

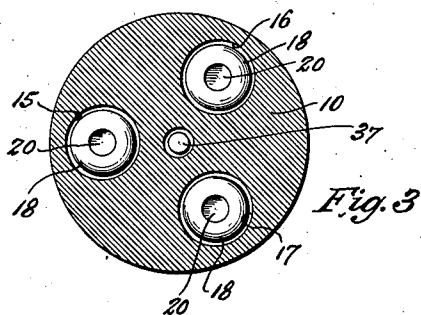
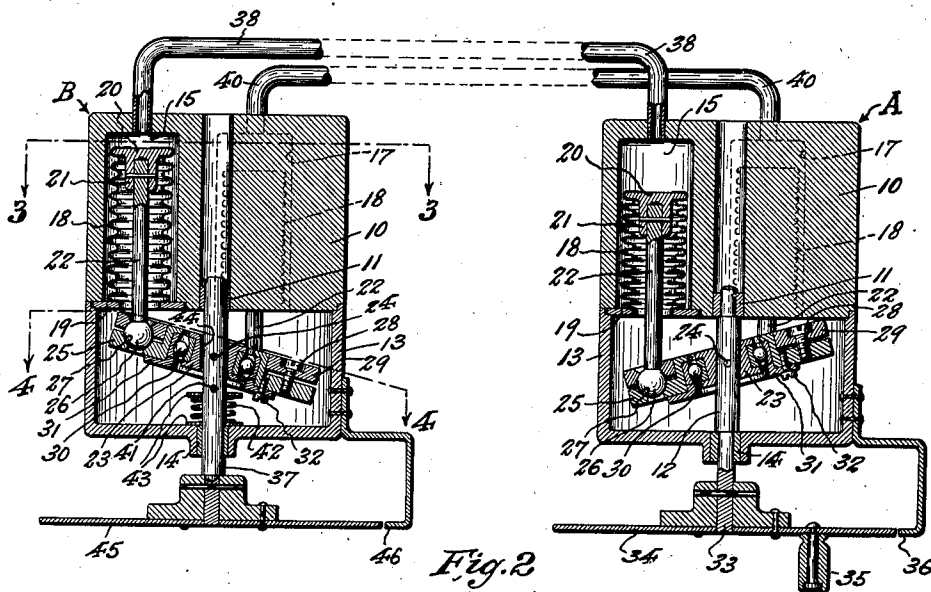
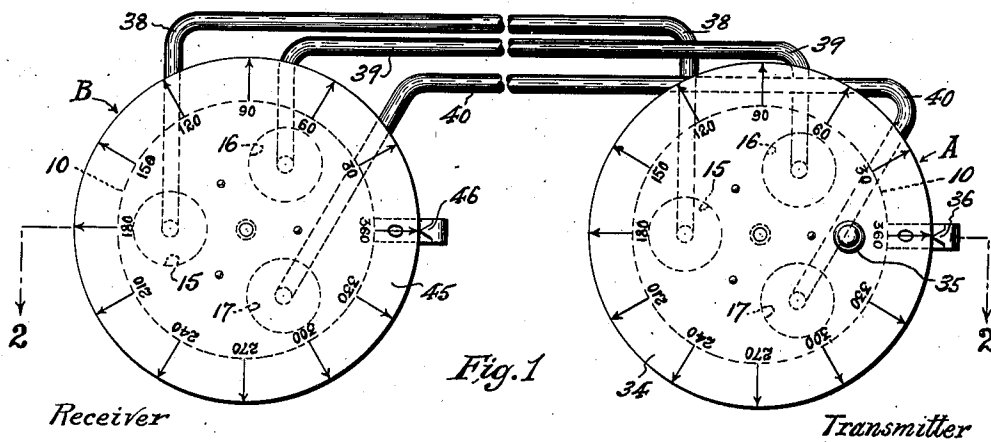
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HYDRAULIC TORQUE TRANSMISSION SYSTEM

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HYDRAULIC TORQUE TRANSMISSION
SYSTEM

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This invention relates generally to a system of transmitting rotary motion between points indirectly or remotely related by means of fluid pressure.

This invention has for an object to provide a fully enclosed synchronous fluid transmission system, including a transmitter and one or more receivers, whereby rotary motion imparted to the transmitter is transmitted in a positive and accurately corresponding degree to the rotatable elements of the receiver or receivers, and in such manner that either continuous rotary motion is attainable or rotative motion of three hundred and sixty degrees or less, as may in any given case be desired.

The invention has for a further object to provide a novel construction of substantially corresponding transmitter and receiver mechanisms characterized by the possession of a novel arrangement and form of active or reactive fluid pressure means, as the case may be, which are cooperative with a rotatable shaft through the agency of a cam transmission means, the arrangement being such that, in preferred form, said fluid pressure means are disposed in parallel relation to the shaft, thus providing a very compact mechanism capable of operative location in comparatively limited or confined spaces.

The invention has for another object to provide in connection with a fully enclosed fluid transmission system as above characterized, means to compensate the system with respect to alterations of fluid volume due to expansion and contraction of the fluid in response to temperature or pressure variations.

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

An illustrative embodiment of the invention is shown in the accompanying drawing, in which:

Fig. 1 is a face view of the hydraulic torque transmission system made according to this invention; Fig. 2 is a sectional view thereof, taken on line 2—2 in Fig. 1; Fig. 3 is a fragmentary sectional view, taken on line 3—3 in Fig. 2; and Fig. 4 is another fragmentary sectional view, taken on line 4—4 in Fig. 2.

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

Referring to the drawing, the reference character A indicates a transmitter mechanism and

the reference character B indicates a receiver mechanism.

The transmitter mechanism A comprises a main body 10 formed to provide an axial bearing means 11 in which is journaled one end of an actuator shaft 12. Connected with said main body 10, at its forward end, is a housing shell 13, the outer end wall of which is provided with an axial bearing 14 in which the outer end portion of said actuator shaft 12 is journaled. Said actuator shaft is so related to its bearings 11 and 14 as to be retained against longitudinal movement although free to rotate. Said main body 10 is provided with a plurality of fluid charged chambers longitudinally disposed and radially spaced equally around and parallel to the axis of said actuator shaft 12. These chambers are at least two in number spaced 90° apart. Preferably three chambers spaced 120° apart are used, but, if desired, more than three may be provided. As shown, these chambers are respectively identified by the reference characters 15, 16 and 17. Said chambers are closed at their rearward ends. Cooperative with each chamber is a longitudinally expandible and contractible bellows member 18. In a preferred arrangement, as shown, each bellows member is secured at its outer open end to an annular anchor plate 19 which is suitably affixed to the body 10 so as to close the open end of the chamber within which the bellows member is disposed. The inner end of said bellows member 18 is closed by a head-piece or plug 20, the same being provided with an axial neck 21 dependent within the bellows member. Affixed to said neck 21 is a stem 22 which extends axially outward through the interior of the bellows member so as to project from the outer open end of the latter. In this preferred arrangement the fluid of the system contacts the bellows members externally, but it will be obvious that a reversal of the arrangement, whereby the fluid of the system internally contacts the bellows members, may be utilized if desired.

Affixed to said actuator shaft 12, below the forward end of said main body 10, and within the housing shell 13, is a cam means which is cooperative with the stems 22 of the several bellows members 18. This cam means may take various forms, but in preferred form is of the wobble-plate type and comprises an annular wobble-plate member 23 which is disposed in transversely oblique relation to the axis of said actuator shaft and at a desired angular pitch, being secured to the latter by a cross-pin 24

so as to turn therewith. Concentrically related to and surrounding the periphery of the wobble-plate member 23 is a coupler ring 25. The bellows-member stems 22 are provided at their free ends with ball joint elements 26 which seat in corresponding sockets 27 with which said coupler ring 25 is provided. Suitably secured to said coupler ring 25, as by screws 28, is a keeper ring 29 to hold said ball joint elements in operative relation to the coupler ring sockets 27. Arranged intermediate the wobble-plate member 23 and the coupler ring 25 is an anti-friction means, preferably in the form of a ball-bearing assembly 30, the same being retained in assembled relation to the wobble-plate member 23 and coupler ring 25 by a keeper annulus 31 which is removably secured to the coupler ring, as by screws 32. The above described means for cooperatively relating the cam to the bellows member stems is subject to considerable variation as to detail and form, for in bare essentials all that is necessary is that a thrusting engagement be established between the cam and the bellows member stems.

A portion 33 of said actuator shaft 12 projects exteriorly from the housing shell 13, and secured thereto is a crank means which is manipulatable to apply rotary motion to said actuator shaft. For purposes of illustration, said crank means is shown in the form of a dial disc or wheel 34 having a handle member 35 suitably connected therewith. The face of said dial-disc or wheel 34 may be provided around its peripheral marginal portions with graduations of suitable character to indicate, by reference to a fixed pointer element 36, rotative movement of selective degree. The character and marking of the dial disc or wheel is subject to wide variation, and, depending upon the use to which the system is to be put, any other means for applying motion to the actuator shaft, either continuously or to obtain a single or any part of a single revolution, may be utilized as may be desirable in any given case.

The receiver mechanism B is, in general, the same in structure as the above described transmitter mechanism A, and like parts thereof are therefore identified by the same reference characters by which corresponding parts of said transmitter mechanism A are indicated, except that the actuated shaft is indicated by the reference character 37. It will be noted that in the receiver mechanism B the wobble-plate cam is set at a correspondingly transverse but opposite pitch angle to the setting of the wobble-plate cam of said transmitter mechanism A.

Interconnecting corresponding fluid charged chambers of the transmitter and receiver mechanisms A and B are fluid conduits or pipes; for example, extending in intercommunicating relation between the chambers 15 is a conduit or pipe 38; between the chambers 16 is a conduit or pipe 39; and between the chambers 17 is a conduit or pipe 40.

Compensating means are provided for guarding the transmitter and receiver mechanisms against relative alterations of phase due to expansion or contraction of the fluid charges thereof under temperature or pressure variations. The compensating elements may be applied to either the transmitter or receiver. In the arrangement as herein shown, and for the purposes of illustration, the compensating elements are shown applied to the receiver mechanism B. The compensating arrangement comprises a mounting of the actuated shaft 37 in its bearings in such

manner as to permit axial shift thereof as well as rotative movement.

If desired the shaft may be yieldably supported subject to axial shift. To so yieldably support the shaft, the same is provided with an abutment pin 41, or other suitable abutment or stop means, which is positioned outwardly of the wobble-plate cam and in spaced relation to the outer end wall of the housing shell 13. Arranged about the actuated shaft 37, between said abutment pin 41 and the housing shell end wall, is a compression spring 42. If desired, footing discs 43 may be associated with the ends of said spring 42. In the event of expansion of the fluid in the system as a whole, the pressure of such expansion will be transmitted through the bellows members 18 and their stems 22 as a direct downward bodily thrust upon the wobble-plate cam with the result that a downward compensating axial movement or shift will be imparted to the actuator shaft 37. Contraction of the fluid in the system operates to effect an upward compensating axial movement of the shaft 37. The use of the spring 42 is not essential when the bellows member stems have a mechanically coupled relation to the wobble-plate cam, but is essential in simpler designs wherein the bellows-member stems merely make thrusting contact with the wobble-plate cam.

It may sometimes occur, especially in systems where the transmitter and receiver may be respectively subject to different local temperature conditions, that a relative variation of pressure in the chambers and bellows members of the one may occur without corresponding changes in the other, and, due to the respectively different volumes of fluid content in the several chambers and bellows members, pressure may be greater in one chamber and bellows member than in its fellows. To permit compensation and equalization of fluid pressure as between the several chambers and bellows members under such circumstances, the wobble-plate cam associated with the actuated shaft 37 is pivotally affixed thereto so as to permit a limited degree of bodily rocking movement relative to the shaft 37 in direction adapted to compensatingly vary its pitch angle. This is attained by providing the wobble-plate cam with a bore 44 of somewhat larger diameter than the diameter of the shaft so that said wobble-plate cam may rock to a limited extent about the cross-pin 24 as a fulcrum. As a consequence of the limited rocking movement thus permitted to the wobble-plate cam, the latter will yield angularly to an extent sufficient to allow the differences in pressure in the several chambers and bellows members to come to equilibrium.

The actuated shaft 37 projects exteriorly of the housing shell 13 and its outer end may be operatively coupled or otherwise utilized to impart the rotary motion transmitted thereto upon operation of the system. For example, a dial-disc 45, suitably graduated to correspond to the indications of the dial disc 34 of the transmitter mechanism A may be affixed to the shaft 37, and its movements read with reference to a fixed pointer element 46.

In the operation of the system, as the actuator shaft 12 is rotated, the wobble-plate cam is likewise rotated whereby, due to its angular disposition on the shaft, the same oscillates the coupler ring in successively shifting vertical planes thus successively reciprocating the stems 22 of the bellows-members 18 of the transmitter mechanism A so as to successively expand and contract

the latter. As a bellows-member 18 expands it forces the fluid in the chamber in which it is operative outwardly thereof and through the connecting conduit or pipe into the corresponding chamber of the receiver mechanism B, thereby compressing the bellows-member in said latter chamber and inducing an outward stroke of the stem 22 connected therewith. The outward stroke of the stem 22 of a compressed bellows member of the receiver mechanism B reacts upon the wobble-plate cam of the latter's actuated shaft 37, causing the cam to rotate and thereupon impart a like rotative impulse to said actuated shaft 37 and the devices operated thereby. It will be understood that outflow of fluid from the chambers of the transmitter mechanism will effect inflow of fluid in corresponding chambers of the receiver mechanism and vice versa, and since the operation of the bellows members in corresponding chambers of the transmitter and receiver mechanisms occur in successive order, successive rotative impulses are transmitted to the wobble-plate cam and actuated shaft of the receiver mechanism B in such manner that any part or a whole revolution of the actuator shaft of the transmitter mechanism A is correspondingly reproduced at the actuated shaft of receiver mechanism B, or, if desired, continuous rotation of said actuated shaft may be produced by continuously rotating the actuator shaft.

It will be obvious that the described system provides a very compact and efficient fully enclosed and synchronous hydraulic transmission means for reproducing rotary motion at points remote from the source of power, while at the same time providing a system which is self-compensating under variations of fluid volume caused by variations in temperature or pressure. It will be understood that the novel system is adapted for use in connection with many different and specific purposes.

It is realized that many changes may be made in the above described constructions, and that apparently widely different embodiments of this invention could be made without departing from the scope thereof; it is therefore intended that all matter contained in the foregoing description and shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

We claim:

1. In a hydraulic torque transmission system, a transmitter and a receiver each having a plurality of fluid charged chambers, fluid conduit means interconnecting corresponding chambers of said transmitter and receiver, reactive reciprocal means in corresponding chambers of said transmitter and receiver, said transmitter having a rotatable actuator shaft, cam means on said actuator shaft for operating the reciprocal means of the transmitter, said receiver having a rotatable actuated shaft, cam means on said actuated shaft adapted to be operated by the reciprocal means of said receiver, means to compensate for expansion or contraction of fluid in the system under temperature or pressure variations comprising, means to retain one of the shafts and its cam means against axial displacement, and means to support the other shaft and its cam means subject to compensating axial displacement.

2. In a hydraulic torque transmission system, a transmitter and a receiver each having a plurality of fluid charged chambers, fluid conduit means interconnecting corresponding chambers

of said transmitter and receiver, reactive reciprocal means in corresponding chambers of said transmitter and receiver, said transmitter having a rotatable actuator shaft, a wobble-plate cam affixed to said actuator shaft for operating the reciprocal means of the transmitter, said receiver having a rotatable actuated shaft, a wobble-plate cam on said actuated shaft adapted to be operated by the reciprocal means of said receiver, and means to compensate any relative variation of fluid pressure in the chambers of the transmitter or receiver, as the case may be, due to fluid expansion or contraction, comprising means to connect one of the wobble-plate cams to its shaft subject to a compensating limited angular pitch variation.

3. In a hydraulic torque transmission system, a transmitter and a receiver each having a plurality of fluid charged chambers, fluid conduit means interconnecting corresponding chambers of said transmitter and receiver, reactive reciprocal means in corresponding chambers of said transmitter and receiver, said transmitter having a rotatable actuator shaft, a wobble-plate cam affixed to said actuator shaft for operating the reciprocal means of the transmitter, said receiver having a rotatable actuated shaft, a wobble-plate cam on said actuated shaft adapted to be operated by the reciprocal means of said receiver, and means to compensate for expansion or contraction of fluid in the system as a whole under temperature or pressure variations comprising, means to retain one of the shafts and its wobble-plate cam against axial displacement, and spring means to yieldably support the other shaft and its wobble-plate cam subject to compensating axial displacement.

4. In a hydraulic torque transmission system, a transmitter and a receiver each having a plurality of fluid charged chambers, fluid conduit means interconnecting corresponding chambers thereof, reactive reciprocal means in corresponding chambers of said transmitter and receiver, said transmitter having a rotatable actuator shaft, a wobble-plate cam affixed to said actuator shaft for operating the reciprocal means of the transmitter, said receiver having a rotatable actuated shaft, a wobble-plate cam on said actuated shaft adapted to be operated by the reciprocal means of said receiver, and means to compensate expansion or contraction of fluid under temperature or pressure changes comprising, means to retain one of the shafts and its wobble-plate cam against axial displacement, spring means to yieldably support the other shaft and its wobble-plate cam subject to compensating axial displacement, and means to connect one of said wobble-plate cams to its shaft subject to compensating limited angular pitch variation.

5. In a hydraulic torque transmission system, a transmitter and a receiver, said transmitter having an axially disposed actuator shaft, said receiver having an axially disposed actuated shaft, said transmitter and receiver each having a plurality of fluid charged chambers spaced around and disposed parallel to the shafts thereof, fluid conduit means interconnecting corresponding chambers of said transmitter and receiver, reactive reciprocal means in corresponding chambers of said transmitter and receiver, said reciprocal means each having operating stems, an actuator wobble-plate cam affixed to said transmitter actuator shaft in oblique angular relation to the axis thereof, means cou-

pling the stems of the reciprocable means of the transmitter chambers with said actuator wobble-plate cam, an actuated wobble-plate cam affixed to said receiver actuated shaft in oblique angular relation to the axis thereof opposite to that of said actuator wobble-plate cam, means coupling the stems of the reciprocable means of the receiver chambers with said actuated wobble-plate cam, and means to compensate for expansion or contraction of fluid under temperature or pressure variations comprising, means to retain one of the shafts and its wobble-plate cam against axial displacement, and means to support the other shaft and its wobble-plate cam subject to compensating axial displacement.

6. In a hydraulic torque transmission system, a transmitter and a receiver, said transmitter having an axially disposed actuator shaft, said receiver having an axially disposed actuated shaft, said transmitter and receiver each having a plurality of fluid charged chambers spaced around and disposed parallel to the shafts thereof, fluid conduit means interconnecting corresponding chambers of said transmitter and receiver, reactive reciprocable means in corresponding chambers of said transmitter and receiver, said reciprocable means each having operating stems, an actuator wobble-plate cam affixed to said transmitter actuator shaft in oblique angular relation to the axis thereof, means coupling the stems of the reciprocable means of the transmitter chambers with said actuator wobble-plate cam, an actuated wobble-plate cam affixed to said receiver actuated shaft in oblique angular relation to the axis thereof opposite to that of said actuator wobble-plate cam, means coupling the stems of the reciprocable means of the receiver chambers with said actuated wobble-plate cam, and means to compensate for expansion or contraction of fluid under temperature or pressure variations comprising, means to retain one of the shafts and its wobble-plate cam against axial displacement, means to support the other shaft and its wobble-plate cam subject to compensating axial displacement, and means to connect one of the wobble-plate cams to its shaft subject to compensating limited angular pitch variation.

7. In a hydraulic torque transmission system, a transmitter and a receiver, said transmitter having an axially disposed actuator shaft, said receiver having an axially disposed actuated shaft, said transmitter and receiver each having a plurality of fluid charged chambers spaced around and disposed parallel to the shafts there-

of, fluid conduit means interconnecting corresponding chambers of said transmitter and receiver, bellows members cooperative with said chambers, said bellows members having stems, an actuator wobble-plate cam affixed to said actuator shaft in oblique angular relation to the axis thereof, means coupling the stems of said transmitter bellows members with said actuator wobble-plate cam, an actuated wobble-plate cam affixed to said actuated shaft in oblique angular relation to the axis thereof opposite to that of said actuator wobble-plate cam, means for coupling the stems of said receiver bellows with said actuated wobble-plate cam, and means to compensate for expansion or contraction of fluid in the system under temperature variation comprising, means to retain one of the shafts and its wobble-plate cam against axial displacement, and means to support the other of the shafts and its wobble-plate cam subject to compensating axial displacement.

8. In a hydraulic torque transmission system, a transmitter and a receiver, said transmitter having an axially disposed actuator shaft, said receiver having an axially disposed actuated shaft, said transmitter and receiver each having a plurality of fluid charged chambers spaced around and disposed parallel to the shafts thereof, fluid conduit means interconnecting corresponding chambers of said transmitter and receiver, bellows members cooperative with said chambers, said bellows members having stems, an actuator wobble-plate cam affixed to said actuator shaft in oblique angular relation to the axis thereof, means coupling the stems of said transmitter bellows members with said actuator wobble-plate cam, an actuated wobble-plate cam affixed to said actuated shaft in oblique angular relation to the axis thereof opposite to that of said actuator wobble-plate cam, means for coupling the stems of said receiver bellows members with said actuated wobble-plate cam, and means to compensate for expansion or contraction of fluid in the system under temperature variation comprising, means to retain one of the shafts and its wobble-plate cam against axial displacement, means to support the other of the shafts and its wobble-plate cam subject to compensating axial displacement, and means to connect one of the wobble-plate cams to its shaft subject to compensating limited angular displacement.

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