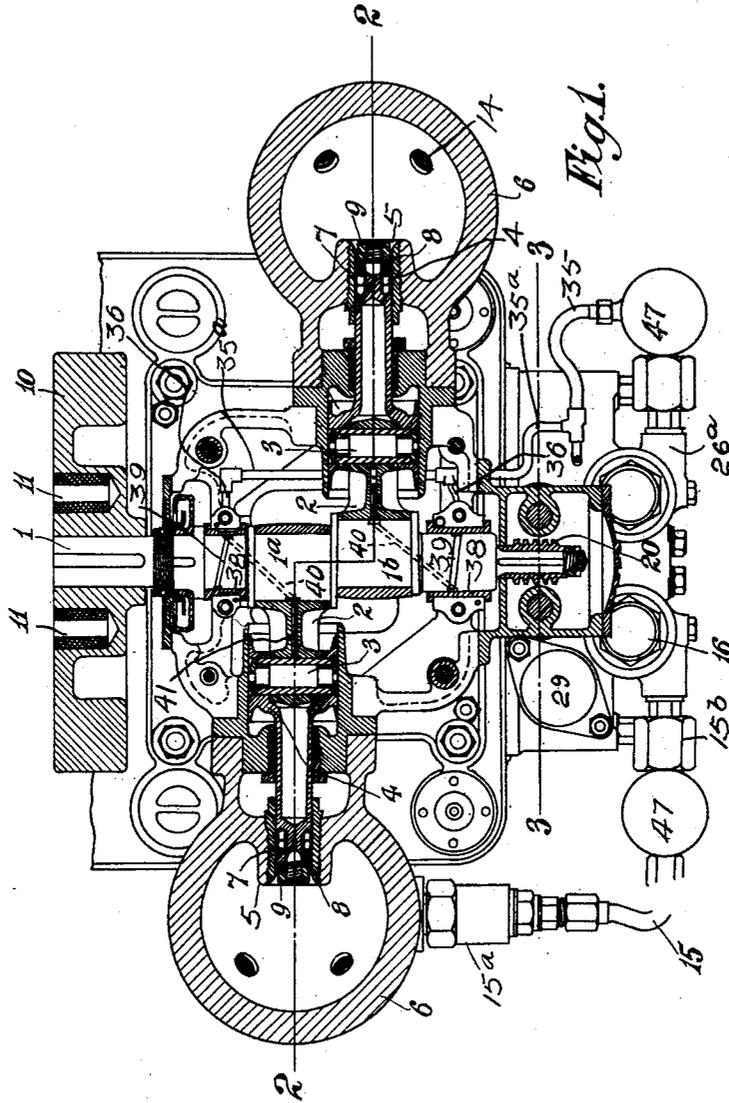


J. HANSON.  
HYDRAULIC APPARATUS.  
APPLICATION FILED OCT. 6, 1920.

1,410,100.

Patented Mar. 21, 1922.

4 SHEETS—SHEET 1.



*Fig. 1.*

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James Hanson.  
By B. Singer, Atty.*

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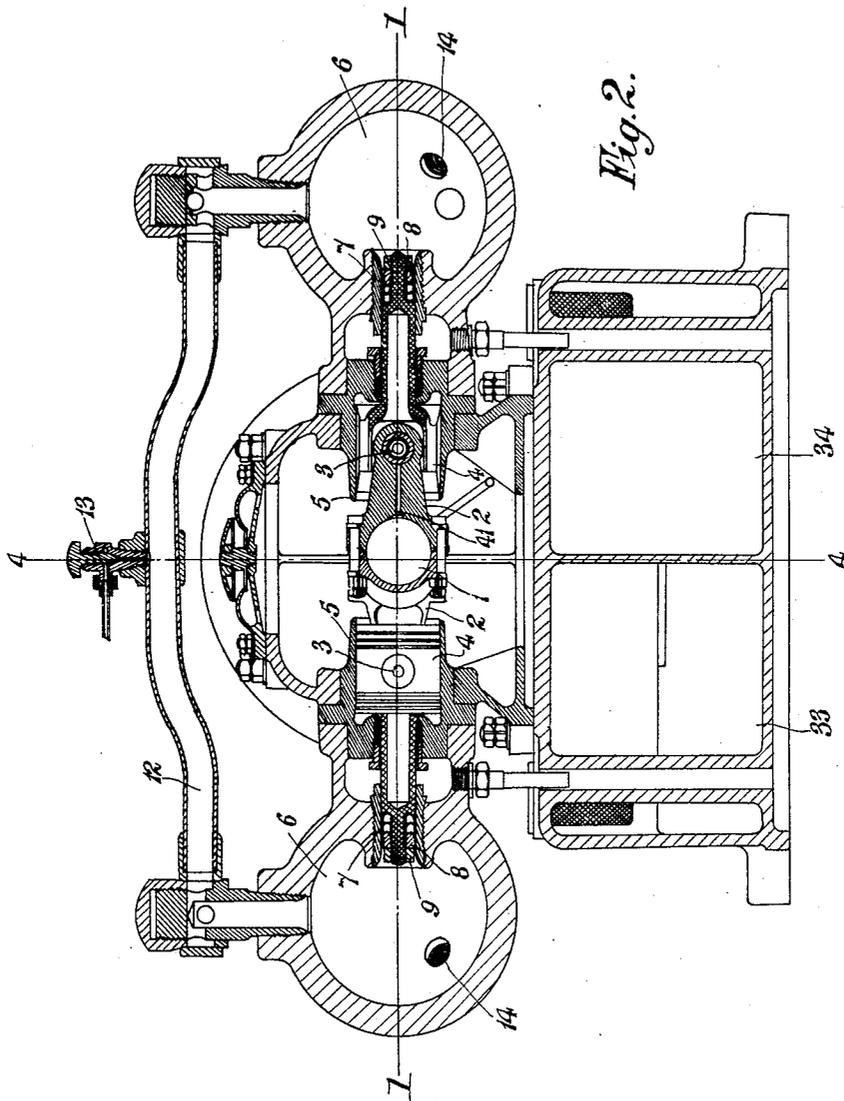


Fig. 2.

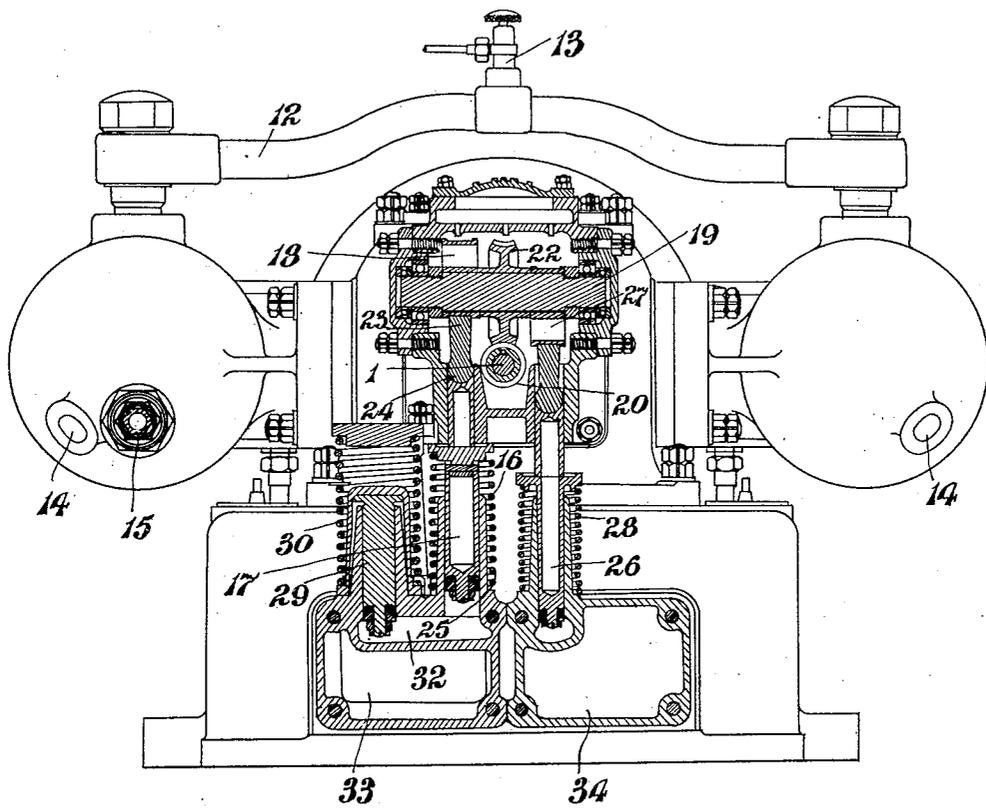
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4 SHEETS—SHEET 3.



*Fig. 3.*

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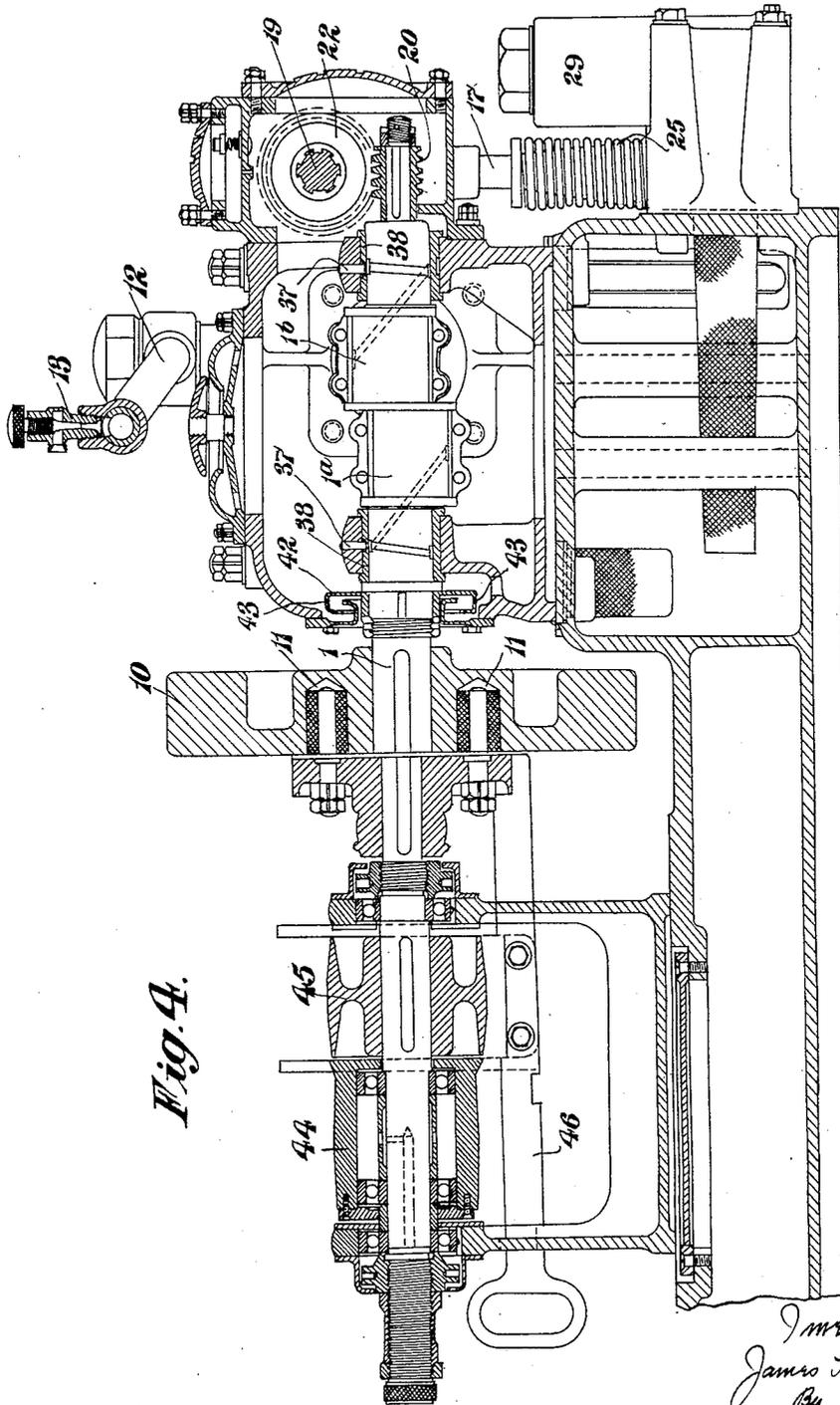


Fig. 4.

Inventor  
James Hanson  
By  
B. Singer, Atty.

# UNITED STATES PATENT OFFICE.

JAMES HANSON, OF STAFFORD, ENGLAND.

## HYDRAULIC APPARATUS.

1,410,100.

Specification of Letters Patent. Patented Mar. 21, 1922.

Application filed October 6, 1920. Serial No. 415,118.

(GRANTED UNDER THE PROVISIONS OF THE ACT OF MARCH 3, 1921, 41 STAT. L., 1313.)

*To all whom it may concern:*

Be it known that I, JAMES HANSON, a subject of the King of Great Britain, and a resident of Stafford, in the county of Stafford, England, have invented certain new and useful Improvements in Hydraulic Apparatus, (for which I have filed applications in England Aug. 8, 1919, Patent No. 153,659; New Zealand on November 6th, 1920; Mexico on December 3rd, 1920; Japan on November 13th, 1920; Brazil on November 11th, 1920; Canada on November 9th, 1920; India on October 29th, 1920; South Africa on October 14th, 1920; Belgium on October 6th, 1920; France on October 4th, 1920; Denmark on December 29th, 1920; Holland on October 1st, 1920; Italy on October 14th, 1920; Norway on September 30th, 1920; Spain on September 30th, 1920; Sweden on October 6th, 1920; Switzerland on October 6th, 1920, and Germany on October 13th, 1920,) of which the following is a specification.

This invention relates to hydraulic apparatus and has reference to wave transmission generators for use in the system of wave transmission disclosed in the specification of Letters Patent No. 9029 of 1913.

The object of the invention is to provide a generator which will be effective in its operation and durable in use and an important feature of the invention resides in the fact that the inertia forces acting on the crank are balanced substantially and the forces due to pressure acting on the crank are balanced absolutely.

The invention consists broadly of a generator having opposed pistons operating in conjunction with a pair of liquid capacities which are coupled together so as to be in effect a single capacity. Further features of the invention consist of means for effecting forced lubrication of the working parts and a special means for ensuring the maintenance of the system full in spite of leakage. The lubrication means comprises a pump driven from the crank shaft through a worm and wheel or other suitable gear, and the means for maintaining the system full comprises a water pump similarly driven from the crank shaft. In the latter case, however, I propose to provide what may for convenience be termed an unloading or compensating device which will be more specifi-

cally described hereafter, and in the case of such tools as rock drills the water pump may operate to discharge water through the drill steel as is not unusual in rock drilling apparatus.

A generator according to my invention is illustrated in the accompanying drawings, Fig. 1 being a sectional plan view on the line 1—1 of Fig. 2.

Fig. 2 is a longitudinal section on the line 2—2 of Fig. 1.

Fig. 3 is a similar view to Fig. 2, the section being taken through the pumps and gear box, on the line 3—3 of Fig. 1, and

Fig. 4 is a sectional elevation through the crank shaft along the line 4—4 of Fig. 2.

Referring to these drawings the numeral 1 designates the crank shaft which has two throws 1<sup>a</sup> and 1<sup>b</sup> and connecting links 2 connect this crank through gudgeon pins 3 with pistons 4, each of which reciprocates in its cylinder 5 which is open to one or other of the spherical capacities 6, packing leathers 7 held in position by washers 8 and a nut 9 serving to prevent leakage from the capacities. The crank shaft 1 is provided with a fly wheel 10, and the drive is transmitted to this fly wheel 10 through pins carried on the rotating part of the driving pulley or prime mover engaging in recesses 11, which may be packed with ferodo.

The two capacities 6 are coupled together by means of a pipe 12 as best shown in Fig. 2, and the highest point of this pipe is provided with a valve 13 for permitting the escape of air when priming the system. The capacities 6 are provided with openings 14 to which pipe lines are connected by means of suitable controlling valves.

One of the capacities 6 is connected by means of the pipe 15 and suitable fitments or unions 15<sup>a</sup> and 15<sup>b</sup> with the water pump 16, which latter serves to prime the system and also operates to ensure the system remaining full in spite of leakage, any leakage which may occur being made up through non-return valves within the fitment or union 15<sup>a</sup> as will be readily understood by persons conversant with apparatus of this general character. The water pump 16 consists of a plunger 17 which is actuated from an eccentric 18 carried upon a shaft 19, this shaft 19 being driven from the worm 20 on the end of the crank shaft 1 by means of

the worm wheel 22. The connection of the eccentric 18 with the plunger 17 is effected by a rod 23 having a spherical end 24 which engages in a concave recess in the plunger head, a spring 25 serving to maintain the engagement and effect the return movement of the plunger. The oil pump comprises similarly a plunger 26 driven from an eccentric 27 on the same shaft 19 as the eccentric 18, a spring 28 effecting the return stroke of the plunger 26. The water pump and the oil pump are in fact of exactly similar construction except that the water pump is provided with a compensating plunger or unloading device 29. This compensating plunger is so loaded by the spring 30 that until the system is full the liquid pumped by the plunger 17 passes through the non-return valve within the fitment or union 15<sup>a</sup> into the system, but immediately the system is full the liquid pumped by this plunger 17 simply operates to move the plunger 29 so that the liquid merely oscillates in the passage 32, no fresh liquid being drawn into the pump cylinders. The water supply for the water pump is contained in a tank 33 and the oil supply for the oil pump is similarly contained in a tank 34, these tanks being formed in the base of the machine. The oil delivered at each stroke by the plunger 26 is conducted by way of the fitment or union 26<sup>a</sup> and pipe 35, 35<sup>a</sup> to effect forced lubrication of various parts of the apparatus. The method adopted will be clear upon reference to Fig. 1, the oil supply passing along the pipes 36 and passages 37 to the crank shaft bearings 38 and thence by way of the passages 39 and 40 bored in the crank shaft to the passage 41 leading to the gudgeon pins 3. Any liquid collecting in the crank case and tending to escape to the outside will collect in the rotating catcher 42 and will be returned by centrifugal force to the crank case, the periphery of the catcher 42 being provided with holes 43 to permit this.

The operation of the apparatus will be best understood from Fig. 4. In the example shown the drive is effected by belts through fast and loose pulleys, the loose pulley being shown at 44 and the fast pulley at 45, while 46 indicates the belt shifting rod. Assuming the apparatus to be driven, the crank shaft 1 will rotate continuously thus reciprocating the pistons 4 and also driving the water and oil pumps. At starting the water pump discharges water through the pipe 15 and non-return valve within the fitment or union 15<sup>a</sup> into the capacity 6 to which it is connected. The air escape valve 13 is opened to permit of the escape of any air in the system, and when the air has been driven out and the system is fully primed, this valve 13 is closed and thereafter the water oscillates between the

plunger 17 and the compensating plunger 29. It should perhaps be mentioned that a steady flow of liquid from both oil and water pumps is ensured by providing air vessels 47 in the usual way. This is desirable by reason of the fact that the pumps employed are single acting plungers and without this provision the delivery would be intermittent. Assuming the system to be full of liquid the reciprocation of the pistons 4 acting synchronously will set up pressure waves in the system in accordance with the now well-known principles of transmission of power by pressure waves. It will be appreciated that by reason of the foregoing construction the forces due to pressure are completely balanced and the crank shaft is not subject to strains consequent upon the rapid pressure rises, moreover the inertia forces are also balanced except for the slight couple due to the offsetting of the throws of the crank. Of course I recognize that complete balance of these inertia forces could also be attained by adopting a complicated crank and forked connecting rods which would get rid of the couple, but we have found that the out of balance component is so small as to be quite unimportant in practice and any advantage arising from eliminating it altogether would be at the sacrifice of the simplicity of the present design.

It should be noted that the term "water pump" has been used for convenience in distinguishing between the pump used for charging the system with its working fluid, and the oil pump used for lubrication purposes, but it will be understood that where oil is used as the working fluid what is characterized as the water pump will not be truly a water pump, the term "water pump" meaning the pump operating upon the working fluid of the system.

What I claim and desire to secure by Letters-Patent is:—

1. A wave transmission generator comprising a pair of pistons disposed in the same horizontal plane, a two throw crank located between and operatively connected to reciprocate said pistons simultaneously in opposite directions, separate capacities in relation to each of which one of said pistons moves to set up pressure waves and a pipe connection between said capacities substantially as specified.

2. A wave transmission generator comprising a pair of pistons disposed in the same horizontal plane, a two throw crank located between and operatively connected to reciprocate said pistons simultaneously in opposite directions, separate capacities in relation to each of which one of said pistons moves to set up pressure waves, and a pipe connection between said capacities, an air discharge valve in said pipe connection, and

means for opening and closing said valve, substantially as specified.

3. A wave transmission generator comprising a pair of pistons disposed in the same horizontal plane, a two throw crank located between and operatively connected to reciprocate said pistons simultaneously in opposite directions, separate capacities in relation to each of which one of said pistons moves to set up pressure waves and a pipe connection between said capacities, a hollow base supporting said pistons, crank and connected capacities, an oil reservoir in said base, a water reservoir in said base, and separately operating oil and water pumps driven from a common shaft for effecting lubrication and charging the system respectively, substantially as specified.

4. A wave transmission generator comprising a pair of pistons disposed in the same horizontal plane, a two throw crank located between and operatively connected to reciprocate said pistons simultaneously in opposite directions, separate capacities in relation to each of which one of said pistons moves to set up pressure waves and a pipe connection between said capacities, a hollow base supporting said pistons, crank and connected capacities, an oil reservoir in said base, a water reservoir in said base, an oil pump operating to draw oil from the oil reservoir and deliver it to the parts to be lubricated, and a water pump operating to draw water from the water reservoir and deliver it to the system, substantially as specified.

5. A wave transmission generator comprising a pair of pistons disposed in the same horizontal plane, a two throw crank located between and operatively connected to reciprocate said pistons simultaneously in opposite directions, separate capacities in relation to each of which one of said pistons moves to set up pressure waves, and a pipe connection between said capacities, a hollow base supporting said pistons, crank and connected capacities, an oil reservoir in said base, a water reservoir in said base, an oil pump operating to draw oil from the oil reservoir and deliver it to the parts to be lubricated, and a water pump operating to draw water from the water reservoir and deliver it to the system and air vessels to which said pumps deliver and from which the oil and water respectively flow at steady pressures, substantially as specified.

rocate said pistons simultaneously in opposite directions, separate capacities in relation to each of which one of said pistons moves to set up pressure waves, and a pipe connection between said capacities, a hollow base supporting said pistons, crank and connected capacities, an oil reservoir in said base, a water reservoir in said base, an oil pump operating to draw oil from the oil reservoir and deliver it to the parts to be lubricated, and a water pump operating to draw water from the water reservoir and deliver it to the system, a worm or an extension of the generator crank shaft for driving both said pumps simultaneously through worm wheel gearing, substantially as specified.

6. A wave transmission generator comprising a pair of pistons disposed in the same horizontal plane, a two throw crank located between and operatively connected to reciprocate said pistons simultaneously in opposite directions, separate capacities in relation to each of which one of said pistons moves to set up pressure waves, and a pipe connection between said capacities, a hollow base supporting said pistons, crank and connected capacities, an oil reservoir in said base, a water reservoir in said base, an oil pump operating to draw oil from the oil reservoir and deliver it to the parts to be lubricated, and a water pump operating to draw water from the water reservoir and deliver it to the system and air vessels to which said pumps deliver and from which the oil and water respectively flow at steady pressures, substantially as specified.

In witness whereof I affix my signature.

JAMES HANSON.