Aug. 17, 1937. T. F. MOORE 2,090,545

WELL POINT

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FIG. 1.

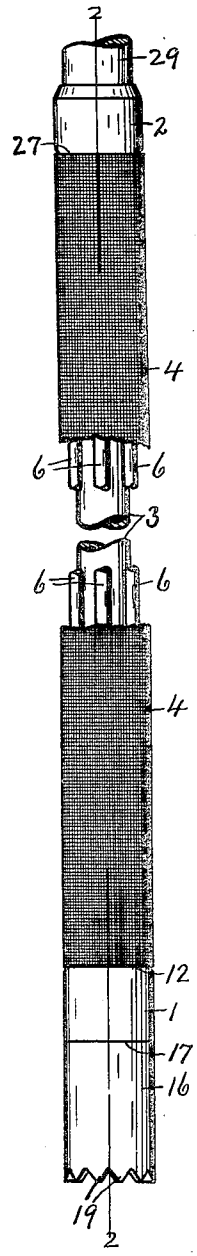


FIG. 2.

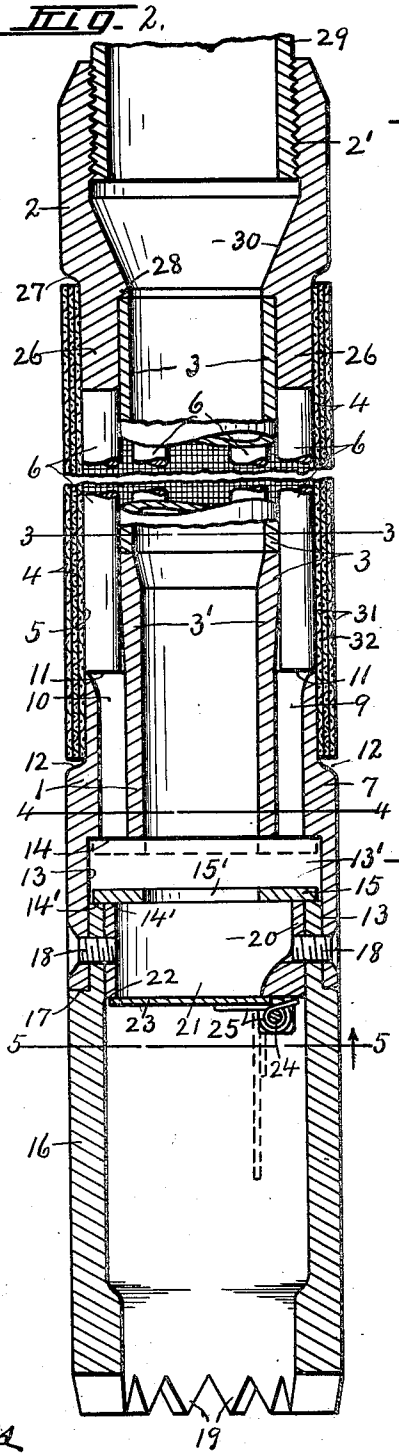


FIG. 3.

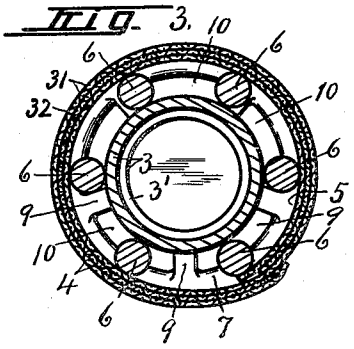


FIG. 4.

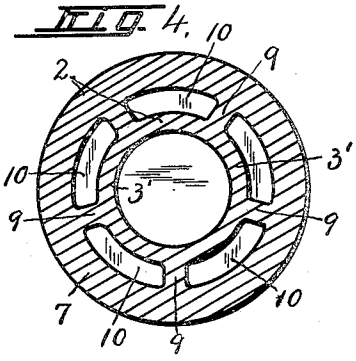
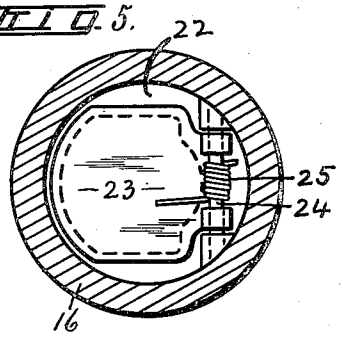


FIG. 5.



INVENTOR
T. F. Moore

WITNESS
J. J. Mains

BY
T. E. Simonton
ATTORNEY

Aug. 17, 1937. T. F. MOORE 2,090,545

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Fig. 6.

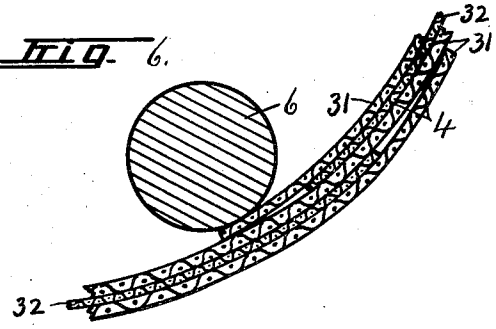


Fig. 7.

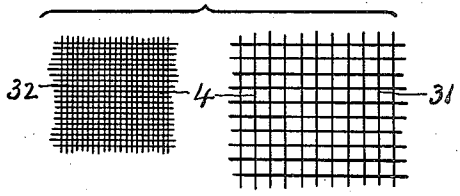
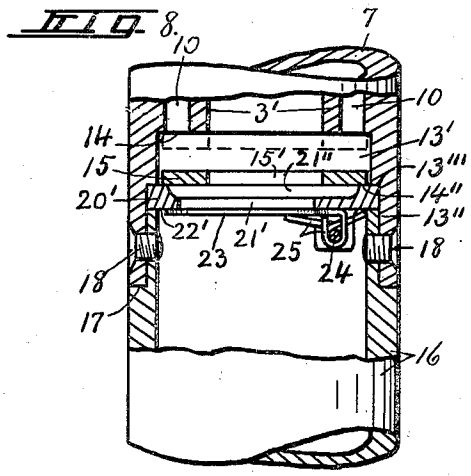


Fig. 8.



INVENTOR
T. F. Moore

WITNESS
J. J. Mains

BY
P. E. Simonton
ATTORNEY

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2,090,545

UNITED STATES PATENT OFFICE

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WELL-POINT

Thomas F. Moore, Morris Plains, N. J.

Application June 17, 1935, Serial No. 26,994

4 Claims. (Cl. 166—7)

This invention relates to certain improvements in well-points of the class set forth in my application Serial No. 698,799 filed November 20, 1933, issued January 14, 1936, as Patent No. 2,027,398, in that it is provided with a central lengthwise jetting-and-suction conduit surrounded by a tubular filtering screen in radially spaced relation thereto to form an intervening filtrate chamber having its lower end connected by one or more ports to an underlying pocket or valve-chamber which is in open communication with the lower open end of the conduit to allow the water in the soil to filter through the screen into the filtrate chamber and thence through the ports into the underlying valve chamber to be withdrawn therefrom through the conduit by any suitable suction device attached to the upper end of said conduit.

This well-point is adapted to be sunk endwise into the soil to be drained to any required depth sufficient to bring the filtering screen below the surface level of the water in the soil during which operation, water or other fluid, under pressure, is introduced from the top downwardly through the central conduit and underlying portion of the well-point for displacing the soil from the lower end thereof and thereby allowing the well-point to sink under its own weight aided by occasional angular movement thereof by hand or otherwise, if necessary.

One of the objects of the present invention is to reduce to a minimum the frictional resistance between the well-point and soil during the sinking operation by making the well-point of relatively small but substantially uniform external diameter from end to end so that its outer surface may be free from obstructions which would otherwise retard its descent into the soil.

When the jetting fluid is directed from the top downwardly through the well-point with sufficient pressure to cause erosion of the underlying soil, the resistance to such erosion will cause a portion of the fluid to be deflected from the bottom upwardly within the well-point with a tendency to escape through the drainage passage which, of course, would reduce the jetting pressure and thereby retard the sinking of the well-point, and one of the objects of the present invention is to provide an improved means in the form of a rigid or inflexible self-opening ring-valve adapted to be actuated by the upwardly deflected portion of the jetting fluid for closing the drainage passage before any appreciable quantity of the fluid can escape therethrough and, at the same time, to permit the jetting fluid to pass through the ring and lower end of the well-point under maximum force and pressure for erosion purposes.

Another object is to provide means in the form of a self-closing check-valve permanently attached to the interior of the well-point some distance above the outlet thereof for controlling communication between the lower end of the central conduit and lower end of the well-point whereby the pressure of the inflowing jetting fluid will open the check-valve to allow said fluid to displace the soil from the lower end of the well-point while, on the other hand, the shutting off of the jetting fluid will allow the check-valve to instantly close so that when the central conduit is connected to a suction device, the entire force of suction will be applied to removing the filtered water from the filtrate chamber with the assurance that none of the unfiltered water nor any solid matter in the well-point below the check-valve can be drawn upwardly into the suction device.

A further object is to maintain a direct unobstructed passage for the jetting fluid through the entire well-point from top to bottom thereof having a cross-sectional area at least equal to that of the interior of the central conduit so that the jetting area at the bottom of the well-point may be even larger if desired.

Other objects and uses relating to specific parts of the well-point will be brought out in the following description.

In the drawings:—

Figure 1 is a side elevation, partly broken away, of a well-point embodying the essential features of my invention.

Figure 2 is an enlarged longitudinal sectional view, partly broken away, of the same well-point taken on line **2—2** Figure 1.

Figures 3, 4 and 5 are transverse sectional views taken respectively in the planes of lines **3—3**, **4—4**, and **5—5**, Figure 2, Figure 5 being inverted.

Figure 6 is an enlarged horizontal sectional view through one of the upright spacing rods and adjacent portion of the tubular screen.

Figure 7 represents face views of a portion of the intermediate fine-mesh screen layer and a portion of the coarse mesh layers shown in Figure 6.

Figure 8 is a side elevation, partly in section, of a portion of a well-point showing a modified arrangement of both check-valves.

The well-point shown in Figures 1 to 5 inclusive is made in the form of a cylindrical shell of any suitable length but of relatively small and

substantially uniform external diameter from end to end to enable it to sink endwise into water-containing soils of widely varying densities under its own weight, aided by angular movement about its axis and also by certain jetting processes hereinafter described, so that when brought to the required depth the water from the soil will drain thereinto to be withdrawn therefrom by any suitable suction device (not shown).

As illustrated, the well-point comprises lower and upper co-axial tubular heads 1 and 2 which are spaced a considerable distance apart axially and are connected by an inner co-axial jetting-and-suction pipe or conduit 3 and a tubular filtering screen 4 surrounding the pipe 3 in radially spaced concentric relation thereto to form an intervening filtrate chamber 5 for receiving the drainage water from the soil after passing through the screen and also for receiving a multiplicity of lengthwise reinforcing rods 6 which are arranged in uniformly spaced relation circumferentially around the pipe 3 and have their lower and upper ends secured respectively to the corresponding heads 1 and 2 for holding the screen in spaced relation to said inner conduit 3.

Lower head

The lower head 1 preferably comprises an outer tubular portion 7 and an inner co-axial tubular portion 3' of appreciably smaller external diameter than the inner diameter of the outer portion 7 and extended into the upper end thereof in radially spaced relation thereto except that the adjacent ends of both portions are united by relatively thin radial webs 9 which are arranged in uniformly spaced relation circumferentially to form a multiplicity of similar lengthwise passages or ports 10 for a purpose presently described. (See Figures 3 and 4.)

The inner tubular portion 3' is of about the same diameter as the pipe or conduit 3 and extends some distance above the outer tubular portion 7 to abut at its upper end against the lower end of said conduit and thereby to form a continuation or extension thereof, the upper end of the tubular portion 3' being arranged in radially spaced relation to the tubular screen 4 a distance substantially equal to the radial thicknesses of the lengthwise spacing rods 6 for receiving the lower ends thereof between them, it being understood that the outer tubular portion 7 is offset radially beyond the periphery of the inner tubular portion 3' so that its upper end face may form an annular shoulder 11 against which the lower ends of the spacing rods 4 may abut. (See Figure 2.)

The external diameter of the upper end of the tubular portion 7 of the lower head 1 is reduced to conform to the inner diameter of the adjacent end of the tubular screen 4 for receiving the lower end of the screen and also to form an annular shoulder 12 against which the adjacent end of the screen is adapted to abut. (See Figure 2.)

The lower end of the lower head 1 is provided with a coaxial cylindrical bore 13 extending radially across the lower ends of the inner tubular portions 3' and ports 10 to form a valve chamber 13' having its top wall disposed in a plane at right angles to its axis to form a flat seat 14 which is adapted to be engaged by a flat ring-shaped check-valve 15 when the latter is closed as shown by dotted lines in Figure 2, said check-valve being preferably made of hard material to take the place of the soft rubber valve shown in my pending application referred to.

The cylindrical bore 13 of the head 1 extends upwardly from the lower end thereof approximately one-half its length for receiving the upper reduced end of a pilot section 16 which extends upwardly into said bore a distance somewhat less than the axial length thereof and has its upper end face disposed in a plane at right angles to its axis to form a flat seat 14' for the ring-valve 15 when the latter is open as shown by full lines in Figure 2.

The pilot section 16 forms a downwardly projecting extension of the lower head 1 and has the external diameter of its upper end reduced to about the inner diameter of the bore 13 to form an annular shoulder 17 against which the lower end of the head is adapted to abut, the reduced upper end of the pilot section being movably fitted in the lower end of the bore and is held in operative position by suitable set screws 18, Figure 2.

The outer diameters of the lower head 1 and pilot section 16 are substantially equal and cylindrical and when assembled are practically continuous and free from obstructions to enable those parts to enter the soil with a minimum frictional resistance, the lower end of said pilot section being serrated at 19 to enable the jetting fluid to pass laterally and outwardly between the serrations and thereby to increase the area of erosion of the underlying soil.

The inner diameter of the pilot section is appreciably greater than that of the central conduit 3' to allow the jetting fluid to spread out over a correspondingly large area in transit therethrough for further increasing the area of erosion of the underlying soil.

A metal bushing 20 is removably fitted within the upper end of the pilot section 16 to extend downwardly a relatively short distance from the upper end thereof and is held in its operative position by the set screws 18 to form a port 21 connecting the valve-chamber 13' with the underlying interior of the pilot section, the upper end face of the bushing being coincident with that of the pilot sections to form the valve seat 14' for the check-valve 15 as shown in Figure 2.

The outer diameter of the ring-valve 15 is slightly less than that of the valve chamber 13' to enable it to move freely between its upper and lower seats 14 and 14' and normally rests loosely upon the lower seat in overhanging relation to the port 21 for a purpose presently described, said check-valve being provided with a central opening 15' co-axial with and of about the same diameter as the interior of the conduit 3' to allow free passage of the jetting fluid therethrough, the remaining portions of the check-valve being of sufficient area to cover the lower ends of the ports 10 when the valve is closed as shown by dotted lines in Figure 2, to prevent escape of the jetting fluid through said ports during the jetting operation.

The lower end face of the bushing 20 is disposed in a plane at right angles to its axis to form a valve-seat 22 adapted to be engaged by a self-closing check-valve 23 which is hinged at 24 to the lower end of the bushing some distance to one side of said axis to swing vertically to and from its seat to close and open the port 21 and is normally closed and yieldingly held in its closed position by means of a relatively stiff spring 25 as shown in Figures 2 and 5, said check-valve 23 being preferably made of metal or other

durable material to take the place of the less durable wooden float-valve shown in my application previously referred to.

The spring **25** is tensioned against the underside of the valve **23** with sufficient pressure to close the valve against its own weight as soon as the jetting operation ceases, it being understood that the suction operation will aid materially in firmly holding the valve in its closed position to not only expediate the withdrawal of the drainage water but also to prevent the passage of any underlying material into the suction device through the conduit **3**.

In the modified construction shown in Figure 8, the diameter of the bore, as **13''**, immediately below the valve chamber **13'** is enlarged to form an annular shoulder **13'''** and in this bore is removably fitted the reduced upper end of the pilot section **16** having its upper end face underlying the annular shoulder **13'''** in axially spaced relation thereto to form an annular groove for receiving the outer marginal edge of a bushing **20'**.

This bushing **20'** projects inwardly beyond the inner walls of the valve-chamber **13'** and pilot section **16** to form upper and lower valve-seats **14''** and **22'** for the adjacent valves **15** and **23** respectively, said bushing having a port **21'** therethrough connecting the valve-chamber **13'** with the underlying interior of the pilot section **16**.

The upper end of the port **21'** is enlarged at **21''** and of greater diameter than the central opening **15'** in the ring-valve **15** to allow the latter to overhang a greater area of said port so that the upwardly deflected portion of the jetting fluid may effect a more instantaneous closing of the valve against its upper seat for closing the drainage ports **10** during the jetting operation.

Upper head

The upper end head **2** is provided with a reduced pendant annular flange **26** and outer and inner annular shoulders **27** and **28** at the upper ends of said flange which latter is closely fitted around and upon the upper end of the conduit **3** and is also closely fitted within the adjacent end of the tubular screen **4** with its shoulders **27** and **28** abutting against the upper end faces of said screen and conduit respectively to assist in rigidly holding the screen and conduit in radially spaced relation, the lower end of said flange being abutted against the upper ends of the rods **6**.

The inner diameters of the annular shoulder **28** of the head **2** and adjacent end of the conduit **3** are equal to form a substantially smooth joint while the outer diameters of said head and adjacent end of the screen **4** are also substantially equal for the same purpose and also to reduce frictional resistance between the soil and well-point as the latter descends into the soil.

The interior diameter of the upper end of the head **2** is appreciably greater than that of the conduit **3** and is threaded at **2'** for receiving an extension pipe **29** which may be connected to a fluid pressure pump or other source of fluid supply under pressure for jetting purposes or it may be connected to a suction device for withdrawing the drainage water from the soil through the well-point, the intermediate portion of said interior being tapered at **30** toward the conduit **3** to cause the inflowing jetting fluid to be concentrated into and directed axially through said conduit with a maximum force.

Spacing rods

The spacing rods **6** are preferably cylindrical and are arranged in circumferentially spaced relation around and against the outer periphery of the conduit **3** and welded thereto if desired to hold them in uniformly spaced relation with their lower and upper ends abutting respectively against the adjacent ends of the corresponding heads **1** and **2** to which they may be welded to assist in holding both heads and the conduit in rigid relation, it being understood that the rods **6** are of uniform diameter from end to end approximately equal to the radial thickness of the flange **26** and the radial distance of the tubular portion **7** beyond the inner tubular portion **3'** of the lower head **1** to form bearings for the inner surface of the tubular screen **4**.

Tubular screen

The tubular screen **4** is of special construction adapted to obviate the use of the external lengthwise reaming bars shown in my pending application referred to in that it consists of a laminated foraminous sheet preferably composed of layers **31** and **32** of woven wire of different mesh wrapped around the outer faces of the stay rods **6** and the reduced ends of the lower and upper parts **7** and **2** as shown more clearly in Figures 2, 3 and 6.

The screen layer **31** is preferably made of comparatively heavy wires interwoven to form a relatively coarse mesh and is of sufficient circumferential length to extend, in this instance, slightly more than two complete turns around the outer surfaces of the rods **6** so that its ends may overlap as shown in Figure 3, the other layer **32** being approximately one half the length of the layer **31** to wrap around said rods slightly more than a single turn to enable its ends to overlap and is composed of wires of comparatively small gage interwoven to form a relatively fine mesh; (see Figures 6, 7 and 8), the axial length of both layers being approximately equal to the distance between the shoulders **12** and **27** on the lower and upper heads **1** and **2** as shown in Figures 1 and 2.

These layers **31** and **32** may be pre-assembled one upon the other with corresponding ends in the same transverse plane, and may then be wrapped firmly around the outer surfaces of the rods **6** in such manner that the finer mesh layer will be interposed between the two turns of the coarser mesh layer as shown in Figures 2, 3 and 6, thus bringing approximately one half of the coarser mesh layer in direct contact with said rods and its remaining half around the outer surface of the finer mesh layer **32**.

For example, as shown in Figures 3 and 6, one end of the coarser mesh layer **31** is welded or otherwise firmly secured to the outer surface of one of the rods **6** after which the corresponding end of the finer mesh layer may be welded or otherwise secured to the outer surface of the coarser mesh layer just beyond the line of securement of the latter layer to the rod, the two layers being then wrapped slightly more than one turn around the outer surfaces of the remaining rods **6**, the remaining portion of the coarser mesh wire being then wrapped another turn around and upon the outer surface of the finer mesh layer and slightly beyond the first ends of both layers in overlapping relation, the last end of the first layer **31** being extended slightly beyond the corresponding end of the second layer **32** and is welded or otherwise secured to the outer surface

of said first layer to complete the tubular form of the laminated screen as shown in Figure 6.

It is now clear that the coarser mesh layer **31** covers the inner and outer surfaces of the finer mesh layer to protect the latter against injury by contact with the rods **6** and soil and at the same time utilizing the finer mesh layer for filtering the drainage water from the soil into the well-point to the exclusion of the solids, while the outer portions of the coarser and stronger layer contact directly with the soil and constitute a means for displacing the contiguous soil as the well-point descends thereon.

It will also be observed that the inner aud outer coarser-mesh layers **31** of the tubular screen serve to reinforce the intermediate finer-mesh layer **32** to prevent undue inward and outward radial displacement or deflection of the portions of the finer mesh layer between the rods **6** and thereby to maintain the maximum capacity of the filtrate chamber **5** under widely varying external or internal radial pressures during the suction and jetting operations.

The pilot section **16** is preferably made separately from the lower head **1** for convenience in forming the bore **13** and valve chamber **13'** and also for milling the valve seat **14** and is assembled upon said head with a sliding or telescopic fit and held in rigid relation to the head by means of the set screws **18** or equivalents, thus permitting the pilot section to be easily removed for repairs or replaced when necessary.

The external diameter of the tubular screen **4** is substantially equal to that of the underlying and overlying portions of the heads **1** and **2** and it therefore follows that the outer surface of the entire well-point is substantially cylindrical and is free from obstructions, thereby reducing to a minimum its friction with the surrounding soil and permitting the well-point to be sunk into soils of various densities with greater rapidity and less strain upon its parts than has heretofore been practised, it being understood that the outer coarser-mesh and heavier wire-screen layer **31** further reduces the friction and serves to effectively disintegrate the adjacent soil as the well-point descends without the use of extra reaming means.

The conduit **3**, valve-ring **15** and port **21** are arranged in co-axial relation and in sequence from the top downwardly while the interior of the well-point below the valve **23** is free from obstructions so that when said valve is opened by the downward pressure of the inflowing jetting fluid, the latter will have a free and unobstructed axial passage through the well-point from top to bottom and around the axis thereof for displacing the underlying soil from the entire area of the discharge end to further accelerate the sinking of the well-point under its own weight as desired.

Operation

The well-point is usually placed in an upright position with its lower end resting upon the ground at the point where it is to be sunk and its upper end is connected to a pressure pump or other source of supply of the jetting water or other fluid which is then caused to pass downwardly into the well-point and through the opening in the ring-valve **15** thereby opening the valve **23** and allowing the fluid to continue its unobstructed flow through the pilot section **16** to impinge against the underlying soil for erosion purposes.

The resistance of this soil to the free passage of the fluid through the outlet causes more or less of the fluid to become trapped in the lower end of the well-point below the conduit **3**, resulting in an upward deflection of a part of said fluid with a tendency to escape through the drainage ports **10**, but this upwardly deflected fluid immediately impinges against the underside of the ring-valve **15** and lifts the same into engagement with the upper seat **14** for closing said ports and thereby preventing the escape of the fluid therethrough and allowing the full force of the fluid to be directed against the underlying soil for displacing the same and allowing the well-point to sink therein under its own weight.

This sinking operation is preferably continued until the entire length or major portion of the tubular screen **4** is brought below the level of the water in the soil sufficient to allow the drainage of the water from said soil through the tubular screen **4** into the filtrate chamber **5** and thence downwardly through the ports **10** into the valve chamber **13'** and port **21**, it being understood that as long as the jetting operation continues, the valve **23** will be opened by the downward pressure of the jetting fluid against the action of its spring **25** and that the upward pressure of the trapped fluid in the well-point below the ring-valve **15** will effectively close the same against its upper seat **14** for closing the ports **10** to prevent the escape of the jetting fluid outwardly through the screen **4**.

When the well-point has been sunk to the required depth, the jetting fluid is shut off thus permitting the valve **23** to be closed by its spring **25** and at the same time, the ring-valve **15** will drop by its own weight to its open position on the lower valve seat **14'** thus opening communication between the chamber **13'** and filtrate chamber **5** through the open ports **10** and allowing the drainage water from the soil to pass through the screen into the filtrate chamber and thence downwardly through the ports **10** into the chamber **13'** and port **21** from which it may be withdrawn by a suitable suction device applied to the upper end of the well-point.

The upper end of the well-point is then connected to a suitable suction device (not shown) for withdrawing the drainage water from the soil through the screen **4** into the filtrate chamber **5** and thence downwardly through the ports **10** into the chamber **13'** and port **21** and upwardly through the conduit **3** to the suction pump to be discharged therefrom to a remote locality, this suction operation being continued until the water in the soil is entirely drained therefrom.

The upward suction through the conduit **3** aids materially in holding the valve **23** in its closed position as long as the suction operation continues, to prevent any possibility of drawing the underlying soil upwardly through the well-point into the suction pump so that the entire suction force may be directed to the withdrawal of the water from the soil into and through the portion of the well-point above said valve leaving the lower part of the well-point below the valve free from the influence of the suction operation.

It is now clear that the operations of both of the valves **15** and **23** are entirely automatic during the jetting and suction periods in that during the jetting period the valve **15** will be closed and the valve **23** opened by the force of the jetting fluid to afford an unobstructed passage for said fluid from the inlet to the outlet

of the well-point while, on the other hand, as soon as the jetting fluid is shut off or immediately upon the beginning of and during the suction period the valve 23 will be closed by its spring 25 and the valve 15 will be opened under its own weight to afford an unobstructed passage for the drainage water from the soil to the suction pump all of which contribute materially to the economic and expeditious sinking of the well-point into the soil and the removal of the water therefrom.

In case the area of the soil to be drained is relatively large, a proportionate number of the well-points may be similarly sunk in or around said area and connected to a common source of supply for the jetting fluid so that all of them may be sunk simultaneously or in quick succession or they may be connected to a single suction device for removing the drainage water therefrom in one operation.

I claim:—

1. A well-point comprising an elongated member having a lengthwise passage therethrough for receiving a jetting fluid, a self-closing valve positioned adjacent the bottom of said passage and normally closing said passage, said valve being adapted to be opened by the pressure of the jetting fluid, and when so opened, affording a substantially unobstructed axial path for the jetting fluid entirely through the well point, means surrounding said passage for directing drainage fluid of fluid-containing soil into said well point passage at a point above the valve aforesaid, said means including a filter screen surrounding said passage in radially spaced relation thereto, and mounting means therefor, and valve means for controlling the admittance of said drainage fluid to the well point passage, said valve means also being located above the first mentioned self-closing valve and normally closing responsive to the passage of a jetting fluid through the well point to prevent escape of the jetting fluid from the well point through the drainage fluid directing means.

2. A well-point comprising a central lengthwise inner conduit adapted to receive a jetting fluid under pressure, a tubular screen surrounding said conduit in radially spaced relation thereto to form an intervening filtrate chamber, means including a lower head surrounding the lower end of the conduit for supporting said screen with the chamber normally in open communication in a downward direction with the lower end of said conduit, a valve seat carried by said lower head and spaced below the lower end of said conduit, and an inflexible ring valve normally resting on said valve seat and being adapted to be actuated by the influx of the jetting fluid in said conduit for closing communication between said chamber and conduit, and consequently preventing the jetting fluid from passing to the filtrate chamber, and causing the jetting fluid to be discharged from the bottom of the well-point.

3. A well-point adapted to be sunk endwise into water-containing soil, and comprising an inner conduit adapted to be connected to a suction device for producing suction therein, and a laminated tubular screen surrounding the conduit and supported at circumferentially spaced intervals in radially spaced relation thereto to form an intervening filtrate chamber normally in open communication with the interior of the conduit, said screen being composed of a continuous length of relatively coarsely foraminate sheet material extending about the conduit for substantially two turns, and a single turn of relatively finely foraminate sheet material interposed between the two turns first mentioned.

4. A well-point adapted to be sunk endwise into water-containing soil, and comprising an inner conduit adapted to be connected to a suction device for producing suction therein, lengthwise bars arranged in circumferentially spaced relation around and against the outer face of the conduit, and a laminated tubular screen surrounding the conduit in radially spaced relation thereto to form an intervening filtrate chamber normally in open communication with the interior of the conduit, said screen being composed of a continuous length of relatively coarsely foraminate sheet material having one end thereof secured to one of the bars, and a shorter length of relatively finely foraminate sheet material superposed on said first sheet and having one end secured to the latter just beyond the line of securement of the latter to the bar, the two sheets being wrapped together around the bars slightly more than one turn, and the remaining portion of the coarsely foraminate sheet being wrapped another turn around and upon the outer surface of the finely foraminate sheet and terminating slightly beyond the first ends of both sheets in overlapping relation, and the terminating end secured to the outer surface of the underlying turn of the coarsely foraminate sheet.

THOMAS F. MOORE.