Nov. 13, 1928. 1,691,687

J. S. WATTS

PIPE LINE SAMPLING DEVICE

Filed Dec. 7, 1925 2 Sheets-Sheet 1

Fig. 1

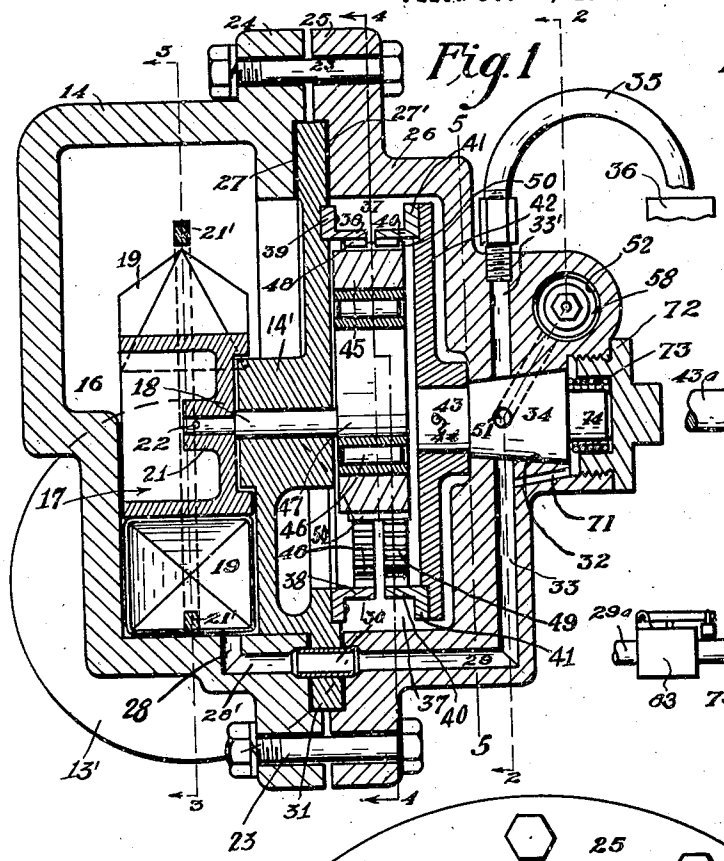


Fig. 6

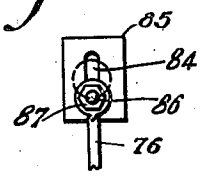


Fig. 5

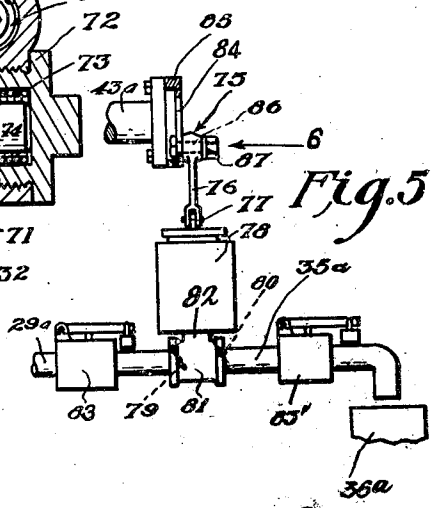
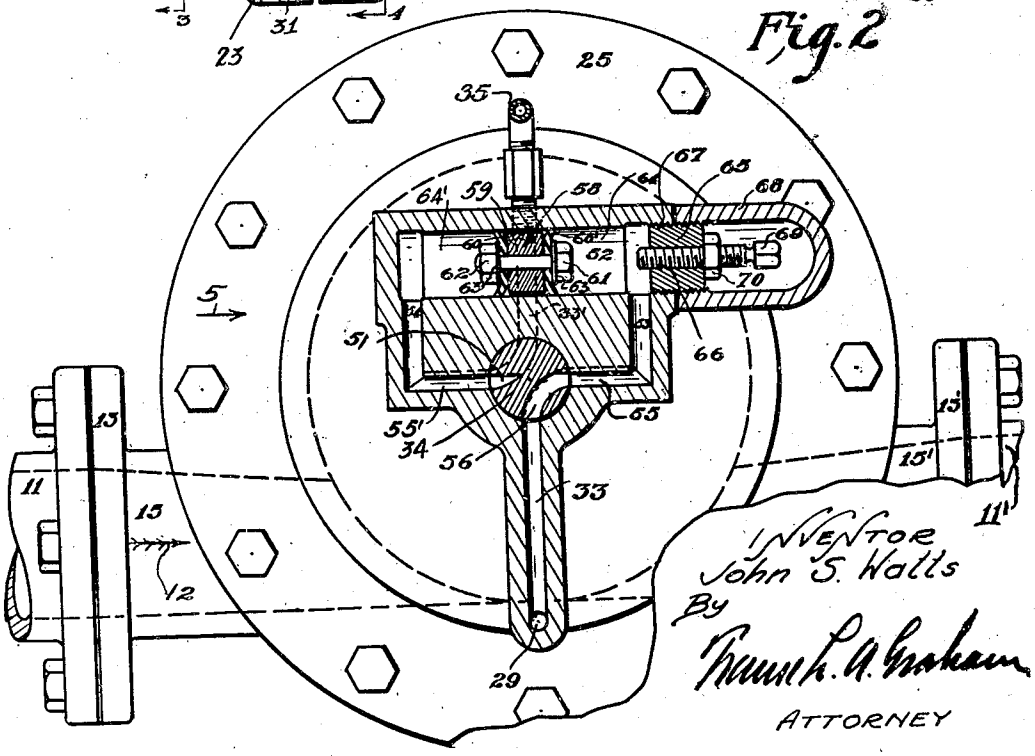


Fig. 2



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Fig. 3

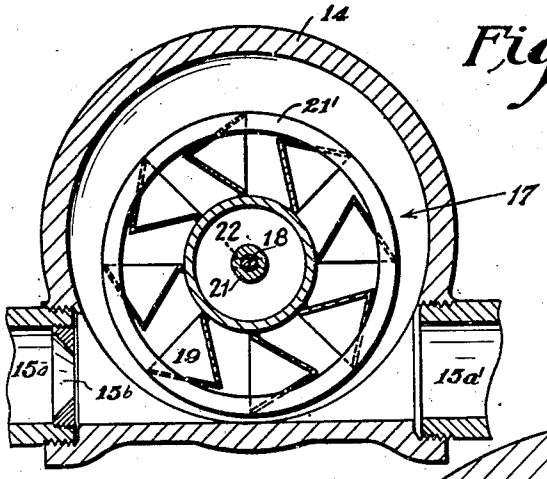
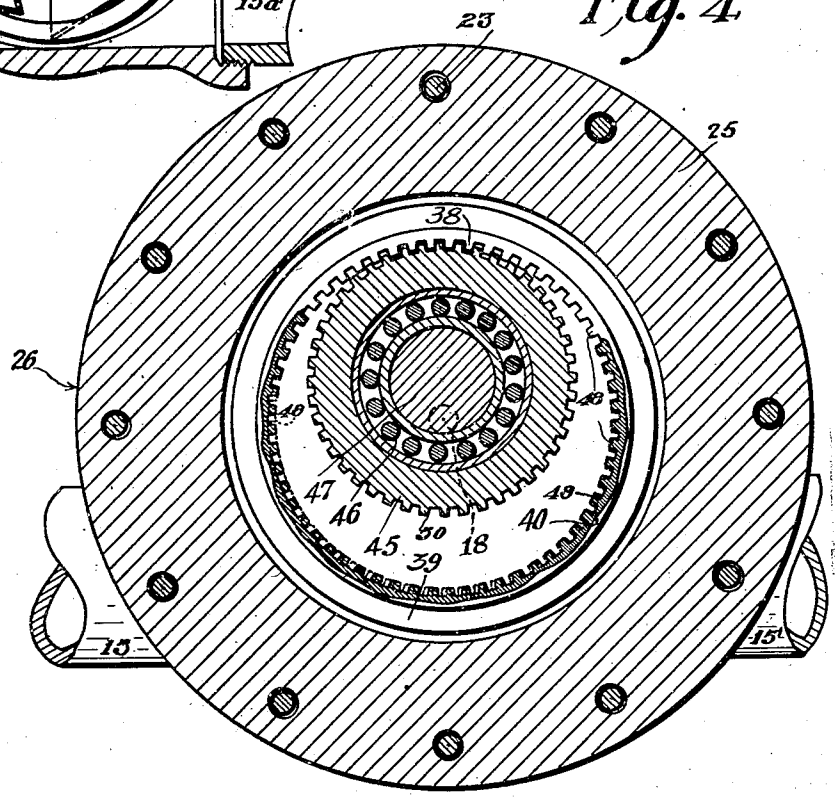


Fig. 4



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UNITED STATES PATENT OFFICE.

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PIPE-LINE SAMPLING DEVICE.

Application filed December 7, 1925. Serial No. 73,715.

As may be inferred from the above designation, this invention is designed to provide means for continuously taking representative quantities of a liquid, flowing through a pipe, in such manner that the total quantity taken shall accurately represent, in its composition, the average quality of the liquid delivered through the mentioned pipe, within the period during which the sampling may have been continued.

It being customary to deliver oils varying in composition or quality successively through an identical pipe, and customary to base the price of such oils upon the composition or quality thereof, it becomes a matter of great practical importance to provide sampling means whose operation is dependent upon the rate of advance of the oil delivered through said pipe, so that an increased number of unit quantities may be taken for sampling purposes when the oil is rapidly advanced; and it is also important that the unit quantities so taken should be typical,—and not such as might collect at a specific level, outside the main current of the advancing stream of oil. It is accordingly an object of my invention to provide a sampling device which, although comprising continuously-moving parts, is so easily operated that driving of said parts may be effected by the advance of the oil to be tested; and preferred embodiments of my invention may each comprise a rotor interposed in and operated by an advancing stream of oil,—the movement of this rotor being utilized either to manipulate a valve, controlling a port or ports through which oil may be intermittently forced, or to operate a pump, by which predetermined quantities of oil may be intermittently taken, collectively to constitute a typical sample; or, optionally employing a novel reducing gear hereinafter described, I may embody in a single sampling organization both a valve rotating mechanism and a plunger mechanism,—the latter, when employed, being preferably provided with means for adjustably varying the length of the plunger stroke.

Other objects of my invention may be best appreciated from the following description of typical embodiments thereof, taken in connection with the appended claims and the accompanying drawings, in which—

Fig. 1 may be regarded as a transverse section through a preferred embodiment of my invention.

Fig. 2 is an elevational view, partially sectioned to a broken plane such as that indicated by the line 2—2 of Fig. 1.

Fig. 3 is a vertical section, on a slightly reduced scale, taken substantially as indicated by the line 3—3 of Fig. 1.

Fig. 4 is an additional vertical section taken substantially as indicated by the broken line 4—4 of Fig. 1.

Fig. 5 is an elevational view, taken from the general direction indicated by the arrow 5 of Fig. 2 and illustrating optional alternative features capable of being substituted for so much of the organization shown in Fig. 1 as appears at the right of the line 5—5 thereof.

Fig. 6 is a detail view taken substantially as indicated by the arrow 6 of Fig. 5.

Referring to the details of that specific embodiment of my invention illustrated in Figs. 1–4 inclusive, 11 and 11′ may be sections of a pipe line through which oil, or other liquid, may be assumed to advance, either at a constant rate or at a varying rate, in the direction indicated by the arrow 12, Fig. 2; and between these sections I may secure, as by means of integral flanges 13, 13′, a hydraulic motor organization of any preferred character, as, for example, an organization comprising a main casting 14 and a bearing casting 14′, the walls of these castings being shown as substantially fluid-tight, to adapt them to resist high internal pressure. The former is shown as comprising tubulations 15, 15′ and an intervening expansion providing a completely enclosed motor chamber 16.

The motor chamber 16 is shown as communicating eccentrically (at or near the bottom thereof) with the mentioned tubulations, and as adapted to contain a pressure-driven or impact-driven wheel or rotor 17 of any preferred design. The shaft 18 of the mentioned wheel or rotor 17 (shown as carrying buckets 19 and as secured to or integral with a chambered hub 21, and a peripheral ring

21′) may be secured thereto in any preferred way, as by means of a pin 22; and a relative rotation of the shaft 18, or its equivalent, as produced by the assumed pressure due to the advance of oil or other liquid to be sampled, may be utilized in any one of various ways to deliver or measure typical unit quantities thereof into any suitable receptacle of sufficient capacity to receive the same during a predetermined period,—as an interval of eight or twelve or twenty-four hours.

For example, I may secure the bearing casting 14′, or its equivalent, by clamping the same, as by means of bolts 23, between flanges 24 on the main casting 14 and similar flanges 25 on a subsidiary or complemental casting 26 (annular gaskets being preferably interposed at 27 and 27′); and I may bore the main casting 14, as at 28, 28′ and the complemental casting 26, as at 29, in such manner as to provide an outlet for a thoroughly admixed and therefore representative unit quantity of the oil or other liquid passing through the tubulations 15, 15′,—utilizing the rotation of shaft 18 to impart movement, directly or indirectly, either to a reciprocable plunger or to a valve. Thus the frequency with which the said plunger is reciprocated or the said valve is opened may be exactly or approximately proportional to the rate of advance of the oil or other liquid to be sampled.

Reliably to conduct liquid from the passage 28 (in casting 14) to a subsidiary passage 29 (in casting 26) or its equivalent, and in order to prevent relative rotation of the bearing casting 14, or its equivalent, and to facilitate assembly and disassembly without the use of interior threaded connections, I may employ means such as a short nipple or tubular pin 30, shown as extending through a flange 31 by which said bearing casting is retained between castings 14 and 26; and, in the form of my invention illustrated in Figs. 1 to 4, I show the latter casting as provided with a subsidiary and central but slightly tapered passage 32, which may be coaxial with the shaft 18, and which is so related to a passage 33, communicating with the mentioned passage 29, leading from the rotor chamber 16, that the interposition of a suitably fitting tapped plug or valve 34 in the passage 32 is effective to control the outflow of unit quantities of oil, collectively to constitute a sample, through the mentioned passages 28, 28′, 29, and 33, and also through a passage 33′ connected with any suitable pipe 35, to conduct the same to a collecting receptacle,—represented diagrammatically at 36.

Instead of connecting the shaft 18, or its equivalent, directly with the valve 34, or its equivalent, I prefer to interpose a suitable reducing gear therebetween; and I show the subsidiary casting 26 as providing a chamber 37 of sufficient size to accommodate a novel and exceptionally simple reducing gear or train suitable for the purpose referred to. This train may comprise a fixed ring gear 38, shown as integral with a flange 39, by which it may be secured to the bearing casting 14′, or its equivalent, and a movable ring gear 40,—shown as secured by a flange 41 to a disc 42, which may be secured to an integral extension 43 of valve 34, as by means of a pin 44. Between the mentioned gears I show a smaller gear 45 as rotatably mounted (by means of roller bearings 46) upon an eccentric core 47, integrally or otherwise rigidly connected with the shaft 18.

The teeth 48 and 49 of the ring gears 38 and 40, although both sets are engageable by the teeth 50 of the smaller gear 45, are unequal in number. For example, the ring gear 38 may be provided with one hundred teeth 48 and the movable ring gear 40 may be provided with ninety nine teeth 49. It will be obvious that, using this arrangement, although the smaller gear 45 is prevented, by reason of its engagement with the fixed gear 38, from rotating upon its own axis, the teeth of said small gear, during a complete rotation of the eccentric 47, are effective, by a camming or wedging action, to rotate the gear 40, relatively to the gear 38, through an arc corresponding to the interval between two teeth on one of the mentioned ring gears. That is to say, the device described effects substantially a hundred-to-one reduction in rate of rotation between the shaft 18 and the valve 34, or its equivalent.

Instead of relying upon means such as a floating valve in an interposed receptacle to predetermine the quantity of oil or other liquid delivered through the valve 34, or its equivalent, during each period of communication of an opening 51 therein with one of the passages 33, 33′, I prefer to employ means comprising a plunger movable in a cylindrical chamber, to restrict the volume of liquid delivered to the receptacle 36, or its equivalent during each opening of the valve 34. For this purpose, instead of providing a passage directly through said valve, I may channel the casting 26 and the valve 34 in substantially the general manner indicated in Fig. 2. That is to say, although the passages 33, 33′ may be coaxial, by providing, in another plane, a cylindrical chamber 52, whose ports 53 and 54 may alternately be placed in communication with the passages 33, 33′ by means of additional bores or passages 55, 55′,—as by means of curved passages 56 and 51 related thereto in the manner illustrated,—I may utilize means such as a movable plunger 58 in measuring or predetermining the volume of each unit quantity of oil delivered toward the receptacle 36.

The plunger 58 is shown as comprising a central body 59 and cupped washers 60, 60′,

secured on the opposite sides thereof by a mere bolt 61 carrying a nut 62 and washers 63,—a rotation of the valve 34 through the position in which it is shown in Fig. 2 being effective to permit a flow of liquid into the space 64, so that pressure applied thereby is effective, by so advancing the plunger 58 as to diminish the complemental chamber 64′, to force the oil or other liquid previously admitted to the latter chamber out through passages 54, 55′ and 33′.

It will be obvious that a rotation of the valve member 34 through an angle of 90°, and in either direction from the position in which it is shown, is effective to admit oil in turn to the chamber 64′, and to force the oil previously delivered into chamber 64 out through the pipe 35; and that the rate at which unit quantities of oil are so delivered, being dependent upon the rate at which the valve 34 is rotated, may be exactly or substantially proportional to the rate of advance of the oil or other liquid through the pipe comprising sections 11, 11′.

In order to adapt organizations of the general character described to the taking of substantially uniform total samples, as, for example, samples amounting to bout ten quarts or ten gallons in eight or twenty-four hours, it being obvious that the bulk of these total samples would otherwise vary within unit limits depending upon the rate of advance of the oil or other liquid through the pipe in which my sample-taking organization is interposed, I may, if desired, provide means for varying the stroke of the plunger 58, or its equivalent; and my preferred means for the latter purpose may comprise means such as a plug 65 shown as provided with continuous internal and external threads at 66 and 67,—the latter of these threads being used not only for the retention of said plug but for the retention of a removable cap 68, and the former of said threads being shown as engageable by a stroke-determining threaded pin 69, preferably carrying a lock nut 70.

By the use of means of the general character described, it will be obvious that so long as oil, or the like, is flowing at any usual rate through the pipe comprising sections 11, 11′, samples will be intermittently taken and permitted to accumulate within the receptacle 36, or its equivalent; and that the volumes of total samples collected during unit periods of time may be rendered substantially proportional to the volume of oil passing through the main pipe, notwithstanding variations in the rate of advance of the oil or other fluid through the mentioned pipe. It will be obvious that, if found expedient in particular cases, I may so construct one or both of the tubulations 15, 15′ (somewhat as suggested by dotted lines, Fig. 2) as to produce a local acceleration of the oil or other fluid passing therethrough.

Although the principles of my invention, in its broader aspects may be regarded as independent not only of the use of any specified reduction gear, but independent also of any special expedients used locally to increase the velocity of flow or of impact of the advancing liquid (and independent also of any means used to reciprocate a plunger and to press a valve 34, or its equivalent, to its seat) I suggest in Fig. 3 the use of replaceable tubulations 15^a and $15^{a'}$, in order that, according to the circumstances of use, these tubulations may either be straight or may be given an inward or an outward taper; and, if desired the inlet tubulation or an equivalent main fluid passage may alternatively or additionally be provided with a replaceable or removable choke member 15^b, shown as threaded therein and as adapted to function as a nozzle in directing a stream of oil, or the like, against the buckets 19. If desired, in order to establish an inward pressure on the end of the valve 34, or its equivalent, I may provide, as suggested in Fig. 1, a passage 71, for the admission of oil thereto, the oil being confined by means such as a plug 72, or its equivalent; or, if desired, like pressure may be produced by resilient means such as a compression spring 73 shown as housed in said plug 72 and surrounding an extension 74 of valve 34.

As indicated in Fig. 5, instead of permitting the pressure of the advancing fluid directly, although intermittently, to act upon a reciprocating plunger, I may, if desired, utilize the rotation of a shaft 43, or the rotation of an equivalent shaft 43^a driven in a similar manner, or in any desired manner, to reciprocate a plunger within a suitable pump, the inlet of said pump being in communication with a passage 29^a, identical with or comparable to the passage 29, shown in Figs. 1 and 2. For example, I may secure a crank pin 75 eccentrically upon the outer end of the shaft 43^a, connecting the same by means such as a rod 76 with a reciprocable member 77, adapted to move a plunger within a suitable pump 78. This plunger may be unprovided with valves, a regulated advance of unit quantities of the oil or other liquid sampled being effected by the suitable use of an inwardly opening valve 79 and an outwardly opening valve 80 at the respective ends of a T fitting 81, shown as secured below the pump barrel 78 by a nipple 82.

If the mentioned valves 79 and 80 are mere flap valves, additional relief valves may advantageously be interposed, as at 83 and 83′, both in the inlet 29^a to the pump 78 and in the outlet 35^a therefrom, as diagrammatically indicated; and the latter valve should, in the use of this embodiment of my invention, be set at a pressure slightly greater than the former,—in order that oil may not flow continuously through the pipes 29^a and 35^a, and to assure flow therefrom only during the "downward" strokes of the plunger (not

shown) within the cylinder 78, or its equivalent. In order to vary the stroke of this plunger, I may employ means such as an adjustable connection comprising a slot 84 in a plate 85 secured to the shaft 43ª and a clamping bolt 86, carrying a nut 87, adjustable to predetermine the throw of the crank pin 75, or its equivalent,—thereby delivering, even under widely varying conditions of use, representative samples of comparatively uniform volume (or of any desired volume) into receptacles 36ª, or their equivalents.

Although I have herein completely described a single embodiment of my invention, suggesting alternative means for reciprocating a plunger through predetermined distances, it should be understood that various features of my invention might be independently employed (the described reducing gear being in fact the subject matter of a separate application, Serial No. 81,979, filed January 18, 1926, and also that numerous modifi ations additional to those suggested herein might be devised by those skilled in the art to which this case relates, without involving the slightest departure from the spirit and scope of my invention, as the same is indicated above and n the following claims.

I claim as my invention:

1. In an organization of the general character described: a main member interposable in a pipe line through which a fluid is advancing under pressure, said member providing a main passage, with which a subsidiary passage communicates, and a completely closed rotor chamber, said passages and chambers having walls adapting them to resist internal pressure; a revolving rotor in said chamber, operated by the main stream of fluid passing through the pipe line; and means, driven by said rotor, for causing successive unit quantities of fluid to advance through said subsidiary passage.

2. In an organization of the general character described: a main member interposable in a pipe line through which a fluid is advancing under pressure, said member providing a main fluid passage with which a subsidiary passage communicates; a valve mounted in said subsidiary passage; a completely closed rotor chamber; and a rotor in said chamber comprising a shaft carrying buckets, said subsidiary passage valve being mounted on a shaft concentric with said rotor shaft and driven therefrom by a reducing gear.

3. In an organization of the general character described: a main member interposed in a pipe line through which a fluid is advancing under pressure, said member providing a main passage with which a subsidiary passage communicates; a completely closed rotor chamber, said passages and said chamber having walls adapting them to resist internal pressure; a rotor in said chamber; and means driven by said rotor for causing successive unit quantities of fluid to advance through said subsidiary passage, said rotor being supported exclusively by the shaft extending through a bearing casting which serves as a partition and in which a shaft rotatable by the rotor shaft is disposed coaxially therewith and provided with means for controlling the intermittent advance of separate unit quantities of fluid.

4. In an organization of the general character described: a main member interposed in a pipe line through which a fluid is advancing under pressure, said member providing a main passage with which a subsidiary passage communicates; a completely closed rotor chamber, said passages and said chamber having walls adapting them to resist internal pressure; a rotor in said chamber; means driven by said rotor for causing successive unit quantities of fluid to advance through said subsidiary passage, said rotor being supported exclusively by a shaft extending through a bearing casting which serves as a partition and in which a second shaft rotatable by said rotor shaft is disposed coaxially therewith and provided with means for controlling the intermittent advance of separate unit quantities of fluid; and reducing gear between the mentioned coaxial shafts.

5. In an organization of the general character described: a main member interposed in a pipe line through which a fluid is advancing under pressure, said member providing a main passage with which a subsidiary passage communicates; a completely closed rotor chamber, said passages and said chamber having walls adapting them to resist internal pressure; a rotor in said chamber; means driven by said rotor for causing successive unit quantities of fluid to advance through said subsidiary passage, said last mentioned means comprising a plunger movable in a cylinder; and means, dependent upon the rate of rotation of said rotor, for imparting reciprocatory motion to said plunger.

6. In an organization of the general character described: a main member interposed in a pipe line through which a fluid is advancing under pressure, said member providing a main passage with which a subsidiary passage communicates; a completely closed rotor chamber, said passages and said chamber having walls adapting them to resist internal pressure; a rotor in said chamber; means driven by said rotor for causing successive unit quantities of fluid to advance through said subsidiary passage, said last mentioned means comprising a plunger; means for varying the stroke of said plunger; and means dependent upon the rate of rotation of said rotor for imparting reciprocatory motion to said plunger.

7. In an organization of the general char-

acter described: a hydraulic motor organization comprising a member having walls adapted to resist high internal pressures and providing a rotor chamber and a main fluid passage to permit the advance therethrough of an operating fluid, there being a revolving rotor in said chamber, operable by the main stream of fluid, and a subsidiary passage in communication with said main passage; and means, operable by said rotor, for causing a flow through said subsidiary passage proportionate to the flow through said main passage.

In testimony whereof, I have hereunto set my hand at Los Angeles, California, this 28th day of November, 1925.

JOHN S. WATTS.