Oct. 14, 1958 E. B. CLARK 2,856,580

MAGNETIC INSERT FINDER

Filed Sept. 30, 1957 3 Sheets-Sheet 1

FIG. 1.

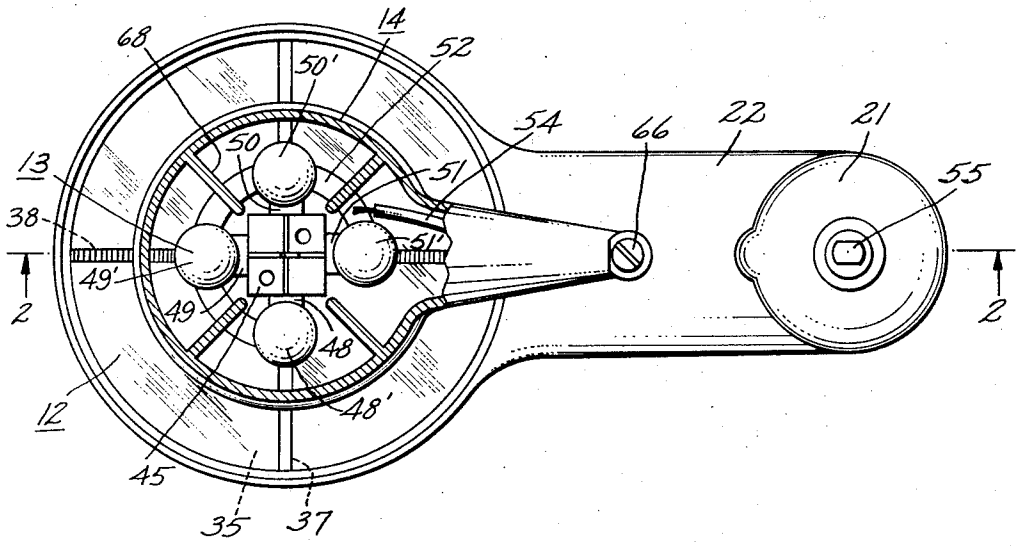
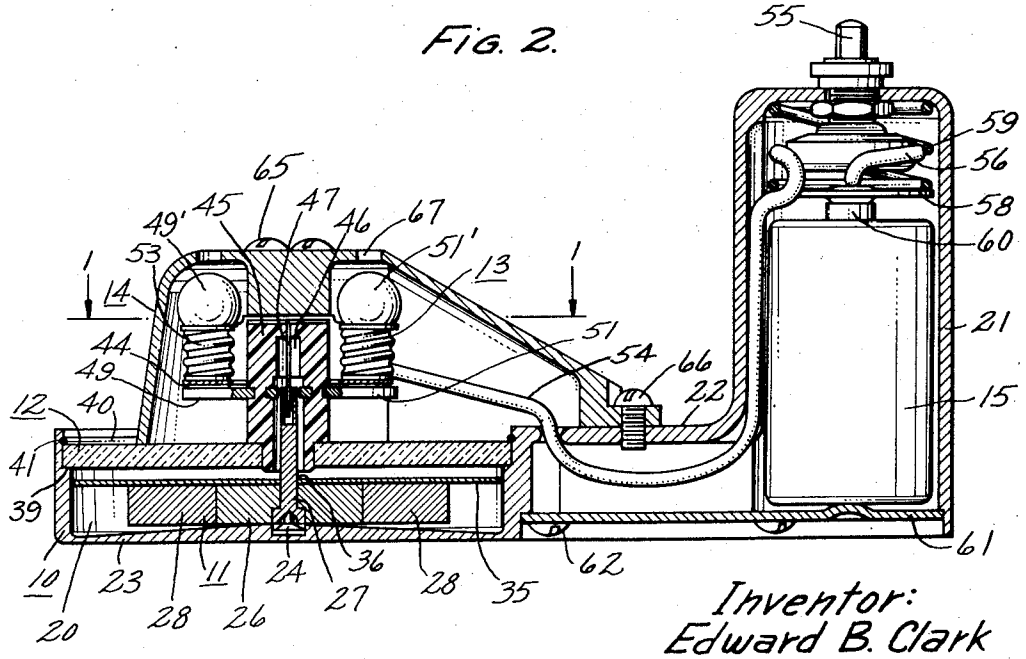


FIG. 2.



Inventor:
Edward B. Clark
by Richard L Caslin
His Attorney

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MAGNETIC INSERT FINDER

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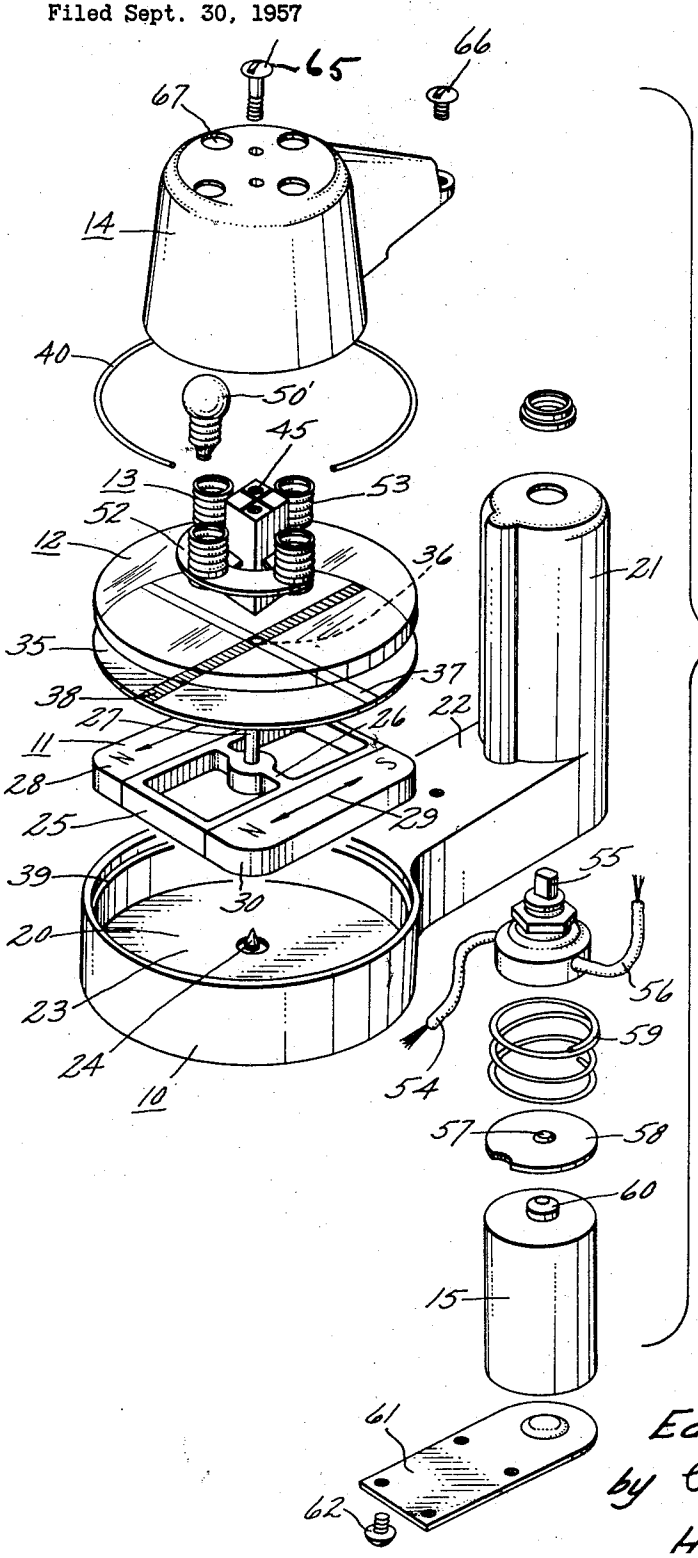


FIG. 3.

Inventor:
Edward B. Clark
by Richard L Caslin
His Attorney.

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MAGNETIC INSERT FINDER

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FIG. 4.

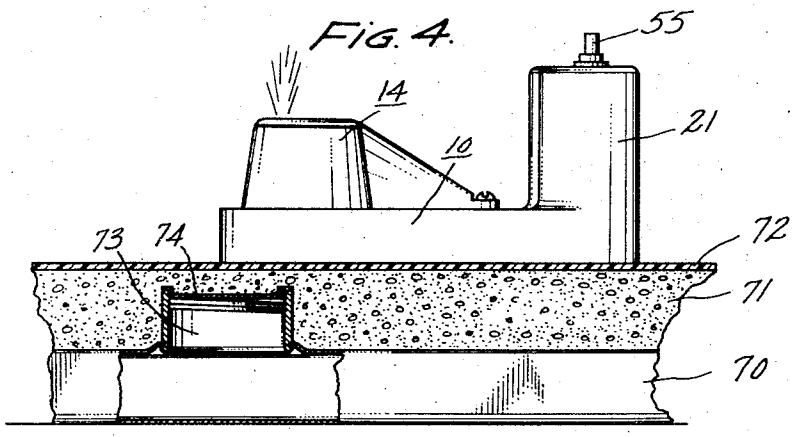


FIG. 5.

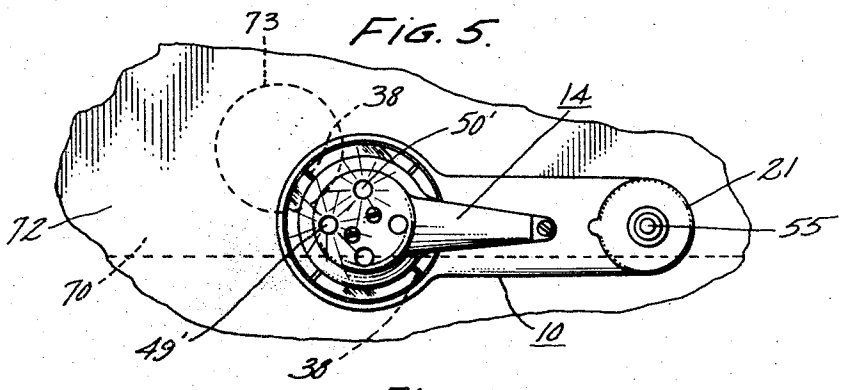


FIG. 6

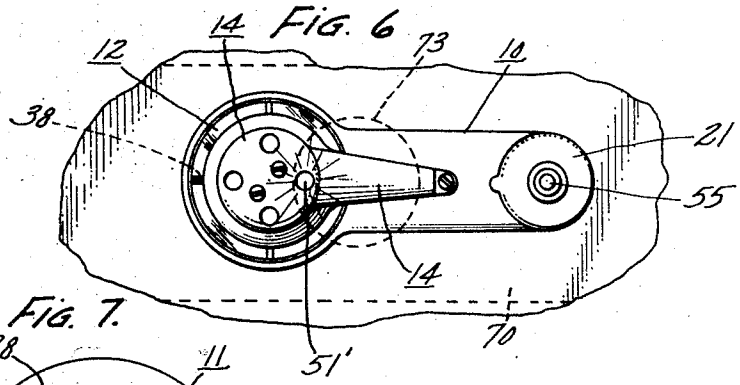
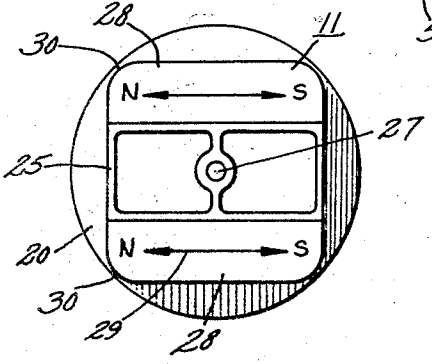


FIG. 7.



Inventor:
Edward B. Clark
by Richard L Caslin
His Attorney

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2,856,580

MAGNETIC INSERT FINDER

Edward B. Clark, Milford, Conn., assignor to General Electric Company, a corporation of New York

Application September 30, 1957, Serial No. 687,324

13 Claims. (Cl. 324—41)

The present invention relates to underfloor wiring distribution systems and particularly to a magnetic device or finder for locating the exact positions of steel inserts mounted on the top of underfloor ducts that lie buried within a concrete floor.

Underfloor wiring distribution systems are found mainly in large fireproof stores and office buildings. For instance, in a large office containing many desks it is often necessary to provide electric power and telephone service for nearly every desk. One accepted method is to run wires through a network of steel ducts or raceways buried in the concrete floor. These ducts are joined by suitable junction boxes which have removable covers that are flush with the finished flooring of the building. A plurality of steel inserts are mounted at various places along the top surface of the ducts to extend up through the concrete for supporting the floor outlets that will be in the proper position to provide the necessary electrical services.

After a building is in use for many years, working conditions oftentimes become crowded and additional floor outlets are required. For this reason, the underfloor duct systems are built so they may be expanded by providing each duct at the outset with shortened steel inserts at spaced intervals. Accordingly, additional floor outlets may be installed after once locating the shortened inserts and cutting through the floor to gain access to them. Then, suitable fittings may be added to the insert to build it up to the proper height where the floor outlet will be properly positioned on the floor.

The principal object of this invention is to provide a magnetic insert finder with a simple indicator means that is sensitive enough to enable a semi-skilled operator to locate the exact center of a steel insert that is completely buried within a concrete floor.

A further object of this invention is to provide a magnetic insert finder with a rotatable magnet assembly that when used on the floor will turn to point in the direction of a steel insert, and when the finder is brought over the insert, the magnet assembly will dip down abruptly due to the increased magnetic attraction and provide visual indication which will enable the operator to determine the exact center of the underlying insert.

The illustrated embodiment of the present invention has a hollow metal housing having non-magnetic properties that is elongated in shape to define two separate compartments. A rotatable magnet assembly is located in one of the compartments, while a small dry cell battery is situated at the other end of the housing in the second compartment. The magnet assembly has a vertical metal post extending through the assembly and seated on a pinpoint bearing in the bottom wall of the housing. A transparent plate is assembled in the housing above the magnet assembly for viewing the position of the magnet from above. The vertical post also extends through the transparent plate and into the bore of a hollow insulating boss that is mounted on the plate as a portion of an indicator lamp assembly. A vertical dampening spring is fixed at one end to the boss and at its other end to the post to hold the magnet assembly normally in a horizontal plane. A series of electrical contacts are fixed on the boss and each has an inner surface within the bore of the boss that are spaced from each other as well as from the end of the post. A small indicator lamp is associated with each contact and they are connected in parallel in a circuit that includes the beforementioned battery. The circuit also includes the vertical post as a movable contact member for making engagement with one or more of the fixed contacts. A downturned cup member overlies the lamp assembly and completes the housing. The metal housing serves as a ground or common return for completing the circuit. The metal material forming the housing as well as the vertical post of the magnet assembly must be electrically conductive but non-magnetic so as not to interfere with the operation of the magnet. Accordingly, the housing is cast from brass and the vertical post is a gold plated brass rod.

My invention will be better understood from the following description taken in connection with the accompanying drawings and its scope will be pointed out in the appended claims.

Figure 1 is a top plan view of an insert finder partly in cross-section taken on the line 1—1 of Figure 2.

Figure 2 is a cross-sectional, side elevational view taken on the line 2—2 of Figure 1.

Figure 3 is an exploded view of an insert finder embodying my invention.

Figure 4 is a cross-sectional, elevational view taken through a typical floor construction showing the location of a steel insert mounted on a duct with a magnetic insert finder embodying my invention positioned on the floor.

Figure 5 is a plan view of the floor construction of Figure 4 showing the duct and insert in dotted lines and the type of visual indication which the finder provides as it nears one edge of the insert.

Figure 6 is a top plan view similar to that of Figure 5 with the insert finder in another position to show how the indication changes depending upon the location of the insert.

Figure 7 is a diagrammatic showing of the magnet assembly and the clearance between the poles of the two bar magnets and the inner walls of the housing.

Referring in detail to the drawing and in particular to the exploded view of Figure 3, a preferred embodiment of this invention is shown comprising a metal housing **10**, a magnet assembly **11**, a transparent plate **12** supporting a lamp assembly **13**, a down-turned metal cup **14** that encloses the indicator means, and, finally, a small dry cell battery **15** for supplying the current to energize the lamp assembly **13**. The above elements have been listed in this catalog fashion to simplify the understanding of the invention. These elements represent the main elements of the invention as it was originally conceived. First, there is a recessed metal housing **10** of elongated form having a circular cavity or chamber **20** at one end and an upright battery carrier **21** of tubular construction at the opposite end. The battery carrier **21** is separated from the circular chamber **20** by an intermediate portion **22** of the housing of such length that the steel ends of a standard leakproof flashlight battery **15** will not be close enough to the poles of the magnet assembly **11** as to interfere with the proper operation of the magnet in seeking a steel insert buried in the floor.

Looking at both Figures 2 and 3, the circular chamber **20** is shown as being open at the top and closed at the bottom by bottom wall **23**. The center of the chamber **20** has a pinpoint bearing or pivot **24** on which the magnet assembly **11** is universally fulcrumed to turn either about

a vertical axis or tilt through a slight anglef rom a horizontal plane in any direction radiating from the bearing.

The magnet assembly **11** is the prime element or nucleus of this invention. As seen in Figure 3, the magnet assembly **11** has a metal framework **25** of rectangular shape in plan view, with a central transverse rib **26** containing a central opening for receiving a vertical contact post **27** that extends therethrough. A permanent bar magnet **28** is cemented to the outer surfaces of the longer sides of the rectangular frame **25** and are coextensive therewith so that the resulting magnet assembly **11** is nearly square in plan view as best seen in Figure 7. The direction of magnetism of the bar magnets **28** is lengthwise of the magnets as depicted by the arrows **29**. This places the poles of the magnet assembly at the opposite ends of each bar magnet—like poles being arranged at the same end of the frame **25**.

It is an accepted principle that the two poles of a magnet have exactly the same strength. The two bar magnets **28** are identical magnets so that all four poles of the magnet assembly **11** are of equal strength. The lines of force in a magnetic field of a single magnet are directed away from the North or N pole and toward the South or S pole. Since the magnetic field can have only one direction at a given point, the lines of force never cross one another. Like poles of the two magnets **28** are arranged adjacent each other and the lines of force of each magnet will be directed between the two poles of each individual magnet rather than divided between the corresponding unlike pole of the other magnet.

The outer corners **30** of the bar magnets are rounded so that the maximum length of magnet may be used within the circular chamber **20** leaving only a slight clearance between the rounded corners and the inner sides of the chamber. The maximum length of magnet is desirable because it determines the available magnetomotive force which is the force that tends to produce the magnetic field. Another reason for the rounded corners **30** is to increase the cross-sectional area of the pole faces from the ends of each magnet around to the sides so that a portion of the magnetic field will emanate from the sides of the magnet assembly thereby improving its side tracking ability. It should be noted that the magnet assembly **11** lies within a horizontal plane. This position has been chosen because the finder is to be used on the floor and moved around until it finally overlies the steel insert. Hence, the insert will lie within the normal magnetic fields of the two bar magnets. This would not be true if the magnet assembly were arranged in a vertical plane. Magnetic lines of force take the path of least reluctance; for example, they travel more easily through steel than through the air. The addition of steel or other magnetic substance having low reluctance within a magnetic circuit concentrates the flux in the steel thereby increasing the magnetic attraction of the magnet for the steel.

The center contact post **27** of the magnet assembly **11** extends completely through the transverse rib **26** of the frame **25** and its bottom end is seated on the pinpoint bearing **24**, as best seen in Figure 2. A thin insulating plate or dial **35** has a central opening **36** which fits over the post **27** so that the dial may rest on the top of the magnet assembly **11** and be cemented in place in a predetermined position. The top surface of the dial **35** is graduated by two intersecting lines of paint **37** and **38**. Line **37** is of white paint and is arranged transversely to the direction of magnetism of the two bar magnets, while line **38** is of red paint and is parallel to the direction of magnetism. The open top wall of the circular chamber **20** is closed by a transparent plate **12** of plastic or glass that slips down into the chamber **20** and is seated on a circular ledge **39**. This transparent plate **12** must be held in place and this is accomplished by a split retaining ring **40** of spring wire material which is laid over the plate **12** and snaps into place to lie within a circular groove **41** formed in the inner side walls of the chamber **20**, as best seen in Figure 2.

The contact post **27** of the magnet assembly **11** must extend above the transparent plate **12** which requires a central opening in the plate for receiving the post. A hollow boss **45** of molded insulating material such as a phenolic compound is assembled face downward within the central opening of the transparent plate **12**. The hollow portion or bore **46** of the boss **45** is larger in diameter than the size of the post **27** to allow the post to turn as well as tilt about the bottom pivot **24** in the chamber **20**. A dampening spring **47** of tempered steel wire is assembled in the boss **45** above the post with one end fixed in the boss and the opposite end inserted into the top portion of the contact post **27**. This dampening spring **47** is of such strength that it will normally hold the contact post and, hence, the magnet assembly **11** in a central position. Thus, the movement of the magnet assembly will be mostly a rotary movement about the vertical axis of the post.

When the insert finder is moved over a steel insert, the magnet assembly **11** will be tilted abruptly by a force of magnetic attraction that will overcome the resistance of the dampening spring **47** and move the post **27** until it strikes the inner surface of the bore **46** of the hollow boss. The vertical post **27** serves as the movable contact of a switching arrangement that includes four fixed contacts, each arranged 90° apart within the bore of the hollow boss **45**. These fixed contacts are numbered **48—51** in Figure 1. The inner ends of these four contacts are molded within the boss **45** and each has an inner contacting surface that terminates adjacent the inner surface of the bore **46** so that they may be engaged by the top portion of the movable contact post **27**. The two opposite contacts **49** and **51** are arranged along the longitudinal axis of the housing **10**, while the other two contacts **48** and **50** are arranged transversely to this longitudinal axis. An insulating washer **44** is seated on the outer end of each fixed contact and an arcuate shunt **52** is seated on each of the washers and insulated from the fixed contacts. Four screwshell lamp sockets **53** are seated directly on the shunt **52** and over the fixed contacts. Each lamp socket **53** has a central contact (not shown) that is insulated from the shunt and fastened to the related fixed contact for holding the lamp socket in place and serving as the central contact thereof.

As seen in Figures 1 and 2, a lead wire **54** is attached at one end to the shunt **52** and at its opposite end to an on-off push button canopy switch **55** that is assembled within the battery carrier **21**. Looking at Figures 2 and 3, the canopy switch **55** has a second lead wire **56** that is soldered to the center rivet **57** of an insulated pressure plate **58**. A coil spring **59** encompasses the canopy switch **55** and bears at one end against the inner surface of the top wall of the battery carrier **21** and at its other end biases the pressure plate **58** downward to hold the center rivet **57** against the center contact **60** of the battery **15**. A bottom cover plate **61** is fitted over the bottom wall of the battery carrier **21** and held in place by suitable screws **62**.

Turning back to Figures 1 and 2, four lamps **48'—51'** are mounted in the lamp sockets **53**. The lamps must be protected from mechanical injury and also shaded from each other so that they may be distinguishable in well lighted areas. A down-turned cup member **14** is fitted over the lamp assembly **13** and rests at one end on the center portion of the transparent plate **12** while its opposite end rests on the intermediate portion **22** of the housing **10**. Suitable screws **65** and **66** fasten the cup **14** to the housing. The top wall of the cup **14** has four small openings **67** that overlie the four lamps **48'—51'**. Within the inner top portion of the cup **14** are a series of baffles **68** which project radially toward the center of the cup to provide a shade between each

lamp. These baffles **68** only project down slightly below the glass envelope of the lamps **48'—51'**.

The magnet assembly **11** is influenced by any magnetic material that is brought within its magnetic field. The dry cell battery **15** is a standard flashlight battery and its steel ends have magnetic properties, but the battery is spaced from the magnet assembly **11** by such a distance that it does not adversely affect the proper operation of the magnet. The same holds true for the canopy switch **55**. The dampening spring **47** is made of steel, but since it is vertically arranged in the exact center of the vertical post **27**, it is symmetrical with respect to the magnet. Also, it could be made of Phosphor bronze. All of the other metal parts of the insert finder, namely, the housing **10**, the frame **25**, the post **27**, the contacts **48—51**, the shunt **52** and cup **14** along with the fastening screws **65** and **66**, are of electrically conducting material having non-magnetic properties such as brass or copper.

The cross-sectional elevational view of Figure 4 shows a typical floor construction with an underfloor duct or raceway **70** buried in the concrete fill **71** that is in turn covered by a finished floor covering **72** such as a linoleum or composition tile. Also buried within the concrete fill **71** is a shortened steel insert **73** that is cylindrical in shape and mounted in the top wall of the duct **70**. The open top of the insert **73** is closed by a snap-on cap or cover plate **74** which prevents the concrete from entering the insert while it is being poured. Normally it is possible to locate the ducts **70** since they extend in a straight line between the junction boxes. Each junction box is visible since they have a removable cover that is flush with the top surface of the floor. Accordingly, it is possible to draw a chalk line along the approximate center of the ducts.

In practice the operator will place the insert finder **10** on the floor over one edge of the duct and move it parallel to the chalk line until the red line **38** of the graduated dial **35** swings toward the insert **73**, as is shown in Figure 5. This swinging of the dial **35** is caused by the magnetic attraction of the magnet assembly **11** for the steel insert **73**. Then the insert finder is moved in the direction defined by the red line **38** which lies parallel with the direction of magnetism of the bar magnets **28**. Once the magnet assembly **11** overlies any portion of the insert **73**, the magnetic force will be strong enough to overcome the dampening spring **47** and the magnet assembly will dip down toward the insert bringing the movable contact post **27** against one and possibly two of the three fixed contacts **48—50** of the device. This is the situation shown in Figure 5 where both lamps **49'** and **50'** are lighted. As the insert finder continues to move over the insert and the magnet assembly **11** begins to pass beyond it, the magnet will tip in the opposite direction and the post will swing to engage one and possibly two of the other fixed contacts. In the example of Figure 6, lamp **51'** is lighted which would indicate to the operator that the center of the insert **73** is somewhere between the two positions of the finder in Figures 5 and 6. Once the finder is in a central position over the insert, all four of the lamps will be out or unlighted. Then by marking a pencil mark around the outside of the circular chamber **20**, it would be possible to cut through the finished flooring **72** and uncover the insert **73**.

Having described above my invention of a novel magnetic insert finder for use in buildings having underfloor wiring distribution systems, it should be readily apparent to those skilled in this art that the resulting device is highly sensitive to the presence of magnetic material buried in the floor. Accordingly, the insert finder may be moved across the floor until it points out the direction of the insert and subsequently the exact center of the insert.

Modifications of this invention will occur to those skilled in this art and it is to be understood, therefore,

that this invention is not limited to the particular embodiments disclosed but that it is intended to cover all modifications within the true spirit and scope of this invention.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. An insert finder for an underfloor wiring distribution system comprising in combination a metal housing having non-magnetic properties, a permanent magnet assembly lying within a horizontal plane and fulcrumed at its center on a pinpoint bearing on the bottom wall of the housing, a vertical metal contact post extending through the magnet assembly and seated on the pinpoint bearing, a transparent plate assembled in the housing over the magnet and having an enlarged central opening for receiving the post therethrough, a hollow boss centered over the opening in the transparent plate and integral therewith for loosely receiving the said post, a plurality of electrical contacts mounted on the boss and each having an inner surface within the boss spaced from each other and engageable by the end of the post, and separate indicator means associated with each electrical contact, whereby the presence of a magnetic material in the field of the magnet assembly will cause the magnet to align itself in the direction of said material, and when the finder is moved over the material, the magnet will tip downward due to its magnetic attraction for the material and close the circuit between the movable contact post and one of the electrical contacts to energize the indicator means, making it possible to locate the exact center of the magnetic material.

2. An insert finder for an underfloor wiring distribution system comprising in combination a housing, a permanent magnet assembly lying within a horizontal plane and fulcrumed at its center on a bearing on the bottom wall of the housing, a vertical contact post extending through the magnet assembly and seated on the said bearing, a hollow boss formed in the upper portion of the housing for loosely receiving the upper end of the said post, a plurality of fixed electrical contacts mounted on the boss and each having an inner surface within the boss spaced from each other and from the end of the post, and a dampening spring associated with the post to hold it normally in a central position away from the said contacts, and separate indicator means associated with each contact and forming the load of a parallel circuit, whereby the presence of a magnetic material in the field of the magnet assembly will cause the magnet to turn itself in the direction of said material, and when the finder is moved over the material, the magnet will tip downward due to its magnetic attraction for the material and close the circuit between the contact post and one of the electrical contacts to energize the indicator means until the magnet is directly over the center of the insert and the magnet is balanced in a central position with the contact post spaced from the fixed contacts.

3. An insert finder for an underfloor wiring distribution system comprising in combination a metal housing having non-magnetic properties, a permanent magnet assembly lying within a horizontal plane and fulcrumed at its center on a bearing on the bottom wall of the housing, the magnet assembly including two bar magnets arranged in parallel on opposite sides of a metal frame where the frame has non-magnetic properties, like poles of both magnets being arranged at the same end of the frame, a vertical metal contact post extending through the center of the frame of the magnet assembly and seated on the bearing of the housing, a hollow boss located within the housing for loosely receiving the top portion of the post, a plurality of fixed electrical contacts mounted on the boss and each having an inner contacting surface within the boss spaced from each other and from the end of the post, and a dampening spring within the boss engaging the post and normally holding the post equidistant from the said contacts, and an indicator lamp associated

with each contact and forming the load of a parallel circuit, whereby the presence of a steel insert within the field of the bar magnets will cause the magnet assembly to turn in the direction of the insert, and when the finder is moved over the insert, the magnet assembly will tip downward due to its magnetic attraction for the insert, thereby closing the circuit between the contact post and one of the fixed contacts to energize at least one of the lamps and make it possible to locate the approximate center of the insert.

4. An insert finder as recited in claim 3 wherein a dry cell battery is assembled in the housing and connected in the parallel circuit of the lamps to energize the lamps when the circuit is closed by the tilting of the magnet assembly as it moves over the insert.

5. An insert finder as recited in claim 4 wherein the housing includes a transparent plate supported by the housing over the magnet assembly so that the position of the magnets may be readily observed, the said hollow boss being fastened to the top surface of the plate, and the contact post extending through the plate and into the boss.

6. An insert finder for use with an underfloor wiring distribution system comprising in combination a hollow housing, a four pole magnet assembly lying within a horizontal plane and fulcrumed about its center on a bearing on the bottom wall of the housing, a vertical contact post extending above the magnet assembly, the upper portion of the housing having a plurality of fixed electrical contacts spaced around the upper end of the contact post, and an indicator lamp associated with each fixed contact and arranged in a parallel battery circuit, the housing being of a conductive metal having non-magnetic properties such as brass to serve as the ground return of the circuit.

7. An insert finder as recited in claim 6 wherein a graduated dial is fastened to the top surface of the magnet assembly in a predetermined manner, and a transparent plate is formed as part of the walls of the housing so that the turning movement of the dial and hence the magnet assembly may be observed.

8. An insert finder as recited in claim 7 wherein the magnet assembly includes a rectangular metal frame with a transverse central rib, a similar pair of permanent bar magnets joined to the longer sides of the frame to form a square magnet assembly in plan view, like poles of the magnets being arranged at the same ends of the frame.

9. An insert finder as recited in claim 8 wherein a dampening spring is mounted in the housing and engages the vertical contact post of the magnet assembly to limit the movement of the said assembly to a turning movement about the vertical axis of the post until the magnet assembly is tilted by the close proximity of a steel insert underlying the finder.

10. An insert finder for use with an underfloor wiring distribution system comprising in combination a hollow metal housing with two separate compartments, the first compartment at one end of the housing being circular and open at the top, the second compartment being at the opposite end and receiving a small dry cell battery, the first compartment containing a horizontal magnet assembly that is balanced at its center on a pinpoint bearing on the bottom wall of the compartment, a central contact post extending vertically through the magnet assembly and up through a transparent plate assembled in the housing above the magnet assembly, a hollow insulating boss mounted in the housing and telescopically arranged over the upper portion of the contact post, a plurality of fixed electrical contacts supported from the boss and each having an inner contacting surface disposed adjacent the upper end of the post, and an indicator lamp associated with each contact and arranged in parallel in a battery circuit that includes the metal housing as a ground return, and a downturned cup member assembled over the indicator lamps and boss member as the top portion of the housing, small openings formed in the top wall of the cup for viewing the lamps, and a series of barriers within the cup to shade the lamps from each other.

11. An insert finder as recited in claim 10 wherein a graduated dial is fastened to the top surface of the magnet assembly in a predetermined manner so that the turning movement of the dial and hence the magnet assembly may be observed through the said transparent plate.

12. An insert finder as recited in claim 10 wherein the magnet assembly includes a rectangular metal frame with a transverse central rib supporting the vertical contact post, a similar pair of permanent bar magnets, each magnet joined to one of the longer sides of the said frame and being coextensive therewith to form a square magnet assembly in plan view, like poles of the two magnets being arranged at the same ends of the frame, the outer corners of the poles of the magnets being rounded so that the maximum length of magnets may be used within the confines of the said circular compartment of the housing.

13. An insert finder as recited in claim 12 wherein the said hollow insulating boss includes a vertical dampening spring fixed at one end to the boss and engaging the top portion of the contact post with its other end to hold the magnet assembly normally in a balanced position limiting its movement to turning about the vertical axis of the contact post, the proximity of a steel insert under the magnet assembly causing the assembly to tilt and overcome the resistance of the dampening spring so that the contact post will engage at least one of the fixed contacts and energize the related indicator lamp.

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