No. 844,161. PATENTED FEB. 12, 1907.

W. MAUSS.

RECIPROCATING ENGINE.

APPLICATION FILED DEC. 21, 1906.

Fig. I

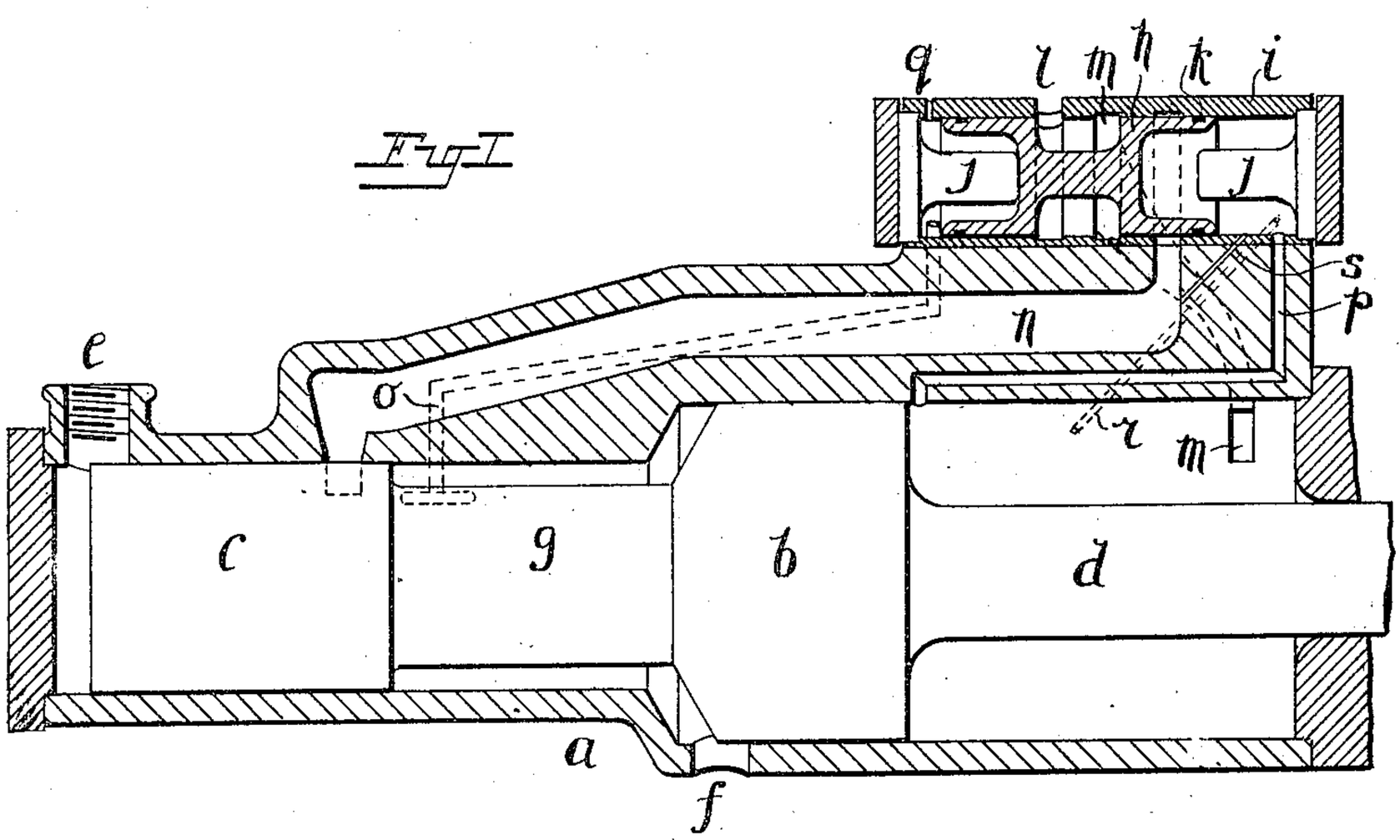
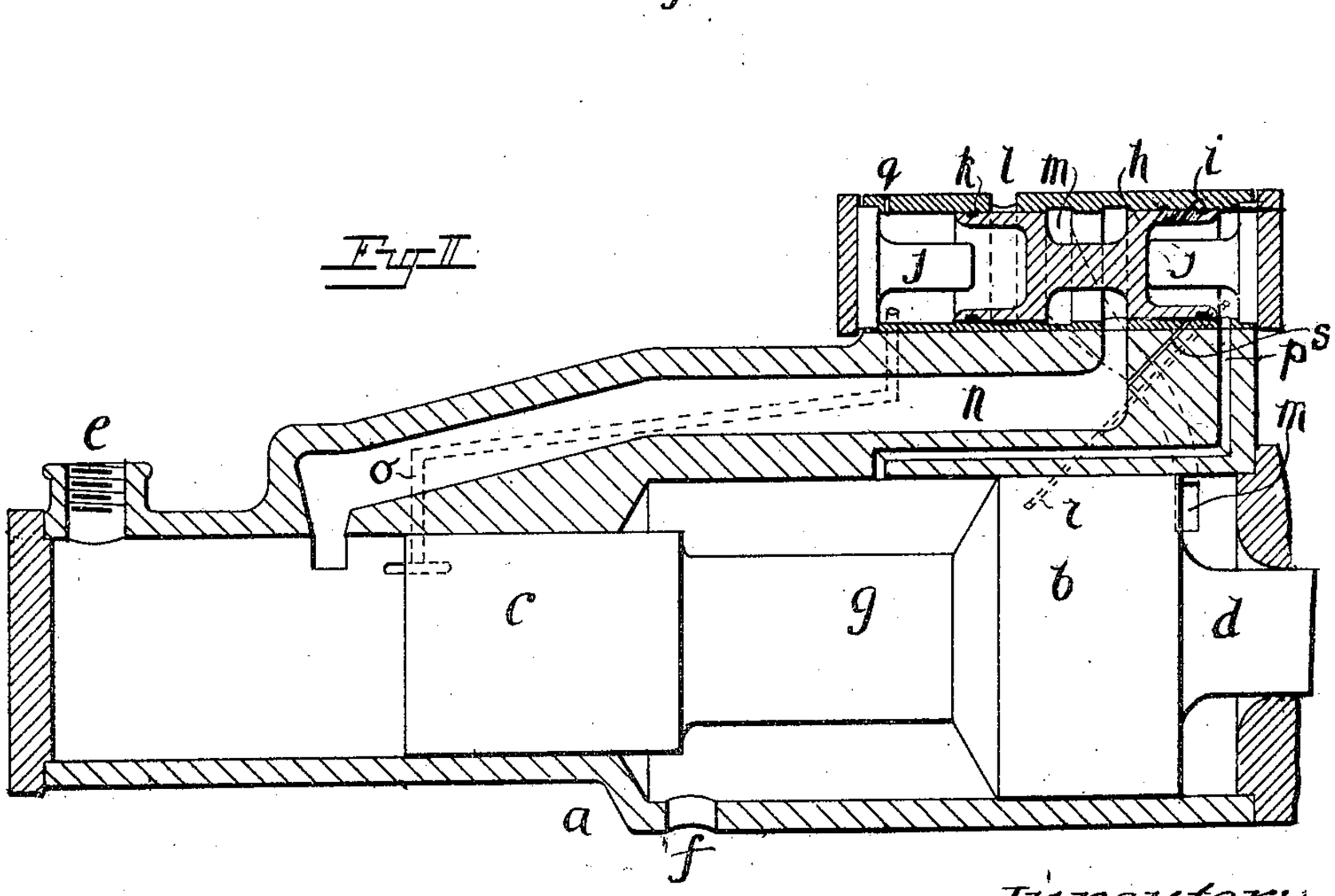


Fig. II



Witnesses:-

C. H. Crawford

Isaj. Morgenthal.

Inventor:-

Wilhelm Mauss

by P. Synnestvedt Attorney

UNITED STATES PATENT OFFICE.

WILHELM MAUSS, OF BRAKPAN, TRANSVAAL, ASSIGNOR TO THE KONOMAX ROCK DRILL SYNDICATE, LIMITED, OF JOHANNESBURG, TRANSVAAL.

RECIPROCATING ENGINE.

No. 844,161. Specification of Letters Patent. Patented Feb. 12, 1907.

Application filed December 21, 1906. Serial No. 348,917.

To all whom it may concern:

Be it known that I, WILHELM MAUSS, mechanical engineer, a German subject, residing at the Rand Central Electric Works, Brakpan, in the Colony of the Transvaal, have invented certain new and useful Improvements in Controlling the Working Fluid of Rock-Drilling and other Reciprocating Engines, of which the following is a specification, reference being had therein to the accompanying drawings.

This invention relates to the control of the working fluid for reciprocating engines, such as percussive rock-drilling machines, and more especially the type of rock-drilling machines described in the specification of patent application Serial No. 305,685, in which machine the rear piston-face is exposed constantly to full pressure while the working fluid (hereinafter referred to as "air") operates expansively upon the relatively larger front piston-face.

The principal object of the present invention is to provide a simple and efficient means for effecting the supply, cut-off, and exhaust of the air for the front cylinder in a machine of the last-named type.

A further object is to provide an admission and exhaust valve for the front cylinder operated by air from either end of the cylinder alternately which shall always open fully to exhaust, and so prevent cushioning of the piston of the working stroke.

A further object is to provide a valve mechanism applicable to fluid-operated rock-drilling and other percussive tools generally, which enables short and light but uncushioned blows to be delivered when desired by simply throttling the air-supply to the tool and without, as is usual, altering the position of the machine in relation to the body upon which the blows are delivered, which again renders the movement of the valve, and therefore the proper working of the tool, independent of the position of the tool, and which by doing away with possible dead-points in the valve's movement permits the tool to be started in any position.

These and other objects are attained by the valve mechanism, of which one form is shown in the accompanying drawings applied to an expansively-working rock-drilling engine as described in said application, Serial No. 305,685, Figure I being a longitudinal section of the machine with the piston at its rear limit; and Fig. II a similar view, but showing the piston at the end of its forward travel.

a indicates the cylinder; *b*, the larger front piston member working therein; *c*, the smaller rear piston member; *d*, the piston-rod, to which the drill is chucked; *e*, the air-inlet, communicating constantly with the rear piston-face, and *f* the exhaust to atmosphere from between the pistons, all of which features are as disclosed in said prior specification, with the exception that a clearance *g* is in the present instance turned upon the smaller piston member.

The valve-gear proper comprises a double-headed piston-valve *h* of known form working within the valve-chest *i*.

j are stops limiting the travel of the piston-valve, and leather packing-rings *k* preclude rebound of the valve from the stops.

The valve works over the three main ports *l*, *m*, and *n*. Of these *l* is the exhaust-port, opening directly to atmosphere. *m* communicates with the front end of the cylinder, and *n* conducts full-pressure air from the rear cylinder.

o is a duct taking air from the high-pressure cylinder to the rear of the valve, and *p* is a similar duct in the front cylinder, leading to the front end of the valve.

The normal operation—*i. e.*, when using about the ordinary working pressure of air—is as follows: The piston and valve being at their extreme backward positions, as in Fig. I, the front of the cylinder is communicating with atmosphere through ports *m* and *l*. Upon opening the air-supply cock the piston, propelled by the full pressure upon its rear face *c*, moves freely forward to deliver its working blow, and when nearing the end of its outward stroke uncovers hole *o*. By this means pressure is brought to bear upon the rear end of the valve, the front face of which is open to exhaust through *p* and *f*. The valve being thus thrown forward, the position of all parts becomes that illustrated in Fig. II. With the valve so disposed, exhaust port *l* is closed and live air is admitted through *n* and *m* to the front cylinder, causing the piston to begin its rearward stroke. Near the end of such stroke air is admitted to the front of the valve through *p* and exhausted from behind the same through *o*, *g*,

and *f*. The valve now returns fully to its initial position, exhaust occurs from the front cylinder, and the cycle recommences.

As already mentioned, the sequence of operations just described is effected when making full strokes with normal air-pressure; but under other conditions, such as when making light strokes with throttled supply, the operation is somewhat different.

In the drawings, *q* is a small hole through which leakage from the rear of the valve-chest constantly takes place.

r is a small passage leading from the large cylinder to the front of the valve-chest, its opening into the large cylinder being so placed as to be uncovered to pressure by the piston when the latter is making the shortest stroke which is practically desirable. *s*, again, is a small passage leading from the port *n* or other source of high-pressure air to the front end of the valve-chest and opening thereinto at about the point illustrated.

q, *r*, and *s* are all of such bore as to pass air very slowly in comparison with the ducts *o* and *p*.

Reduction of working pressure due to throttling will reduce the rearward travel of the piston after closure of port *n*. Such travel, however, will always be sufficient to uncover passage *r* to pressure, although in many cases not duct *o* to exhaust. In this case pressure on the rear of the valve will be relieved by leakage through *q*, and the pressure in the front cylinder being necessarily higher than atmospheric and being transmitted through *r*, the valve will travel sufficiently far to at least partially uncover port *l*, and so cause more or less complete exhaust from the front cylinder. Such exhaustion, however, deprives the valve of its normal motive power, and to preclude its moving sluggishly or stopping entirely it is arranged that immediately before uncovering port *l* the valve shall uncover passage *s*, thereby admitting in front of itself live air stored in port *n*, by which a smart completion of its rearward travel is assured.

It will be understood that the operation of the valve by functioning of the passages *q*, *r*, and *s* tends to occur under all conditions of working, although the amount of air which such passages are capable of passing is relatively so small that under normal conditions of working said by-passes do not appreciably affect the direct working of the machine as first described.

Besides causing the valve to operate, however much the main inlet is throttled, the passages *q*, *r*, and *s* assist the efficient operation of the drill in other respects. Thus when full pressure is used, but an accumulation of broken rock in the hole sets up such friction against the drill as to preclude the completion of the full backward stroke after cut off, the valve will after a short interval be thrown back to exhaust, and the drill will thereupon make a second forward stroke under full pressure, and so tend to clear itself; and, again, when drilling downward any difficulty of working due to the weight of the valve, which might otherwise occur, is eliminated by the final throw over of the valve under full pressure. It may be observed in this connection that no material retardation of the valve would occur when drilling upwardly, since the forward stroke of the valve is in every case made under full pressure.

The invention has hitherto been described with reference to the particular type of drill wherein constant pressure is applied to a small rear piston and air is expanded against a larger front piston and wherein consequently the valve is called upon to control the air in the front cylinder only. It is, however, to be understood that the features of the leakage-hole *q* and passages *r* and *s* may advantageously be applied to the air-operated piston-controlled valves of percussive machines generally—*e. g.*, those of the ordinary class in which the cylinder is of uniform bore throughout and full-pressure air is used in either end alternately. Such hole and passages would be arranged as in the above example to move the valve to exhaust from the front cylinder. The valves would thereby be freed from the tendency to hang at dead-points, the machine would be rendered capable of working with short and light uncushioned strokes by merely throttling the air-inlet, and, furthermore, sticking of the drill on the back stroke would to a large extent be overcome.

I claim as my invention—

1. In a reciprocating engine having a small rear piston area exposed to constant pressure and a relatively larger front piston area against which the air acts expansively, the improved means for controlling the air as hereinbefore described, comprising an air-operated valve for controlling admission to and exhaust from the front cylinder, a port for conducting live air from the rear cylinder to the valve, which port is arranged to be covered by the small piston upon its rearward stroke to cause expansion in the front cylinder, air-ducts from the cylinders controlled by the piston to operate the valve, a small leakage-hole at the rear of the valve-chest, a small auxiliary pressure-duct from the front cylinder to the front of the valve-chest adapted to be opened by the piston after a certain fraction of its rearward stroke and a means for supplying full-pressure air to insure the final throw-over of the valve to exhaust the front cylinder.

2. In a reciprocating engine having constant full pressure on the rear piston-face and in which the air operates expansively on the front piston-face, and having a piston-con-

trolled valve for controlling admission to and exhaust from the front cylinder, an air-port from the rear cylinder to the valve for the supply of full-pressure air to the front cylinder which port is adapted to be covered by the rear piston during its backward stroke to produce expansion in the front cylinder.

3. In a reciprocating percussive engine having an air-operated piston-controlled distributing-valve; a means for moving the valve to exhaust the front cylinder independently of the normal pressure and exhaust ducts for the valve, comprising in combination a hole permitting a continuous small leakage from one side of the valve, and a relatively small pressure-duct to the other side of the valve from the front cylinder adapted to be opened by the piston at a certain fraction of its backward stroke.

4. In a reciprocating percussive engine having an air-operated piston-controlled distributing-valve, a means for moving the valve to exhaust the front cylinder independently of the normal pressure and exhaust ducts for the valve, comprising in combination a hole permitting a continuous small leakage from one side of the valve, a relatively small pressure-duct to the other side of the valve from the front cylinder adapted to be opened by the piston at a certain fraction of its backward stroke, and means for admitting full-pressure air to the latter side of the valve immediately before the valve exhausts the front cylinder.

5. In a reciprocating percussive engine having an air-operated piston-controlled distributing-valve, means for admitting full-pressure air during the travel of the valve to exhaust the front cylinder, in combination with means for exhausting the air at the opposite end of the valve independently of the regular exhaust.

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

WILHELM MAUSS.

Witnesses:

ALFRED L. SPOOR,

W. HILLMAN VINCENT.