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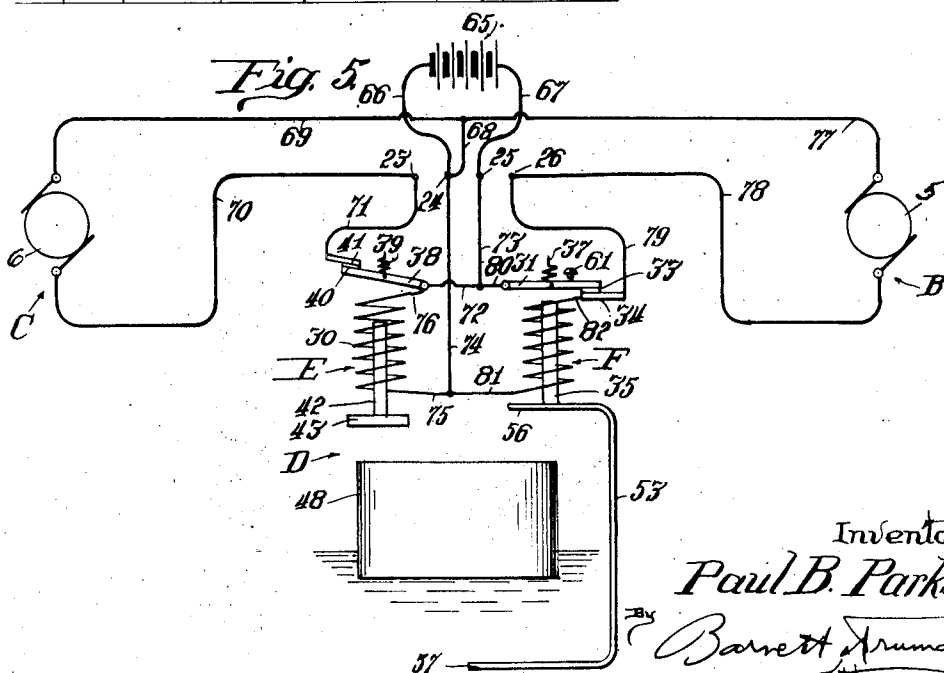
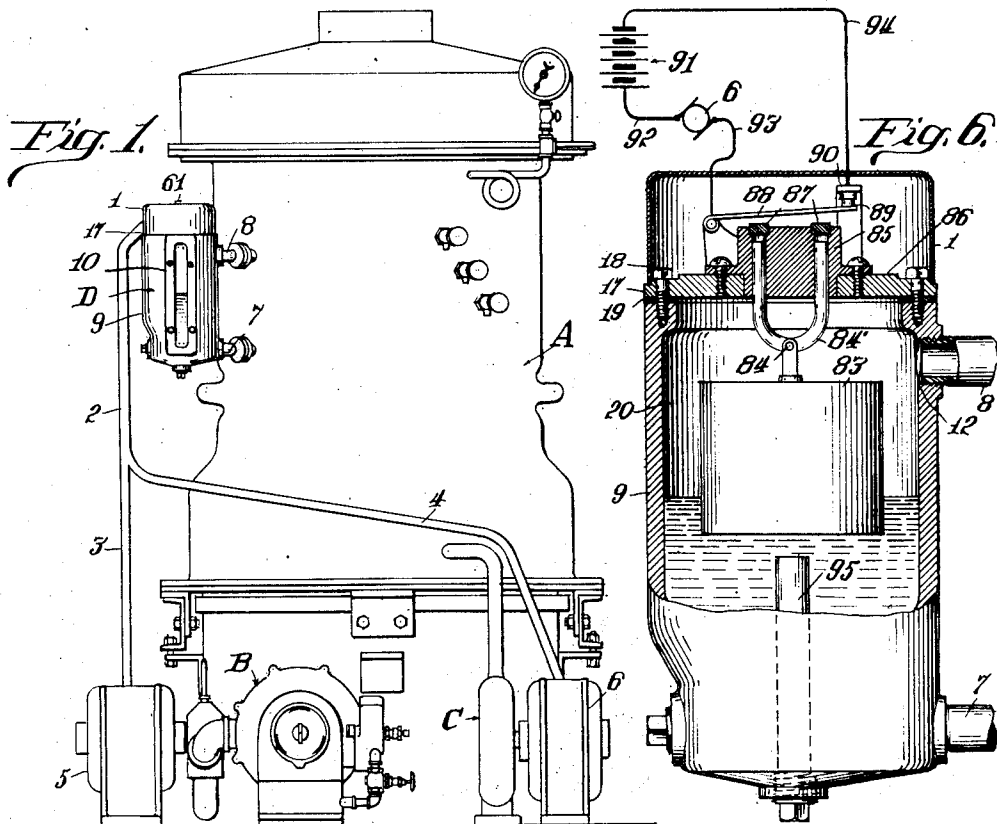
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WATER LEVEL CONTROL

Filed Oct. 27, 1932

2 Sheets-Sheet 1



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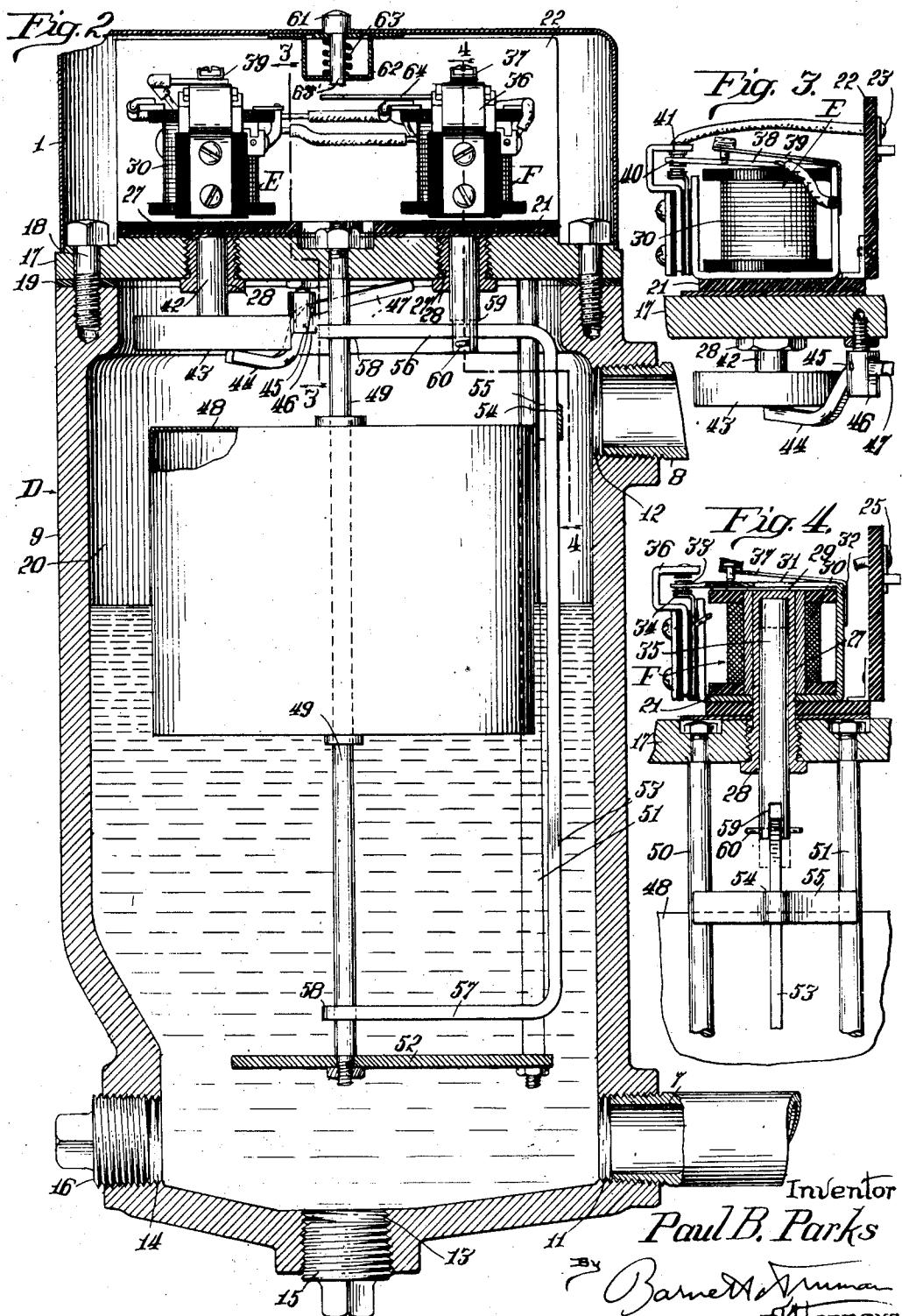
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UNITED STATES PATENT OFFICE

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WATER LEVEL CONTROL

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4 Claims. (Cl. 200—84)

This invention relates to new and useful improvements in a water level controller, and more particularly to a magnetically operated float-controlled mechanism for maintaining the water
5 at substantially a predetermined level in a boiler or similar device.

The example of the invention here shown is especially designed for use in heating equipment comprising a boiler, a motor-driven oil burner, and a motor-driven pump for feeding water into the boiler. The improved water level controller comprises a small container adapted to be attached exteriorly to the boiler so that the water level in the container will correspond to the water
10 level in the boiler. A pair of similar electro-magnetic devices are mounted on the container, each device comprising a normally energized coil and a core which is movable from an effective position within the coil when the magnet will have sufficient strength to attract an armature, to an ineffective partially withdrawn position which will so diminish the strength of the magnet that the armature will be returned by a spring to a second position. A float means within the container moves the respective cores at its upper and lower limits of travel. Suitable switch mechanisms actuated by the armatures of the electro-magnetic devices control the circuits of the water pump and burner-motor. The operation is such
15 that when a predetermined maximum water level is reached the pump-motor will be stopped, and if the water level falls to a predetermined minimum the burner motor will be stopped. It will be apparent as the description proceeds that the novel control mechanism used, and the novel principles of operation can be adapted to other uses than the specific example herein set forth.

The principal object of this invention is to provide an improved water level controller of the type briefly referred to hereinabove and disclosed more in detail in the specifications which follow.

Another object is to provide an improved magnetic switch-operating device comprising an automatically movable core adapted to change the effective strength of the magnet.

Another object is to provide an improved float-controlled magnetic device for stopping the operation of a water pump when a predetermined
20 maximum water level is reached.

Another object is to provide an improved float-controlled magnetic device for stopping a burner-motor when a predetermined minimum water level is reached.

Another object is to provide an improved fluid-

tight float operated switch-controller in which no packing means is necessary about moving parts.

Other objects and advantages of this invention will be more apparent from the following detailed description of one improved form of mechanism constructed and operating according to the principles of this invention.

In the accompanying drawings:

Fig. 1 is an elevation illustrating the operation of the improved water-level controller in connection with a boiler.

Fig. 2 is a central vertical section through the controller, on an enlarged scale.

Fig. 3 is a partial vertical section, taken substantially on the line 3—3 of Fig. 2.

Fig. 4 is a partial vertical section taken substantially on the line 4—4 of Fig. 2.

Fig. 5 is a wiring diagram.

Fig. 6 shows a modification.

Referring first to Fig. 1, A indicates the boiler of a heating system, B is an oil-burner assembly for heating the boiler, C is a water-pump assembly for forcing water into the boiler, and D indicates the improved water-level controller forming the particular subject matter of this invention. The switch mechanisms which are housed in the upper casing 1 of the controller are included in electric circuits the wires of which extend through a conduit 2 having branches 3 and 4 leading respectively to the actuating motor 5 of the oil burner B, and the driving motor 6 for the pump C. The circuits and wiring connections are indicated diagrammatically in Fig. 5, as hereinafter referred to. The controller D is mounted in a convenient position on the side of boiler A and is connected therewith by the pipes 7 and 8 so that the water level within the controller casing 9 will correspond with the water level in the boiler A. A water level indicator 10 may be mounted on the front of casing 9 in well known manner.

The specific construction of the water-level controller D is best shown in Figs 2, 3, 4 and 5. The casing 9 is provided with ports 11 and 12 in one side into which are connected the pipes 7 and 8 which communicate with the boiler, and drain openings 13 and 14 may also be provided, these openings being normally closed by plugs 15 and 16 respectively. The casing 9 is closed at the top by a cover plate 17 secured in place by bolts 18. There are no unclosed openings in the cover 17, and a gasket 19 is clamped between the cover and the top of casing 9 so that the chamber within the casing will be fluid-tight, the only com-

munication therewith being to the boiler through pipes 7 and 8.

The switch assembly is supported on closure plate 17 and is enclosed by the upper casing 1 already referred to. The switch assembly comprises a pair of similar electromagnetic devices or relays E and F which are alike except for certain details hereinafter pointed out. The two magnetic devices are mounted on a plate 21 of insulating material carried by the closure 17, and an upright insulating panel 22 carried by plate 21 supports the several terminals 23, 24 25 and 26 to which the circuit wires are attached (see Fig. 5). Each of the magnetic devices comprises a central upwardly projecting thimble 27 of non-magnetic material which is secured at its lower open end 28 in the closure plate 17 and is closed at its upper end 29 (see Fig. 4). An electromagnetic coil indicated generally at 30 surrounds the upwardly projecting portion of thimble 27, these coils being normally energized. The electro-magnetic device F (see Figs. 2 and 4) comprises an armature 31 pivotally mounted at one end on a support 32 and carrying at its free end a contact member 33 adapted to engage a fixed contact 34 and complete a circuit when the armature 31 is drawn downwardly by the magnet 30. A movable core 35 is vertically slidable within thimble 27. When this core is moved up to the position shown in solid lines in Fig. 4 the magnet will have sufficient strength to attract the armature 31 and complete the circuit through contacts 33 and 34. When core 35 is partially withdrawn from the coil, as indicated in dotted lines Fig. 4, the strength of the magnet will be so diminished that the armature 31 will be moved upwardly against a stop 36 by the adjustable spring 37 thus breaking the circuit through contacts 33 and 34. The strength of the energized coil 30 is sufficient to normally hold the core 35 up in the position shown in solid lines, and the armature 31 will normally be drawn downwardly by the magnetic device so as to complete the circuit through contacts 33 and 34.

The magnetic device E (see Figs 2 and 3) comprises a pivoted armature 38 which is normally held up by adjustable spring 39 so as to bring a contact member 40 carried by the free end portion of the armature in engagement with a fixed contact 41 and thus complete an electrical control circuit. The slidable core 42 of magnetic device E is normally held in partially withdrawn position by the weight 43 at its lower end so that the magnetic attraction of coil 30 of device E is so weakened that it is incapable of pulling down the armature 38 which is held up by spring 39 in the normal position shown in Fig. 3. However, if core 42 is elevated (by mechanism hereinafter described) so as to be fully projected within the coil 30, the magnet will be so strengthened that it will draw down the armature 38 and break the circuit by separating contacts 40 and 41. The weight 43 is normally supported, when coil 42 is in partially withdrawn position, by the lower arm 44 of a lever intermediately pivoted at 45 in a supporting plug 46 secured in closure plate 17, the other arm 47 of the lever engaging the lower face of the closure plate, as shown in solid lines in Fig. 2.

A float 48 is supported by the water or other liquid in casing 9 and is vertically slidable on a central guide rod 49 secured at its upper end in closure plate 17. A pair of similar downwardly projecting rods 50 and 51 (see Fig. 4) are also mounted at their upper ends in the closure plate

17, and the lower end portions of the three parallel rods 49, 50 and 51 are connected by a limit plate 52. A vertically movable operating rod 53 is guided at 54 in a bracket plate 55 secured to the rods 51 and 50. Operating rod 53 has upper and lower horizontally extending arm portions 56 and 57, each provided with a loop 58 at its inner end vertically slidable on the central guide rod 49. The upper arm 56 of this operating rod extends through a slot 59 formed in the lower end of core 35 of the magnetic device F, and a pin 60 passed through the slotted portion of the core beneath the arm 56 normally supports the rod from the core 35.

At 61 is indicated a reset push button which is mounted in a bracket 62 carried by the upper casing 1 and is normally held elevated by spring 63. The stem 63' of this push button device is adapted to engage and depress an arm 64 extending laterally from the armature 31 of electromagnetic device F so as to reestablish the circuits through contacts 33 and 34, as will be hereinafter apparent.

In the general operation of this device, with the water level, and consequently the float 48, in an intermediate position as shown in Fig. 2 all of the circuits will be closed and both the burner motor 5 and the pump motor 6 will be in operation. When a desired maximum water level has been established in the boiler and consequently in the container 9, the float 48 will be elevated to such a level that it will engage the lever arm 44 and lift the weight 43 so as to project core 42 upwardly into the coil 30 of electromagnetic device E thus causing the armature 38 to be drawn down so as to break the pump operating circuit between the contacts 40 and 41. The pump-motor cannot start again until the water level has fallen so as to lower the float 48 and permit the core 42 to be lowered by the weight 43 so that armature 38 will be released and the motor circuit will again be established between the contacts 40 and 41. On the other hand if the water in the boiler and consequently in container 9 falls to a predetermined minimum, the float 48 will be lowered so as to engage and pull down the arm 57 of operating rod 53 thus pulling core 35 of the electro-magnetic device F down to the position shown in dotted lines in Fig. 4 thus weakening this magnet so that armature 31 will be released and will be drawn upwardly by spring 37 thus breaking the circuit between contacts 33 and 34. This will stop the burner motor 5 so that the boiler cannot be dangerously overheated while there is insufficient water in the boiler.

The operation will be better understood by reference to the wiring diagram shown in Fig. 5 which shows one form of circuit suitable for performing these functions. At 65 is indicated a battery or other suitable source of electric power connected by wires 66 and 67 with the terminals 24 and 25 on panel board 22. With the float 48 in the intermediate position shown, a pump-operating circuit is completed as follows: From battery 65 through wires 66, 68 and 69, pump motor 6, wires 70 and 71, switch contacts 41 and 40, armature 38, and wires 72, 73 and 67 back to the battery. At the same time electro-magnetic device E is energized by means of the following circuit: From battery 65 through wires 66, 74 and 75, coil of magnet E, and wires 76, 72, 73 and 67 back to the battery. It will be noted that this latter circuit remains complete at all times, but when the core 42 of magnet E has been lowered

by the weight 43, the strength of magnet E is insufficient to pull down the armature 38 which is held up by spring 39 so as to complete the first described operating circuit for pump motor

6. However, when core 42 has been elevated by float 48 to its effective position within the coil of magnet E, the strength of this magnet will be increased so that it will draw down the armature 38 and break the pump operating circuit by separating contacts 40 and 41. As soon as the water level has decreased sufficiently to permit weight 43 to again lower the core 42, magnet E will no longer be strong enough to hold down the armature 38 and spring 39 will elevate this armature to again complete the pump motor circuit by bringing together the contacts 40 and 41.

Under normal conditions an operating circuit for burner-motor 5 will be completed as follows: From battery 65 through wires 66, 68 and 77, motor 5, wires 78 and 79, contacts 34 and 33, armature 31, and wires 80, 73 and 67 back to the battery. At the same time an energizing circuit for electro-magnetic device F is completed as follows: From battery 65 through wires 66, 74 and 81, coil of magnet F, wire 82, contacts 34 and 33, armature 31, and wires 80, 73 and 67 back to the battery. When the water level has fallen to a dangerous minimum, the float 48 will engage the arm 57 and draw core 35 downwardly so as to weaken the electro-magnetic device F whereupon spring 37 will pull up the armature 31 and separate the contacts 33 and 34. It will be noted that this will break both of the last described circuits so that both the burner-motor 5 and the magnet F will be deenergized. The burner-motor cannot again be started in operation without manually depressing the reset button 61 so as to push down armature 31 and cause the contacts 33 and 34 to reengage. This will again start the motor 5, and if the water level has been raised so as to elevate the float 48, the magnet F will again draw up the core 35 so that the magnet will have sufficient strength to retain the armature 31 in the position shown in Figs. 4 and 5. However, if the water level has not been raised, the magnet F will not have sufficient strength to raise both the core 35 and float 48 so that as soon as reset button 61 is released the armature 31 will again be raised by spring 37 and the motor circuit will again be broken. Therefore it is impossible to again place the burner in continuous operation until a proper water level has again been established in the boiler.

The modification shown in Fig. 6 illustrates the use of a permanent magnet to perform a function similar to that performed by the electro-magnetic devices E and F previously described. In this simplified construction a device for controlling the pump motor only is shown. The plate 83 is connected at 84 with a permanent magnet 84', the upwardly projecting arms of which are guided for vertical movement in suitable guide passages in the block 85 of brass or other suitable non-magnetic material which is carried by the closure plate 86. The upper ends of the guide passages are closed by iron blocks 87 which practically form continuations of the magnet when it is elevated to its extreme upper position by the upward movement of float 82. When the water level is below its maximum, the magnet will not be sufficiently powerful to draw down the armature 88 which is normally held up by suitable spring means so as to cause the engagement of contacts 89 and 90 thus completing a pump-operating circuit as follows:

From battery 91 through wire 92, pump-motor 6, wire 93, armature 88, contacts 89 and 90, and wire 94 back to the battery. When the water level falls, the float 82 will be lowered so as to pull down the magnet 84 and release armature 88 thus permitting the pump to operate. When a maximum water level is reached, the magnet 84 will be elevated so as to draw down the armature 88 and break the pump-operating circuit. A support 95 is provided to limit the downward movement of float 82 and thus prevent the magnet from being completely withdrawn from the guide block 85.

It will be noted that in either form of this device the container 9 is completely sealed, there being no moving parts which project through any wall of the container. A fluid-tight construction is thus provided without the necessity of using any packing means about moving parts. It will be apparent that this principle of controlling electric circuits magnetically might be applied to other uses than the one here shown by way of example, and it is intended that all such uses shall be considered as covered by this invention insofar as the scope of the following claims will permit.

I claim:

1. In combination, a container for a liquid, a float in the container, a closure for the top of the container, an electromagnetic device comprising a thimble mounted in the closure, the thimble being closed at its upper end and opening at its lower end into the container, a normally energized coil surrounding the thimble, a core guided for vertical movement within the thimble, a weight suspended from the core and normally functioning to withdraw the core from the coil, a member normally supporting the weighted core in withdrawn position, a switch mechanism adjacent the coil and having an operating arm, means for normally holding the arm in one position while the weighted core is withdrawn from the coil, the arm being attracted to a second position when the strength of the magnet is increased by elevating the weighted core to an effective position within the coil, and means for guiding the float for vertical movement in the container independent of the core, the float functioning when elevated to a predetermined height to lift the core to its effective position.

2. In combination, a container for a liquid, a float in the container, a closure for the top of the container, an electro-magnetic device comprising a thimble mounted in the closure, the thimble being closed at its upper end and opening at its lower end into the container, a normally energized coil surrounding the thimble, a core guided for vertical movement within the thimble, a weight suspended from the core and normally functioning to withdraw the core from the coil, a movable member normally supporting the weighted core in withdrawn position, a switch mechanism adjacent the coil and having an operating arm, means for normally holding the arm in one position while the weighted core is withdrawn from the coil, the arm being attracted to a second position when the strength of the magnet is increased by elevating the weighted core to an effective position within the coil, and means for guiding the float for vertical movement in the container independent of the core, the float when elevated to a predetermined height engaging and moving the supporting member to lift the core to its effective position.

3. In combination, a container for a liquid, a

float in the container, a closure for the top of the container, an electro-magnetic device comprising a thimble mounted in the closure, the thimble being closed at its upper end and opening at its lower end into the container, a normally energized coil surrounding the thimble, a core guided for vertical movement within the thimble, a switch mechanism positioned adjacent the coil and having an operating arm which is attracted to one position when the core is elevated within the thimble, means for moving the arm to a second position when the strength of the magnet is diminished by lowering the core to a partially withdrawn position, the core being normally retained in elevated position within the thimble by the magnetic attraction of the coil, and a member suspended from the core and having a portion positioned to be engaged by the float to withdraw the core when a predetermined minimum liquid level is reached within the container.

4. In combination a container for a liquid, a float in the container, a closure for the top of the container, a pair of separate similar electro-magnetic devices each comprising a thimble mounted in the closure, the thimble being closed at its upper

end and opening at its lower end into the container, a normally energized coil surrounding the thimble, and a core guided for vertical movement within the thimble, a pair of switch mechanisms one positioned adjacent each coil and having an operating arm which is attracted to one position when the core is elevated within the thimble, and means for moving the arm to a second position when the strength of the magnet is diminished by lowering the core to a partially withdrawn position, means for supporting one of the cores in a partially withdrawn position, the other core being normally held up in elevated position within the coil by the magnetic attraction of the coil, and means projecting from the last mentioned core beneath the path of travel of the float in the lower portion of the container, the float operating to lift the first mentioned core to its effective position within one coil when a predetermined maximum liquid level is reached within the container, and the float engaging the last mentioned means to lower the second core to its ineffective position when a predetermined minimum liquid level is reached within the container.

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