. Each of these guide rods 35 passes through aligned openings in the horizontal member 31 and the respective flange 29*a* or 30*a* of the mounting frame as shown in Figure 2.

The means which coact with the magnet and its supporting plate for operating the switch arms 13 and 14 comprises a cam device preferably in

the form of a stud 36 of insulating material that is secured to the mounting plate 34 and passes freely down through an opening 31*a* in the horizontal member 31 of the magnet supporting frame. This camming stud 36 has wedge shaped or tapered faces 37 to enter between the flared end portions 15 and 16 of the switch contact arms 13 and 14 in the manner shown in Figures 2 and 3.

The guide rods 35 are surrounded by expansion coil springs 36*a* that are seated at their lower ends on the flanges 29*a* and 30*a* respectively of the frame and the upper portions of these springs terminate beneath the horizontal frame member 31 where they are engaged with adjustable stops 38 on the guide rods 35 and held in place by screws 38*a* to adjustably tension the springs 36*a*. The energy exerted by the springs is preferably insufficient to lift the magnet 32 and carrier plate 34 and it therefore allows the magnet and carrier to rest upon the top surface of the cross member 31 of the supporting frame. In other words, the tension of the spring does not have sufficient energy to actually lift the magnet assembly, but such energy will materially assist in balancing the weight of the magnet to such an extent that whenever a ferro-magnetic metal is placed in the field of the magnet, the latter will be displaced upwardly as shown in dotted lines in Figure 3.

The upward movement of the magnet and its carrier will withdraw the cam stud 36 from between the ends of the contact arms 13 and 14 to permit them to move towards each other until the contact blocks 17 and 18 are engaged thus to close the circuit through the conductor wires 24*a* and 26*a* that are connected to the terminals 24 and 26 respectively. The wire conductors 24*a* and 26*a* receive electric current from the suitable source such as a battery 39, and when the arms of the switch are closed this electric current passes through and energizes a solenoid device 40 interposed in the circuit for actuating a suitable counter device 41.

In Figure 1 the magnetic switch unit assembly is identified generally as X, and as shown in this figure the top plate 10 of the housing is close to or in contact with a traveling belt or other suitable conveyor 42 upon which articles 43 containing ferro-magnetic material are disposed in tandem arrangement and are suitably spaced from veach other to successively enter and leave the field of the magnet 32. The conveyor or belt 42 is trained upon suitable rollers 44, one of which is shown in Figure 1, and the trunnions 45 of the rollers 44 are journalled in spaced, horizontally disposed parallel angle metal sills 46. Means are provided for feeding or depositing these artices 43 successively upon the traveling apron or conveyor 42 as shown at the right in Figure 1. This feeding means preferably comprises a chain conveyor 47 engaged with sprockets 48 and provided with laterally disposed paddles or plates 49, which, while the chain conveyor 47 passes around the sprockets 48 are adapted to discharge or deliver the articles 43 one at a time so that they are arranged in spaced relation in a longitudinal row along the top of the belt or conveyor 42 as schematically shown in Figure 1.

From the foregoing it will be seen that, as each article 43 enters the field of the magnet 32, the magnet will be drawn upwardly away from its seat on the frame member 31, thereby withdrawing the stud or cam device 36 from between the flared ends 15 and 16 of the switch

arms 13 and 14, which permits said arms to move towards each other until the contact blocks 17 and 18 have engaged each other. This closes the circuit through the conductors 24a and 26a to energize the solenoid 40 which will thereby move the counter one digit. When the article 43 passes out of the magnetic field as shown in Figure 1 the magnet will be free to return or drop back to its normal position on the horizontal member 31 of the frame. At the same time the wedge member or cam device 36 will enter between the flanged ends 15 and 16 of the switch arms, thereby forcing these arms apart and disengaging the contact blocks 17 and 18 to open the circuit through the conductors and deenergize the solenoid which will return to its normal position until the circuit is reformed when the next article 43 enters the field of the magnet.

It will, of course, be understood that various details of construction may be varied through a wide range without departing from the principles of this invention and it is, therefore, not the purpose to limit the patent granted hereon otherwise than necessitated by the scope of the appended claims.

I claim as my invention:

1. A magnetic switch construction comprising, in combination, a frame structure including a spaced apart pair of U-shaped members extending vertically and opening horizontally, said U-shaped members having the top legs thereof in a common plane, a magnet structure supported upon said top legs, guide studs carried by said magnet structure and extending down slidably through the respective legs of said U-members, and counter-balancing coiled compression springs encircling said studs and cooperating at their upper ends with said studs and resting at their lower ends upon the lower legs of said U-members.

2. In combination in a magnetic switch construction of the character described, an upright frame structure, a magnet structure supported upon said frame structure and adapted to be raised therefrom in response to passage of a ferromagnetic article through the magnetic field above said magnet structure, a switch mounted below said magnetic structure, means on said magnet structure for operating said switch in response to movement of the magnet structure into and out of engagement with the frame structure, and a pair of guide studs projecting downwardly from said magnet structure, said frame structure having spaced horizontal members slidably engaging said studs for guiding the same in a vertical path.

3. In combination in a compact magnetic switch unit, a fully enclosing housing, said housing adapted to be mounted underneath a conveyor with the top closure of the housing closely adjacent to the path of movement of ferromagnetic articles over the conveyor, a supporting frame extending across the interior of the housing in spaced relation below said top closure having a centrol opening therein and having downwardly depending sides attached to said housing with inturned ends remote from said frame, guide studs slidably depending through said supporting frame and through said inturned ends to depend therebelow on either side of said housing, a magnet structure in the space between the frame and said top closure having said guide studs attached thereto and resting on said supporting frame, a cam device carried by said magnet structure projecting through said central opening in said frame, upwardly extending opposing yieldable switch arms below said supporting frame normally urged toward each other to close a circuit but separated by said cam device for breaking a circuit when said magnet structure rests on said frame, said magnet structure being movable toward said top closure in response to the passage of a ferromagnetic article across the top of said top closure whereby to attract the magnet upwardly, said cam device being withdrawn from said switch arms to close the circuit when the magnet structure is raised from the frame, said guide studs guiding said magnet structure in a straight vertical path, and compression springs telescoping over said studs between said supporting frame and said inturned ends of said frame sides, the lower end of each spring seated on one of said inturned ends and the upper end fixed with respect to the associated stud so as to urge said stud and said attached magnet structure upwardly, said springs serving to counter-balance but being insufficient alone to overcome the weight of said magnet structure.

4. A magnetic switch construction comprising, in combination, a frame structure including a pair of opposed U-shaped members extending vertically and opening horizontally, said U-shaped members having top legs thereof in a common plane, a magnet structure supported upon said top legs, guide studs carried by said magnet structure and slidably depending through the respective legs of said U-members, counterbalancing coiled compression springs telescoping over said studs and cooperating at their upper ends with said studs and resting at their lower ends upon the lower legs of said U-members, said magnet structure being adapted to be raised from said top legs with the aid of said springs in response to the proximity of a ferromagnetic article thereabove, a switch mounted below said magnetic structure, and means depending between said top legs for operating said switch in response to movement of the magnet structure into and out of engagement with the frame structure, the force of gravity alone being sufficient to return said magnet structure to rest upon said top legs against the resisting force of said counterbalancing springs when said ferromagnetic article is removed from proximity to said magnet structure.

5. In combination in an electrical switch construction of the character described, a supporting frame structure adapted to be mounted below the path of movement of ferromagnetic articles, a magnet structure supported on said frame structure and adapted to leave said frame structure and move toward a ferromagnetic article entering into the magnetic field thereof above said frame structure, guide studs extending from said magnet structure and slidably cooperating with said frame structure, springs engaging said frame, and means on said studs engaging said springs, said springs normally supporting a substantial portion of the weight of said magnet structure and assisting in raising the magnet structure from the frame structure coincident with attraction of the magnet structure by a ferromagnetic article as aforesaid.

6. A magnetic switch construction comprising, in combination, a frame structure including a space opposed pair of U-shaped members extending vertically and defining horizontal gaps, said U-shaped members having the top legs thereof in a common plane, a magnet structure supported

upon said frame structure and adapted to be raised therefrom in response to the passage of a ferromagnetic article through the magnetic field above said magnetic structure, guide studs carried by said magnet structure and extending down slidably through the respective legs of said U-shaped members for guiding said magnet structure in a straight vertical reciprocating movement, and means below said frame structure and adapted normally to support a substantial portion of the weight of said magnet structure and to assist in lifting the magnet structure from the frame structure coincident with attraction of the magnet structure by a ferromagnetic article as aforesaid.

7. In combination in a magnetic switch adapted to be used below the supporting run of a conveyor for detecting the passage over the switch of a ferromagnetic object, a support, a pair of opposed upwardly extending normally closed switch elements adapted to be connected in an electrical circuit and carried by said support in a fixed position and being separable by engagement of the upper end thereof for opening the circuit, a permanent magnet block, means for supporting said magnet block directly above said switch contact elements, and a contact element separating stud fixedly secured to and depending below the magnet block and in the lowermost position of the magnet block separating said switch elements, the magnet block being movable solely gravitationally downwardly, but being movable upwardly in response to the magnetic attraction of a ferromagnetic article passing over the switch, and said magnetic block automatically dropping back to

the lowermost, switch element separating position thereof in the absence of a ferromagnetic article above the switch.

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