J. DUNLOP.

APPARATUS FOR TRANSMITTING POWER.

APPLICATION FILED JULY 5, 1910.

989,583. Patented Apr. 18, 1911.

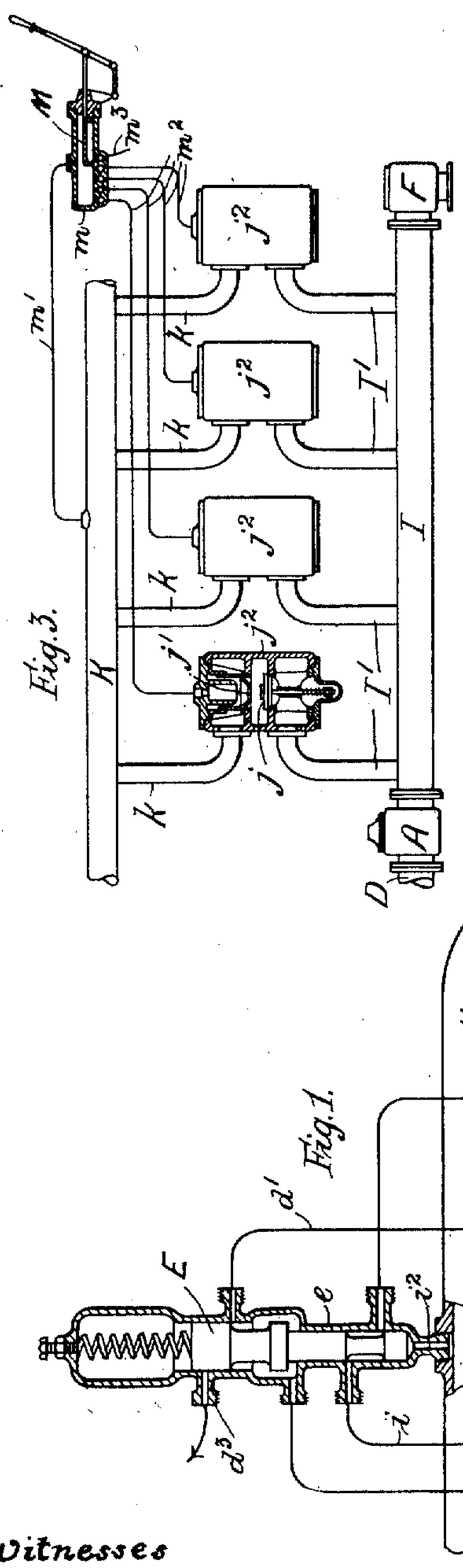

Fig. 3.

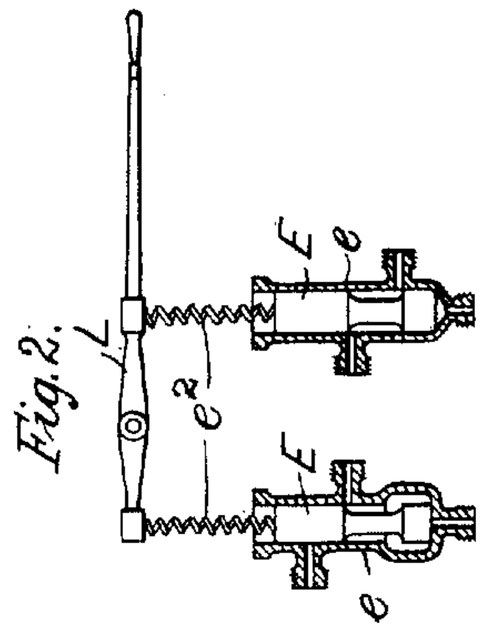

Fig. 2.

Fig. 1.

Witnesses

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UNITED STATES PATENT OFFICE.

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APPARATUS FOR TRANSMITTING POWER.

989,583. Specification of Letters Patent. **Patented Apr. 18, 1911.**

Application filed July 5, 1910. Serial No. 570,290.

To all whom it may concern:

Be it known that I, JAMES DUNLOP, a subject of the King of the United Kingdom of Great Britain and Ireland, and residing at Dennistoun, Glasgow, Scotland, have invented a certain new and useful Improvement in Apparatus for Transmitting Power, of which the following is a specification.

This invention relates to "two pipe," "dense air" or "closed circuit" systems for transmitting power by compressed air.

The system shown and described in Letters Patent of the United States No. 965,285, granted to me July 26, 1910, comprises, in general, an air compressor driven by a suitable engine, a compressed air motor, a delivery pipe for conveying compressed air from the compressor to the motor, and a return pipe for reconveying the air from the exhaust of the motor to the compressor. In said system a hand operated isolating valve is provided at the inlet of the air compressor so that the return pipe of the system may be isolated from the air compressor, and a hand operated atmospheric valve is provided at the inlet of the air compressor so that the inlet of the air compressor may be put in communication with the atmosphere when it is required to charge the system.

The primary object of this invention is to make the isolating valve or valves and the atmospheric valve or valves automatic in their movements so that the pressure and quantity of air maintained in the system will be controlled and provided for without any necessity for the use of a supplementary air compressor, or, if a supplementary air compressor be used, without any necessity for the use of any other apparatus than the automatic isolating and atmospheric valves to control both the main and the supplementary air compressors, the movements of the automatic isolating and atmospheric valves being such that the system may be operated as a variable pressure system or as a constant pressure system as required.

A further object is to control the movements of the isolating and atmospheric valves so that when a multiple cylinder air compressor is used the pressure and quantity of air circulated in the system may be regulated to suit the power and speed of the air engine without the use of valve actuating mechanism for the air compressor.

In the accompanying drawings, Figure 1 shows diagrammatically part of a "closed circuit" air-transmission system equipped with isolating and atmospheric valves adapted to operate in accordance with the invention. Fig. 2 shows a modified construction of pilot valve. Fig. 3 shows diagrammatically a modification hereinafter referred to.

Referring to the drawings, I prefer to employ an isolating valve A of the equilibrium type provided with a piston B sliding in a cylinder C the arrangement being such that one side b of the piston is at all times exposed to the pressure in the return pipe D of the system, while the other side b' of the piston is exposed alternately to the pressure in the return pipe of the system, through the branches d, d', and to the atmosphere through the branch d' and the outlet d^3. This alternation of pressure is determined by a weighted or spring loaded pilot valve E so arranged that until the desired pressure to be maintained in the system is attained both sides of the isolating valve piston B will be exposed to the pressure in the return pipe D of the system so that the isolating valve A will be kept closed, and when the desired pressure is attained the movement of the pilot valve E under that pressure within the branch d will establish communication between the atmosphere at d^3 and the side b' of the isolating valve piston B, thus putting it out of balance and so causing the isolating valve A to open.

The atmospheric valve F is preferably of the ordinary lift type and is provided with a piston G sliding in a cylinder H the arrangement being such that one side g of the piston G is at all times exposed to the pressure in the inlet pipe I of the air compressor J while the other side g' of the piston G is exposed alternately, to the pressure in the inlet pipe I of the air compressor, through the branches i, i', and to the pressure in the delivery pipe K of the system through the inlet i^2 and the branch i'. This alternation of pressure is determined by the weighted or spring loaded pilot valve E which at such times as it establishes communication between the atmosphere at d^3 and the side b' of the isolating valve piston B will also expose the side g' of the atmospheric valve piston G to the pressure in the delivery pipe K of the system, the atmospheric valve F being thus closed at such times as the isolating valve A is opened and

vice versa. The pilot valve E is preferably constructed in the form of a plunger of two diameters sliding in a cylinder *e* provided with suitable ports the plunger being provided with suitable grooves to control the alternations of pressure above described. The smaller and the annular areas of the plunger are made equal so that with the delivery and return pipes of equal capacity the sum of the pressures acting on the plunger will be a constant no matter what difference exists between the pressures in the delivery and return pipes K, D, of the system respectively. The delivery pipe pressure may act on the smaller area and the return pipe pressure on the annular area or vice versa provided the ports and grooves are arranged to suit.

As shown in Fig. 2, instead of being of two diameters, the pilot valve may be arranged with two separate plungers E each within a cylinder *e* and each provided with a weight or a spring e^2, the springs, when such are used, being of equal range under equal pressures and arranged to abut on a double armed lever L or the equivalent, so that on release of one spring e^2 and compression of the other spring e^2 the pilot valves E will no longer move in unison but will move at such times that the isolating valve A will open and close so as to maintain any desired difference of pressure between the delivery and return pipes of the system and the atmospheric valve F will open and close so as to maintain the quantity of air in the system. From this it will be seen that when a supplementary air compressor is used for the purpose of making up leakage the isolating valve may be placed at the inlet of the main air compressor and the atmospheric valve at the inlet of the supplementary air compressor and that the system will operate as a constant pressure system without any other apparatus being used to control the system.

Referring to Fig. 3, this construction of pilot valve will permit multiple cylinder air compressors to operate variable power and speed air engines without the necessity for the use of valve actuating mechanism for the compressor inlet and delivery valves *j*, *j'*, if any of the well known devices for holding open the delivery (or the inlet) valves of the compressor be arranged to be hand operated so that one or any other number of compressors may be brought into action as required. As shown, the delivery valve *j'* of each compressor is adapted to be controlled by a hand operated regulating valve M located within a casing *m* which is connected to the delivery pipe K by a branch *m'* and is connected by branches m^2 to the valve chests j^2 of the air compressors: the arrangement is such that one or more of the air compressors may be brought into action when the valve M is moved to permit communication between one or more of the delivery valves *j'* and the delivery pipe K, through the intermediary of the branches *m'*, m^2, but when said valve M is moved so as to permit communication between one or more of the delivery valves *j'* and a branch m^3 leading to the atmosphere, said valves *j'* and the corresponding number of air compressors are thrown out of action. In the case of the inlet valves pressure is used to lift these valves from their seats and so put the compressor out of action and the removal of the pressure brings the compressor again into action. The inlet pipe I has branches I' leading to the valve chests j^2 which chests have also branches *k* leading to the delivery pipe K. D is the return pipe. A is the isolating valve and F is the atmospheric valve.

It will thus be understood that the system operates partially as a variable pressure system and partially as a constant pressure system more or less according to the number of air compressor cylinders in action and to the power and speed required of the air engine.

What I claim is:—

1. In a closed circuit system for transmitting power by compressed air, the combination of an air compressor, an isolating valve and an atmospheric valve in said circuit, and pilot valve elements automatically controlled by the pressure in said system for controlling the opening and closing of said isolating and atmospheric valves.

2. In a closed circuit system for transmitting power by compressed air, the combination of an air compressor, return and delivery pipes leading to and from said air compressor respectively, isolating and atmospheric valves in said return pipe, and means whereby the opening and closing of said valves is automatically controlled by the pressure in said delivery pipe.

3. In a closed circuit system for transmitting power by compressed air, the combination of an air compressor, return and delivery pipes leading to and from said air compressor respectively, isolating and atmospheric valves in said return pipe, and pilot valve elements automatically controlled by the pressure in said delivery pipe for controlling the opening and closing of said isolating and atmospheric valves.

4. In a closed circuit system for transmitting power by compressed air, the combination of a multiple cylinder air compressor, inlet and delivery valves for the respective cylinders of said compressor, an isolating valve and an atmospheric valve in said circuit, pilot valve elements automatically controlled by the pressure in said system for controlling the opening and closing of said isolating and atmospheric valves, and means for controlling the opening and closing of

one of the valves of each of said compressor cylinders.

5. In a closed circuit system for transmitting power by compressed air, the combination of a multiple cylinder air compressor, inlet and delivery valves for the respective cylinders of said compressor, an isolating valve and an atmospheric valve in said circuit, pilot valve elements automatically controlled by the pressure in said system for controlling the opening and closing of said isolating and atmospheric valves, a fluid conduit communicating with one of the valves of each of said compressor cylinders, the opening and closing movements of said last-named valves being controlled by fluid pressure in said conduits, and a valve for controlling said conduits.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

JAMES DUNLOP.

Witnesses:
WALLACE CRANSTON FAIRWEATHER,
JOHN MCCLEARY, Jr.