June 18, 1929. E. J. ARMSTRONG 1,717,599

FLUID ACTUATED ENGINE

Filed April 12, 1926 3 Sheets-Sheet 1

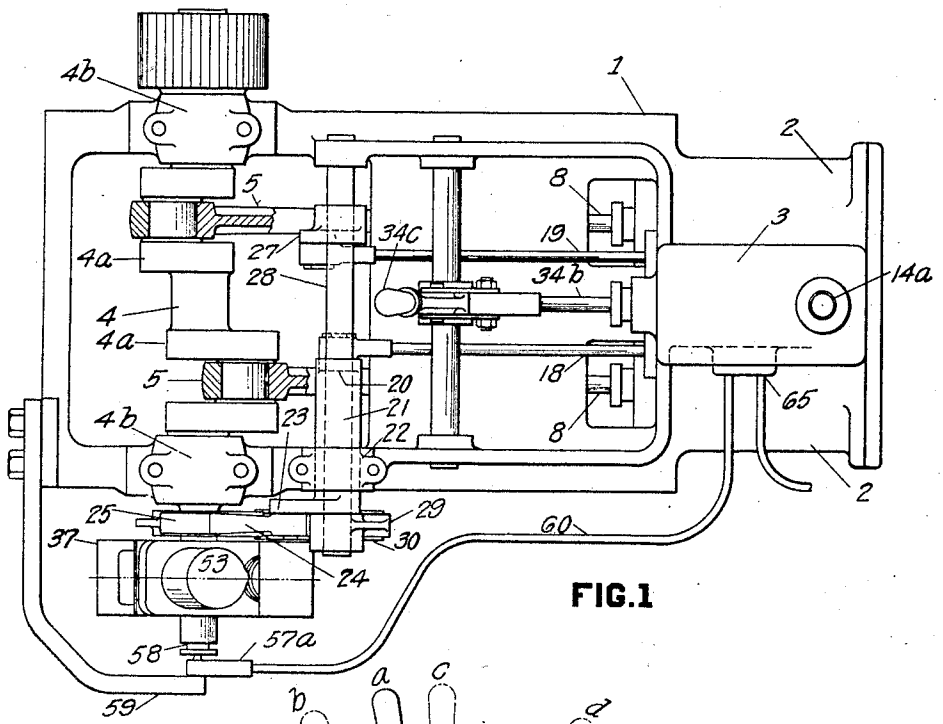


FIG.1

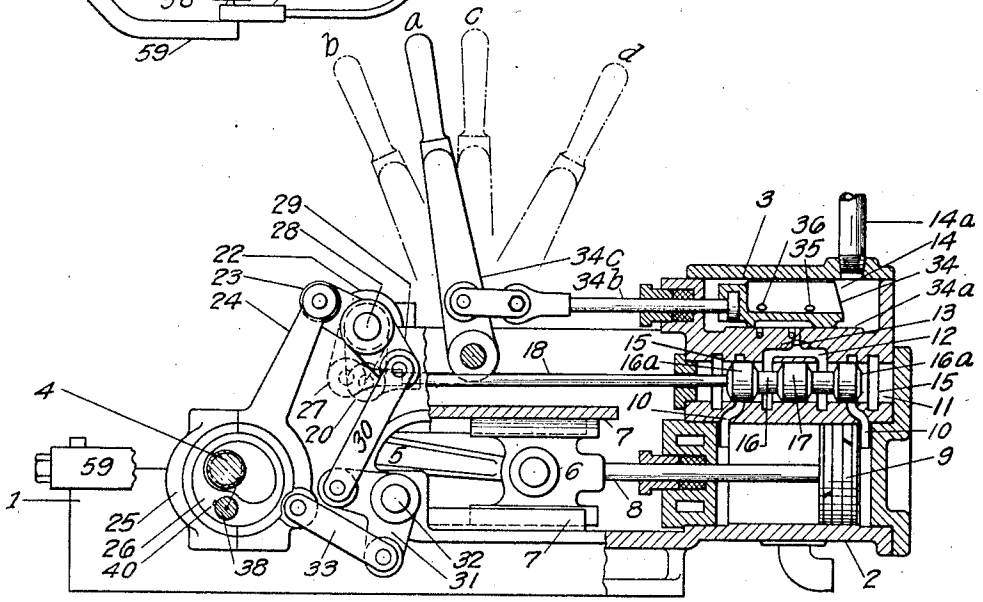


FIG.2

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FLUID ACTUATED ENGINE

Filed April 12, 1926 3 Sheets-Sheet 2

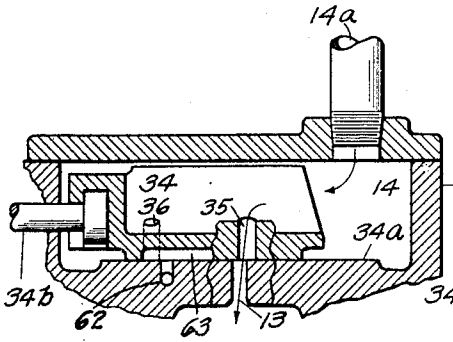


FIG.6

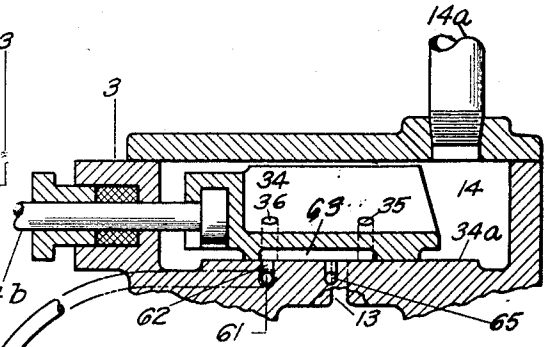


FIG.5

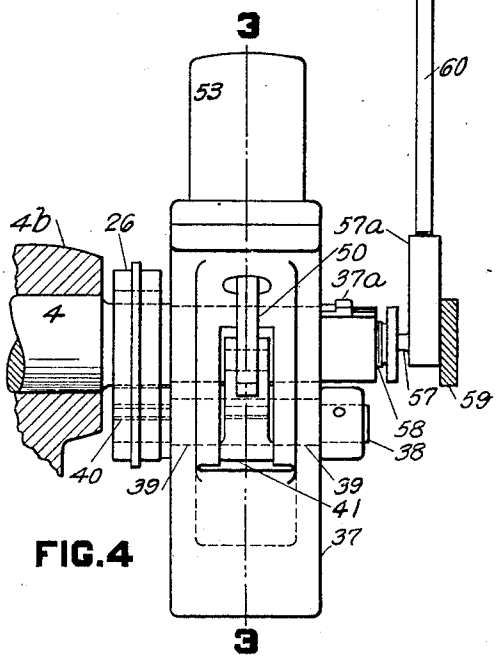


FIG.4

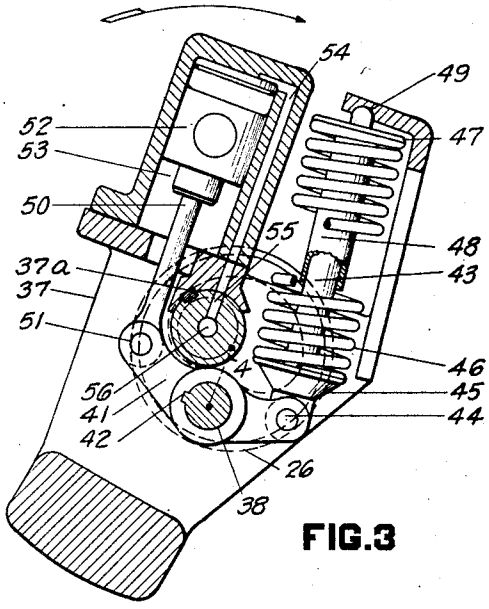


FIG.3

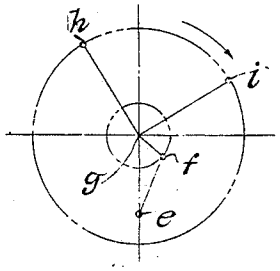


FIG.7

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June 18, 1929. E. J. ARMSTRONG 1,717,599

FLUID ACTUATED ENGINE

Filed April 12, 1926 3 Sheets-Sheet 3

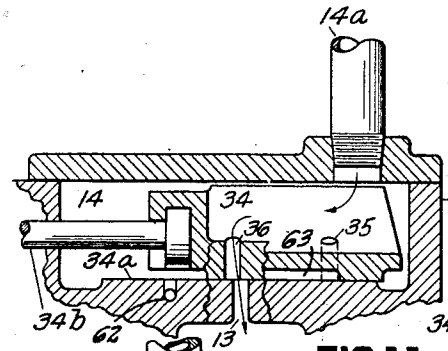


FIG.11

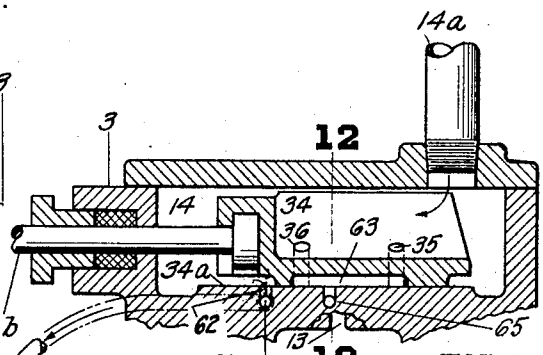


FIG.10

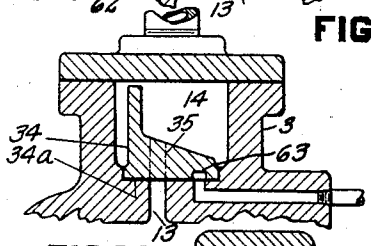


FIG.12

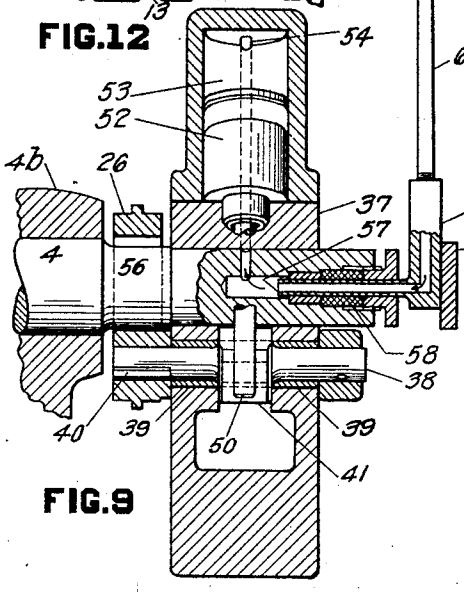


FIG.9

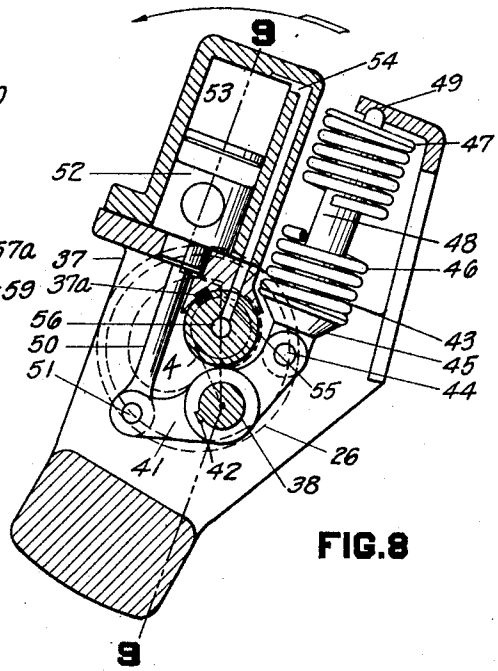


FIG.8

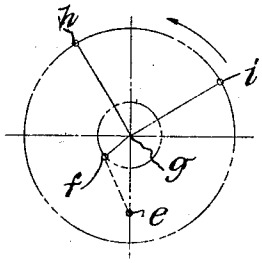


FIG.13

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Patented June 18, 1929. 1,717,599

UNITED STATES PATENT OFFICE.

EDWIN J. ARMSTRONG, DECEASED, LATE OF ERIE, PENNSYLVANIA, BY JESSIE W. ARMSTRONG AND BEATRICE A. BENEDICT, EXECUTRICES, OF ERIE, PENNSYLVANIA, ASSIGNORS, BY MESNE ASSIGNMENTS, TO BUCYRUS-ERIE COMPANY, OF SOUTH MILWAUKEE, WISCONSIN, A CORPORATION OF DELAWARE.

FLUID-ACTUATED ENGINE.

Application filed April 12, 1926. Serial No. 101,419.

In many fluid-actuated engines it is desirable to conveniently control the position of the eccentric controlling the valves of the engine. This is particularly true as to the reversal of the engine. With engines such as are used on power excavating devices, and in similar situations where reversals are of great frequency and the reversal control is only one of a number of controlled movements which require the attention of the operator it is of great importance to simplify this control so as to require a minimum of attention on the part of the operator. In the specific embodiment of the invention, as exemplified in this application, the control of the eccentric and consequently the control of the direction of the movement of the engine is connected with the throttle of the engine so that a single movement actuating the throttle also determines the direction of movement of the engine with the opening of the throttle by movement in one direction giving one direction of movement to the engine and a reverse opening movement of the throttle giving a direction of movement to the engine in a reverse direction. Features and details of the invention will appear from the specification and claims.

The invention is illustrated in the accompanying drawings as follows:—

Fig. 1 shows a plan view of the engine.

Fig. 2 a side elevation, partly in section, showing the valve and eccentric construction.

Fig. 3 a section of the eccentric control mechanism on the line 3—3 in Fig. 4 with the eccentric thrown to drive the engine in a forward direction.

Fig. 4 an end elevation of the same.

Fig. 5 a sectional view through the throttle and reversing valve showing the same in a neutral position,

Fig. 6 a similar view with the throttle partly opened for a forward movement of the engine.

Fig. 7 is a diagram showing the relative crank and eccentric positions in Fig. 3.

Fig. 8 a section similar to Fig. 3 with the eccentric thrown to reverse the direction of movement of the engine.

Fig. 9 a sectional view of the actuating mechanism on the line 9—9 in Fig. 8.

Fig. 10 a section similar to Fig. 5 with the valve set for a reverse motion of the engine and putting the controlling mechanism in the position shown in Figs. 8 and 9.

Fig. 11 a view similar to Fig. 10 but with the throttle advanced to a position admitting steam to the engine.

Fig. 12 a section on the line 12—12 in Fig. 10.

Fig. 13 a diagram showing the relative crank and eccentric positions with the control mechanism in the position shown in Fig. 8.

1 marks the frame of the engine, 2 the cylinders, 3 the valve chest, 4 the crank shaft, 4^a the cranks, 4^b bearings for the crank shaft, 5 connecting rods, 6 cross heads, 7 cross head guides, 8 piston rods, 9 pistons, 10 steam ports leading from the cylinder to the engine valve chamber 11, 12 steam passages leading from the chamber 11 through a port 13 to the throttle valve chamber 14, 15 exhaust ports leading from the valve chamber 11, 16^a the end elements of the engine valve 16, said elements operating across the ports 10 and 15, 17 the center element of the valve operating over the ports or passages 12. This is the ordinary cylindrical engine valve construction cutting off the fluid on the inner end of the end element 16^a. Valve rods 18 and 19 lead from the valves 16. The rod 18 is connected with a rocker 20 formed on a sleeve 21. The sleeve 21 is carried in a bearing 22 and is provided with a rocker 23. The rocker 23 is connected by an eccentric rod 24 with an eccentric strap 25 and the eccentric strap is mounted on an eccentric 26. The rod 19 has a rocker 27 carried by a shaft 28. The shaft 28 extends through the sleeve 21 and has a rocker 29 at its outer end. The rocker 29 is connected by a link 30 with a bell crank lever 31. The bell crank lever 31 is mounted on a pin 32 and is connected by a link 33 with the eccentric 26 operating at 90° from the rod 24 so as to operate the engines with the angular relation of the cranks as indicated.

A throttle valve 34 is of a sliding type operating on a valve face 34ª in the chamber 14. It has ports 35 and 36 extending through it and each of these ports is adapted to be brought into register with the port 13 leading to the valve chamber 11. Either of the ports 35 or 36 deliver steam, or fluid to the engine, the purpose of the two ports being to give the throttle a double opening so that the throttle may be connected with the controlling means for positioning the eccentric. Fluid is delivered to the chamber 14 through a pipe 14ª and the valve 34 is connected by a valve rod 34ᵇ with an operating lever 34ᶜ.

A carrier 37 is mounted on the end of the crank shaft being locked by means of a key 37ª. A rock shaft 38 is journalled in bearings 39 in the carrier and the eccentric 26 is locked on the rock shaft 38 by means of a key 40. A rock lever 41 is also locked on the rock shaft by means of a key 42. A rod 43 is connected with one end of the rock lever by means of a pin 44. A spring base 45 is mounted on the rod 43 and a spring 46 is seated on the base 45 and against a base 47. The base 47 is carried by a sleeve 48, the sleeve having a small projection extending into a socket 49 in the carrier. The spring is of sufficient strength to maintain the eccentric in a position to drive the engine in a forward direction.

A rod 50 is connected to the rock arm 41 by a pin 51, the pin being at the opposite end of the rock arm 41 from the pin 44. The rod 50 is connected with a piston 52 arranged in a cylinder 53. The cylinder is mounted on the carrier. A port 54 leads from the cylinder to a radial opening 55 in the crank shaft. The crank has an axial bore 56 extending from the radial opening 55 to the end of the shaft and this connects with a pipe 57 extending into the bore through a stuffing box 58 in the end of the crank shaft. The pipe 57 extends from a fitting 57ª and the fitting is secured to a plate 59 extending from the engine frame. The fitting is connected by a pipe 60 with a passage 61 in the valve chest and the passage 61 leads through a port 62 through the valve seat 34ª.

The position of the port 62 is such as to be closed with the valve shown as in Fig. 5, this position of the valve corresponding to the position *a* of the handle 34ᶜ shown in full lines Fig. 2. If it is desired to move the engine forward the valve 34 is drawn to the position shown in Fig. 6 opening the port 35 to the port 13 and this is accomplished without uncovering the port 62 as clearly shown in Fig. 6, the position of the handle being at *b*. If, however, it is desired to reverse the engine the valve is first moved to the position shown in Fig. 10. By placing the handle 34ᶜ at position *c* uncovers the port 62 and puts fluid on the piston 52 throwing the parts to the position shown in Fig. 8 and this movement of the eccentric sets the valve gear for a reverse movement. A continued movement of the valve to the position shown in Fig. 11 admits steam by way of the port 36 to the port 13, the handle being in the position *d* for accomplishing this purpose. This opening of the valve giving the engine fluid does not close the opening to the port 62 so that the pressure is maintained on the piston 52 and the valve gear in its proper relation and the valve gear is held in this position until it is desired to close the throttle, the throttle being closed in advance of the closing of the port 62. With the return of the valve mechanism to the position shown in Figs. 2 and 5, or the closed position, the port 62 is brought under the valve passage 63 which connects the port 62 with an exhaust port 65, thus exhausting the fluid from the cylinder 53 and permitting the return of the valve gear to the position shown in Fig. 3, or a position for a return movement of the engine. The eccentric it will be noted is mounted with a carrier center at the axis of the shaft 38 and as the eccentric is swung the center of the eccentric is swung across the axis of the crank shaft 4. Thus while the eccentric is moved approximately 90° on the carrier of the shaft 37 the center of the eccentric is moved in the ordinary manner of swinging eccentrics entirely across the axis of the crank shaft. This swinging of the eccentric and its relation to the crank centers is illustrated in Figs. 7 and 13 in which the carrier center *e*, the eccentric center *f*, the crank shaft center *g*, and the centers of the cranks *h* and *i* are shown diagrammatically in the usual manner. The eccentric, of course, in the reversal is not carried to a position of 180° because it is desired to depart from this to the extent of the lap and lead of the valve.

What is claimed as new is:—

1. In a fluid actuated engine, the combination with the valve operating parts comprising a cylinder, a piston, engine valve, crank and crank shaft, connections between the crank and piston, an eccentric, and connections between the eccentric and engine valve, of a carrier mounted on the crank shaft with an axis eccentric to the shaft and on which the eccentric is swingingly mounted; and a fluid-actuated mechanism carried by the carrier controlling the position of the eccentric to reverse the same comprising a rock shaft carrying the eccentric, a rock arm on the rock shaft, a piston connected with the rock arm, a cylinder in which the piston operates and means delivering fluid to the cylinder.

2. In a fluid actuated engine, the combination with the valve operating parts comprising a cylinder, a piston, engine valve,

crank and crank shaft, connections between the eccentric and engine valve, of a carrier mounted on the crank shaft with an axis eccentric to the shaft and on which the eccentric is swingingly mounted; and a fluid-actuated mechanism carried by the carrier controlling the position of the eccentric to reverse the same comprising a rock shaft carrying the eccentric, a rock arm on the rock shaft, a piston connected with the rock arm, a cylinder in which the piston operates and means delivering fluid to the cylinder through the crank shaft.

3. In a fluid actuated engine, the combination with the valve operating parts comprising a cylinder, a piston, engine valve, crank and crank shaft, connections between the eccentric and engine valve, of a carrier mounted on the crank shaft and on which the eccentric is swingingly mounted; and a fluid-actuated mechanism carried by the carrier controlling the position of the eccentric comprising a rock shaft carrying the eccentric, a rock arm on the rock shaft, a piston connected with one end of the rock arm, a cylinder in which the piston operates, a spring operating on the opposite end of the rock arm and throwing the eccentric when the piston is relieved of pressure, and means for delivering fluid to the cylinder.

4. In a fluid actuated engine, the combination with a cylinder, a piston, an engine valve, a crank, a shaft driven by the crank, connections between the crank and piston, an eccentric on the shaft, and connections between the eccentric and the engine valve, of a fluid-actuated mechanism acting on the eccentric to throw the same to reverse the engine; a throttle valve; and means actuated with the throttle valve controlling the mechanism, said means operating by a continuous movement to position the eccentric in both directions in advance of the throttle opening and permitting variations of the throttle valve independently of variations of the position of the mechanism.

5. In a fluid actuated engine, the combination with a cylinder, a piston, an engine valve, a crank, a shaft driven by tre crank, connections between the crank and piston, an eccentric on the shaft, and connections between the eccentric and engine valve, of a fluid actuated mechanism acting on the eccentric to throw the same to reverse the engine; a throttle valve; and means actuated with the throttle valve controlling the mechanism, said means operating to position the eccentric in both directions in advance of the throttle opening.

6. In a fluid actuated engine, the combination with a cylinder, a piston, an engine valve, a crank, a shaft driven by the crank, connections between the crank and piston, an eccentric on the shaft, and connections between the eccentric and engine valve, of a fluid actuated mechanism acting on the eccentric to throw the same to reverse the engine; a controlling valve for the mechanism and operating to actuate the mechanism; and a throttle valve moving with said controlling valve and having two open positions opening after the opening of said controlling valve, said throttle being free to operate at either of said open positions without disturbing the mechanism.

7. In a fluid actuated engine, the combination with a cylinder, a piston, an engine valve, a crank, a shaft driven by the crank, connections between the crank and piston; an eccentric; and connections between the eccentric and engine valve, of a fluid actuated mechanism acting on the eccentric to throw the same to reverse the engine; a controlling valve for the mechanism operating to control the movement of the mechanism in both directions to reverse the engine; and a throttle valve moving with said controlling valve and having two open positions opening after and with a continuing movement of the controlling valve.

8. In a fluid actuated engine, the combination with a cylinder, a piston, an engine valve, a crank, a shaft driven by the crank, connections between the crank and piston, an eccentric on the shaft, and connections between the eccentric and engine valve, of a fluid actuated mechanism acting on the eccentric to throw the same to reverse the engine; and a valve sliding on a valve seat, said valve seat and valve being double ported to afford a throttle opening with a movement of the valve in either direction, said valve and valve seat being ported to open to a controlling mechanism, the opening to the controlling mechanism being in each direction in advance of the throttle opening.

9. In a fluid actuated engine, the combination with a cylinder, a piston, an engine valve, a crank, a shaft driven by the crank, connections between the crank and piston, an eccentric on the shaft, and connections between the eccentric and engine valve, of a fluid actuated mechanism acting on the eccentric to throw the same to reverse the engine; and a valve sliding on a valve seat, said valve seat and valve being double ported to afford a throttle opening with a movement of the valve in either direction, said valve and valve seat being ported to open to a controlling mechanism, the throttle openings and openings to the controlling mechanism being accomplished by a continuous movement of the valve in either direction.

10. In a fluid actuated engine, the combination with a cylinder, a piston, an engine valve, a crank, a shaft driven by the crank, connections between the crank and piston, an eccentric on the shaft, and connections

between the eccentric and the engine valve, of a throttle valve; a fluid actuated mechanism acting on the eccentric to throw the same to reverse the engine; and a single actuating control means for the throttle valve and said mechanism and controlling the fluid actuated mechanism to throw the eccentric in advance of the opening of the throttle in each direction and permitting the variation of the opening of the throttle independently of a variation of the control mechanism when thrown in either direction.

In testimony whereof we have hereto set our hands.

JESSIE W. ARMSTRONG,
BEATRICE A. BENEDICT,
Executrices of the Estate of Edwin J. Armstrong, Deceased.