Oct. 31, 1950 S. O. ALLEN 2,527,670

HELICAL PUMP

Filed April 4, 1946 2 Sheets-Sheet 1

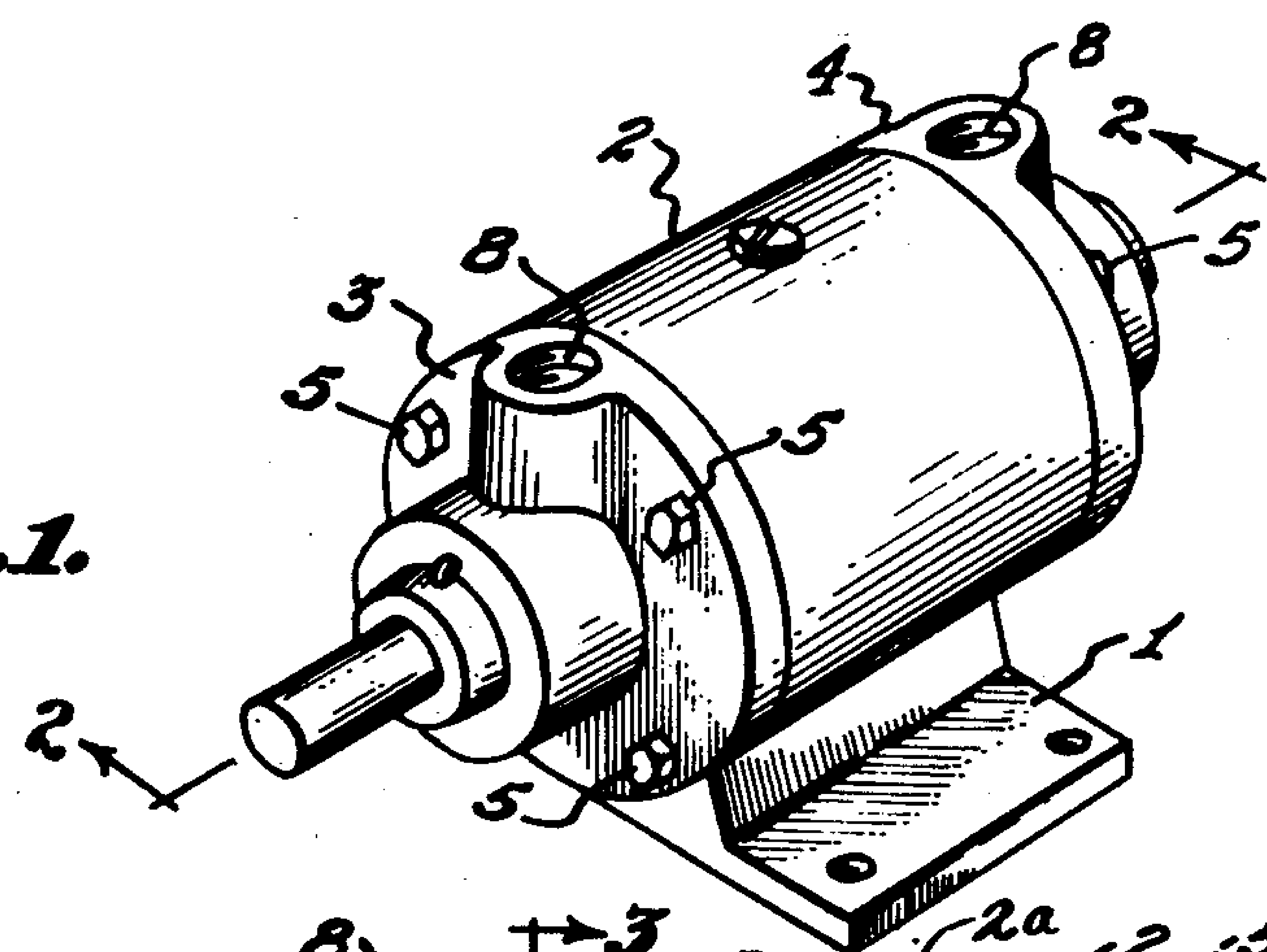

FIG. 1.

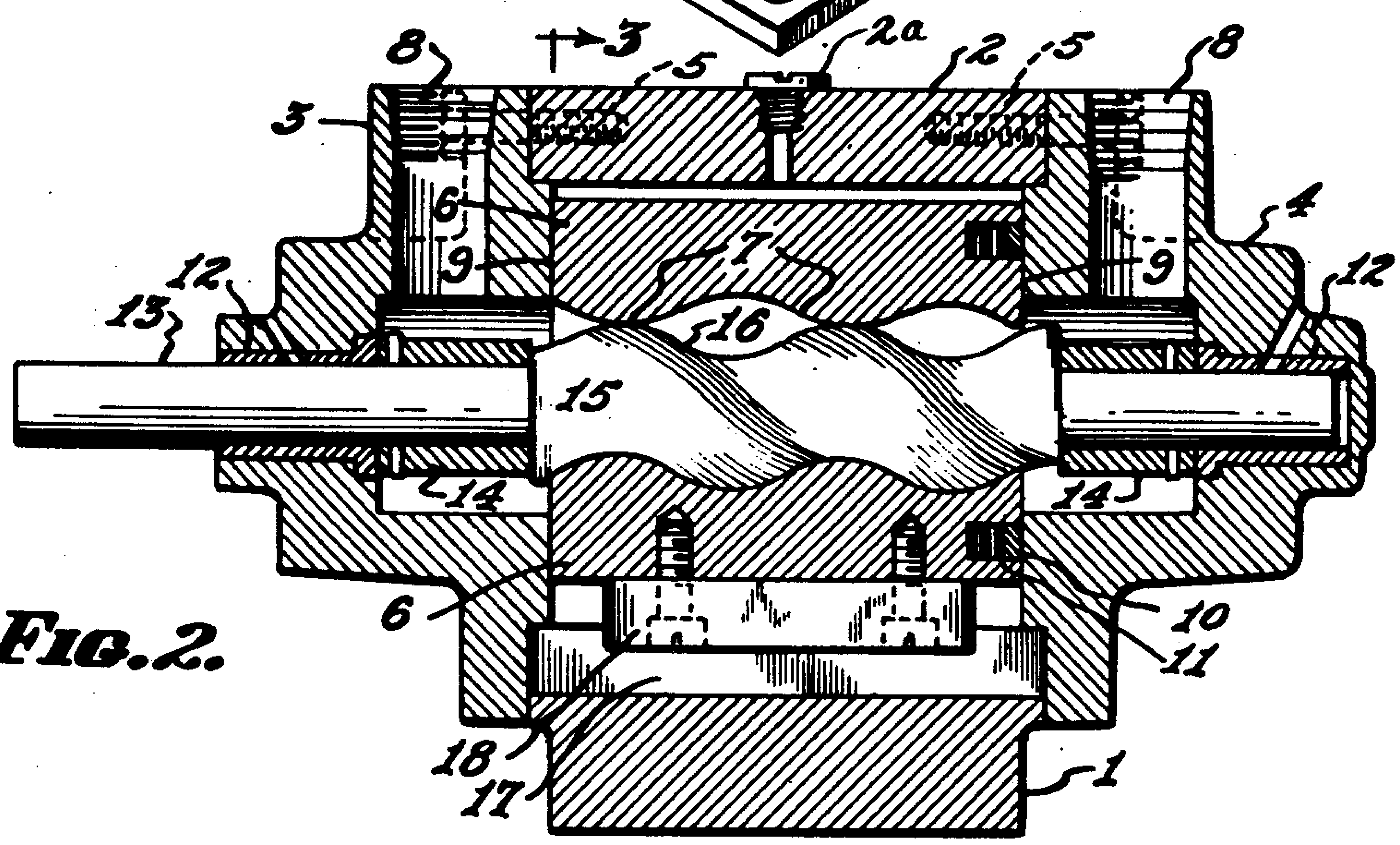

FIG. 2.

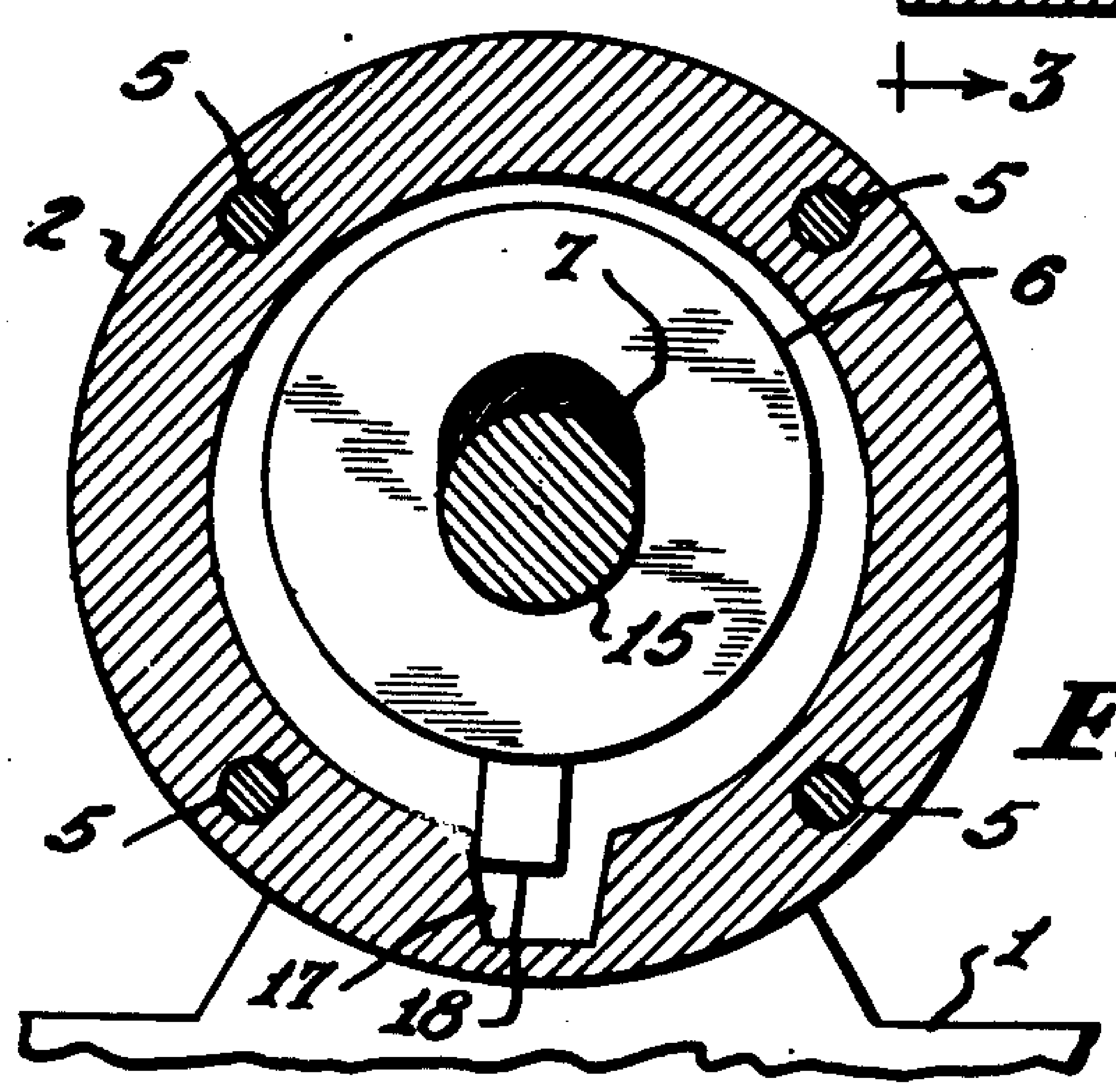

FIG. 3.

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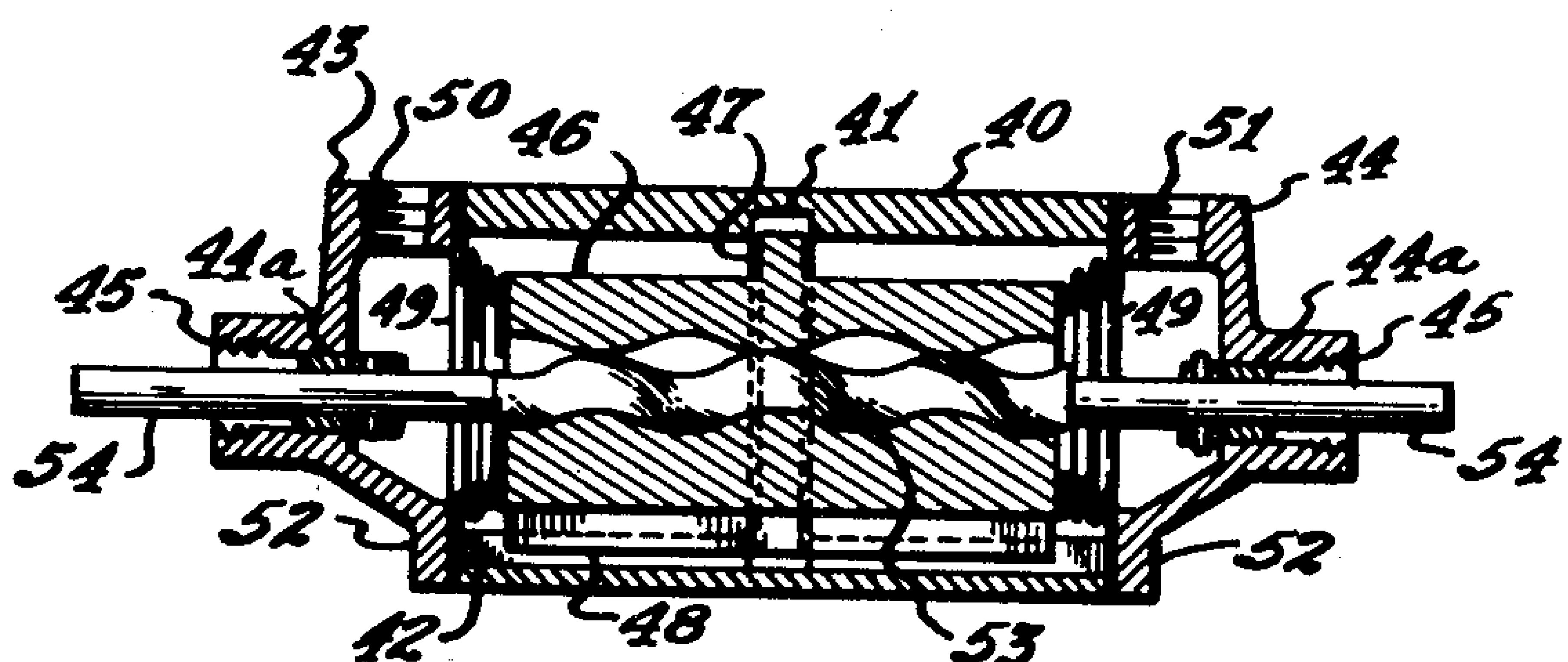

FIG. 4.

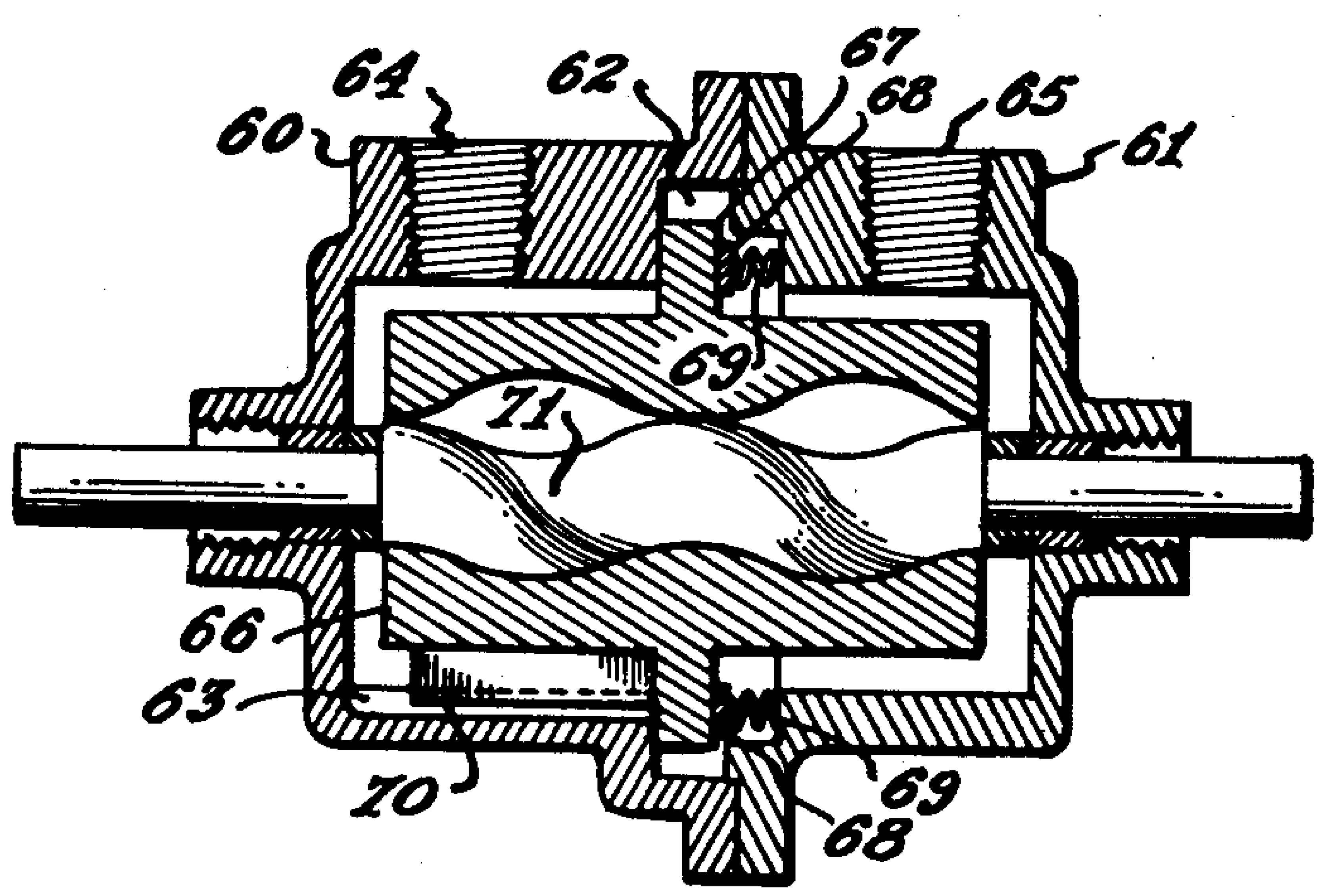

FIG. 5.

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UNITED STATES PATENT OFFICE

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HELICAL PUMP

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12 Claims. (Cl. 103—117)

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My invention relates to pumps using "gear" elements such as are described by R. Moineau originally in his U. S. Letters Patent No. 1,892,217, wherein there is provided a hollow stator having internal threads or helically arranged grooves, and a rotor therein also having helical threads, there being one more thread in the stator than in the rotor and the pitch of the stator threads having the same relation to the rotor as the number of teeth, i. e., if there are two threads in the stator to one on the rotor, then the stator threads will have twice the pitch of the rotor threads. As explained by Moineau this results in a particularly effective self-sealing pumping action.

However, in order to cause one of the members in this arrangement to rotate while the other stands still against rotation, it is necessary to provide for a freedom of orbital movement of the other. This is because the rotor in revolving with relation to the stator does not remain on a single axis but instead the relation of the structural parts are such that the rotor axis revolves in a circle, in the opposite direction to the rotation of its surface.

In the commercial pumps formed on this principle it has been customary to drive the rotor element by means of a shaft which has a universal joint in it, thus permitting the rotor to gyrate about on its axis as well as to rotate. Necessities of providing an adequate seal for the driving shaft in such an arrangement has resulted in providing within the pump chamber itself for a stub shaft connected by a universal joint with the rotor and in turn connected by another universal joint with the driving shaft. In this way a shaft rotating on a single axis can be introduced into the pump casing and readily sealed by means of a packing gland or otherwise. In such an arrangement the end thrust of the rotor is normally taken by the driving shaft and the rotor simply mounted within the stator as its sole bearing.

It is desirable to provide for a mode of operating the Moineau type of pump without the use of this universal type of drive because it takes up space, and may be a source of trouble.

The object of my invention is to provide for a driven rotor in a structure constructed and operating on the Moineau general principle in which the rotor is mounted on its center axis in the pump casing, and carries its own thrust members within the casing. The stator, on the other hand, is so mounted that it can move to and fro in the casing, but is preferably prevented from rotating by means of a key engaging loosely in a

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slotted portion of the casing. The stator is thus no longer technically a stator, and will hereinafter be referred to as the female helical element. In this way a Moineau type pump can be constructed with a maximum of economy and in a very compact form, and driven from any source of power without external thrust bearings, and with no universal joints.

I show in the drawings and describe in detail one preferred form in which I have constructed a pump according to my invention, and several alternative forms, but it will be understood that these are but illustrative of the possible forms which are the equivalent thereof, and that in the claims that follow I set forth the novelty which is illustrated by these examples.

In the drawings:

Figure 1 is a perspective of a completed pump from the exterior.

Figure 2 is a section through the pump on the line 2—2 of Figure 1.

Figure 3 is a section taken along the line 3—3 of Figure 2.

Figure 4 is a longitudinal section of one alternative form of pump according to my invention.

Figure 5 is a longitudinal section of a third form.

The pump structure illustrated is small in size and is of the two-to-one type of Moineau pump, viz: the female helical element has two threads on its interior and the rotor, or male helical element, one thread on its exterior. It will be evident that other types of Moineau pump as set forth in his patent above referred to can be adapted to the invention and that the size (i. e. length and thickness) of the elements may be modified very considerably. Also the precise mathematical solutions as brought by Moineau need not be followed except for maximum performance.

The pump is shown as having a base 1, and a cylindrical body 2, with two heads 3 and 4 held in place on the body by means of bolts 5.

The interior of the cylindrical body is larger than the circumference of the female helical element of the pump. This element in the form shown is a hollow cylinder 6 having a double helical thread 7 formed therein. The two heads of the pump casing have orifices 8 therein for inflow and outflow into the pump. Depending upon the direction of movement of its rotary member this pump will operate in either direction, hence either orifice 8 can be the inlet and the other the outlet of the pump.

The two heads of the pump casing are formed with bearing faces 9, against which the ends of the female helical element find a slide bearing. If required, it may be desirable to equip one or both ends of the female helical element with a sealing ring 10 urged outwardly by a spring 11. This is desirable where the cylinder of the pump is filled with oil for lubication of the female helical element rotation preventing means and the oil is to be prevented from seeping into the outlet and inlet portions of the two heads.

The two heads of the casing are provided with sleeve bearings 12, 12, in hollow bosses thereon, for the spindle 13 of the pump rotor. In assembling the pump it is desirable to prevent end play of the rotor by the use of sleeves and washers 14, 14, which bear on the shoulders of the two sleeve bearings 12. The rotor 15, fast on the spindle, has a main body lying within the female helical element and equipped with a single spiral thread 16. This thread has a pitch of one half that of the double threaded female helical element.

As noted by Moineau in his aforesaid patent, it is readily possible to have rotor and stator threads or teeth, which are of different conformation and number. Thus three threads in the female helical element and two in the rotor or male helical element may be used in which case the pitch of the rotor threads is to the pitch of the female helical element threads as 2 is to 3.

In order to prevent the female helical element from rotating it is provided with a key 18 extending longitudinally thereof, which key lies loosely in a groove 17 formed in the interior of the casing. The proportions of the key to the keyway should be such as to permit the female helical element to move in an orbital path, and at the same time to remain in rotation preventing relation, whatever orbital position it may take. Through an access plug *2a* oil may be injected into the space surrounding the female helical element, thus damping its movement and imparting quiet operation.

As so constructed the pump is operated by rotating the rotor, whose spindle is on its center axis. The rotor helical tooth is such as to maintain contact with the internal helices in the female helical element but since, in the exemplary form, the latter has a straight-sided oval hole in any cross section and the rotor is circular in cross section like one end of the oval hole, it is necessary for maintenance of revolution of one of the two elements with reference to the other, that one of the two transcribes an orbital path. In the present pump the driven member is the rotor and the female helical element then takes an orbital path, being prevented from rotation, and both the rotor and female helical element being held against endwise movements within the pump casing, the result is a positive feed of the pump in through one of the orifices in the casing and out through the other.

The female helical element is free to take an orbital path with reference to the axial center of the rotor, and the keyway prevents the rotation of the female helical element. The end thrust on the rotor is provided for within the casing by the two sleeves. The drive has no universal joints in it, and the sliding contact of the ends of the female helical element toward which it tends to feed endwise, is amply sealed by provision of machined surfaces on the inner faces of the heads and on the end of the female helical element. The result is a simple and effective structure.

It is not necessary that the inlet and outlet openings be radial with reference to the heads of the pump casing. Instead they may be parallel with the axis of the casing, as in a deep well pump, for example. The pump rotor and female helical element parts as shown may be made of metal, or one of the pump elements of metal and the other of a reinforced consolidated resinous material, or both of this latter material, or one or both of the said elements may have a facing of a deformable resilient material such as rubber or other plastic substance. Fiber washers may be employed at the several end bearing surfaces if desired. Also other equivalent means may be employed to retain the female helical element against rotation while permitting it to move in an orbital path.

Also packing glands may be used for the spindle of the rotor if it be found that the face contact of the sleeves 14, 14 is not sufficient to act as a seal.

The pump shown in Figure 4 is one in which the principle of my invention may be applied to very small pumps, the drawing being near to actual scale. In this form the pump may have a cylinder 40, which may be made of thick walled tubing formed with an internal circumferential groove 41, and with a longitudinal groove 42. The end caps 43 and 44, are here shown as alike having bearings for the rotor shaft at 44, and internally threaded projections at 45 into which packing glands (not shown) may be inserted. The female helical element 46 has a peripheral central rib 47, which engages as a thrust collar in the groove 41 of the cylinder, and it also has a lengthwise key 48 which engages loosely in the groove 42. Two end seals 49 which may be secured between the end caps and the cylinder and wipe on the ends of the female helical element, serve to form an enclosed chamber about the female helical element. The inlet boss 50 and outlet boss 51 are provided in the two end caps, which are held in position by means of flanges 52, bolted or screwed to the ends of the cylinder.

In this form as in the preferred form, there is an enclosure which can be filled with oil, in which the female helical element moves. The thrust is, however, taken by the midrib on the female helical element, while the rotation is prevented, as in the first instance by a key, that permits the center of the female helical element to move in an orbital path. The rotor 53, as shown has its shaft 54 mounted on the true center of the rotor in the bearings.

In Figure 5, the casing is made up of two halves 60 and 61, bolted together. The one half 60, has a circumferential internal groove 62, and a longitudinal groove 63. The two halves have the inlet 64 and outlet 65 in them. The female helical element 66 has a mid-rib 67 peripherally thereof which lies in the groove 62. In this instance the mid-rib is thrust against the one wall of the internal groove 62 by means of a thrust ring 68 pressed by springs 69 against the opposite wall of the mid-rib. The female helical element has a lengthwise rib 70 as in the other example which by loose engagement in the groove 63 holds the female helical element against rotation while permitting an orbital movement. The rotor 71 is mounted on true centers, in bosses in the two casing halves.

This form of device has been shortened considerably over the first form illustrated.

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

1. A pump having a casing provided with inlet and outlet fluid ports, a female element mounted as a unit in said casing for orbital movement, a rotor within the female element, said rotor and female element having interengaging helical threads thereon, there being one more thread on the female element than on the rotor, and the pitch of the threads on the female element having the same relation to the pitch of the rotor threads as the number of threads on said female element bear to the number of threads on the rotor, a spindle for the rotor extending on the center of the axis thereof, journals in the pump casing for the spindle, said casing being of an internal dimension sufficient to permit the female element to move as a unit in an orbital path due to the rotation of the rotor therein, and means to hold the female element against revolution within the casing without limiting its freedom to move orbitally therein.

2. The combination of claim 1, in which the rotor is provided with means within the casing to absorb the end thrust of said rotor.

3. The combination of claim 1 in which the female element is provided with means within the casing to resist the end thrust of said female element.

4. The combination of claim 1 in which the rotor is provided with members within the casing to absorb the end thrust of said rotor, and the female element is also provided with means within the casing to resist the end thrust of said female element.

5. A pump having a hollow cylindrical casing provided with inlet and outlet fluid ports, heads for the casing, having ports into said casing therein, bearing surfaces on said heads defining the ends of a chamber within the casing, a female element mounted as a unit in said casing for orbital movement therein, and of smaller diameter than the interior of the casing so as to be free to move therein, and arranged to take endwise sliding bearing on the bearing surfaces last above noted, said female element having a plurality of helical teeth therein, a rotor within the female element, said rotor having one less helical tooth than the female element, a spindle for driving the rotor, journals in the heads for the spindle, end thrust resisting elements about the spindle and bearing against the faces of said journals and the body of the rotor, and means to hold the female element against revolution within the casing without limiting its freedom to move orbitally therein, as and for the purpose described.

6. The combination of claim 5 in which the female element has a resiliently pressed sealing ring mounted in at least one end thereof and urged to a bearing against the female element end bearing surface of the head.

7. A pump having a chamber provided with inlet and outlet fluid ports, a female element movably mounted as a unit in said chamber for orbital movement, and having internal helical threads therein, a rotor within the female element also helically threaded, there being one more thread on the female element than on the rotor, and the pitch of the threads on the female element having the same relation to the pitch of the rotor threads as the number of threads on said female element bear to the number of threads on the rotor, means for supporting the rotor on its center axis within the chamber, means within the chamber retaining the female element against rotation while permitting it to move orbitally as a unit, and means for maintaining a separation within the chamber between the two ends of the female element.

8. The combination of claim 7 in which the said means for maintaining a separation comprise means at the ends of the chamber having a slide bearing on the ends of the female element.

9. The combination of claim 7 in which the said means for maintaining a separation comprise a peripheral rib on the female element, and an internal groove in the chamber wall in which it engages, and means for forcing the rib against one wall of the groove.

10. The combination of claim 7 in which the said means for maintaining a separation comprise at least one bellows seal held at an end of the chamber and slidably engaging the respective end of the female element.

11. The combination of claim 10 in which said means in interengaging relationship comprise a circumferential rib and groove, one a part of the chamber, and the other a part of the female element.

12. A pump having a chamber provided with inlet and outlet fluid ports, a female element mounted as a unit in said chamber for orbital movement, and having internal helical threads therein, a rotor within the female element also helically threaded, there being one more thread on the female element than on the rotor, and the pitch of the threads on the female element having the same relation to the pitch of the rotor threads as the number of threads on said female element bear to the number of threads on the rotor, means for supporting the rotor on its center axis within the chamber, means within the chamber retaining the female element against rotation while permitting it to move orbitally as a unit, and means for maintaining a separation within the chamber between the two ends of the female element, including means on said female element and means in the chamber disposed in interengaging relationship and preventing endwise movement of the female element, while permitting said orbital movement.

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