No. 791,896. PATENTED JUNE 6, 1905.

F. GERB.

VALVE MOTION FOR AIR COMPRESSORS.

APPLICATION FILED SEPT. 16, 1902.

3 SHEETS—SHEET 1.

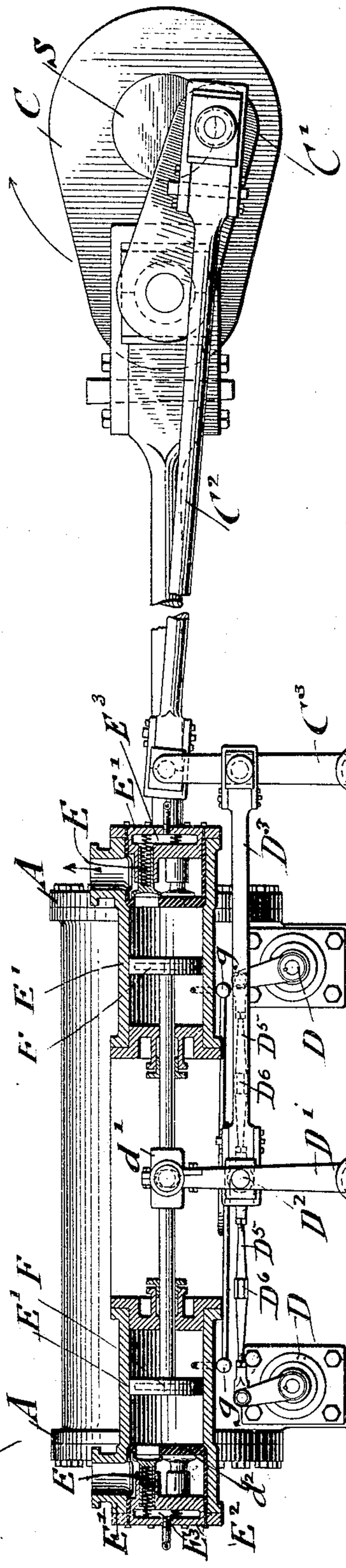

Fig. 1.

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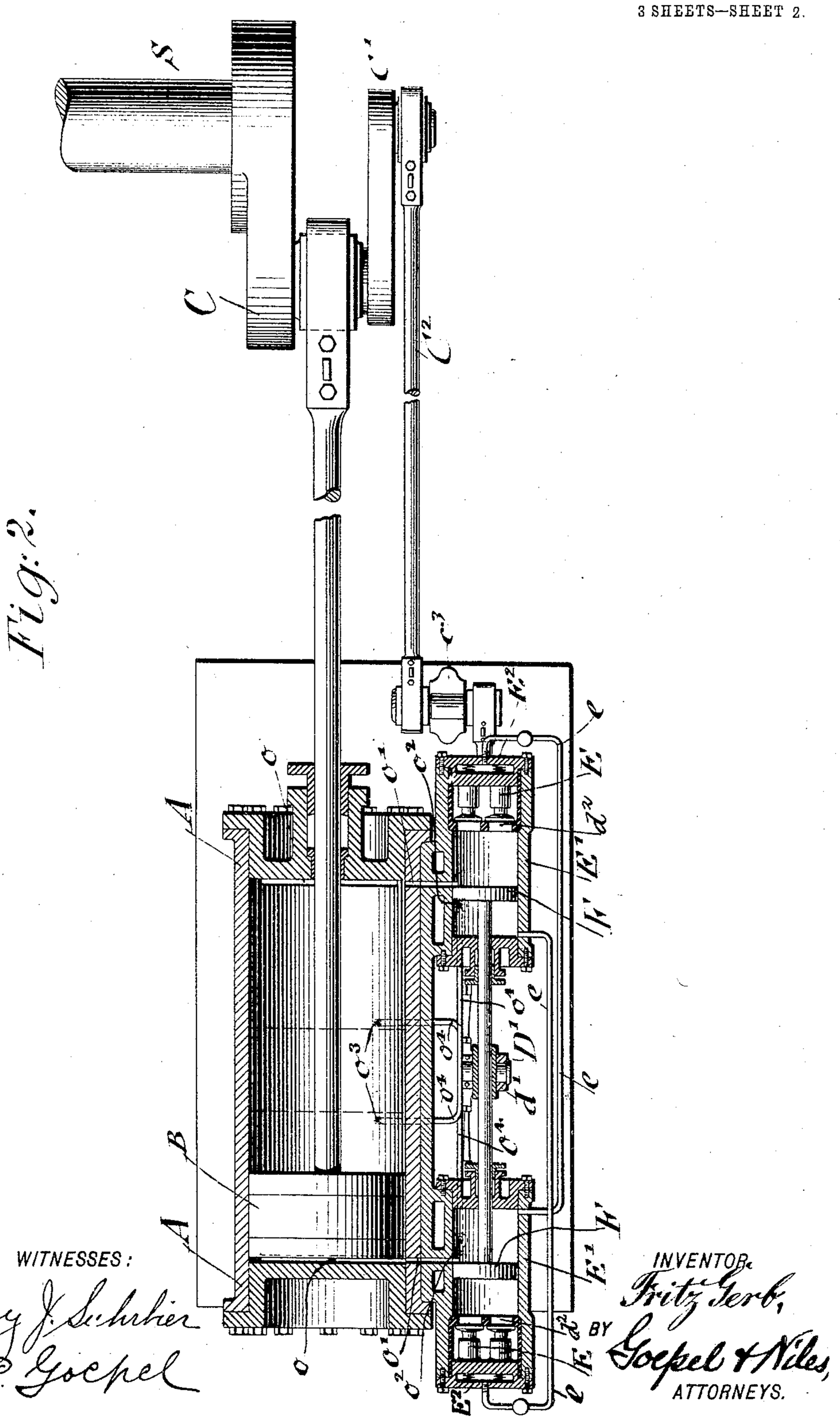
Fig. 2.



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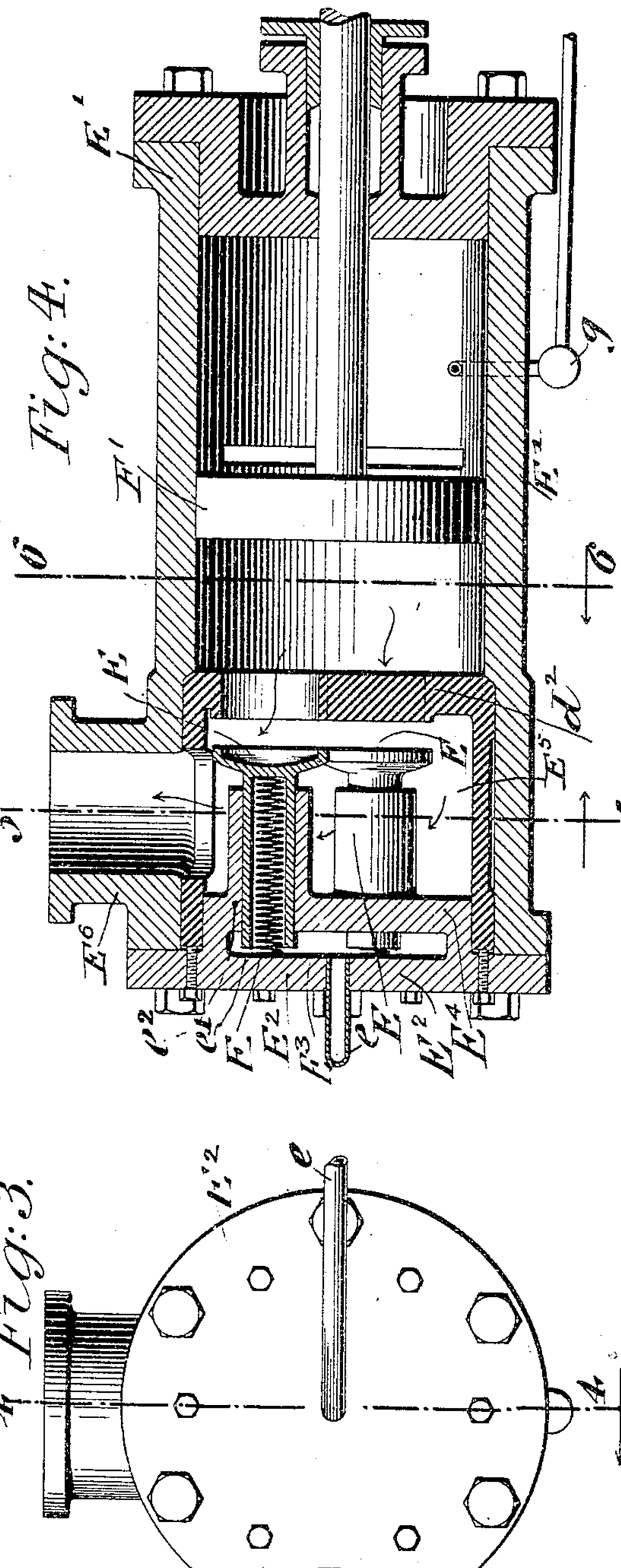

Fig. 4.

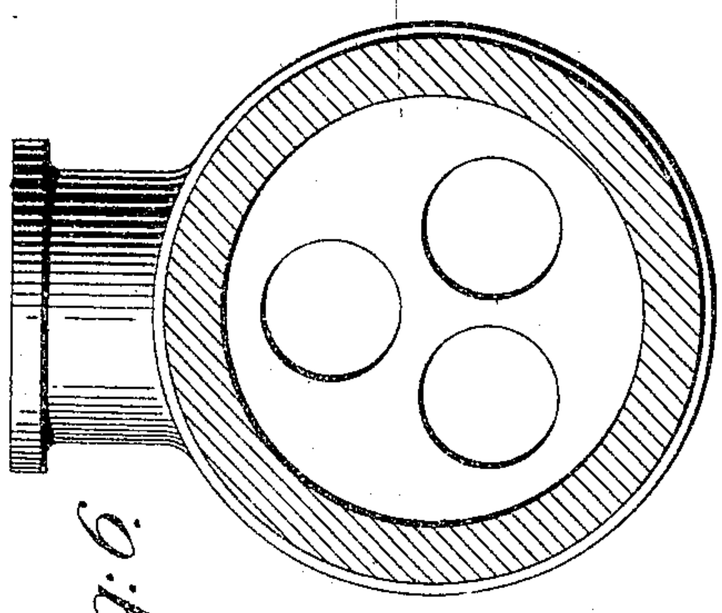

Fig. 6.

Fig. 3.

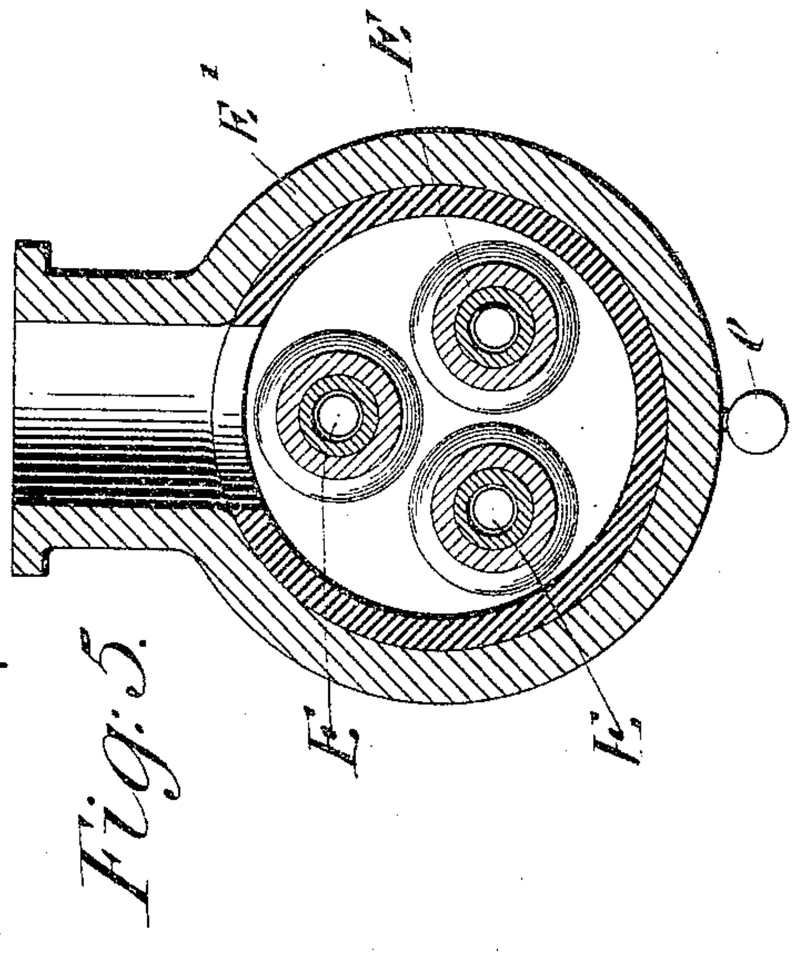

Fig. 5.

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UNITED STATES PATENT OFFICE.

FRITZ GERB, OF NEW YORK, N. Y.

VALVE-MOTION FOR AIR-COMPRESSORS.

SPECIFICATION forming part of Letters Patent No. 791,896, dated June 6, 1905.

Application filed September 16, 1902. Serial No. 123,559.

To all whom it may concern:

Be it known that I, FRITZ GERB, a citizen of the Empire of Germany, residing in New York, borough of Manhattan, and State of New York, have invented certain new and useful Improvements in Valve-Motions for Air-Compressors, of which the following is a specification.

This invention relates to an improved valve-motion for air-compressors, and has for its object to provide means whereby to relieve the pressure of the compressed air in the space formed between the heads of the main cylinder and the main piston at the end of each stroke.

The invention has further for its object to provide means for an effective closing of the outlet-valves and, lastly, to provide means whereby the outlet-valves are operated independently of the main piston.

For this purpose the invention consists of a valve-motion for air-compressors which comprises a main cylinder, a piston in the same, suction-valves at the ends of said main cylinder operated in the nature of Corliss valves, means for operating said suction-valves, a piston-valve at each end of the main cylinder and communicating therewith, cylinders for said piston-valves, outlet-valves in said cylinders, means for reciprocating said piston-valves in connection with the valve-gear of the suction-valves, and pipes for connecting the end of the cylinder opposite to the outlet-valves of one of the piston-valves with the outlet-valve end of the other cylinder; and the invention consists, further, of channels connecting the ends of the main cylinder with ports in the cylinders of the piston-valves, pipes provided with check-valves connecting the cylinders of the piston-valves with orifices in the main cylinder at opposite sides of the median position of the main piston, so as to relieve the pressure of the compressed air at the end of each stroke of the main piston by causing the air to pass into the piston-valve cylinder at the same end of the main cylinder and forcing part of the air through the pipes leading to the outlet-valves of the other piston-valve cylinder for partly closing the same and forcing the other part into the main cylinder, as will be more fully described hereinafter and finally pointed out in the claims.

In the accompanying drawings, Figure 1 represents a side elevation of my improved valve-motion for air-compressors, showing the same partly in section through the piston-valves and outlet-valves at one end of the same. Fig. 2 is a horizontal section through the main cylinder and piston-valves, showing the connection of the main cylinder with the piston-valve cylinders, arranged at the side of the same and showing the connection of the main piston and piston-valve piston-rod with the cranks of the driving-shaft, the cranks of the main piston-rod and piston-valve piston-rod being approximately ninety degrees apart. Fig. 3 is an end elevation of one of the outlet-valves, drawn on a larger scale. Fig. 4 is a vertical longitudinal section on line 4 4, Fig. 3; and Figs. 5 and 6 are vertical transverse sections, respectively, on lines 5 5 and 6 6, Fig. 4.

Similar letters of reference indicate corresponding parts.

Referring to the drawings, A represents the air-compressing cylinder, and B the piston of the same. The piston-rod of the main piston B is connected in the usual manner by a connecting-rod with a crank-pin on the crank C of the driving-shaft S. The suction-valves D D, arranged at the lower part of the main cylinder adjacent the heads of the same, are constructed in the nature of Corliss valves and operated from a crank C′, which is attached to the crank-pin and placed at an angle to the main crank C, the relative position of the crank C′ to the crank-pin of the main crank C being such that the same follows at an angle of ninety degrees the motion of the main crank, as indicated by the diagram shown in Fig. 1. The angle may be either more or less than ninety degrees, depending on practical determination.

The crank-pin of the crank C′ is connected by a connecting-rod C^2 with an oscillating lever C^3, which is pivoted at its lower end to the bed-plate of the compressor. The cranks of the suction-valves D D are connected with each other by rods D^5, adjustable at D^6, and with an oscillating lever D′, pivoted at its

lower end to the bed-plate of the compressor and similar to and connected with the oscillating lever C^3 by a rod D^3 by means of a pivot-pin D^2 and whereby oscillating motion is imparted to the lever D′ and to the suction-valves D. The upper end of the oscillating lever D′ is pivoted to a sleeve d', that forms the coupling for the piston-rods of the pistons F of the piston-valves that are located at the side ways of the main cylinder. These outlet-valves are constructed in the nature of cup-valves having hollow tubular shanks for permitting the insertion of cushioning-springs and are guided in outlet-ports at the end of the piston-valve cylinders E′, and the hollow shanks e' of the outlet-valves are spring-cushioned and guided in stationary sleeves e^2. The ends of the outlet-valve chambers E^5 are closed by heads E^2, between which and the partitions E^4 spaces E^3 are formed that communicate with the tubular shanks of the outlet-valves, as shown in Figs. 1 and 4, Fig. 1 showing valves in closed position, while Fig. 4 shows them in open position ready to admit the compressed air to a suitable receiver connected with the outlet-valve chamber E^5 at E^6.

Three outlet-valves E are preferably arranged with three outlet-openings in the partition-wall d^2 between the valve-cylinder and the outlet-valve chest, as shown in Fig. 4. The sockets e^2 for guiding the shanks e' of the outlet-valves E are preferably cast in one piece with the head of the valve-chest, the partition-wall d^2 being made in one piece with a cylindrical portion that is tightly fitted into the end of the piston-valve cylinder. The opposite end of the piston-valve cylinder is closed by a head in the usual manner, all as shown in Fig. 4.

The ends of the cylinder A communicate with the suction-valves D by slots o, arranged at the lower part of the main cylinder adjacent to the heads of the same, and communicate by side channels o' with the cylinders E′ of the piston-valves, as shown clearly in Fig. 2. The cylinders E′ are provided with openings o^2, which are connected by pipes o^4, having check-valves g, with openings o^3 in the main cylinder A, located, respectively, at each side of the median position of the main piston B, the opening of one of the piston-valve cylinders connecting with the opening at one side of the median position of the main piston and the opening in the other piston-valve cylinder connecting with the opening in the main cylinder at the opposite side of the median position of the main piston, as shown in Fig. 2, in which the median position of the main piston B is indicated in dotted lines. The channels o' form in connection with the space in the cylinders E′ at one side of the piston F and with the pipe o^4, connected with the opening o^3, a channel forming communication between one end of the main cylinder and the opening o^3 in the other end of the same. The compressed air that is in the clearance or spaces between the head of the cylinder and piston of the main cylinder passes into the cylinder E′ of the piston-valve, is there brought to atmospheric pressure, and forced by the piston F through the pipe o^4 into the main cylinder. To prevent any air compressed by the opposite stroke of the piston from passing from the main cylinder into the piston-valve cylinder, the check-valve g is arranged in the pipe o^4, which check-valve opens under the influence of the air compressed by the piston-valve, but closes under the influence of the compression-stroke of the main cylinder. For the purpose of producing an effective closing of the outlet-valves as soon as the compressed air is discharged through the same the inner end of one of the piston-valve cylinders is connected by a pipe e with the outlet-valve head E^2 of the opposite piston-valve cylinder, so that the air that is pushed forwardly by the piston F of one of the piston-valves is transferred to the space E^3 of the end of the other piston-valve, so as to produce by its pressure on the outlet-valves the effective and reliable closing of the same in connection with helical springs actuating the outlet-valves, as shown in Fig. 4.

The operation of my improved valve-motion for compressors is as follows: When the piston of the air-compressing cylinder A has arrived at one end of its stroke, as shown in Fig. 2, and is about to start on its return stroke toward the right, the piston F of the outlet-valve cylinder has just passed the port of the connecting-channel o', moving toward the left, and establishes thereby communication between the main cylinder and the right-hand end of the piston-valve cylinder, so that the compressed air or other fluid in the main cylinder can pass from the clearance in the main cylinder into the piston-valve cylinder E′. At the same time the piston F forced the compressed air, which was formed by the forward stroke of the main piston and is now in the left-hand end of the piston-valve cylinder E′, through the outlet-valves into the receiver the outlet-valves were opened by the pressure of the compressed air of the main cylinder. They remain open inasmuch as the air is now forced through the same by the piston F. The piston F of the right-hand piston-valve has, in the meantime, after it has passed the port of the channel o', compressed the air in the left-hand end of the right-hand piston-valve and compelled this air to pass through the connecting-pipe E to the space E^3 of the left-hand piston-valve, so as to produce by its pressure and the effect of the cushioning-springs the reliable closing of the outlet-valves of the left-hand piston-valve cylinder just before the piston F reaches the end of its stroke, so that some of the compressed air may be used as a cushion. In the meantime the left-hand suction-valve has been opened

and the main piston has again commenced its suction-stroke, moving toward the right, drawing in the air at the left-hand side and compressing the air at its right-hand side in the main cylinder. Just before the piston B arrives at the end of its return stroke at the right of the cylinder A the piston F of the right-hand piston-valve closes the port of the outlet-channel o' and entraps a quantity of compressed air in the main cylinder for forming a cushion therein. Immediately after the piston F passes the port o' and the compressed air, which just exerted a desirable cushioning effect on the main piston, is forced into the left-hand part of the right-hand cylinder-valve and is brought there to atmospheric pressure. The piston F continuing in its stroke forces the air in the right-hand part of the right-hand piston-valve cylinder through the outlet-valves into the receiver. The piston F in the left-hand piston-valve cylinder compresses the air therein and forces it through the pipe e into the outlet-valve chamber e^3 of the right-hand piston-valve cylinder and effects the closing of the outlet-valves just at a moment before the piston F of the right-hand cylinder reaches the end of its stroke. The left-hand piston F continues to compress the air, and in the meanwhile the main piston B is moved again toward the left over the opening o^3, and by the combined suction action of the right-hand part of the main cylinder and the compression action of the right-hand part of the left cylinder E′ the air in the right-hand part of the left cylinder E′ passes into the main cylinder, so that atmospheric pressure is established in the right-hand part of the left cylinder E′. When the piston F of the left-hand cylinder E′ moves again toward the left, it causes a small vacuum in the left-hand part of the left cylinder E, and when it reaches its median position closes the channel o' and causes the compressed air to be entrapped between the main piston B and the head of the cylinder A, which compressed air exerts a desirable cushioning effect on the main piston B. When this desired effect has been maintained for a short time, the piston F of the left-hand cylinder E′ uncovers the channel o' and the clearance or compressed air between piston B and the head of the cylinder A passes into the right-hand part of the left-hand cylinder E′ and is brought there on account of the vacuum produced to atmospheric pressure. The left hand F, continuing its movement, compresses the air in the left-hand part of the left-hand cylinder E′ and forces the same through the outlet-valves until they are closed by the compression of the air in the left-hand part of the right-hand cylinder E′, forced through the pipe e, and closing the valves E of the left-hand cylinder E′. This alternating play of the piston-valves produces the effective closing of the outlet-valves, and thereby the more reliable and effective working of the air-compressor and its outlet-valves and especially permits an operation of the piston-valves independently of the main piston. The operation of the piston-valves in connection with pressure-equalizing pipes at each end of the main compressing-cylinder takes place alternately in proper play with the motion of the main piston.

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

1. The combination, with an air-compressing main cylinder and piston, suction-valves located at the ends of the main cylinder, and means for actuating the suction-valves, of piston-valves, each comprising a cylinder and a piston movable therein, at the ends of the main cylinder, means for operating the piston-valves a rod connecting the piston-valve pistons, channels connecting the ends of the main cylinder with the cylinders of the piston-valves, outlet-valves at the outer ends of the piston-valve cylinders, and pipes connecting the inner end of one piston-valve cylinder with the outer end of the other piston-valve cylinder.

2. The combination, with an air-compressing main cylinder and piston, suction-valves located at the ends of the main cylinder, and means for actuating the suction-valves, of piston-valves, each comprising a cylinder and a piston movable therein, at the ends of the main cylinder, means for operating the piston-valves a rod connecting the piston-valve pistons, channels connecting the ends of the main cylinder with the cylinders of the piston-valves, outlet-valves at the outer ends of the piston-valve cylinders, and pipes connecting the inner ends of the piston-valve cylinders with the opposite ends of the main cylinder to which the piston-valve cylinder is located.

3. The combination with an air-compressing main cylinder and piston, suction-valves located at the ends of the main cylinder, and means for actuating the suction-valves, of piston-valves, each comprising a cylinder and a piston movable therein, at the ends of the main cylinder, means for operating the piston-valves a rod connecting the piston-valve pistons, channels connecting the ends of the main cylinder with the cylinders of the piston-valves, outlet-valves at the outer ends of the piston-valve cylinders, pipes connecting the inner end of one piston-valve cylinder with the outer end of the other piston-valve cylinder, and pipes connecting the inner ends of the piston-valve cylinders with the opposite ends of the main cylinder to which the piston-valve cylinder is located.

In testimony that I claim the foregoing as my invention I have signed my name in presence of two subscribing witnesses.

FRITZ GERB.

Witnesses:
PAUL GOEPEL,
C. P. GOEPEL.