P. CRAMER.

HYDRAULIC CLUTCH.

APPLICATION FILED AUG. 27, 1910.

993,825.

Patented May 30, 1911.

2 SHEETS—SHEET 1.

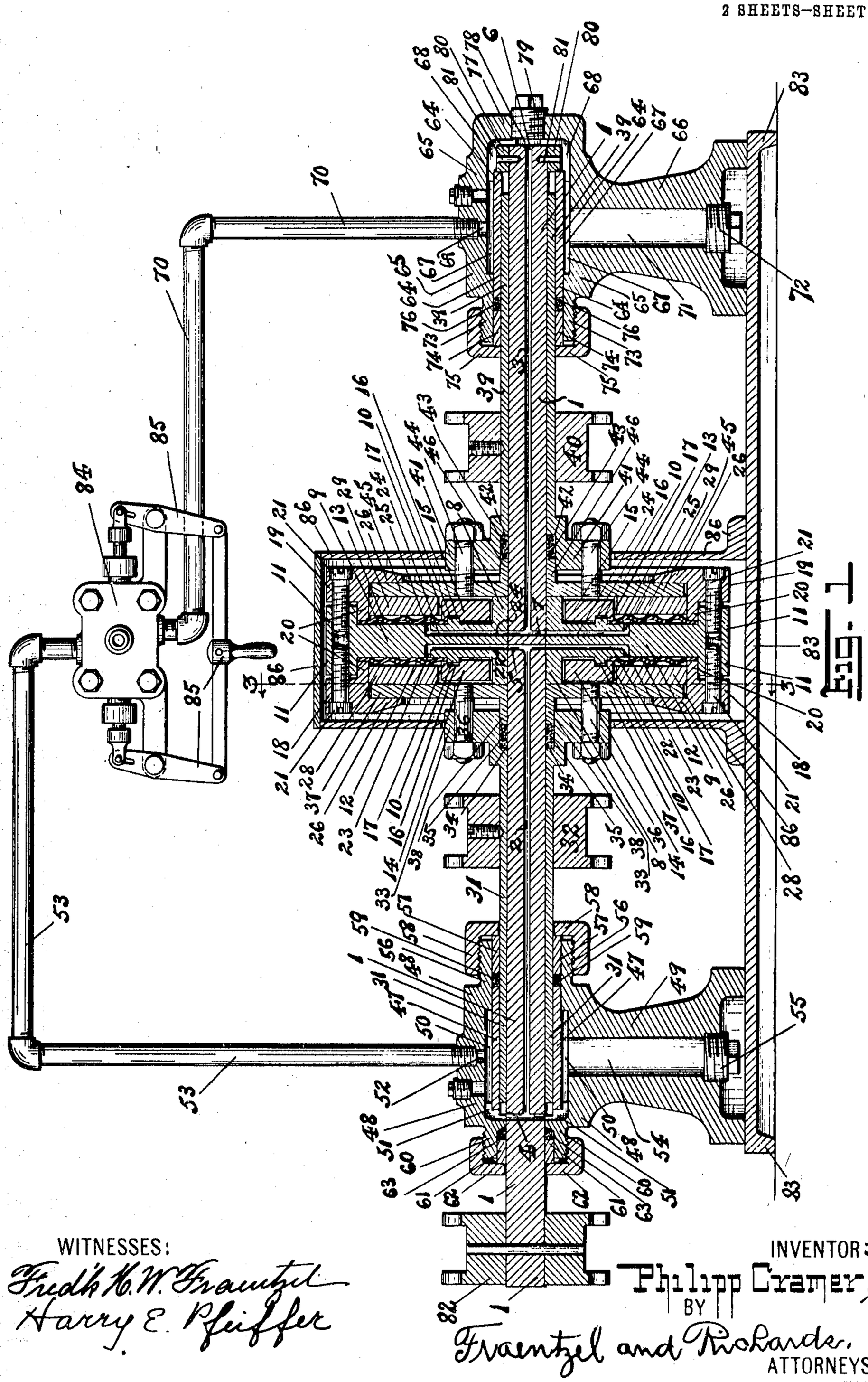

FIG. 1

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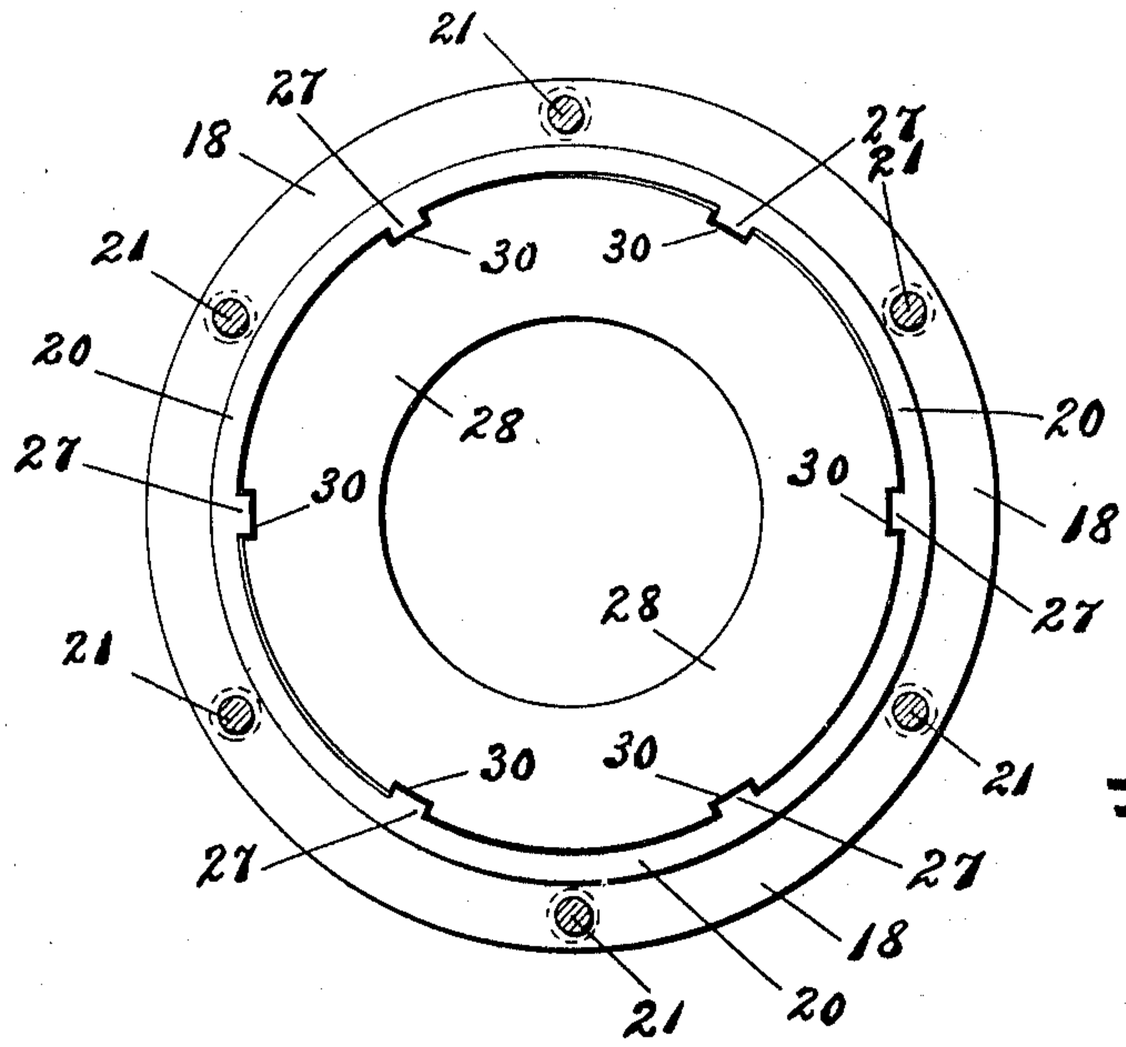

Fig. 2

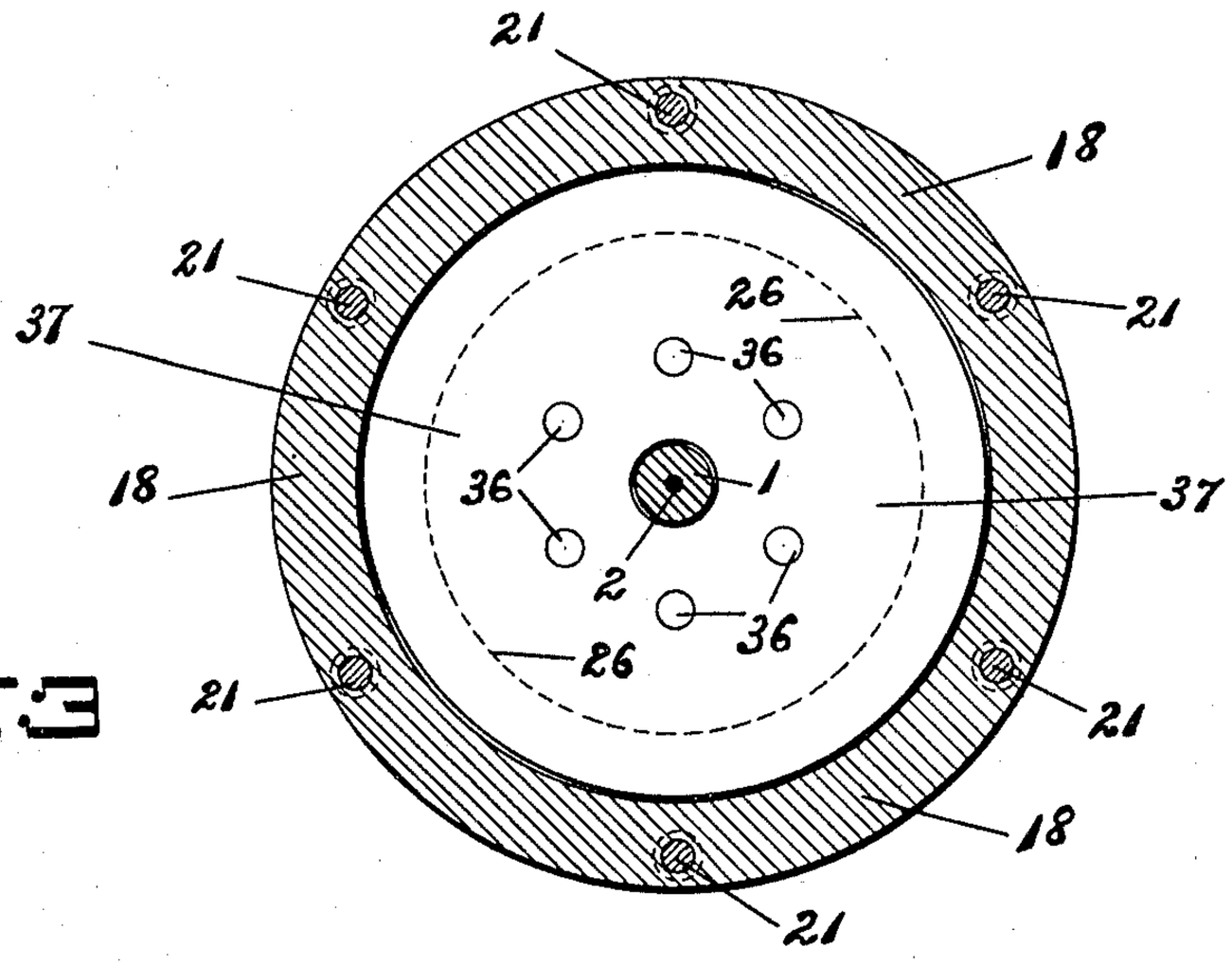

Fig. 3

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UNITED STATES PATENT OFFICE.

PHILIPP CRAMER, OF NEWARK, NEW JERSEY.

HYDRAULIC CLUTCH.

993,825. Specification of Letters Patent. Patented May 30, 1911.

Application filed August 27, 1910. Serial No. 579,246.

To all whom it may concern:

Be it known that I, PHILIPP CRAMER, a subject of the Emperor of Germany, residing at Newark, in the county of Essex and State of New Jersey, have invented certain new and useful Improvements in Hydraulic Clutches; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to characters of reference marked thereon, which form a part of this specification.

This invention has reference, generally, to improvements in hydraulic clutches; and, the invention refers, more particularly, to a novel clutch which is extremely sensitive and is very quick-acting and most effective and efficient in its action.

The invention has for its principal object to provide a novel clutch-mechanism of the general character hereinafter more particularly specified which is operated by means of hydraulic pressure, and which is simple in its construction and operation, being at the same time very sensitive, so that the slighest increase or decrease of the hydraulic pressure is sufficient to throw in or out of operation the mechanical elements of the clutch, thus rendering the clutch very rapid in its action, and in its practical operation being most easily manipulated and controlled.

The present invention has for its further object to provide a construction of hydraulic clutch which is peculiarly adapted to obtain a quick reversal of the direction of revolution of shaft driven by means of the said clutch, whereby accurate and rapid reversing movements of a driving shaft and mechanism driven from said shaft may be obtained.

Other objects of the present invention not at this time more particularly enumerated will be clearly understood from the following detailed description of the said invention.

With the various objects of the said invention in view, the invention consists, primarily, in the novel construction of hydraulic clutch hereinafter set forth; and, the said invention consists, furthermore, in the several novel arrangements and combinations of the various devices and parts, as well as in the details of the construction of the said parts, all of which will be more particularly described in the following specification, and then finally embodied in the clauses of the claim which are appended to and which form an essential part of this specification.

The invention is clearly illustrated in the accompanying drawings, in which:—

Figure 1 is a longitudinal vertical section of a hydraulic clutch-mechanism showing one embodiment of the principles of the present invention; Fig. 2 is a detail face view of a binder-ring, illustrating the relation thereto of a friction clutch-ring; and Fig. 3 is a detail transverse sectional representation, taken on line 3—3 in said Fig. 1, looking in the direction of the arrow *x*.

Similar characters of reference are employed in the said above described views, to indicate corresponding parts.

Referring now to the said figures of the drawings, the reference-character 1 indicates a suitable shaft which is provided with a pair of longitudinally extending fluid-conducting passages or ducts, indicated respectively by the reference-characters 2 and 3. The said duct or passage 2 is provided at one end with right-angled extensions or inlet ducts 4 which lead to the outer surface-portions of the said shaft. Similarly, the said duct or passage 2 is provided at its opposite end with right-angled extensions or outlet-ducts 5 also leading to the outer surface of the said shaft 1. The said duct or passage 3 terminates in the end of said shaft 1, forming at such point, an inlet or mouth 6, and said duct or passage 3 being provided at its opposite end with right-angled extensions or outlet ducts 7 which lead to the outer surface of the said shaft 1. Mounted upon said shaft, and secured thereon by means of its hub-portion 8 is a clutch-disk 9, said disk being provided upon each of its outer faces with an annular rib or shoulder 10 which is concentric with the said hub, and upon its outer peripheral edges the said disk is provided with slightly larger ribs or shoulders 11. Arranged upon each of the said outer faces of the said clutch-disk 9, between the said above-mentioned inner and outer ribs or shoulders 10 and 11, respectively, are suitably formed diaphragm-members 12 and 13 which are arranged in such a manner so that the respective inner and outer peripheries thereof abut upon the respective annular ribs or shoulders 10 and 11. The inner periphery of the said respective diaphragm-members 12 and 13 are bound or retained in

operative relation to said clutch-disk 9 by means of the respective inner binder-rings 14 and 15 which are each provided with a concentric groove or channel 16 adapted to dovetail over and upon said annular rib or shoulder 10, whereby a shoulder 17 of each binder-ring may be brought into binding or gripping engagement with the inner peripheral portions of the respective diaphragm-members 12 and 13. The said binder-rings 14 and 15 may be retained in their binding or gripping positions by means of suitable fastening devices, such as ordinary screws, stud-screws, bolts, or the like, whereby the said binder-rings may be tightly drawn in connection with said clutch-disk 9. Similarly, the outer peripheral portions of the respective diaphragm-members 12 and 13 are bound or retained in operative relation to said clutch-disk 9, by means of the respective outer binder-rings 18 and 19, which are each provided with an inwardly extending shoulder 20 adapted to be brought into binding or gripping engagement with the outer peripheral portions of the said diaphragm-members 12 and 13. The said binder-rings 18 and 19 are retained in their respective binding or gripping positions by means of any suitable fastening devices, such as screws 21, whereby the said binder-rings may be tightly drawn in connection with said clutch-disk 9. The said clutch-disk 9 is further provided with suitably disposed fluid-conducting passages or ducts 22, the inlet ends of which connect and register with the previously mentioned outlet ducts 5. The said ducts or passages 22 are further provided with outlet portions 23 which lead out to the side face of the said clutch-disk 9, and in back of said diaphragm-member 12, so as to bring or convey oil, or some other suitable fluid, under pressure, against the said diaphragm-member 12 so as to actuate the same in the manner presently more fully set forth. In like manner, the said clutch-disk 9 is further provided in its main body with another set of suitably disposed ducts or fluid-conveying passages 24, the inlet portions of which connect and register with the previously mentioned outlet ducts 7. The said ducts or passages 24 are further provided with outlet portions 25 which lead out to the side face of the clutch-disk 9, and in back of the diaphragm-member 13, so as to bring or convey oil, or some other suitable fluid, under pressure, against the said diaphragm-member 13 to actuate the same, in the manner to be presently set forth. The said binder-rings 18 and 19 are each provided with an inwardly extending flange or shoulder 26, and said rings are each further provided with a plurality of ribs or tongues 27 upon the inner concentric faces thereof. The reference-characters 28 and 29 indicate, respectively, friction clutch-rings which are provided in their outer peripheral faces with a plurality of grooves or rings 30, corresponding in their positions and disposal with said rings or ribs 27 of the respective binder-rings 18 and 19, and being adapted to engage with the same, whereby said friction clutch-rings 28 and 29, while being capable of free lateral or shifting movements with relation to the respective binder-rings 18 and 19, are nevertheless carried around and revolve simultaneously with the said binder-rings.

Suitably arranged upon the shaft 1, to one side of said clutch disk 9, is a hollow shaft 31 which is adapted to revolve independently of the said shaft 1. Secured to said hollow shaft 31 is a driving sprocket, or pulley 32, or the like, for driving or revolving the said hollow shaft 31. The said hollow shaft 31 is also provided with a suitable flange or shoulder 33 formed with a chambered portion 34 in which may be arranged a suitable packing, as 35. Connected with the said flange or shoulder 33, by means of stud-screws and nuts 36, or other suitable fastening means, is a friction-disk 37, said disk being provided with a suitable gland 38 adapted to enter said chambered portion 34 and secure therein the said packing 35. The outer portion of said friction-disk 37 lies between said flange or shoulder 26 of the binder-ring 18 and the friction clutch-ring 28, so that the same may be operatively engaged by the ring 28. It will be understood, that when said hollow shaft 31 is revolved, said friction-disk 37 will also revolve therewith. In like manner, there is arranged upon said shaft 1, at the other side of said clutch-disk 9, another hollow shaft 39 which also revolves independently of the said shaft 1, and preferably in the construction here shown in the opposite direction to the revolutions of said hollow shaft 31. Secured to said hollow shaft 39 is a driving sprocket, or pulley 40, or the like, for driving the said shaft 39. Said hollow shaft 39 is also provided with a flange or shoulder 41 which is formed with a chambered portion 42 in which may be arranged a suitable packing, as 43. Connected with said flange or shoulder 41 of the said hollow shaft 39, by means of stud-screws and nuts 44, or other suitable fastening means, is a friction-disk 45, said disk being provided with a gland 46 which is adapted to enter said chambered portion 42 and secures therein the said packing 43. The outer portion of said friction-disk 45 lies between the said flange or shoulder 26 of the binder-ring 19 and said friction-clutch 29, so that the same may be operatively engaged by the said clutch-ring. It will be understood, that when the said hollow shaft 39 is revolved, said friction-disk 45 is also revolved therewith. Said hollow shaft 31, together with one end of said shaft 1, is supported by means of a suitable journal-sleeve

47 which in turn is supported in a bearing-block 48 mounted upon a suitable standard 49. The said bearing-block 48 is constructed in such a manner so that around the said journal-sleeve 47 a fluid-receiving chamber 50 is provided. The said chamber 50 is connected by means of suitable ducts or passages 51 with said inlet ducts 4 which are connected with the fluid-conveying passage or duct 2, so that oil, or other fluid, under pressure, may be delivered to said duct or passage 2. The said chamber 50 is also provided with a suitable inlet 52 adapted to receive the one end of a feed-pipe 53. The said chamber 50 is further provided with a downwardly extending chamber 54 arranged in the said standard 49, said chamber being closed at the bottom by means of a suitable plug 55. The bearing-block 48 is provided at the one side, where enters the hollow shaft 31, with a stuffing box 56, a gland 57, and a cap 58 for securing a packing 59 in its proper position with relation to said hollow shaft 31, and thereby rendering the said bearing-block fluid-tight. In like manner, said bearing-block 48 is provided at its other side, beyond which passes the free end of said shaft 1, with a similar stuffing box, as 60, a gland 61, and a cap 62, for securing a packing 63 in its proper relation to said shaft 1, so as to render the said bearing-block fluid-tight at that point. Said hollow shaft 39, together with the opposite end of the shaft 1, is supported by means of a journal-sleeve 64 which in turn is supported in a bearing-block 65 mounted upon a suitable standard 66. The said bearing-block 65 is constructed in such a manner so as to provide around the said journal-sleeve 64 a fluid-receiving chamber 67. This chamber 67 is connected by means of suitable ducts or passages 68 with the mouth or inlet 6 of the previously mentioned duct or passage 3, so that oil, or other fluid, under pressure, may be delivered to said duct or passage 3. The said chamber 67 is also provided with a suitable inlet 69 adapted to receive the one end of a feed-pipe 70. The said chamber 67 is further provided with a downwardly extending chamber 71 arranged in said standard 66, said chamber being closed at the bottom by means of a suitable plug 72. Said bearing-block 65 is provided at its one side, where enters the said hollow shaft 39, with a stuffing box 73, a gland 74, and a cap 75, for securing a packing 76 in its proper relation with said hollow shaft 39, to thereby render said bearing-block 65 fluid-tight. The end of said shaft 1 terminates within said bearing-block 65 which is closed at its outer side by the wall 77 in which there is a passage 78 connecting said inlet 6 of said duct or passage 3 with said ducts or passages 68 of the bearing-block 65. The said passage 78, however, is closed by means of a suitable plug 79. The said shaft 1 is maintained against longitudinal movement or slipping by means of a collar 80 which is mounted upon the end-portion of said shaft and is secured thereto by means of pins 81. Said collar 80 rides against one end of said journal-sleeve 64 on one side, and against said wall 77 of the bearing-block 65 upon its other side, whereby the same prevents said longitudinal movement of the shaft 1.

The free end of the shaft 1 may be provided with a sprocket-wheel, pulley, or other suitable power transmission device, as 82.

The previously mentioned standards 49 and 66 may be arranged upon a suitable base, as 83, if desired.

The respective feed pipes 53 and 70 each connect with a controlling valve, preferably a slide-valve-mechanism 84, of any desirable construction. The said valve 84 is adapted, upon the operation of its handle or lever 85, to shift the pressure of a fluid, such as an oil, either to one feed-pipe or to the other, alternatively, as will be clearly evident.

The said clutch-disk 9 and the various parts coöperating therewith and adjacent thereto may be inclosed, if desired, in a suitably constructed shell or casing, as 86.

The respective hollow shafts 31 and 39 are mechanically connected with a source of power and are revolved, respectively, in opposite directions. Under normal conditions, said hollow shafts 31 and 39 revolve freely upon the shaft 1, while the latter remains stationary. Upon a proper operation of the slide-valve 84, the fluid, such as oil, which passes through said valve under high pressure, is caused to distribute said high pressure through said feed pipe 53, whereupon the oil in the chamber 50 of the bearing-block 48 passes said high pressure on through said ducts or passages 51, and into the duct or passage 2 of the main shaft 1. The said duct or passage 2 being in communication with the duct or passage 22 of the clutch-disk 9, the oil under high pressure is passed behind the said diaphragm-member 12, so as to cause the same to expand or bulge outwardly. This outward bulging of said diaphragm-member 12 brings the same in contact with the friction clutch-ring 28, whereby the latter is pressed outwardly and causes a gripping of the outer portion of said friction-disk 37 which is being revolved in one direction by said hollow shaft 31; and, by wedging said friction-disk 37 between said flange or shoulder 26 and the friction clutch-ring 28, immediately causes a revolution of said clutch-disk 9, which being fast upon said shaft 1 causes a like revolution thereof. Upon a reverse movement of the operating lever 85 of the valve 84, the high pressure is immediately cut off from the feed pipe 53 and consequently

the pressure being reduced in the various ducts and passages hereinabove mentioned, being released through a suitable vent or exhaust simultaneously opened in said slide-valve mechanism 84, the diaphragm-member resumes its normal initial position, whereby a release of the various clutching parts is secured and the clutch-disk 9 and shaft 1 again cease to revolve. Upon a further or continued reverse movement of said operating lever 85 of the valve 84, the high pressure is distributed through said feed pipe 70 and by means of the various connecting passages and chambers finds its way through said duct or passage 3 of the shaft 1, and thence through the passage or duct 24 of the clutch-disk 9, so that an operation of said diaphragm-member 13, the friction clutch-ring 29 upon the friction-disk 45, which is turned in an opposite direction by said hollow shaft 39, causes a consequent opposite revolution of said clutch-disk 9 and said shaft 1. It will thus be seen, that the said shaft may be caused to operate or revolve in any desired direction, according to the distribution of the high pressure of an operating fluid into and through the various parts of the herein above described mechanism. The arrangement and combination of the various parts are such that the slightest increase or decrease of pressure causes the operation of the clutch. Hence, a very sensitive and a quick-acting clutch is the result.

I am aware, that changes may be made in the various arrangements and combinations of the several devices and parts, as well as in the details of the construction of the said parts, without departing from the scope of the present invention as set forth in the foregoing specification and as defined in the clauses of the claims which are appended thereto. Hence, I do not limit my present invention to the exact arrangements and combinations of the various devices and parts as described in the said specification, nor do I confine myself to the exact details of the construction of the said parts as illustrated in the accompanying drawings.

I claim:—

1. In a hydraulic clutch, the combination with a shaft provided with fluid-conveying passages or ducts, of a clutch-disk also provided with fluid-conveying passages or ducts in communication with those of the said shaft, an expansible diaphragm-member connected with said clutch-disk, a hollow shaft mounted upon said first mentioned shaft, a friction-disk driven thereby, and means operated by said diaphragm-member for gripping said moving friction-disk so as to communicate its revolving movement to said clutch-disk and the shaft connected therewith.

2. In a hydraulic clutch, the combination with a shaft provided with fluid-conveying passages or ducts, of a clutch-disk also provided with fluid-conveying passages or ducts in communication with those of the said shaft, an expansible diaphragm-member connected with said clutch-disk, a hollow shaft mounted upon said first mentioned shaft, a friction-disk driven thereby, means operated by said diaphragm-member for gripping said moving friction-disk so as to communicate its revolving movement to said clutch-disk and the shaft connected therewith, and high-pressure bearings for supporting said shaft and its hollow shaft.

3. In a hydraulic clutch, the combination with a shaft provided with fluid-conveying passages or ducts, of a clutch-disk also provided with fluid-conveying passages or ducts in communication with those of the said shaft, an expansible diaphragm-member connected with said clutch-disk, a hollow shaft mounted upon said first-mentioned shaft, a friction-disk driven thereby, means operated by said diaphragm-member for gripping said moving friction-disk so as to communicate its revolving movement to said clutch-disk and the shaft connected therewith, high-pressure bearings for supporting said shaft and its hollow shaft, said high-pressure bearings being provided with fluid-receiving chambers and passages communicating with said fluid-conveying passages or ducts of said shaft, and means for conveying and controlling said high pressure fluid through said various passages or ducts, substantially as and for the purposes set forth.

4. In a hydraulic clutch, the combination with a shaft provided with fluid-conveying passages or ducts, of a clutch-disk also provided with fluid-conveying passages or ducts in communication respectively with those of said shaft, a pair of expansible diaphragm-members connected with said clutch-disk, a pair of oppositely revolving hollow shafts, a friction-disk connected with each hollow shaft, and means operated by the respective diaphragm-members for gripping said friction disks so as to impart the movement of either one or the other of said friction-disks to said clutch-disk and the shaft connected therewith.

5. In a hydraulic clutch, the combination with a shaft provided with fluid-conveying passages or ducts, of a clutch-disk also provided with fluid-conveying passages or ducts in communication respectively with those of said shaft, a pair of expansible diaphragm-members connected with said clutch-disk, a pair of oppositely revolving hollow shafts, a friction-disk connected with each hollow shaft, means operated by the respective diaphragm-members for gripping said friction-disks so as to impart the movement of either one or the other of said friction-disks to said clutch-disk and the shaft connected

therewith, and a pair of high-pressure bearings for supporting said shaft and the respective hollow shafts.

6. In a hydraulic clutch, the combination with a shaft provided with fluid-conveying passages or ducts, of a clutch-disk also provided with fluid-conveying passages or ducts in communication respectively with those of said shaft, a pair of expansible diaphragm-members connected with said clutch-disk, a pair of oppositely revolving hollow shafts, a friction-disk connected with each hollow shaft, means operated by the respective diaphragm-members for gripping said friction-disks so as to impart the movement of either one or the other of said friction-disks to said clutch-disk and the shaft connected therewith, a pair of high-pressure bearings for supporting said shaft and the respective hollow shafts, said high-pressure bearings being provided with fluid-receiving chambers and passages communicating with said fluid-conveying passages or ducts, and means for conveying and controlling said high pressure fluid through said various passages or ducts, substantially as and for the purposes set forth.

7. In a hydraulic clutch, the combination with a shaft, of a clutch-disk provided upon each side with an expansible diaphragm member, means connected with said shaft and clutch-disk for conveying a high pressure fluid to each diaphragm-member so as to expand the same, a pair of oppositely revolving hollow shafts arranged upon said first-mentioned shaft, one upon each side of said clutch-disk, a friction-disk connected with each hollow shaft, and means operated by the expansion of said diaphragm-members for gripping said friction-disks so as to impart the movement of either one or the other of said friction-disks to the said clutch-disk and the shaft connected therewith, substantially as and for the purposes set forth.

8. In a hydraulic clutch, the combination with a shaft, of a clutch-disk provided upon each side with an expansible diaphragm-member, means connected with said shaft and clutch-disk for conveying a high pressure fluid to each diaphragm-member so as to expand the same, a pair of oppositely revolving hollow shafts arranged upon said first-mentioned shaft, one upon each side of said clutch-disk, a friction disk connected with each hollow shaft, means operated by the expansion of said diaphragm-members for gripping said friction-disks so as to impart the movement of either one or the other of said friction disks to the said clutch-disk and the shaft connected therewith, and a pair of high-pressure bearings for supporting said shaft and the said hollow shafts, substantially as and for the purposes set forth.

9. In a hydraulic clutch, the combination with a shaft, of a clutch-disk provided upon each side with an expansible diaphragm-member, means connected with said shaft and clutch-disk for conveying a high pressure fluid to each diaphragm-member so as to expand the same, a pair of oppositely revolving hollow shafts arranged upon said first-mentioned shaft, one upon each side of said clutch-disk, a friction-disk connected with each hollow shaft, and a laterally movable friction clutch-ring arranged between each diaphragm-member and said friction-disk, substantially as and for the purposes set forth.

10. In a hydraulic clutch, the combination with a shaft, of a clutch-disk provided upon each side with an expansible diaphragm-member, means connected with said shaft and clutch-disk for conveying a high pressure fluid to each diaphragm-member so as to expand the same, a pair of oppositely revolving hollow shafts arranged upon said first-mentioned shaft, one upon each side of said clutch-disk, a friction-disk connected with each hollow shaft, a laterally movable friction clutch-ring arranged between each diaphragm-member and said friction-disk, and a pair of high pressure-bearings for supporting said shaft and the said hollow shafts arranged therewith, substantially as and for the purposes set forth.

11. In a hydraulic clutch, the combination with a shaft, of a clutch-disk provided upon each side with an expansible diaphragm-member, inner binder-rings connected with each side of said clutch-disk for engaging and holding the inner marginal edge of each diaphragm-member, outer binder-rings connected with each side of said clutch-disk for engaging and holding the outer marginal edge of each diaphragm-member, an inwardly extending flange or shoulder connected with each outer binder-ring, a pair of oppositely revolving hollow shafts arranged upon said first-mentioned shaft, a friction disk connected with each hollow shaft the outer peripheral portion of each friction-disk lying between one of said diaphragm-members and the shoulder of one of said outer binder-rings, means operated by the expansion of said diaphragm-members for gripping said friction-disks so as to impart the movement of either one or the other of said friction-disks to said clutch-disk and shaft, and means connected with said shaft and clutch-disk for conveying a high pressure fluid to each diaphragm-member so as to expand the same, substantially as and for the purposes set forth.

12. In a hydraulic clutch, the combination with a shaft, of a clutch-disk provided upon each side with an expansible diaphragm-member, inner binder-rings connected with each side of said clutchdisk for engaging

and holding the inner marginal edge of each diaphragm-member, outer binder-rings connected with each side of said clutch-disk for engaging and holding the outer marginal edge of each diaphragm-member, an inwardly extending flange or shoulder connected with each outer binder-ring, a pair of oppositely revolving hollow shafts arranged upon said first-mentioned shaft, a friction disk connected with each hollow shaft the outer peripheral portion of each friction-disk lying between one of said diaphragm-members and the shoulder of one of said outer binder-rings, means operated by the expansion of said diaphragm-members for gripping said friction-disks so as to impart the movement of either one or the other of said friction-disks to said clutch-disk and shaft, means connected with said shaft and clutch-disk for conveying a high pressure fluid to each diaphragm-member so as to expand the same, said means comprising the provision in said shaft and said clutch-disk of fluid-conveying passages or ducts having their respective outlets back of said diaphragm-members, substantially as and for the purposes set forth.

13. In a hydraulic clutch, the combination with a shaft, of a clutch-disk provided upon each side with an expansible diaphragm-member, inner binder-rings connected with each side of said clutch-disk for engaging and holding the inner marginal edge of each diaphragm-member, outer binder-rings connected with each side of said clutch-disk for engaging and holding the outer marginal edge of each diaphragm-member, an inwardly extending flange or shoulder connected with each outer binder-ring, a pair of oppositely revolving hollow shafts arranged upon said first-mentioned shaft, a friction disk connected with each hollow shaft, the outer peripheral portion of each friction-disk lying between one of said diaphragm-members and the shoulder of one of said outer binder-rings, means operated by the expansion of said diaphragm-members for gripping said friction-disks so as to impart the movement of either one or the other of said friction-disks to said clutch-disk and shaft, means connected with said shaft and clutch-disk for conveying a high pressure fluid to each diaphragm-member so as to expand the same, said means comprising the provision in said shaft and said clutch-disk of fluid-conveying passages or ducts having their respective outlets back of said diaphragm-members, a pair of high-pressure bearings for supporting said first-mentioned shaft and said hollow shafts, said high pressure bearings being provided with fluid-receiving chambers and passages communicating with said fluid-conveying passages or ducts of said shaft, and means for conveying and controlling said high pressure fluid through said various passages or ducts, substantially as and for the purposes set forth.

15. In a hydraulic clutch, the combination with a shaft, of a clutch-disk provided upon each side with an expansible diaphragm-members, inner binder-rings connected with each side of said clutch-disk for engaging and holding the inner marginal edge of each diaphragm-member, outer binder-rings connected with each side of said clutch-disk for engaging and holding the outer marginal edge of each diaphragm-member, an inwardly extending flange or shoulder connected with each outer binder-ring, a pair of oppositely revolving hollow shafts arranged upon said first-mentioned shaft, a friction disk connected with each hollow shaft the outer peripheral portion of each friction-disk lying between one of said diaphragm-members and the shoulder of one of said outer binder-rings, a laterally movable friction clutch-ring arranged between each diaphragm-member and said friction disk, and means connected with said shaft and said clutch-disk for conveying a high pressure fluid to each diaphragm-member so as to expand the same, substantially as and for the purposes set forth.

16. In a hydraulic clutch, the combina-

tion with a shaft, of a clutch-disk provided upon each side with an expansible diaphragm-member, inner binder-rings connected with each side of said clutch-disk for engaging and holding the inner marginal edge of each diaphragm-member, outer binder-rings connected with each side of said clutch-disk for engaging and holding the outer marginal edge of each diaphragm-member, an inwardly extending flange or shoulder connected with each outer binder-ring, a pair of oppositely revolving hollow shafts arranged upon said first-mentioned shaft, a friction disk connected with each hollow shaft the outer peripheral portion of each friction-disk, and means lying between one of said diaphragm-members and the shoulder of one of said binder-rings, a laterally movable friction clutch-ring arranged between each diaphragm-member and said friction-disk for conveying a high pressure fluid to each diaphragm-member so as to expand the same, said means comprising the provision in said shaft and said clutch-disk of fluid-conveying passages or ducts having their outlets back of said diaphragm-members.

17. In a hydraulic clutch, the combination with a shaft, of a clutch-disk provided upon each side with an expansible diaphragm-member, inner binder-rings connected with each side of said clutch-disk for engaging and holding the inner marginal edge of each diaphragm-member, outer binder-rings connected with each side of said clutch-disk for engaging and holding the outer marginal edge of each diaphragm-member, an inwardly extending flange or shoulder connected with each outer binder-ring, a pair of oppositely revolving hollow shafts arranged upon said first-mentioned shaft, a friction disk connected with each hollow shaft the outer peripheral portion of each friction disk lying between one of said diaphragm-members and the shoulder of one of said binder-rings, a laterally movable friction clutch-ring arranged between each diaphragm-member and said friction-disk, and means for conveying a high pressure fluid to each diaphragm-member so as to expand the same, said means comprising the provision in said shaft and said clutch-disk of fluid-conveying passages or ducts having their outlets back of said diaphragm-members, and a pair of high pressure bearings for supporting said first-mentioned shaft and said hollow shafts, substantially as and for the purposes set forth.

18. In a hydraulic clutch, the combination with a shaft, of a clutch-disk provided upon each side with an expansible diaphragm-member, inner binder-rings connected with each side of said clutch-disk for engaging and holding the inner marginal edge of each diaphragm-member, outer binder-rings connected with each side of said clutch-disk for engaging and holding the outer marginal edge of each diaphragm-member, an inwardly extending flange or shoulder connected with each outer binder-ring, a pair of oppositely revolving hollow shafts arranged upon said first-mentioned shaft, a friction disk connected with each hollow shaft the outer peripheral portion of each friction-disk lying between one of said diaphragm-members and the shoulder of one of said outer binder-rings, a laterally movable friction clutch-ring arranged between each diaphragm-member and said friction-disk, and means for conveying a high pressure fluid to each diaphragm-member so as to expand the same, said means comprising the provision in said shaft and said clutch-disk of fluid-conveying passages or ducts having their outlets back of said diaphragm-members, a pair of high pressure bearings for supporting said first-mentioned shaft and said hollow shafts below shafts, said high pressure bearings being provided with fluid-receiving chambers and passages communicating with said fluid-conveying passages or ducts of said shaft, and means for conveying and controlling said high pressure fluid through said various passages or ducts, substantially as and for the purposes set forth.

19. In a hydraulic clutch, the combination with a shaft, of a clutch-disk provided upon each side with an expansible diaphragm-member, inner binder-rings connected with each side of said clutch-disk for engaging and holding the inner marginal edge of each diaphragm-member, outer binder-rings connected with each side of said clutch-disk for engaging and holding the outer marginal edge of each diaphragm-member, an inwardly extending flange or shoulder connected with each outer binder-ring, a pair of oppositely revolving hollow shafts arranged upon said first-mentioned shaft, a friction disk connected with each hollow shaft the outer peripheral portion of each friction-disk lying between one of said diaphragm-members and the shoulder of one of said outer binder-rings, a series of ribs upon the inner surface of said outer binder-rings, friction clutch-rings provided with a plurality of grooves or channels adapted to receive the said ribs, said clutch-rings being arranged, respectively, between each diaphragm-member and said friction-disk, and means for conveying a high pressure fluid to each diaphragm-member, so as to expand the same, said means comprising the provision in said shaft and said clutch-disk of fluid-conveying passages or ducts having their outlets back of said diaphragm-members, substantially as and for the purposes set forth.

20. In a hydraulic clutch, the combination with a shaft, of a clutch-disk provided upon

each side with an expansible diaphragm-member, inner binder-rings connected with each side of said clutch-disk for engaging and holding the inner marginal edge of each diaphragm-member, outer binder rings connected with each side of said clutch-disk for engaging and holding the outer marginal edge of each diaphragm-member, an inwardly extending flange or shoulder connected with each outer binder-ring, a pair of oppositely revolving hollow shafts arranged upon said first-mentioned shaft, a friction disk connected with each hollow shaft the outer peripheral portion of each friction-disk lying between one of said diaphragm-members and the shoulder of one of said outer binder-rings, a series of ribs upon the inner surface of said outer binder-rings, friction clutch-rings provided with a plurality of grooves or channels adapted to receive the said ribs, said clutch-rings being arranged, respectively, between each diaphragm-member and said friction-disk, means for conveying a high pressure fluid to each diaphragm-member, so as to expand the same, said means comprising the provision in said shaft and said clutch-disk of fluid-conveying passages or ducts having their outlets back of said diaphragm-members, and a pair of high pressure bearings for supporting said first-mentioned shaft and the said hollow shafts, substantially as and for the purposes set forth.

21. In a hydraulic clutch, the combination with a shaft, of a clutch-disk provided upon each side with an expansible diaphragm-member, inner binder-rings connected with each side of said clutch-disk for engaging and holding the inner marginal edge of each diaphragm-member, outer binder-rings connected with each side of said clutch-disk for engaging and holding the outer marginal edge of each diaphragm-member, an inwardly extending flange or shoulder connected with each outer binder-ring, a pair of oppositely revolving hollow shafts arranged upon said first-mentioned shaft, a friction disk connected with each hollow shaft the outer peripheral portion of each friction-disk lying between one of said diaphragm-members and the shoulder of one of said outer binder-rings, a series of ribs upon the inner surface of said outer binder-rings, friction clutch-rings provided with a plurality of grooves or channels adapted to receive the said ribs, said clutch-rings being arranged, respectively, between each diaphragm-member and said friction-disk, means for conveying a high pressure fluid to each diaphragm-member, so as to expand the same, said means comprising the provision in said shaft and said clutch-disk of fluid-conveying passages or ducts having their outlets back of said diaphragm-members, a pair of high pressure bearings for supporting said first-mentioned shaft and the said hollow shafts, said high pressure bearings being provided with fluid-receiving chambers and passages communicating with said fluid-conveying passages or ducts of said shaft, and means for conveying and controlling said high pressure fluid through said various passages or ducts, substantially as and for the purposes set forth.

In testimony, that I claim the invention set forth above I have hereunto set my hand this 26th day of August, 1910.

PHILIPP CRAMER.

Witnesses:
FREDK. C. FRAENTZEL,
FREDK. H. W. FRAENTZEL.