United States Patent [19]

Riddiford

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[54] **DEVICES FOR AUTOMATICALLY CONTROLLING THE WATERING OF PLANTS**

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[52] **U.S. Cl.** **137/408,** 251/65

[51] **Int. Cl.** **F16k 31/08**

[58] **Field of Search** 137/408; 251/65

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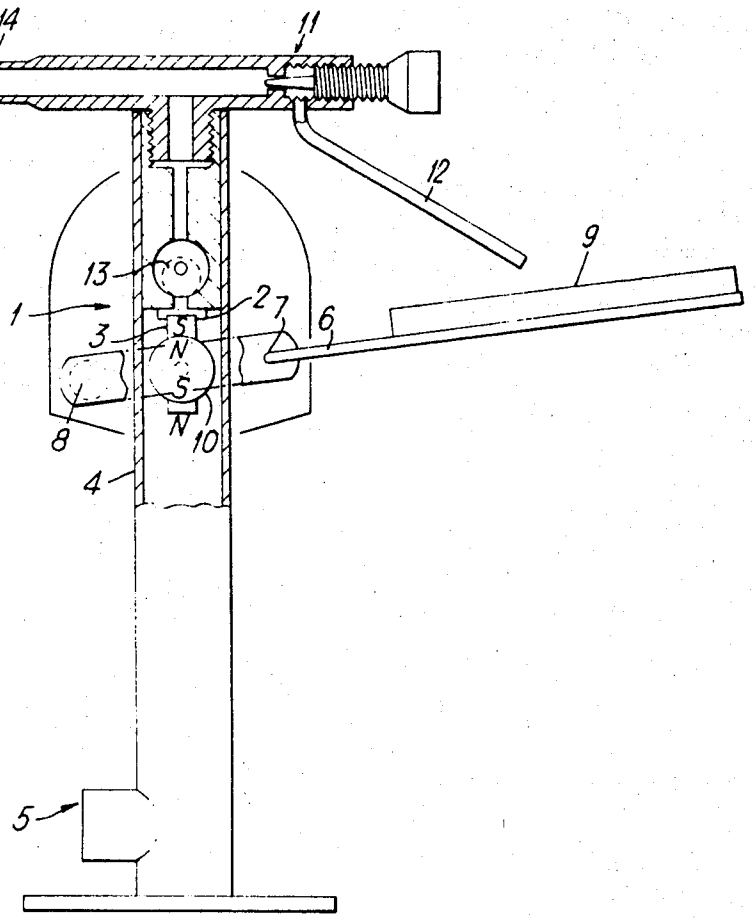
Primary Examiner—Henry T. Klinksiek

Attorney—Bacon & Thomas

[57] **ABSTRACT**

An automatic watering device for seeds or plants comprises a magnetic valve arranged in a waterflow conduit controlled by the movement of a permanent magnet outside of the conduit, the movement of such magnet being controlled by the increase and decrease in weight of a water retentive means arranged to receive water from the supply via the device.

16 Claims, 20 Drawing Figures



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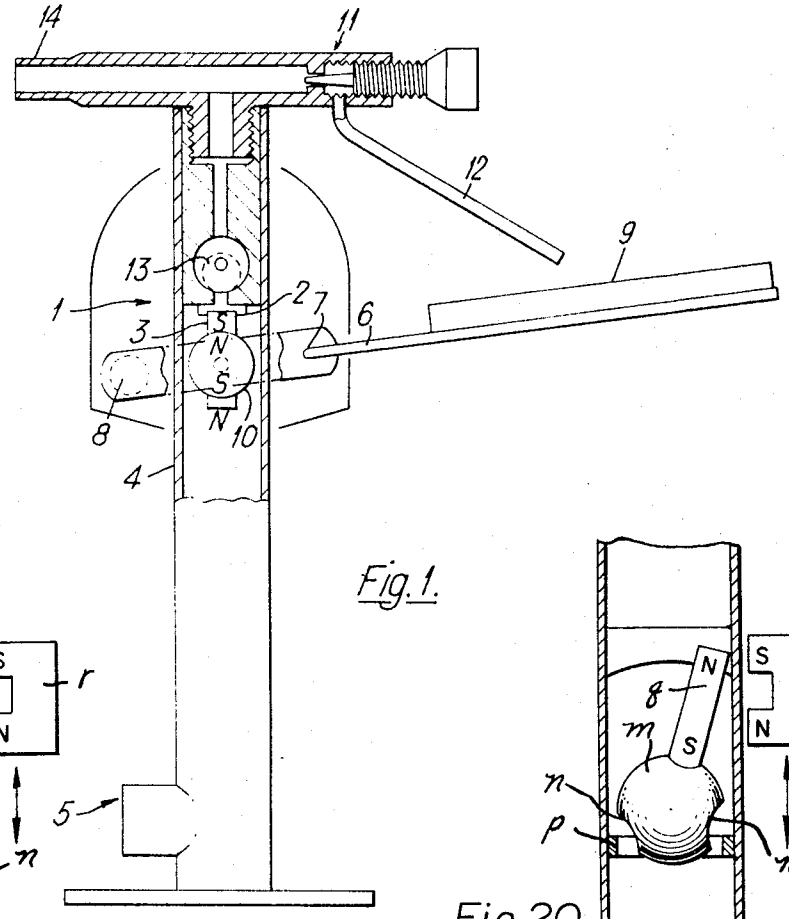


Fig. 1.

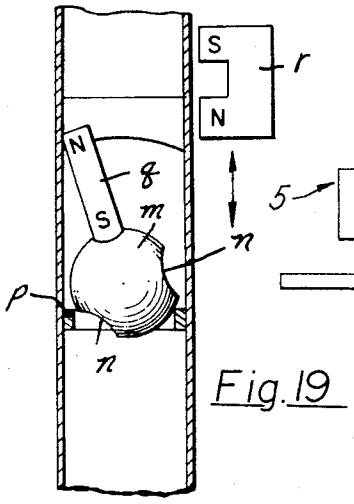


Fig. 19

Fig. 20

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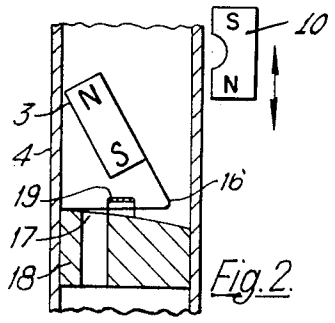


Fig.2.

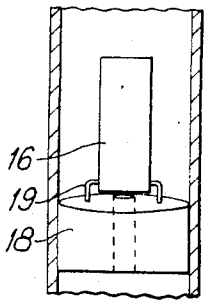


Fig.3.

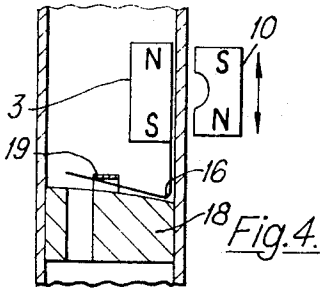


Fig.4.

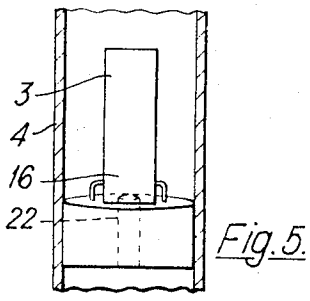


Fig.5.

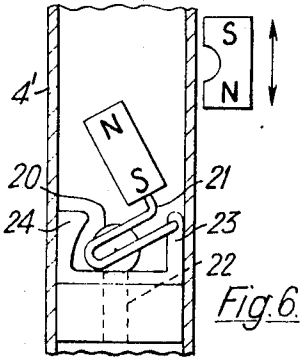


Fig.6.

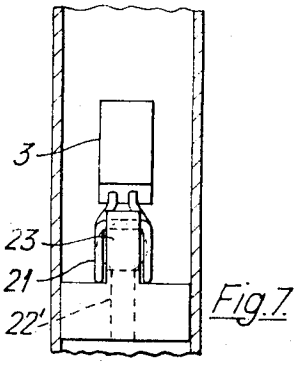


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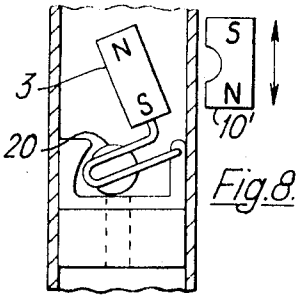


Fig.8.

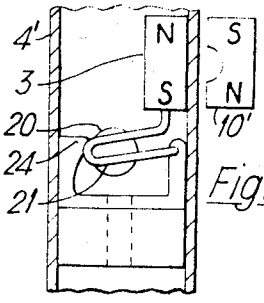


Fig.9.

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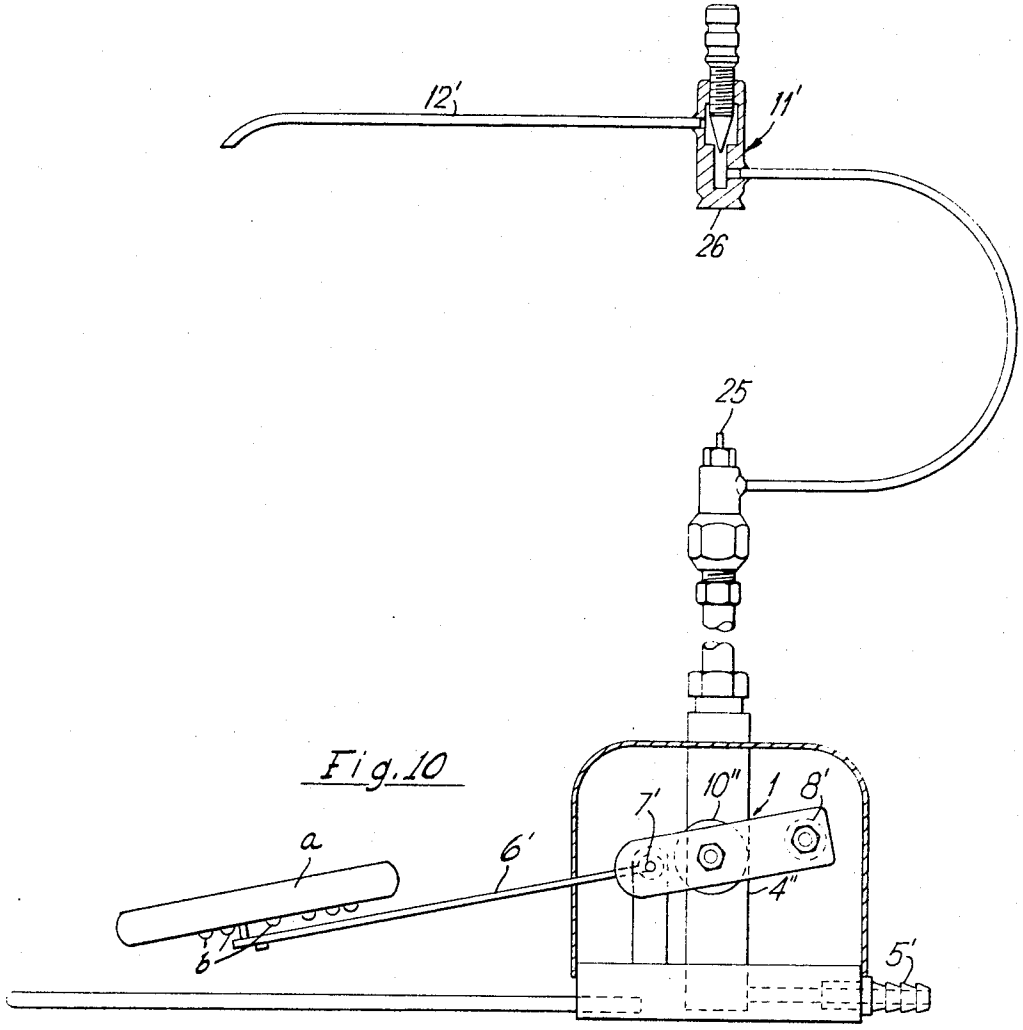


Fig. 10

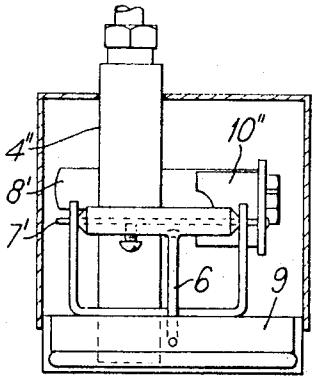


Fig. 11.

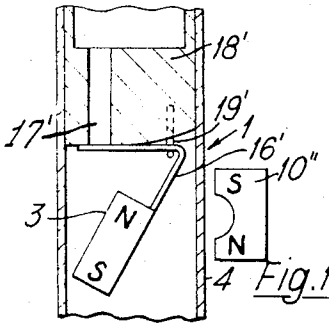


Fig. 12.

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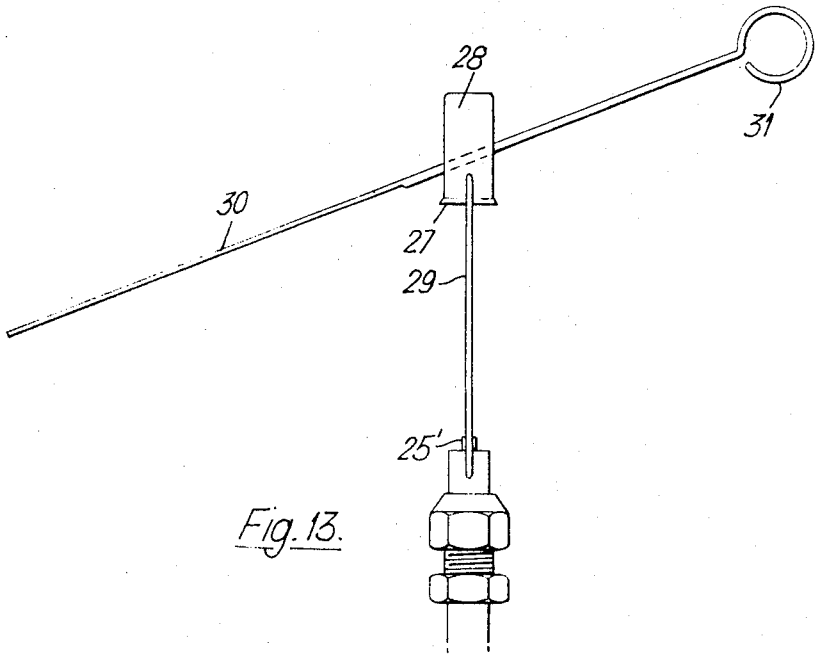


Fig. 13.

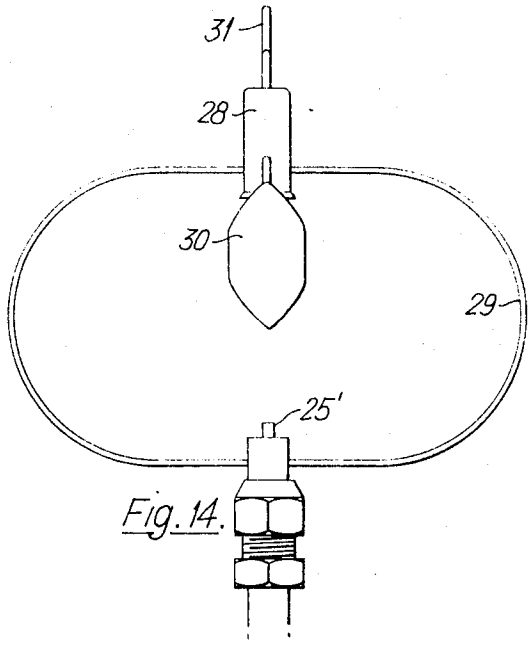


Fig. 14.

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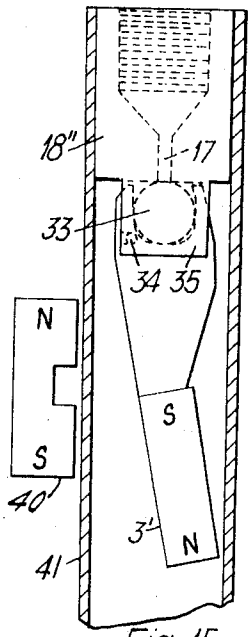


Fig. 15.

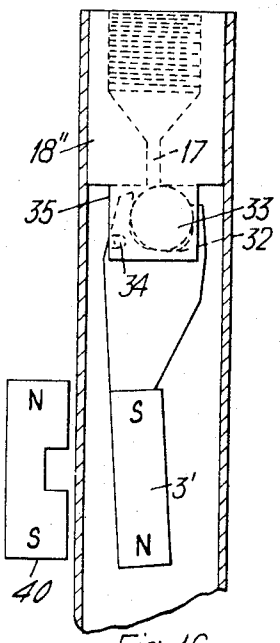


Fig. 16.

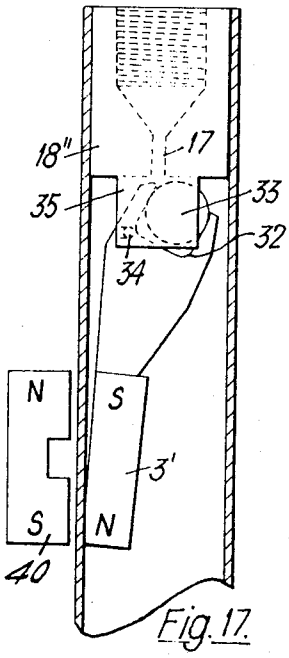
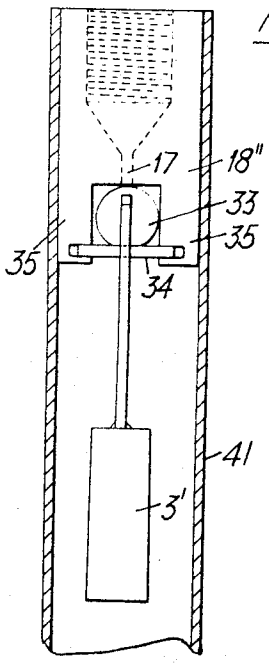


Fig. 17.

Fig. 18.



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DEVICES FOR AUTOMATICALLY CONTROLLING THE WATERING OF PLANTS

This invention relates to the watering of seeds or plants, and is particularly directed to improvements in devices for automatically controlling the watering of seeds or plants.

It is an object of the invention to provide such a device in which the valve is such as to operate satisfactorily in conjunction with a high pressure water supply, e.g., normal mains pressure.

According to the present invention there is provided a device for automatically controlling the watering of seeds or plants, comprising a valve including a movable valve member having an operating lever which carries or incorporates a first permanent magnet and which is enclosed with the valve member in a water flow conduit connectible to a water supply; and valve operating means including a second permanent magnet mounted outside of said conduit for movement relative to said first permanent magnet so as by magnetic cooperation with the latter to control opening and closing movement of the valve member, said valve operating means further including a part which is movable to effect the movement of said second permanent magnet between its valve opening and valve closing positions and which part is adapted, in use of the device, to support at least part of the weight of a water retentive means arranged to receive water from said supply via the device, said support part being biased in its valve opening direction of movement but being arranged to be urged in its valve closing direction of movement by the weight of said water retentive means so as to control opening and closing of said valve in response to variations in the weight of said water retentive means.

It has been found that a device incorporating a valve as set forth above operates satisfactorily in conjunction with a water supply at mains pressure.

In one form of the invention, in the closed condition of the valve the first and second magnets are disposed with their like poles adjacent, opening of the valve being effected by movement of the second magnet into a position where unlike poles are adjacent so that the operating lever is moved by magnetic attraction to open the valve. Alternatively, as already mentioned, the valve could be arranged to be opened by repulsion between the two magnets.

The valve operating lever moves in a pivotal sense to displace the valve member. In most forms of the invention pivotal movement of the operating lever is transmitted directly to the valve member to move the latter in a pivotal manner; alternatively, however, the valve member may be movably associated with a support which pivots with the operating lever so that the movement of the valve member is not of a wholly pivotal nature.

In another arrangement the said operating lever extends from a valve member in the form of a sphere having one or more portions of its surface cut away, e.g. in a scooped out fashion.

An additional preferred feature of devices according to the invention lies in the provision of a weaning control for adjustment of the control device to vary its operating time by applying a further magnetic force to either the first or second magnet or both. Such a weaning control may take the form of a block of ferrous metal mounted in the region of the magnets but whose spacing from such magnets is adjustable. Thus the nearer the ferrous block to either of the magnets the greater will be the attractive force between the block and the respective magnet. Such attractive force may act on the first magnet to alter the effect thereon of the second magnet, or the force may act on the second magnet as an additional, and variable, bias thereon. The weaning control may conveniently also constitute a stop defining one limit position of the second magnet, and in this case the ferrous block is preferably mounted eccentrically between two rotable circular plates of non-ferrous metal, the peripheries of which plates provide said stop.

The ferrous block may conveniently be mounted on the water flow conduit so as to be adjustable toward and away from the magnets.

The water outlet of the control device may be provided with a number of inter-changeable heads, such as for example for misting or for connection to trickle lines with several outlets for pots or gravel trays. When a moisture absorbent pad is provided, this may be wetted by means of a special outlet port in the outlet side of the device, such port preferably having an adjustable flow rate, variable by means of a needle valve for example.

In order that the invention may be more readily understood, certain embodiments thereof will not be described by way of example and with reference to the accompanying drawings, in which:

FIG. 1 is an elevation, partly in section of a first embodiment of a control device according to the invention;

FIG. 2 is a part sectional view of one form of valve in its closed condition for use in a control device according to the invention;

FIG. 3 is a view similar to FIG. 2 but take at right angles thereto;

FIG. 4 is a view similar to FIG. 2 but with the valve in its open condition;

FIG. 5 is a view similar to FIG. 3 with the valve in its open condition;

FIG. 6 is a part sectional view of a modified form of valve;

FIG. 7 is a view similar to FIG. 6 but taken at right angles thereto;

FIG. 8 is a view similar to FIG. 6 but with the valve partly open;

FIG. 9 shows the valve of FIG. 6 fully open;

FIG. 10 is a part-sectional side view of a modified embodiment;

FIG. 11 is a part-sectional front view of the embodiment of FIG. 10;

FIG. 12 is a sectional view through the valve of the embodiment of FIG. 10;

FIGS. 13 and 14 are two views of an alternative outlet arrangement of the device.

FIGS. 15 through 17 are part-sectional views at various stages of opening of a further embodiment of valve;

FIG. 18 is a part-sectional view at right angles of the embodiment of FIGS. 15 through 17; and

FIGS. 19 and 20 illustrate a still further embodiment of the invention.

Referring first to FIG. 1 there is shown a device for automatically controlling the watering of seeds or plants, including a valve generally indicated at 1. The valve includes a movable valve member 2 having an operating lever 3 which incorporates a first permanent magnet of the polarity indicated in the drawing. The

operating lever 3 is enclosed with the valve member 2 in a non-magnetic water flow conduit 4 which is connectible to a water supply at 5. The valve member 2 and operating lever 3 are of the type which will be described in greater detail with reference to FIGS. 2 to 5.

A valve operating means includes a support part 6 in the form of an elongate member pivoted at 7 and carrying at one end a counterweight 8 and at the other a water retentive means in the form of a moisture absorbent pad 9. Pivot 7 may if desired be in the form of a needle pivot. Secured to the member 6 between the pivot 7 and counterweight 8 is a second permanent magnet 10 of the polarity shown mounted outside of the conduit 4 for movement relative to said first permanent magnet 3.

The member 6 supports the weight of pad 9 which pad is arranged to receive water from the supply via the control device and thence via adjustable needle valve 11 and trickle pipe 12.

Owing to the weight of second magnet 10 and counterweight 8, the support part 6 is biased in the anticlockwise direction of movement as seen in FIG. 1.

In the configuration shown in the figure, valve 1 is in its open condition and it will be seen that the unlike poles of the first and second magnets are roughly adjacent. Thus the lower end of first magnet 3 is being urged out of the paper to open the valve. As water flows through the valve 1, a small amount will escape through needle valve 11 and onto pad 9, causing the weight of the pad to increase and thus rotating the support part 6 in the clockwise direction with second magnet 10 moving relative to first magnet 3. In this way the like south poles of the magnet will come into registry effecting an opposite torque on operating lever 3. As will hereinafter be described the valve member 2 will thus close the valve 1, shutting off the supply of water to the seeds or plants and pad 9.

Consequent evaporation of water from pad 9 will thereafter cause support part 6 to rotate counterclockwise, moving second magnet 10 relative to first magnet 3 so that unlike poles again come into registry whereupon the sequence of events described above will begin again. In order to reduce the overall size of pad 9 it may have a corrugated or pleated form.

A weaning control 13 is mounted on the conduit 4 for applying a magnetic force to the second magnet 10 to vary the operation time of the device by adjustably biasing the support part 6. The weaning control 13 alters the operation time of the device by applying a further magnetic force to the second magnet 10 to provide a variable bias on the support member 6. The control comprises a ferrous block mounted eccentrically between two circular non-ferrous plates for rotation by a control knob, so as to cause the ferrous block to be brought nearer to or further away from, the magnet 10, thus varying the amount of magnet attraction existing therebetween.

The outlet of the device, shown at 14 is adapted to receive one of a number of interchangeable heads, such as a misting head or one for connection with trickle lines with several outlets for pots or gravel trays.

As an alternative to moisture absorbent pad 9, the water retentive means may be in the form of a plate a (FIG. 10), preferably circular, formed with a plurality of indentations b adapted to retain droplets of water, mounted on support part 6 for longitudinal adjustment. When the valve 1 is open the plate will collect water and thus move downwardly under the added weight. As it pivots it will close the valve 1 and water will run off the plate leaving only a droplet in each indentation, which droplets will evaporate, eventually to cause valve 1 to open again.

The plate may also be provided with an upturned rim extending around a major part of its periphery the plate being rotatable in its plane about its centre of gravity. It can thus be arranged that water will be retained in the region of the upturned rim the amount retained being variable by rotating the plate. Thus the watering time of the device can be varied. As a further refinement, a second counterweight threadedly mounted on a threaded shank connected to the plate can be provided to allow the valve 1 to open at any desired stage of evaporation.

Turning now to FIGS. 2 to 5, there is shown a valve of the type employed in the FIG. 1 embodiment of the invention. The valve member in this case comprises one limb of a strip of metal 16 bent to form an angle.

An operating lever, carrying the first permanent magnet 3, is provided by the other limb of the member 16. The limb constituting the valve member is arranged to block aperture 17 in the valve seat 18 whilst constrained in a guide member 19 as shown in FIG. 2. In that figure the valve is shown in its closed condition and it will be seen that like poles of the magnets 3,10 are adjacent, exerting a counter clockwise torque on the valve as seen in the figure.

In operation of the control device, movement of the support part caused by lightening of the water retentive means will result in displacement on the second magnet 10 relative to magnet 3 to the position shown in FIG. 4, when unlike poles will be adjacent thus effecting an opposite torque on magnet 3. The valve member will thus pivot open, as shown in FIGS. 4 and 5.

This valve, however, is arranged to be closed by the action of the supply water pressure. The water passing through the valve will exert a counter-clockwise torque on the valve member and operating lever; thus when the second magnet 10 has been displaced sufficiently for the torque exerted by it on the operating lever to be less than that caused by the supply pressure, then the valve will close with a snap action.

An alternative form of valve is shown in FIGS. 19 and 20 where the valve member is in the form of a sphere *m* having scooped out portions *n*, the whole being pivotable and cooperating with valve seat *p* to open and close the valve as shown. Actuation of the valve is achieved by linear movement of controlling permanent magnet *r* cooperating with magnetic operating lever *q* mounted on the sphere *m*.

FIGS. 6 to 9 show a modified form of valve in which the valve member comprises a metal or PTFE sphere 20 supported in a wire cradle 21 having connected thereto an operating lever in the form of the first permanent magnet 3. A second permanent magnet 10' disposed outside water conduit 4' is mounted for vertical displacement brought about by changes in weight of the water retentive means. In this case the valve seat includes a valve bore 22' in which sphere 20 is adapted to seat to close the valve (FIGS. 6 and 7). The cradle 21 is pivotally connected to an upstanding portion 23 of the valve seat, and on the side of the valve seat opposite from portion 23 is a second upstanding and inturned portion 24.

In the FIG. 6 condition, like north poles of the magnets are adjacent and a counter-clockwise torque is exerted on the valve member. As the weight of the water retentive means becomes less, the support part is adapted to move second magnet 10' downwards from the FIG. 6 to the FIG. 8 position where unlike poles come into registry. When this happens, the valve member is urged to move in the clockwise direction as shown to open the valve. In this way the sphere is first lifted slightly sideways off the valve seat before being raised therefrom and being guided by upstanding portion 24 into the FIG. 9 position. The fully open condition of the valve is determined when magnet 3 locates against the inner wall of conduit 4 as seen in FIG. 9.

Referring now to FIG. 10 there is shown a modified embodiment of watering device having an inlet 5', support part 6', water flow conduit 4', pivot 7', counterweight 8', dish a having indentations *b* and arranged close to a growing medium, second magnet 10', needle valve 11', and trickle pipe 12' arranged in a similar way to the FIG. 1 embodiment.

This modified embodiment is provided with a control valve similar to control valve 1 described with reference to FIG. 2, and which itself is shown in more detail in FIG. 12. Such valve consists of a strip of metal 16' bent to form an angle, one limb of which comprises an operating lever carrying the first magnet 3. The strip 16' is suspended from a valve seat 18' by means of a retaining member 19', the whole being pivotable about member 19 such that the other limb can act to open and block the aperture 17'.

Actuation of the control valve is effected by substantially vertical movement of the second magnet 10' in accordance with the rising and falling of the pad 9' owing to the variation in its water content, as explained in connection with the FIG. 1 embodiment. As will be seen, downward movement of the second magnet 10', as the pad gets lighter, brings unlike poles into registry and causes the first magnet 3 to be attracted to the right (FIG. 12) so as to open the valve.

Thus water will issue from outlet jet 25 and strike the base 26 of the needle valve 11' which causes a fine spray to be delivered to the growing medium around the device. Clearly water will also be delivered by the trickle pipe 12' to the pad 9' and cause it to become heavier and so to shut off the valve.

Variation of the amount of water delivered to the growing medium during the watering can be effected by means of the needle valve 11'. Again, variation of the time period between watering can be effected by raising the unit as a whole so as to allow air to flow around the pad 9' to aid evaporation.

The arrangement shown in FIGS. 13 and 14 obviates the need to provide a separate trickle line to moisten the pad. In this case water is arranged to issue from jet 25' as before and to strike the base 27 of a blocking member 28 supported relative to jet 25' by wire loop 29. Part of the water deflected from base 27 in the form of a mist contacts a deflecting means in the form of a flat metal strip 30 supported in block 28, and then runs down the strip to drip onto the pad. The strip 30 can be axially rotated by means of its handle 31 so as to present a lesser or greater surface area to the water coming off the base 27. In this way the amount of water deflected may be varied so as to adjust the watering time to the desired length according to the plants or seeds in the growing medium.

Referring now to FIGS. 15 through 18 a further embodiment of valve includes an operating lever 3' which incorporates a first permanent magnet of the polarity indicated in the drawing. The operating lever is actuated by a second permanent magnet 40 of the polarity shown, mounted outside of the conduit 41 for movement relative to the first permanent magnet.

The flat operating lever 3' is formed at its upper end with a U-shaped recess 32 which forms a cradle for a stainless steel valve ball 33, and serves on actuation so as to open the valve. The lever 3' is pivotally mounted with respect to the valve seat 18' by means of pivot shaft 34 passing through upstanding flanges 35 of the valve seat 18.

Thus in the FIG. 15 position, with like south poles adjacent, the operating lever 3' is biased in an anticlockwise direction and the valve remains shut. On lowering of the second permanent magnet 40 as shown in FIGS. 16 and 17, unlike poles of the two magnets come into registry and the operating lever is pivoted in clockwise direction, displacing the ball 33 from the valve seat 18' to open the valve.

It will thus be seen that the invention provides a simple, robust and efficient control device which will operate automatically to maintain the water content of one, or more if desired, seed or plant containers at a desired level, with a minimum of supervision, and whose control valve operates efficiently in conjunction with a water supply at high pressure, e.g., a mains supply. The use of a water retentive means in the form of an absorbent pad is especially useful, since the device then requires no regulation to take into account the additional weight of the growing plants.

What I claim is:

1. A device for automatically controlling the watering of seeds or plants, comprising a valve including a movable valve member having an operating lever which incorporates a first permanent magnet and which is enclosed with the valve member in a water flow conduit connectible to a water supply; and valve operating means including a second permanent magnet mounted outside of said conduit for movement relative to said first permanent magnet so as by magnetic cooperation with the latter to control opening and closing movement of the valve member, said valve operating means further including a part which is movable to effect the movement of said second permanent magnet between its valve opening and valve closing positions and which part is adapted, in use of the device, to support at least part of the weight of a water retentive means arranged to receive water from said supply via the device, said support part being biased in its valve opening direction of movement but being arranged to be urged in its valve closing direction of movement by the weight of said water retentive means so as to control opening and closing of said valve in response to variations in the weight of said water retentive means.

2. A device according to claim 1 in which the water retentive means comprises a moisture absorbent pad.

3. A device according to claim 2 in which the pad is secured to the support part so as to be wetted when the valve is open.

4. A device according to claim 2 in which the pad is wetted by means of a special outlet port in the outlet side of the device.

5. A device according to claim 4 in which the flow rate of the special port is adjustable.

6. A device according to claim 2 in which means are provided for deflecting part of the outlet of the device onto said pad.

7. A device according to claim 6 in which said deflecting means comprises a flat strip movable so as to present a lesser or greater surface area to said outlet to vary the amount of said outlet deflected onto the pad.

8. A device according to claim 1 in which the water retentive means comprises a plate formed with a plurality of indentations adapted to retain droplets of water.

9. A device according to claim 8 in which the position of said plate on the support part is made adjustable.

10. A device according to claim 1 in which the valve operating lever which carries or incorporates the first magnet is constituted by one of the limbs of an angled metal strip, the other limb constituting the valve member and being arranged, in the closed condition of the valve, to block an aperture in a valve seat, and the second magnet being positioned adjacent the first magnet with like poles adjacent when the valve is closed and being movable to a position in which unlike poles are adjacent to attract the first magnet to open the valve.

11. A device according to claim 1 in which said operating lever extends from a valve member in the form of a sphere having one or more portions of its surface cut away, e.g., in a scooped out fashion.

12. A device according to claim 1 in which the valve member comprises a sphere supported in a cradle having the said operating lever connected thereto, and movement of the second magnet to its valve opening position is arranged to cause the lever to pivot and the cradle to displace the sphere from its associated valve seat.

13. A device according to claim 8 in which the operating lever is formed with means defining a U-shaped recess at one end which serves to receive said sphere.

14. A device according to claim 8 in which the valve includes a valve seat formed with upstanding flanges between which a pivot shaft is arranged, the operating lever pivoting about said pivot shaft.

15. A device according to claim 1 further including a weaning control for adjustment of the control device to vary its operating time by applying a further magnetic force to either the first or second magnet or both.

16. A device according to claim 15 in which the weaning control is in the form of a block of ferrous metal mounted in the region of the magnets but whose spacing from such magnets is adjustable.

* * * * *