

E. M. CRANDALL.  
STEAM, AIR, OR WATER MOTOR.

No. 569,546.

Patented Oct. 13, 1896.

Fig. 1.

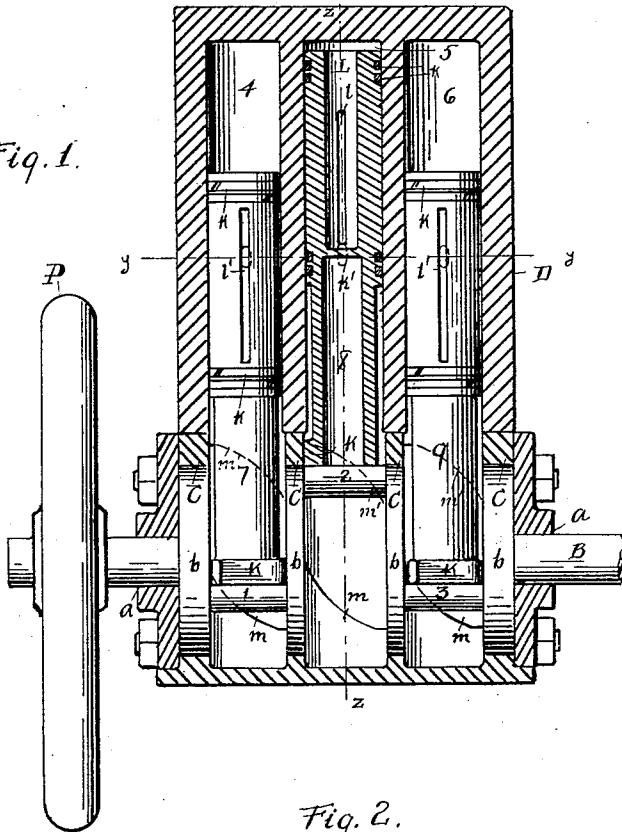
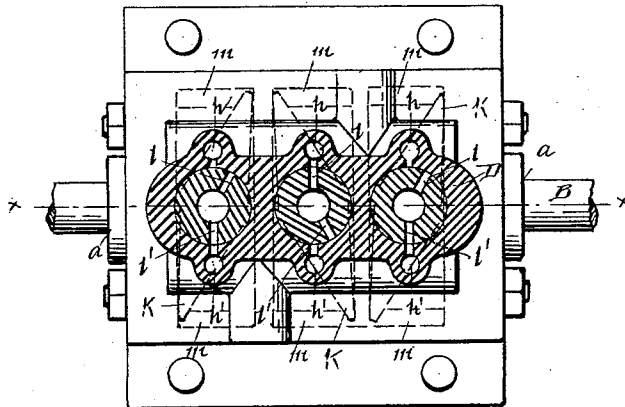


Fig. 2.



Witnesses.

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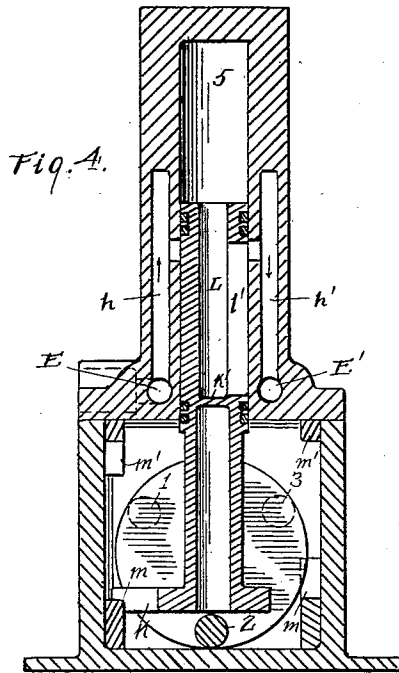
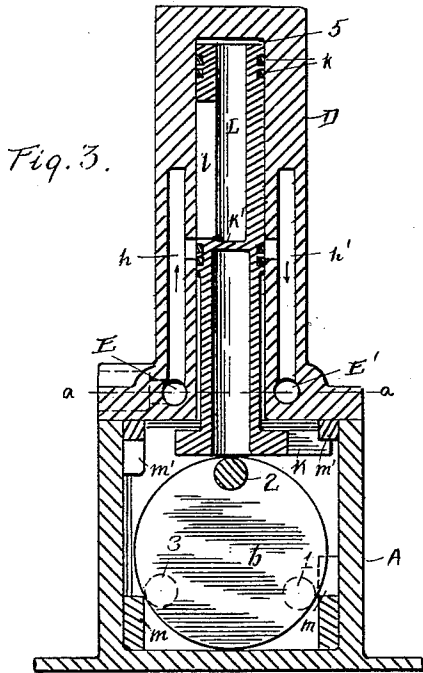
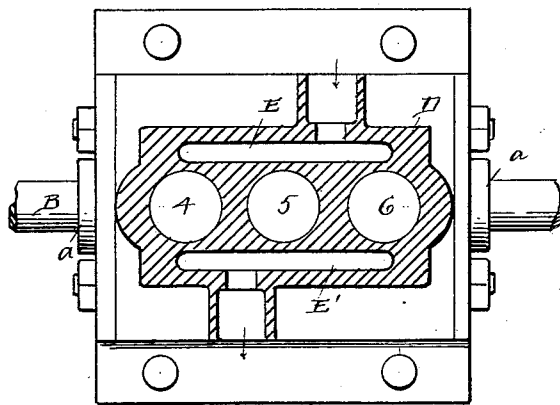


Fig. 5.



Witnesses.

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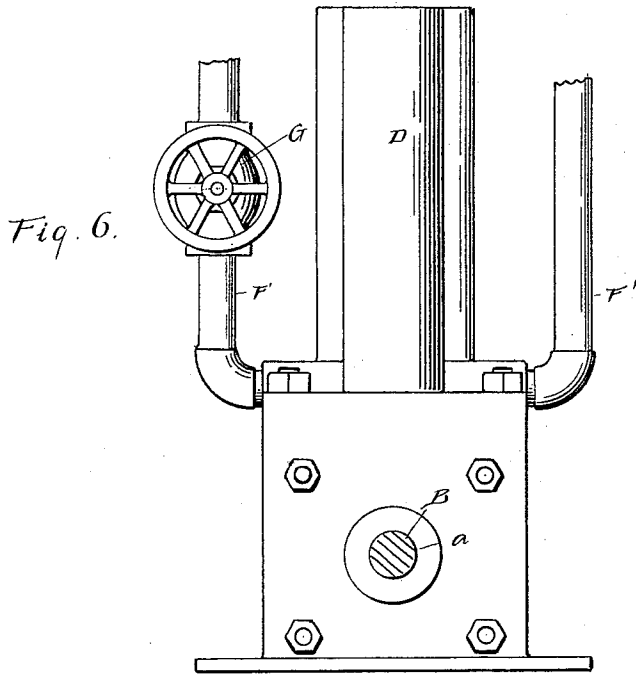


Fig. 7

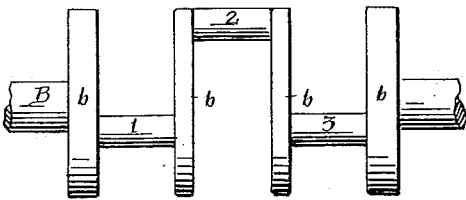
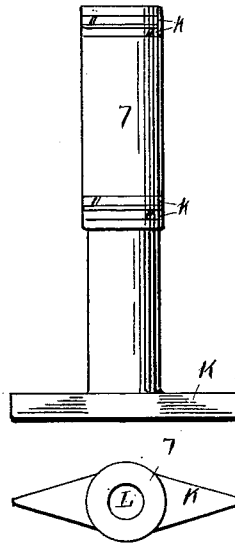


Fig. 8.



Witnesses.

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# UNITED STATES PATENT OFFICE.

EMMET M. CRANDALL, OF ST. JOSEPH, MISSOURI.

## STEAM, AIR, OR WATER MOTOR.

SPECIFICATION forming part of Letters Patent No. 569,546, dated October 13, 1896.

Application filed June 17, 1896. Serial No. 595,881. (No model.)

*To all whom it may concern:*

Be it known that I, EMMET M. CRANDALL, a citizen of the United States, and a resident of St. Joseph, in the county of Buchanan and State of Missouri, have invented certain new and useful Improvements in Steam, Air, or Water Motors; and I do declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to letters and figures of reference marked thereon, which form a part of this specification.

Figure 1 of the drawings is a representation of a section on line  $x x$ , Fig. 2, with middle piston raised. Fig. 2 is a section on line  $y y$ , Fig. 1. Fig. 3 is a sectional view on line  $z z$ , Fig. 1. Fig. 4 is a similar view with piston lowered position. Fig. 5 is a section on line  $a a$ , Fig. 3, pistons being removed. Fig. 6 is an end elevation of motor. Fig. 7 is a detail view of crank-shaft and cranks. Fig. 8 illustrates the piston in detail.

This invention is designed to provide a motor or engine capable of being operated by air, steam, water, or other fluid-pressure, which is direct acting and has no valves, journals, or connecting-rods to get out of order or create lost motion; which is reversible and easy to operate, having three or more cranks, as may be desired, and consequently no dead-center; which has great simplicity in its working parts, and in which the valves and piston are combined, doing away with the reciprocating movement of the ordinary valve motions, and thereby obtaining an increased velocity and simplicity of working.

With these objects in view the invention consists in the novel construction and combination of parts, all substantially as hereinafter described, and pointed out in the appended claims.

The invention is especially valuable for use in shopwork, such as boring out cylinders, drilling and tapping out stay-bolts of boilers, or any work of that description, the engine being operated very conveniently and satisfactorily by compressed air furnished by a Westinghouse locomotive air-pump. It is also valuable for running the dynamos which furnish passenger-trains with electric light, and for many other purposes.

In the accompanying drawings I have shown

a motor having three cranks and as many cylinders and pistons; but it will be obvious from the drawings and the following description that this number may be increased without in any way affecting the spirit and scope of the invention.

Referring to the drawings, the letter A designates a casing. B is a crank-shaft journaled at  $a a$  in the end walls of said casing, and having within the latter three equally-distant cranks designated, respectively, by the numerals 1, 2, and 3. Said cranks are carried by large circular disks  $b$ , which form the arms thereof, and which are neatly fitted to circular bearings C on the inner walls (see Fig. 1) of the casing, whereby the said shaft is relieved from strain.

Upon the casing A is placed the cylinder-case D, which may be an integral casting, bored to form the three cylinders 4, 5, and 6, which are side by side, one in line with each of the cranks of shaft B. Formed in the base of said case D, one at each side, are two longitudinal chambers E and E', the former constituting the induction chamber or chest and the latter the exhaust-chamber. F is the supply-pipe which is connected with the chamber E, and which has a cut-off valve G, and F' is the exhaust-pipe, which is connected with the chamber E'. In the opposite lateral walls of each of the cylinders are two vertical passages or chambers H and H', which communicate, by means of the respective ports  $h h'$ , with the interior of the cylinder about midway between its upper and lower ends, and which at their lower ends communicate with the respective chambers E E'.

The numerals 7, 8, and 9 designate the three pistons, which consist each of an elongated cylinder fitted to work neatly in its cylinder-chamber and provided with suitable packings, as the rings  $k$ . At its lower end each cylinder has an elongated cam-foot K, which impinges upon one of the cranks of the shaft B. Each of said cylinders has a longitudinal chamber L in its upper half, open at the top and closed at the bottom by a wall  $k'$ , below which the cylinder is preferably hollow. Formed in the upper half of said cylinder and communicating with the chamber L are two narrow elongated ports  $l l'$ , which are about one hundred and fifty degrees distant from each other. (See Fig. 2.)

It will be observed that the interior of the

casing A is divided into three compartments by means of the disks *b* and bearings C, each of which compartments communicates at its upper end with one of the cylinder-chambers and forms an enlarged continuation thereof. Formed on the lateral walls of each of the said compartments are the oppositely-inclined ledges or cam-surfaces *m m'*. (See Figs. 1, 2, 3, and 4.) These cam-surfaces are so arranged that the engagement of the feet K of the pistons therewith, when said pistons are near the opposite limits of their strokes, causes the pistons to be partially rotated, whereby the ports *l l'* of each are brought into and out of registration with the induct and educt ports *h h'* at the proper times.

In Fig. 1 the middle crank 2 is shown on top center, the foot K of the piston 8 being in engagement with the upper inclines *m'* of the center compartment of the casing A and the port *l* just coming to register with the induction-port *h*. The end cranks 1 and 3 are at this time in the position also indicated in said figure. As the piston 8 makes its downstroke the port *l* is full open and remains open until the piston reaches nearly the limit of the stroke, when said port commences to close and the port *l'* to open. The position at this time (when the crank 2 is on the bottom center) is shown in Fig. 4. The port *l* of the piston 9 is now wide open and said piston is on the downstroke, while the piston 7 is near the limit of its upstroke with its port *l* about to be opened. Fig. 3 shows the position when the crank 2 is again on top center, port *l* of the piston 8 being open and the port *l'* of the piston 9 also being open for exhaust. The positions of the three pistons and of the several ports at this time will be understood by reference to Figs. 1 and 2. It will be seen that during the downstroke of each piston its foot is impinging upon its respective crank, which slides or rolls thereon. During the opposite stroke the piston is raised by the crank.

To start the engine in either direction, all that is required is to open the cut-off valve and turn the balance-wheel P in the desired direction.

Having thus described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. In a motor, the combination of a crank-shaft, a cylinder having induct and educt ports, a chambered piston having elongated induct and educt ports adapted to be brought into register with the corresponding ports of said cylinder, and having also a foot which impinges upon a crank of said shaft, and means for partially rotating said piston during its reciprocation, to bring the several ports successively into the proper operative relations, substantially as specified.

2. In a motor, the combination of the casing the crank-shaft having three or more cranks inside said casing, a cylinder opposite to each of the said cranks and having induct

and educt ports, the elongated open-ended pistons, having each elongated induct and educt ports, adapted to be brought to register with the corresponding ports of the said cylinder, by a rotary movement of the piston and having also each a foot which impinges upon one of the said cranks, and means for partially rotating the said pistons as they are reciprocated, substantially as specified.

3. In a motor, the combination with the casing having internal circular bearings, the crank-shaft journaled in the walls of the said casing and carrying within the same a series of large circular disks which fit said bearings and which carry equally distant cranks, the cylinder-case having as many independent cylinder-chambers as there are cranks in the said shaft, and opposite the same, said chambers having each an induct and an educt port, the elongated reciprocative open-ended cylinder-pistons, having each an elongated, induct and educt port communicating with the open chamber thereof and adapted to be brought into and out of register with the corresponding ports of the cylinder by a rotary movement of the piston, said pistons also having each a foot which impinges against one of the said cranks, together with means for partially rotating said cranks, together with means for partially rotating said pistons as they are reciprocated, substantially as specified.

4. In a motor, the combination of the casing, having the internal bearings, the crank-shaft, the cylinder-case having as many independent cylinder-chambers as there are cranks in the said shaft, and having also induct and exhaust chambers connected with suitable conduits and also each connected with each of the said cylinder-chambers, the elongated cylinder-pistons, having the open chambers therein, and induct and exhaust ports through the lateral walls of said chambers, and also having each a foot arranged to impinge upon the cranks of the said shaft, together with means whereby said pistons are partially rotated as they are reciprocated to properly operate the induct and exhaust ports, substantially as specified.

5. In a motor, the combination with the series of cylinders, the series of chambered, reciprocative cylinder-pistons, provided with laterally-extending feet, and the crank-shaft having cranks upon which said feet impinge, said cylinders and pistons having suitable induct and exhaust ports, of the casing in which said shaft is journaled, said casing having therein two series of oppositely-inclined cam-surfaces upon which said feet impinge during portions of their strokes, substantially as specified.

In testimony whereof I affix my signature in presence of two witnesses.

EMMET M. CRANDALL.

Witnesses:

WM. B. CHURCHILL,  
G. E. LA PORTE.