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2,629,447

METHOD FOR EFFECTING AND CONTROLLING THE RECHARGE
OF UNDERGROUND FORMATIONS BY SPECIAL WELLS

Filed Dec. 15, 1949

2 SHEETS—SHEET 1

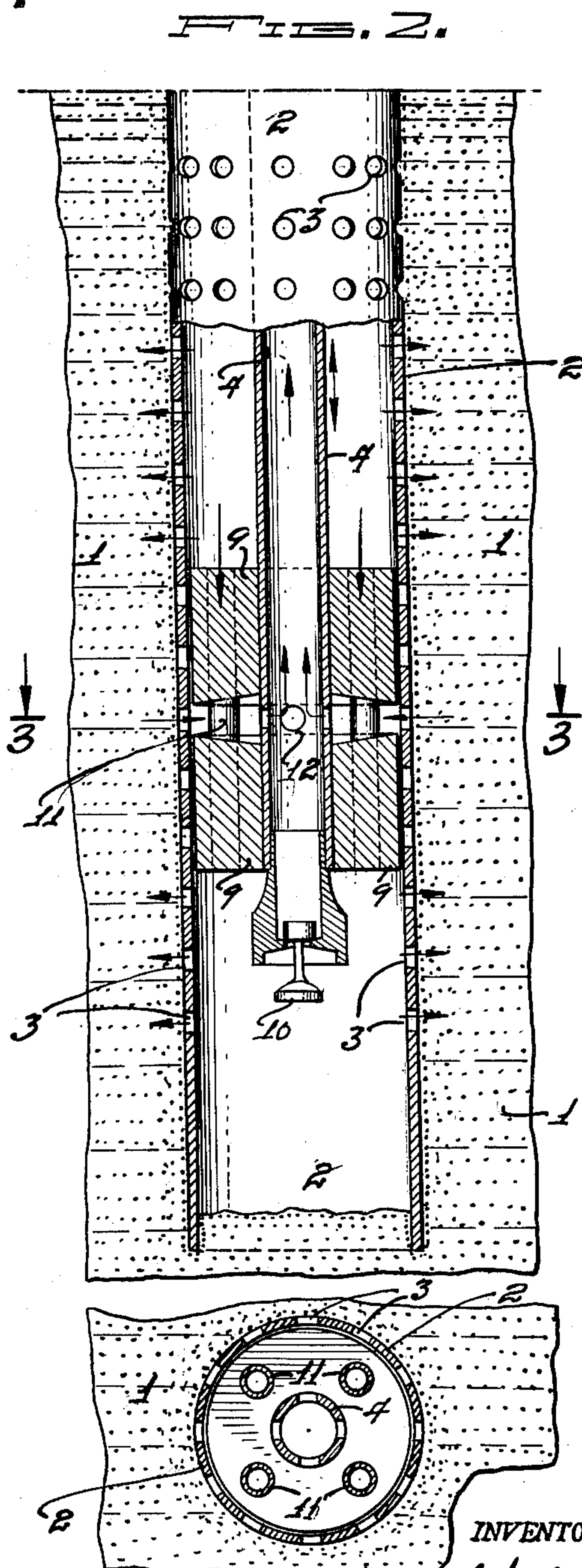
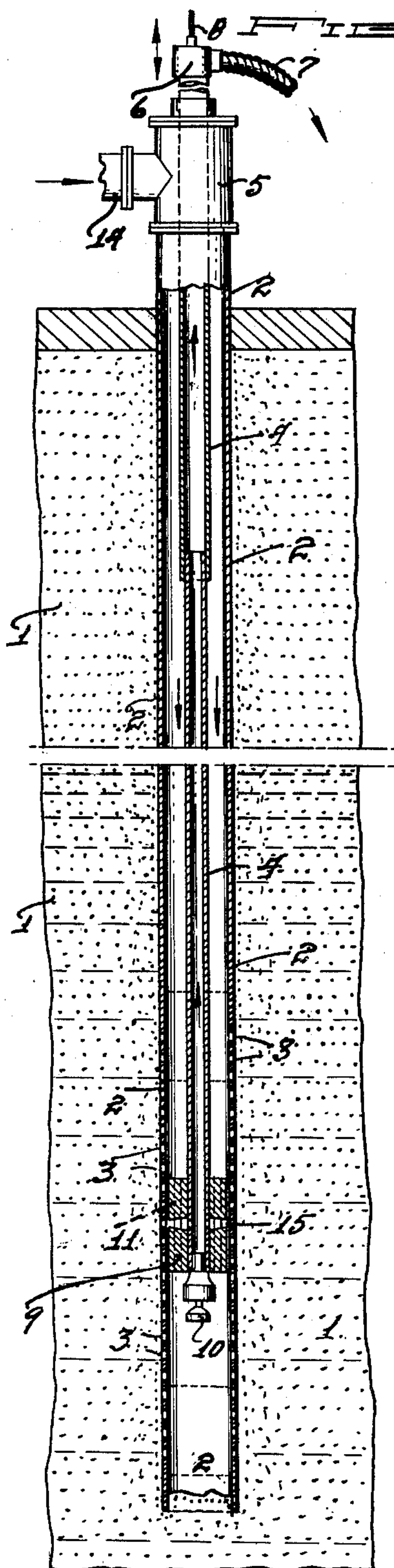


FIG. 3 BY

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2 SHEETS—SHEET 2

FIG. 5.

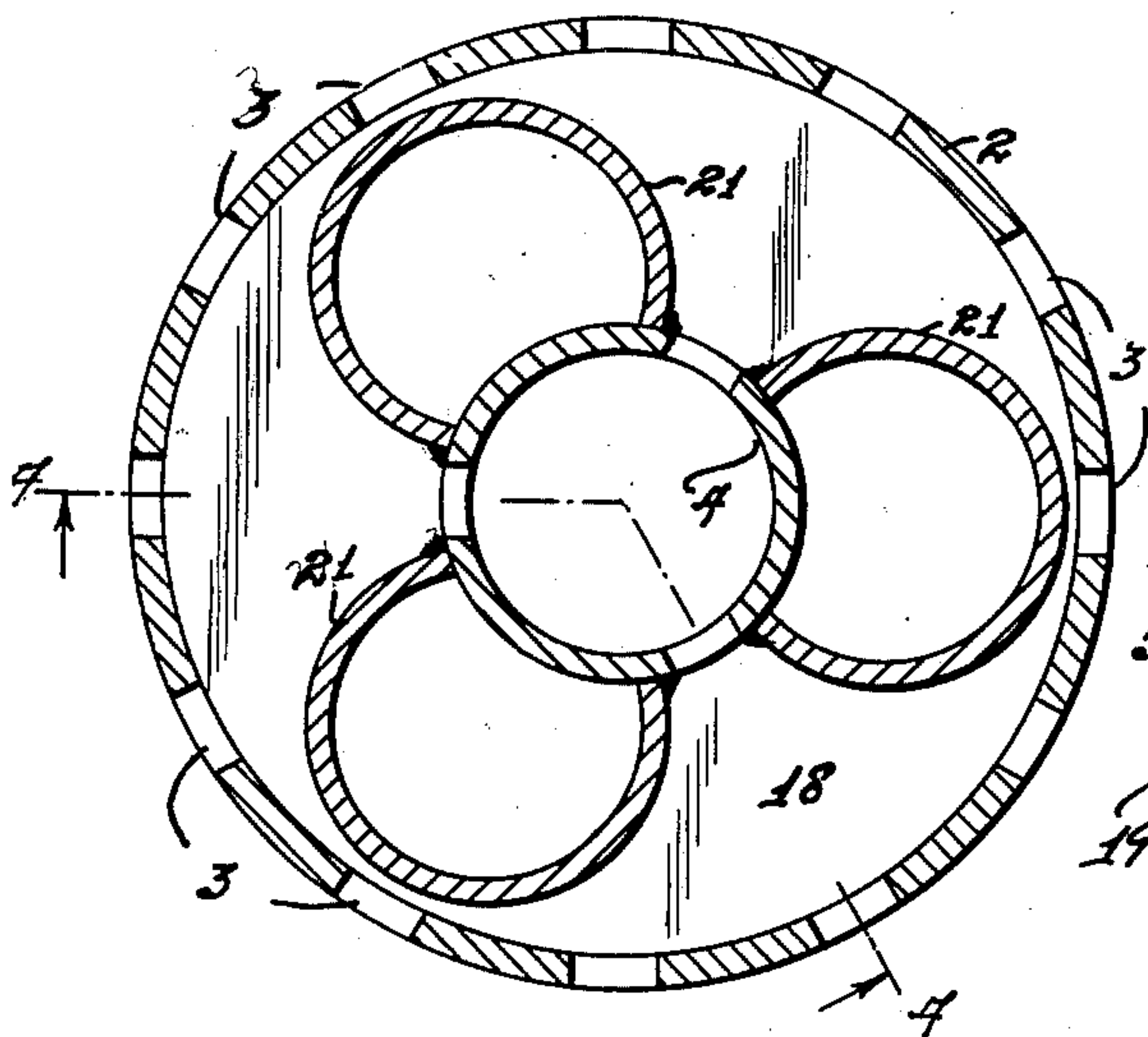


FIG. 4.

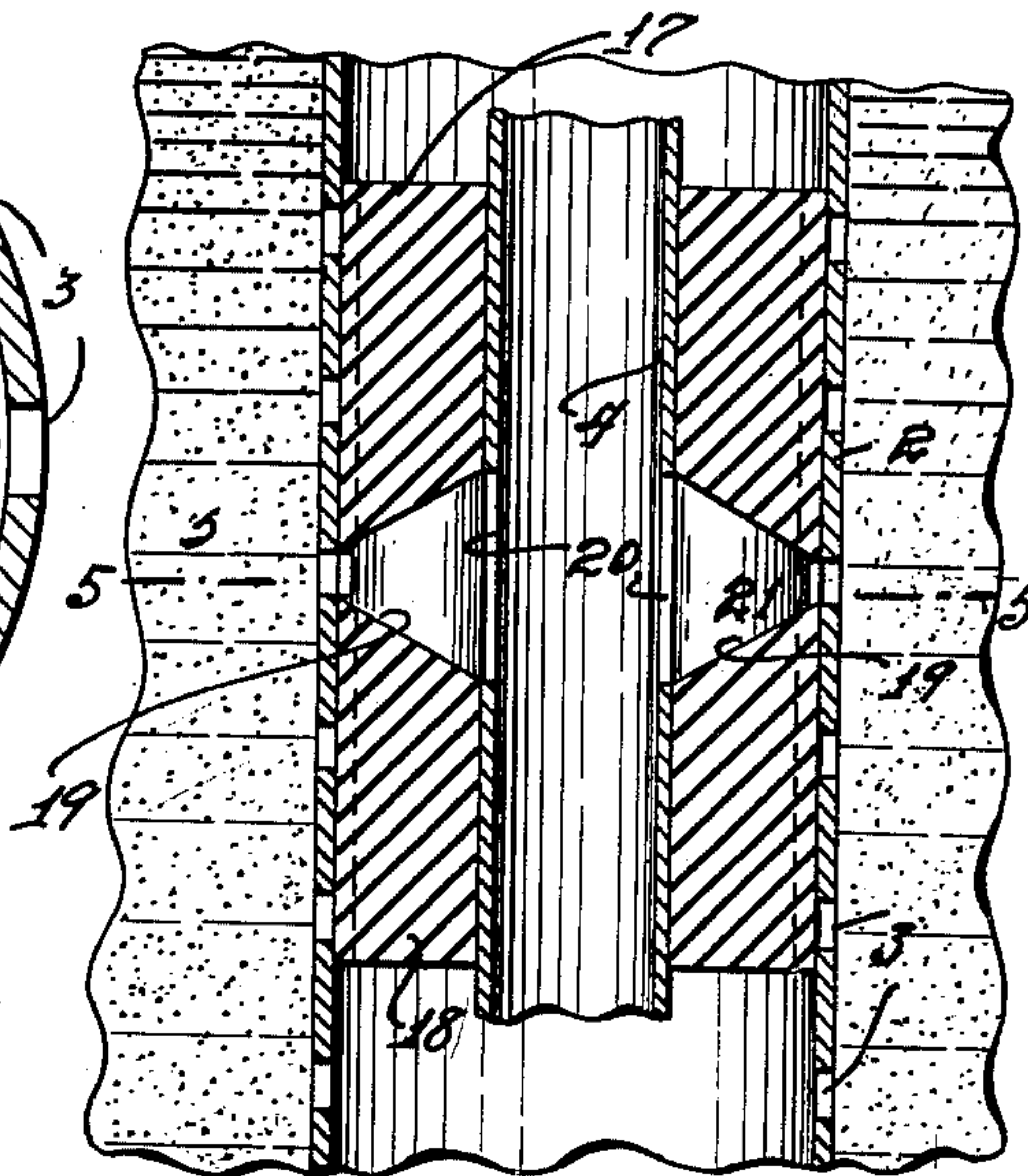


FIG. 7.

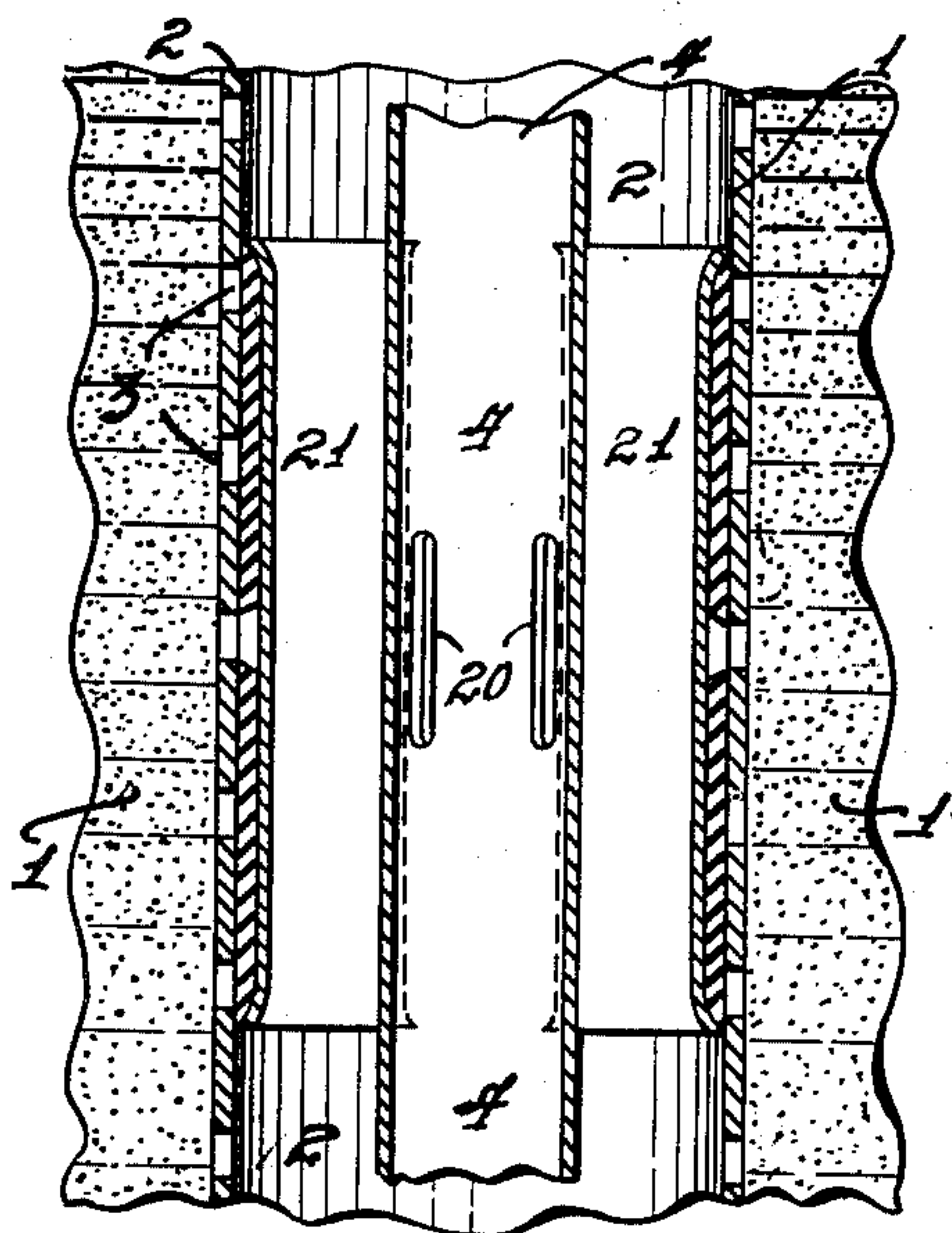
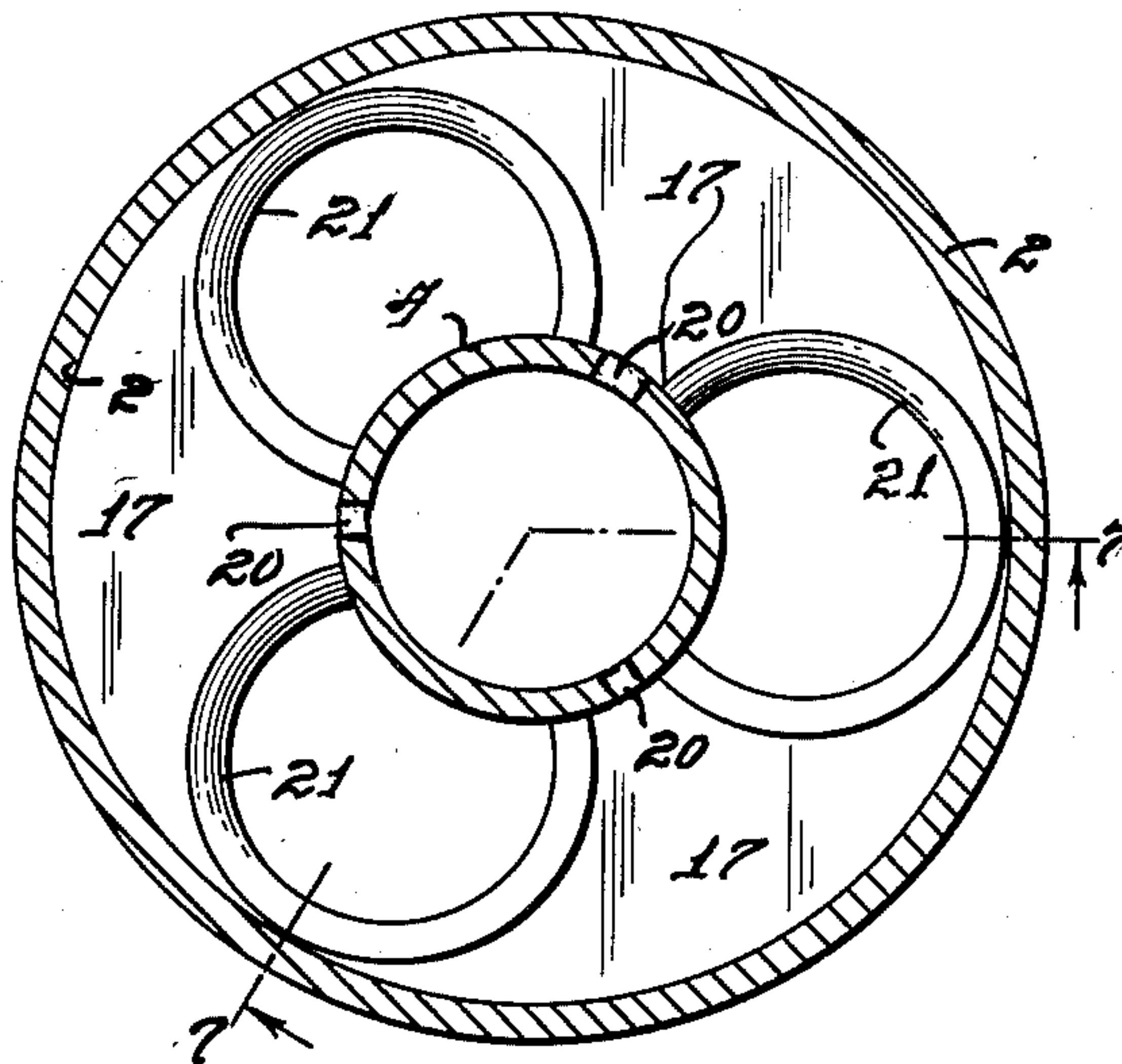


FIG. 6.



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METHOD FOR EFFECTING AND CONTROLLING THE RECHARGE OF UNDERGROUND FORMATIONS BY SPECIAL WELLS

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1 Claim. (Cl. 166—23)

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The present invention relates to the better utilization of water or other fluids by artificial recharging of underground formations permitting such action, as, for example, porous rocks, sand and/or gravel strata in order to create additional supply of fluid at desired areas at a time when the source of fluid supply is on, and for abstraction and use of said fluid or of displaced fluid when such supply substantially decreases. Thus, very large quantities of fluid can be stored underground for later use.

In my method, special means is employed in the formation of the recharging well and the form and relation of its elements to insure massive recharging rates and maintain rich recharge rates by automatic cleaning or flushing of the exposed permeable underground formation or of the openings through which fluid is normally charged from the well into the ground formation.

The above and other objects of the invention will be described with reference to the accompanying drawings, in which:

Fig. 1 is a view largely in sectional elevation showing one form of apparatus for carrying out the invention;

Fig. 2 is a sectional elevation which is enlarged to show the lower end or portion of the apparatus illustrated in Fig. 1;

Fig. 3 is a horizontal section on the line 3—3, Fig. 2;

Fig. 4 is a vertical section through the movable head portion of a modified re-charging well arrangement;

Fig. 5 is a somewhat enlarged horizontal section on the line 5—5, Fig. 4;

Fig. 6 is a horizontal section taken above the movable cleaning head shown in Fig. 4, and somewhat enlarged with respect to that figure, and

Fig. 7 is a vertical section taken on the line 7—7, Fig. 6, reduced in size with respect to that figure.

Referring to the drawings, and particularly Figs. 1—3, inclusive, I have shown at 1 a ground formation of that type adapted to be charged or recharged with water, but which formation is shown schematically. Within the formation is driven or otherwise installed, a casing 2 of suitable cross-section and preferably cylindrical. The lower area of the casing for a considerable distance from its end is provided with openings, as at 3, which have a double function as will later be described.

Within casing 2 is a conduit, preferably of strong rigid metal, and which is shown at 4.

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This conduit projects upwardly from the casing head 5 and is connected to means for raising and lowering it. In Fig. 1 the conduit 4 is shown as having an inlet head 6 in communication with a flexible fluid-receiving tube 7, and head 6 has attached thereto a cable 8 for the purpose of raising and lowering the conduit.

Within casing 2 and carried by conduit 4 is a head 9 of special construction. As can be noted from Figs. 1 and 2, the conduit is closed at its lower end by a weight valve member 10 of such formation that when the conduit and head are moved downwardly until the weight valve strikes the underlying ground formation and is raised, fluid can be drawn from said area directly into the conduit 4.

In the said constructions of Figs. 1 to 3, the head 9 can be slidably raised and lowered by corresponding movements of the tubular conduit which carries it, and at the same time the periphery of the cleaning head closely fits the interior face of the casing 2. The cleaning head has projected therethrough a plurality of tubes 11, and these tubes may hold separate upper and lower head sections as shown in Fig. 4. This spacing provides passageway for fluid passing radially toward the well through selected apertures or screen openings of the casing into the head and through openings 12 (Fig. 2) in the tubular conduit, or passing through a lower well boundary of firm compact porous ground formation which would be the equivalent.

The casing head 5 is provided with a water entrance pipe 14 so that water under pressure may enter the casing to pass downwardly around the conduit and to the head, the pipes 11 providing passage through the head by the water. It will generally be preferred that the volume of water passing through the head be substantially greater than the water passing into the head from the openings in the casing wall. For example, in the embodiment shown in Fig. 2, the passageway at 15 leading through the head to the openings 12 in the conduit is relatively narrow and receives water from a substantially restricted area of the casing.

In the operation of the embodiment shown in Figs. 1 to 3, inclusive, water or some other fluid is led into the casing via a pipe 14 and passes through ports in the casing both above and below the head, the water freely passing through the pipes or tubes 11 which project through the head 9. This casing intake of water may be under a desired pressure, above gravity if desired. Thus the water may be passed into the

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casing in excess of the capacity of the ports 3 to discharge the water into the ground formation. But whether the water discharged from the casing through ports 3 is under gravitational or under applied pressure, a differential in pressure will be created at the area of the casing closed by the head as to casing ports. In other words, there will be hydrostatic pressure above and below those ports of the casing which are opened to the interior of the head in whatever vertical position the head is brought by raising or lowering the tubular conduit 4. This hydrostatic differential in pressure is normally brought into such control as to effect radial flow concentrically inward thus automatically flushing and cleaning the openings in the well screen and the adjacent permeable underground formation.

The clogging of openings or screens in wells of the general type and of the adjacent porous and permeable underground formations has constituted a serious problem for many years. This is caused by matter in suspension carried by the water or other fluid fed into the underground reservoir. By the simple means of my invention, the entire section of the well in communication with the permeable underground formation and the fluid bearing structure adjacent to the well can efficiently be cleaned by raising and lowering the conduit and attached head, through corresponding movements of the conduit itself, and permitting the differential hydrostatic pressure to dislodge and carry inward the material packed about and in the adjacent permeable formation and the openings or screen holes and which has been brought in by the fluid outwardly flowing through the exposed area into the underground formation.

In the modified form shown in Figs. 4 to 7, inclusive, the casing and conduit will be the same, or at least may be the same as that illustrated in Figs. 1 to 3, inclusive. Therefore, the same reference characters have been employed for the said elements. As in the last-named figures, the head is formed as an upper section, indicated at 17, and a lower section which is indicated at 18. Between these sections is a water entrance area indicated in Fig. 4 at 19, and which may surround the tubular conduit 4. The conduit is slotted or otherwise apertured at 20 for the ingress of water to the tubular conduit. However, the tubular conduit itself carries a plurality of vertically arranged metallic pipe members 21. These may be made of split tubing longitudinally spread at the splits and welded to the tubular conduit 4. These members 21 extend through the head sections from end to end thereof, and if desired, they may, by contact with the inner wall of the casing 2 provide independent parallel passageways disposed laterally with respect to the conduit and leading to those openings in the well as are below any given vertical position of the head.

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Due to the proportions of the elements and the relatively high hydrostatic pressure which can be built up, it is entirely feasible to utilize such pressure for carrying the dislodged port-clogging material and accompanying water upwardly out of the tubular conduit without the necessity of suction, but suction can be employed if desired.

It will be understood that various modifications may be made in the form and arrangement of the elements constituting the embodiment shown, without departing from the spirit of my invention.

Having described my invention, what I claim and desire to secure by Letters Patent is as follows:

A method of operating recharging wells of that character having a cased upper section and also a lower section in fluid communication with permeable underground formation, which consists in partially blocking off from within the well a selected section of exposed surface of fluid bearing formation by means of a reverse flow head and withdrawing fluid from said underground formation through unblocked openings opposite the head thence therein and through ports in a conduit carrying said head, and conducting the flow upwards, and discharging the flow at the top of the well, these operations being conducted simultaneously with the feeding of a proportionately larger volume of fluid into the permeable underground formations above and below the head through openings which are in contact with the permeable underground formation, said upward flow being achieved by producing a differential hydrostatic pressure between the fluid in the adjacent underground formation, both above and below said blocked area and the interior of the cleaning head and of the attached conduit, the latter extending to the top of the well, and periodically and automatically creating this differential pressure within the said cleaning head and conduit for effecting reverse flow concentrically towards the cleaning head and up through the conduit to the top of the well.

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