

No. 712,361.

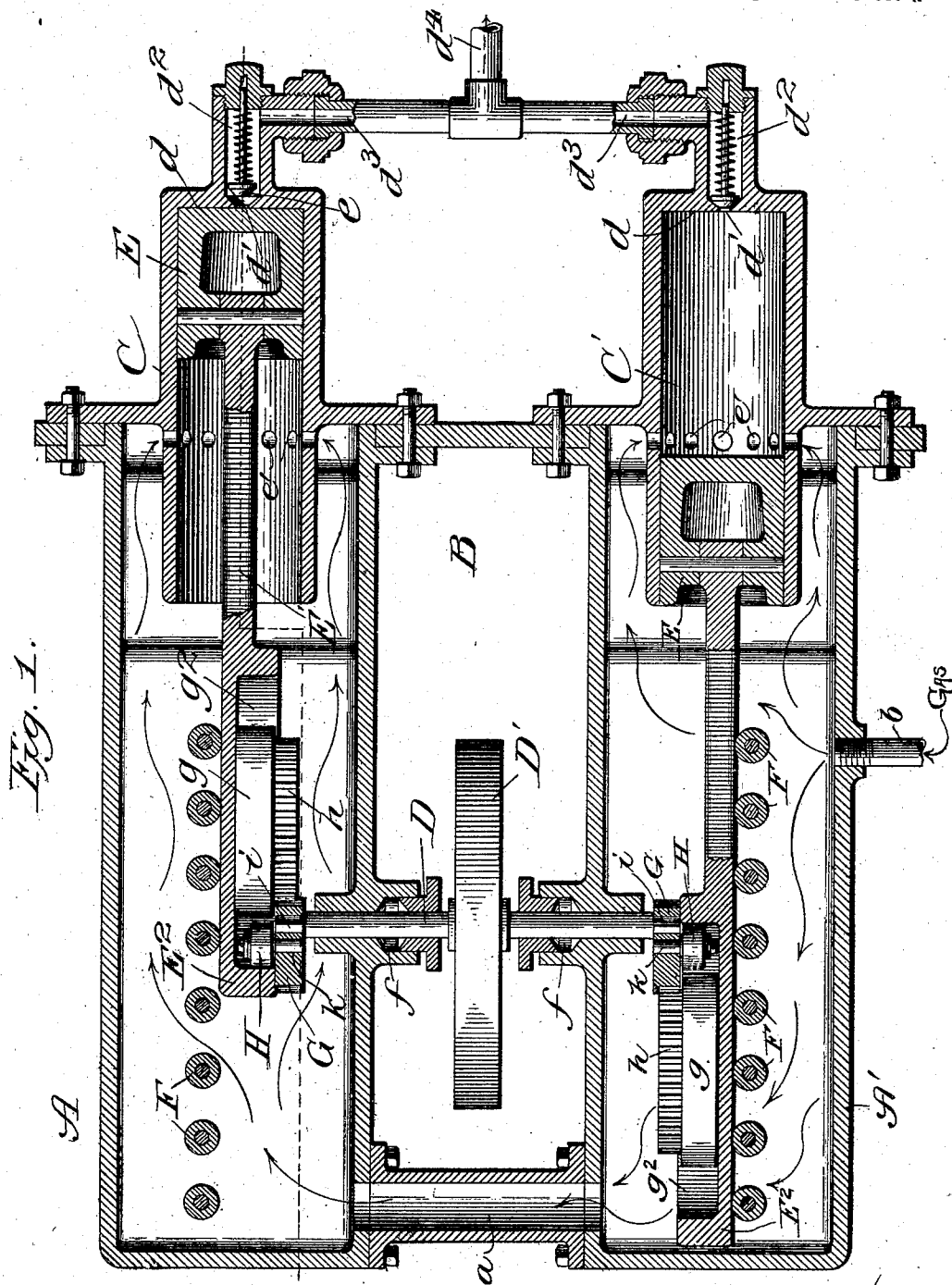
Patented Oct. 28, 1902.

A. R. CLARKE.
RECIPROCATING POWER MECHANISM.

(Application filed Dec. 20, 1901.)

(No Model.)

3 Sheets—Sheet 1.



Witnesses:

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John Anders

Inventor:

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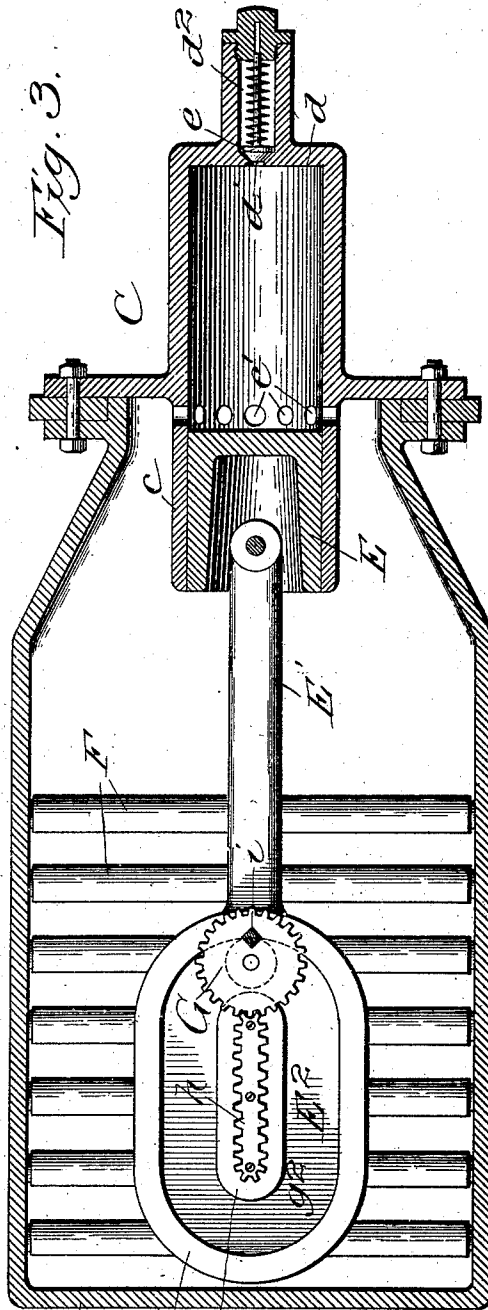
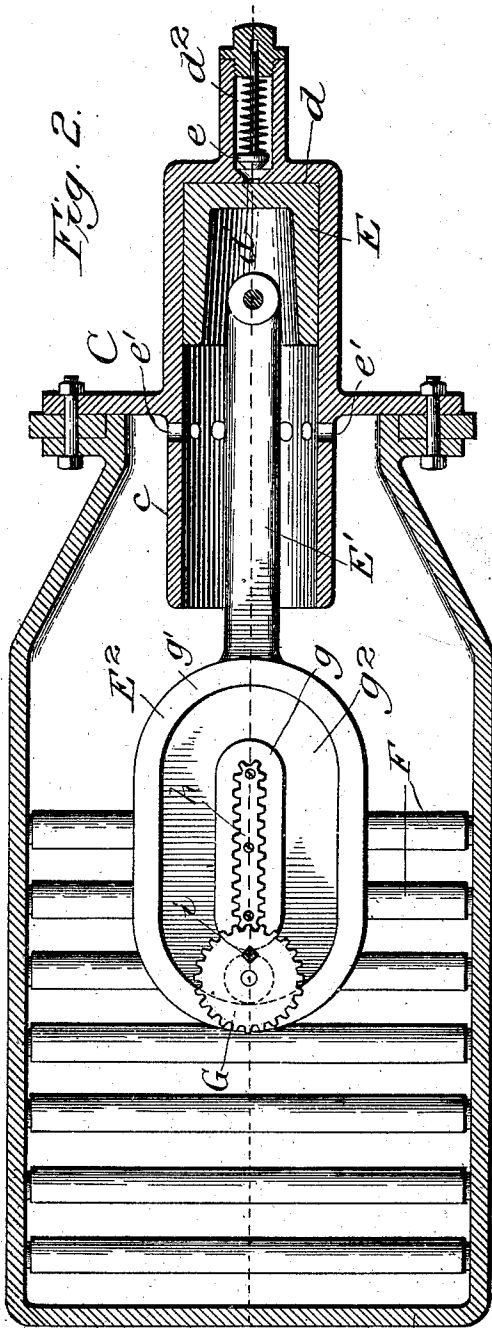
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RECIPROCATING POWER MECHANISM.

(Application filed Dec. 20, 1901.)

(No Model.)

3 Sheets—Sheet 2.



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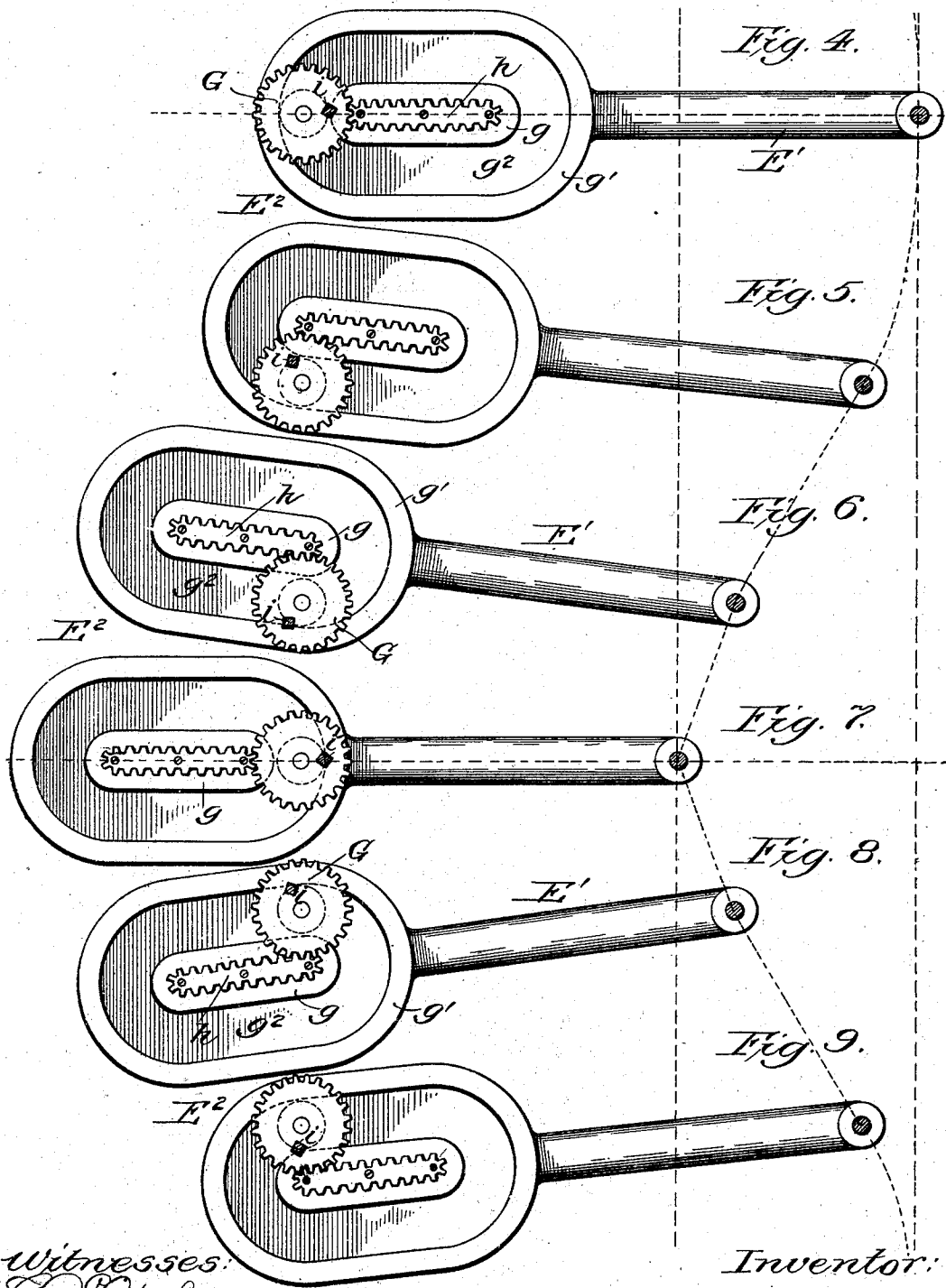
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RECIPROCATING POWER MECHANISM.

(Application filed Dec. 20, 1901.)

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3 Sheets—Sheet 3.



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UNITED STATES PATENT OFFICE.

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RECIPROCATING POWER MECHANISM.

SPECIFICATION forming part of Letters Patent No. 712,361, dated October 28, 1902.

Application filed December 20, 1901. Serial No. 86,624. (No model.)

To all whom it may concern:

Be it known that I, ARTHUR R. CLARKE, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented a new and useful Improvement in Reciprocating Power Mechanism, of which the following is a specification.

My invention relates to improvement in power-transmitting mechanism for converting uniform rotary motion into irregular reciprocating motion, and thereby causing the reciprocating member to move with comparatively great variations in speed and consequent variations in power at different parts of its course.

My improved mechanism may be applied to produce the desired speed and power variations at any parts of the path or stages in the movement of the reciprocating member—as, for example, to effect a slower and more powerful movement and longer pause of said member at one end of its stroke than at the other end thereof.

My invention may be employed to advantage in aeriform fluid-compressors to reciprocate the compressor-piston and move it with increasing power toward the discharge end of its stroke and effect a delay at that end prolonged over the delay at the other end of the stroke. Thus the power which moves the piston will increase in each stroke with the increasing resistance of the fluid as it is being compressed, and at the end of the discharge-stroke the piston may be caused to pause without appreciable variation in clearance a length of time sufficient for the education-valve to close before the piston starts in the backward direction.

In the drawings I show my invention applied to a gas-compressor, which may be a part of an anhydrous ammonia refrigerating apparatus.

Referring to the drawings, Figure 1 is a sectional and partly broken plan view of a double compressor, the section being taken on line 1 in Fig. 2; Fig. 2, a section taken on line 2 in Fig. 1 and viewed in the direction of the arrow; Fig. 3, a section on the same line as Fig. 2, but showing the parts in another position; and Figs. 4, 5, 6, 7, 8, and 9, views illustrating successive relative posi-

tions of the power-transmitting mechanisms in their movement to reciprocate the piston.

A A are close chambers separated from each other by a space B and communicating with each other toward their rear ends through a pipe or conduit *a*. A low-pressure gas-supply pipe *b* leads to the chamber A', and this pipe may be the return-pipe of an anhydrous ammonia compression refrigerating system. At the forward ends of the chambers A A' are heads C C', formed with compressor-cylinders, each having an open inner end portion *c*, projecting into the chamber. The outer ends of the cylinders are closed by walls or cylinder-heads *d*, containing central education-ports *d'*, communicating with valve-chambers *d*², which in turn communicate through ports *d*³ with a common discharge-pipe *d*⁴. In each valve-chamber *d*² is a spring-closed valve *e*, seating against the port *d'*.

D is a power-shaft extending across the space B and journaled toward opposite ends in stuffing-boxes *f* in the sides of the chambers A A'. In the space B the shaft carries a drive-pulley D'.

Working in the cylinders C C' are pistons E, which move from the position shown in Fig. 2 to the position shown in Fig. 3, wherein they uncover inlet-ports *e'*. Pivotaly connected at one end with each piston is a piston-stem E', formed at its opposite end with a flat-sided head or block E² of general elliptical form. Each head E² is provided in one face with a central boss *g* and an outer flange *g'*, forming between them a guide-groove *g*² of general elliptical form. On each boss *g* is an oblong rack *h*, having an endless series of teeth extending parallel with the guide-groove *g*². Each head E² has a smooth rear face which may slide against rollers F, journaled in the upper and lower walls of the chambers.

The shaft D is provided at each end with a central reduced projection *i*, which may be square or otherwise non-circular in cross-section. Fixed eccentrically on each end projection *i* of the shaft is a pinion G, provided with the same number of teeth as the racks *h*. In the center of each pinion G is an opening *k*, receiving a shaft carrying a loose roller H, concentric with the pinion. The rollers

extend into and travel in the guide-grooves g^2 of the heads E^2 and approximate in diameter the width of the grooves, so as to move without material lateral play. The rollers 5 operate to hold the pinions G in engagement with the racks h . The parts are so arranged with relation to each other that in operation the pinion-teeth nearest the center of rotation of the shaft and pinions engage the rear ends of the racks, as shown in Fig. 2, whereby the pinion-teeth farthest from the center of rotation will engage the forward ends of the racks. Owing to the eccentric rotation of the pinions with relation to the shaft they 15 operate with varying leverage against the racks, whereby under uniform rotation of the drive-shaft the racks will be moved more slowly when engaged at their rear ends by the pinions, as shown in Fig. 2, than when engaged at their forward ends thereby, as shown in Fig. 3, and the pistons will be moved toward the ends of their discharge-strokes with gradually-diminishing velocity and with gradually-increasing velocity in the 25 opposite direction. The change in leverage of the pinions also effects a change in the degree of power transmitted to the pistons proportionate to the change in velocity. As a consequence, the compressing power of the pistons increases as they near the ends of their discharge-strokes. This in itself is a great advantage for the reason that it tends to increase the force applied according to the increase in resistance, and vice versa, thus economizing in power without sacrifice in the speed of complete reciprocation of the pistons.

In operation the gas to be compressed, which may be the return gas in an anhydrous-ammonia-compression refrigerating system, as before stated, enters through the pipe b and fills the chambers $A' A$. As the piston in each case nears the end of its return or suction stroke it uncovers the ports e , allowing the gas under its expansion-pressure to fill the cylinder C . Owing to the position of the pinion upon the rack it moves very rapidly, and the ports e' should present an opening large enough for the gas to completely fill out the compressor-cylinder in the short time that the ports are open. The piston is moved rapidly at first and then with gradually-decreasing speed until it reaches the end of its discharge-stroke at the cylinder-head d . As the pinion moves with comparative slowness around the rear end of the rack, a delay occurs in the movement of the piston, causing it to remain for a relatively prolonged time at or approximately at the end of its discharge-stroke.

In aeriform-fluid compressors it is desirable to avoid all clearance between the piston and cylinder-head and to prevent the retrogression of the compressed fluid through the eduction-port in the closing of the valve. Where 65 the valve commences to close at the same time that the piston commences its return stroke, retrogression of some of the compressed fluid

cannot be prevented no matter how quickly the valve may close. Fig. 2 shows the piston in the position of having just completed its 70 discharge-stroke and the valve e about to close. If the return-gas in the chamber A is under a pressure of, say, fifteen pounds and is discharged when compressed against a back pressure of, say, one hundred and fifty pounds any 75 gas retrogressing while the valve e is closing would expand to ten times its compressed volume. Thus if the piston were moved to and from the clearance rapidly the gas retrogressing through the port d' would greatly diminish the capacity of the machine. This difficulty is overcome in my construction by the fact that the slow movement owing to the short leverage of the pinion at the time of the end of the discharge-stroke causes the piston 85 to remain practically at the end of its discharge-stroke for a time prolonged sufficiently to permit the eduction-valve to close before it starts on the return stroke. By thus causing the piston to move rapidly toward and from the suction end of the stroke and comparatively slowly to and from the discharge end of the stroke with a delay at the discharge end variations in speed are properly distributed, so that the compressor 95 may be run to its full capacity at a much higher speed than would otherwise be possible.

The object of the rollers F is to hold the racks in engagement with the pinions. Any other desirable means for the same purpose 100 may be substituted for the rollers.

If desired, an induction-port and valve may be provided in each piston in place of the ports e' , so that gas would be sucked into the cylinders from the beginning until the end of the 105 return strokes of the pistons. This last-named construction is common in aeriform-fluid compressors and for that reason unnecessary to illustrate.

The Figs. 4 to 9, inclusive, show the relative positions of the power-transmitting mechanism in the movement of the piston-stem and tend to illustrate clearly the described movements thereof. The engagement of the pinion-tooth nearest the shaft i with the outer 115 tooth of the rack, as shown in Fig. 4, effects the final movement of the piston to the clearance, and in order that the travel of the piston with relation to the cylinder-head shall be uniform it is necessary, as before stated, 120 that the rack and pinion shall have the same number of teeth.

While I prefer to construct my improvements throughout as shown and described, they may be variously modified in the matter 125 of details of construction without departing from the spirit of my invention as defined by the claims.

What I claim as new, and desire to secure by Letters Patent, is— 130

1. In a power-transmitting mechanism for converting constant rotary motion into variable reciprocating motion, the combination of an eccentrically-rotating driving-pinon

having a circular series of teeth, and a movable endless rack engaging with the pinion to be reciprocated thereby.

2. In a power-transmitting mechanism for
5 converting constant rotary motion into variable reciprocating motion, the combination of an eccentrically-rotating driving-pinion and a movable endless rack having formed
10 of the pinion and engaging with the pinion to be reciprocated thereby.

3. The combination with the drive-shaft of a pinion mounted eccentrically thereon having a circular series of teeth, a head having
15 formed about its center a guide-path for the pinion of general elliptical form, and an endless rack on the head at the center of said path and engaged by said pinion, substantially as and for the purpose set forth.

20 4. The combination with a drive-shaft of a pinion mounted eccentrically thereon having a circular series of teeth, a head having formed about its center a guide-path of general elliptical form, a roller upon and concentric with

the pinion and confined in said path, and an
25 endless rack on the head at the center of said path and engaged by said pinion, substantially as and for the purpose set forth.

5. In a compressor, the combination with a
30 rotary drive-shaft and a reciprocated part, of interposed power-transmitting mechanism, comprising a pinion eccentrically mounted on the shaft, a head on the reciprocated part, an endless rack of general elliptical form on
35 the head having the same number of teeth as the pinion, and means for holding the rack in engagement with the pinion, the rack and pinion being so arranged with relation to each other that the teeth of the pinion nearest its
40 center of rotation engage the end of the rack when the piston is at the end of its discharge-stroke, substantially as and for the purpose set forth.

ARTHUR R. CLARKE.

In presence of—

ALBERT D. BACCI,
M. V. MACKENZIE.