May 9, 1933. E. B. LEAR 1,908,370

GEAR MOTOR

Filed Jan. 5, 1931

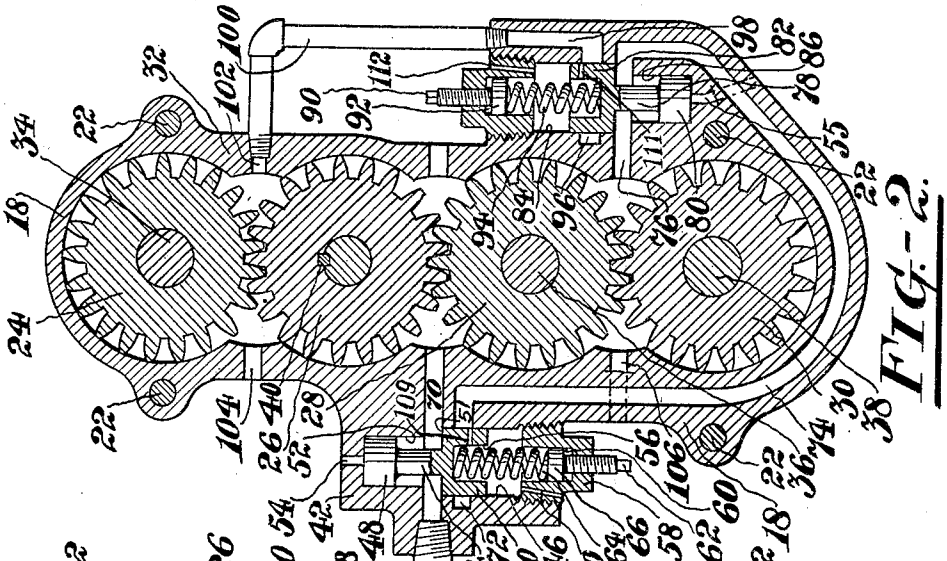

FIG. 2.

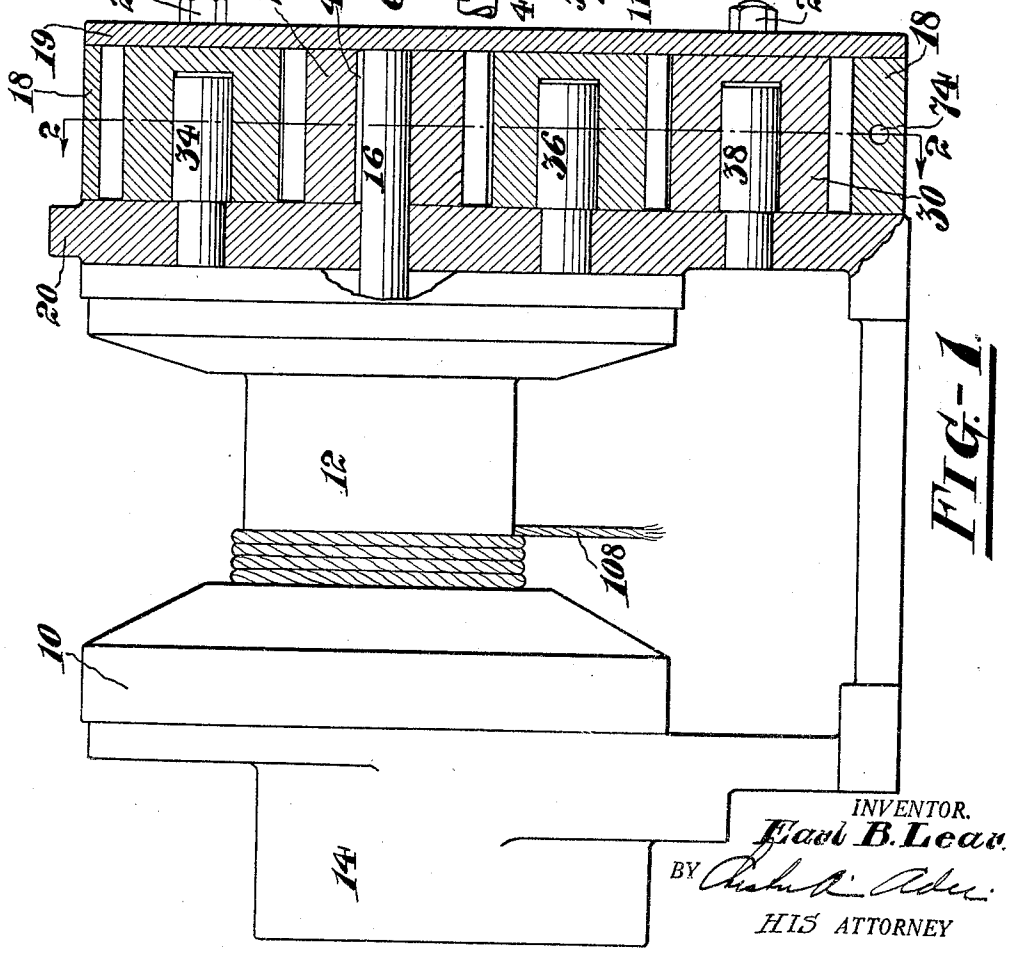

FIG. 1.

INVENTOR.
Earl B. Lear.
BY Richard K. Adee.
HIS ATTORNEY

Patented May 9, 1933 1,908,370

# UNITED STATES PATENT OFFICE

EARL B. LEAR, OF PHILLIPSBURG, NEW JERSEY, ASSIGNOR TO INGERSOLL-RAND COMPANY, OF JERSEY CITY, NEW JERSEY, A CORPORATION OF NEW JERSEY

## GEAR MOTOR

Application filed January 5, 1931. Serial No. 506,661.

This invention relates to gear motors, but more particularly to a gear motor that is automatically responsive to an increase in power requirements.

The object of the invention is to provide a gear motor which will operate at a high degree of efficiency from a point of minimum power requirement to its maximum capacity.

Other objects will be in part obvious and in part pointed out hereinafter.

The objects above referred to are accomplished by the mechanism shown in the accompanying drawing, in which

Figure 1 shows a front elevation of a hoist with the motor attached partly in section.

Figure 2 is a sectional view of Figure 1 taken on the line 2—2 looking in the direction indicated by the arrows.

Referring more particularly to the drawing a hoist 10, not shown in detail since it forms no part of the invention, is provided with a drum 12 operatively connected through reduction gearing (not shown) in the case 14 to a shaft 16.

A casing 18 secured to a frame member 20 of the hoist 10 is adapted to house gears 24, 26, 28 and 30 of a gear motor 32. A cover plate 19 provides a closure for the end of the casing 18 and the casing 18, plate 19 and member 20 are held together by bolts 22. Shafts 34, 36 and 38 are journaled in the frame 20 and gears 24, 28 and 30 rotate on the shafts 34, 36 and 38, respectively. Gear 26 is keyed to shaft 16 by means of a key 40.

An enlargement 42 on the casing 18 is adapted to house a valve 44. A valve chamber 46 is formed in the enlargement 42. The valve 44 is of the differential type having heads 48 and 50 of which the head 50 is the head of larger diameter and its inner end surface constitutes an actuating surface 51 against which pressure fluid from supply constantly acts. The head 50 fits slidably in the valve chamber 46 and the head 48 is adapted to slide in a reduced portion 52 of the valve chamber. A vent 54 leads from the atmosphere to the reduced bore 52. In the head 50 a cup-shaped depression 56 is formed. A threaded plug 58 forms a closure for the valve chamber 46. The plug 58 is provided with a cup-shaped opening 60 and a set screw 62 passes through the head of the plug 58 into the cup 60. A spring 64 fitted in the depression 56 and acting against the head 66 of the set screw 62 opposes movement of the valve 44 in the direction of the plug 58. A pipe 68 conducts pressure fluid to a passage 70 and to the actuating surface 51 from a source of supply (not shown). An annular groove 72 formed in the inner surface of the valve chamber 46 connects with a passage 74 leading to an inlet port 76 between the gears 28 and 30.

A valve assembly similar to that described above is found on the opposite side of the casing 18. This valve assembly comprises a valve 78 having heads 80 and 82, a valve chamber 84, a reduced extension 86 of the valve chamber, a set screw 90 having a head 92, a spring 94 and an annular passage 96. A passage 98 leading from the annular passage 96 connects with a pipe 100 which leads to an inlet port 102 between the gears 24 and 26.

The operation of the motor is as follows: Pressure fluid enters the motor through a pipe 68 and passes through the passage 70 into the casing 18 between the gears 26 and 28. As is well known by those skilled in the art, the gears 26 and 28 will tend to turn clock-wise and counter clock-wise respectively under the influence of the pressure exerted on the gear teeth by the pressure fluid. Portions of the motive fluid will of course be entrapped between the wall of the casing and each pair of gear teeth. This motive fluid will be discharged to the atmosphere through ports 104 and 106. It will be obvious that the shaft 16 will be caused to rotate by rotation of the gears 26 and 28. Rotation of the shaft will be carried to the drum of the hoist 12 through the reduction gears which are not shown, thereby causing the drum 12 to rotate and the cable 108 to be wound about the drum 12. Assuming that too great a load is placed on the cable 108 the gears 26 and 28 will fail to rotate fast enough and fluid pressure will build up in the passage 70 and act upon the valve 44 forcing it downward against the resistance of the spring 64 there-

by opening passage 74 to the source of pressure fluid. Pressure fluid will flow through the passage 74 and from the port 76 between the gears 28 and 30. The pressure fluid entering the port 76 will act upon the gears 28 and 30 causing them to rotate in a counter clock-wise and a clock-wise direction, respectively.

If the gears 28 and 30 are able to rotate with sufficient rapidity to prevent a building up of pressure in the passage 74, the valve 78 will remain in the closed position as shown in the drawing and conditions of load on the hoist and pressure fluid supply to the motor will be such that the load is handled efficiently by the motor. If, however, the gears 28 and 30 rotate so slowly that pressure builds up in the passage 74 the valve 78 will be opened by pressure acting on the head 82 and pressure fluid will enter the annular passage 96 and be conducted by the pipe 100 to the port 102. Pressure fluid will then act upon gears 24 and 26 tending to cause them to rotate in a counter clock-wise and a clock-wise direction, respectively, thus increasing the power of the gear motor by substantially three-fold.

Ports 54 and 55 leading to the bores 52 and 86, respectively, prevent the formation of a vacuum behind the heads 48 and 80 of the valves 44 and 78, respectively. Ports 110 and 112 permit the exhaust of pressure fluid from the valve chambers 46 and 84, respectively, and thus prevent back pressure from acting on the valves 44 and 78 when an increase in fluid pressure tends to open them. The tension on the springs 64 and 94 is adjusted by the set screws 62 and 90, respectively.

When the gears 24 and 30 are not in use as auxiliary motors they are necessarily turning with the motor. Unless the inlet side of these gears is vented, they will act as vacuum pumps, load the motor, and waste power either through the increased load or through opening the valve heads which admit pressure fluid to their inlets and cause them to act as auxiliaries.

In order to permit these gears to idle, ports 109 and 111 are provided in the valves 50 and 82 so that when the valves are in closed position with respect to their function as fluid supply valves they are in position to act as vents by connecting the fluid supply passages to atmosphere. The inlet side of the motor comprising gears 28 and 30 is vented through passages 74, 76 and 106, valve chamber 46 and vent 110. The inlet side of the motor, comprised of gears 24 and 26, is vented through its corresponding passages.

Assuming that the motor must overcome static friction in the bearings of the hoist, as in starting, it will be noted that if the load is too great for gears 26 and 28, the valve 44 will be opened and pressure fluid delivered to gears 28 and 30, thereby doubling the force exerted on the hoist. Should that force be insufficient another pair of gears will be automatically supplied with pressure fluid, and so on until the hoist is started. However, once the static friction is overcome, the consumption of pressure fluid will be automatically reduced in accordance with the power required to run the hoist. And thus the objects hereinbefore referred to are accomplished.

I claim:

1. A gear motor comprising a casing, a pair of motor gears rotatably mounted therein, a fluid supply passage thereto and fluid outlet passages therefrom to admit and discharge pressure fluid for actuating the motor, an additional gear in the casing entrained with one of said gears and rotatable therewith, and means in the casing to automatically admit pressure fluid to the additional gear and thus cause it to coact with said motor gears as an auxiliary thereto.

2. A gear motor comprising a casing, a pair of motor gears rotatably mounted therein, a fluid supply passage thereto and fluid outlet passages therefrom to admit and discharge pressure fluid for actuating the motor, an additional gear in the casing entrained with one of said gears and rotatable therewith, a connecting passage from the inlet side of the motor to an opposite side thereof between one of the first mentioned gears of said motor and said additional gear, and means in said passage to automatically admit pressure fluid to the additional gear and thus cause it to coact with said motor as an auxiliary thereto.

3. A gear motor comprising a casing, a pair of motor gears rotatably mounted therein, a fluid supply passage thereto and fluid outlet passages therefrom to admit and discharge pressure fluid for actuating the motor, an additional gear in the casing entrained with one of said gears and rotatable therewith, a connecting passage from the inlet side of the motor to an opposite side thereof between one gear of said motor and said additional gear, and means including a valve chest and a valve therein to admit pressure fluid through the connecting passage to the additional gear in one position of the valve, and passages in the valve chest and valve to communicate the connecting passage with the atmosphere in another position of the valve.

4. A gear motor comprising a casing, a pair of motor gears rotatably mounted therein, a fluid supply passage thereto and fluid outlet passages therefrom to admit and discharge pressure fluid for actuating the motor, an additional gear in the casing entrained with one of said gears and rotatable therewith, a connecting passage from the inlet side of the motor to an opposite side thereof between one gear of said motor and said additional gear, and a valve in the casing having an actuating surface exposed to pressure fluid in the supply

passage whereby, upon an increase in the value of the pressure fluid in the supply passage, the valve is actuated to admit pressure fluid into the connecting passage and thus cause the additional gear to coact with said motor as an auxiliary thereto.

5. In a gear motor, a casing, a pair of motor gears mounted therein, a pressure fluid supply inlet between said gears to deliver actuating fluid thereto, separate exhaust outlets for each gear, an additional gear in the casing entrained with one of said gears, a connecting passage from the inlet side of the motor to an opposite side thereof between one gear of said motor and said additional gear, and a pressure fluid actuated valve subjected to fluid supply and being responsive to fluctuations in the value of the fluid supply to establish and cut-off communication between the source of supply and the connecting passage.

6. In a gear motor of the relay type, a casing containing a primary gear motor having a plurality of gears, and an auxiliary gear entrained with one of the gears, a fluid inlet between the gears of the primary motor, a second fluid inlet to deliver pressure fluid to the auxiliary gear, a valve chest having a valve chamber and a port and connecting said fluid inlets, a valve in said valve chest to control communication between the fluid inlets and being responsive to variations of pressure in the fluid supply, a spring to hold the valve in position to block communication between said fluid inlets when the motor is operating under light load conditions, said valve having a port to register with the first mentioned port for opening said second fluid inlet to atmosphere, and an actuating surface on the valve against which pressure fluid acts to open communication between said fluid inlets and to close said second fluid inlet to atmosphere when the motor is under increased load.

In testimony whereof I have signed this specification.

EARL B. LEAR.