No. 665,849. Patented Jan. 8, 1901.

C. F. BERGMANN.

INTERNAL COMBUSTION MOTOR.

(Application filed Sept. 5, 1899.)

(No Model.) 4 Sheets—Sheet 1.

Fig. 2.

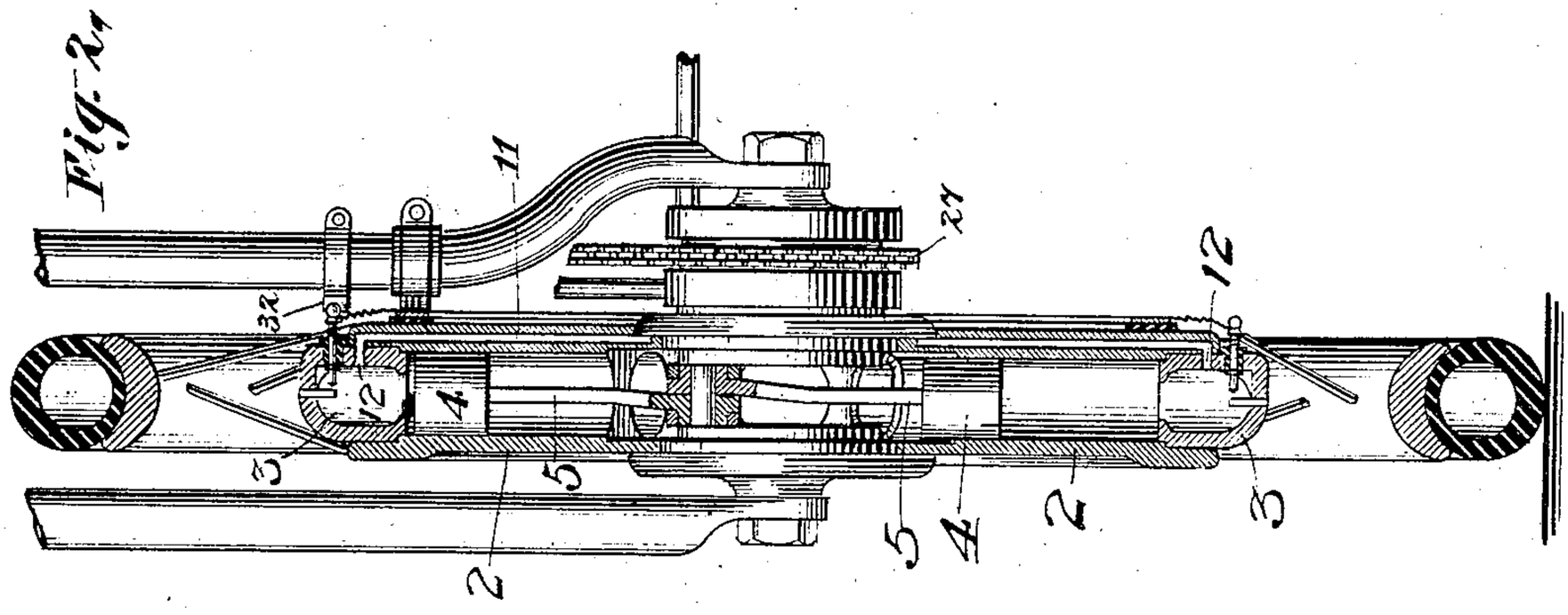
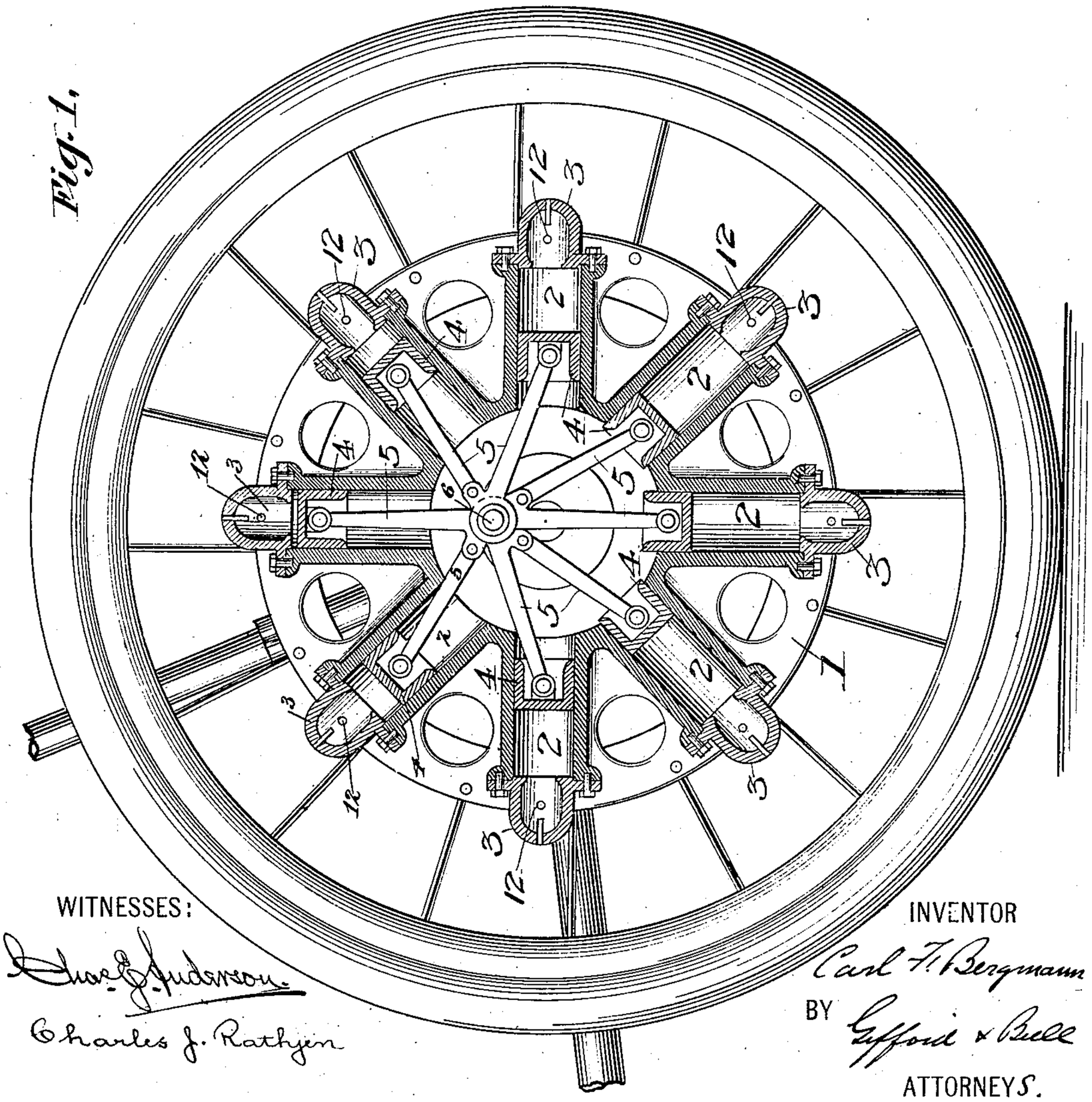


Fig. 1.



WITNESSES:

Chas. J. Anderson.

Charles J. Rathjen

INVENTOR

Carl F. Bergmann

BY Lyford & Bell

ATTORNEYS.

No. 665,849. Patented Jan. 8, 1901.

C. F. BERGMANN.

INTERNAL COMBUSTION MOTOR.

(Application filed Sept. 5, 1899.)

(No Model.) 4 Sheets—Sheet 2.

Fig. 8.

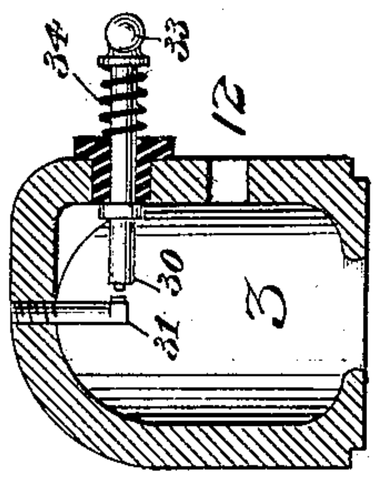


Fig. 7.

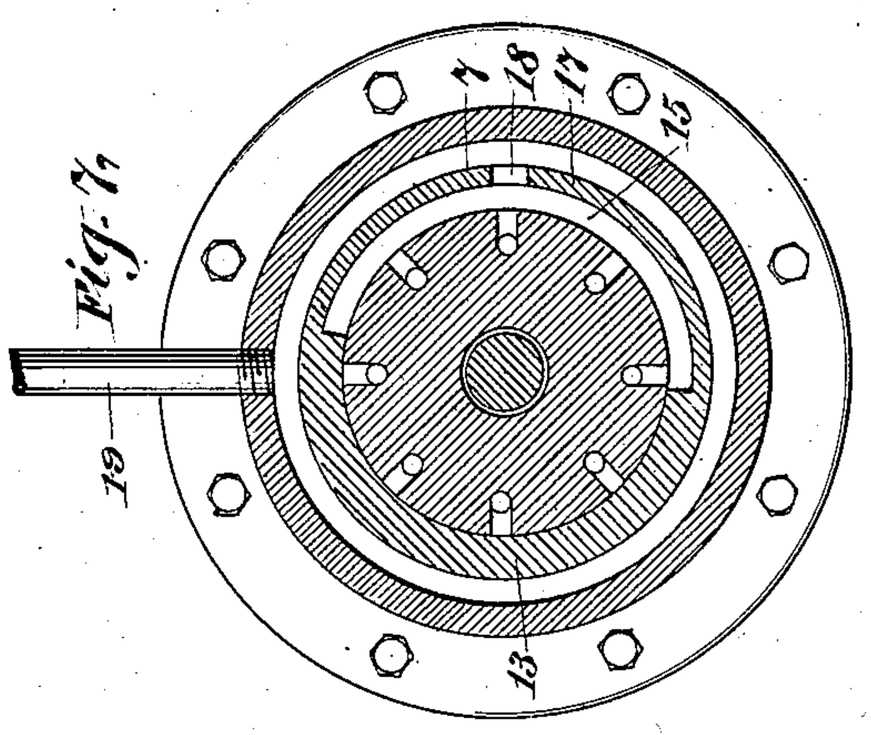


Fig. 5.

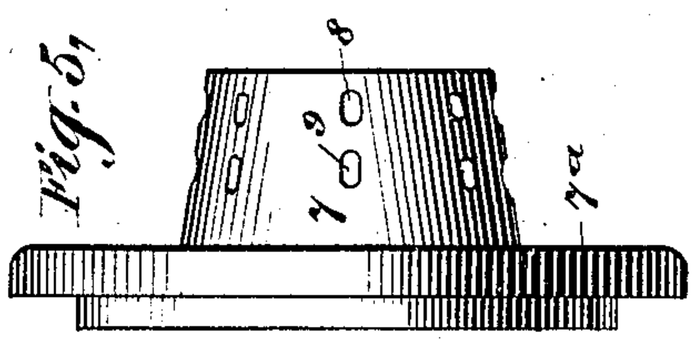


Fig. 4.

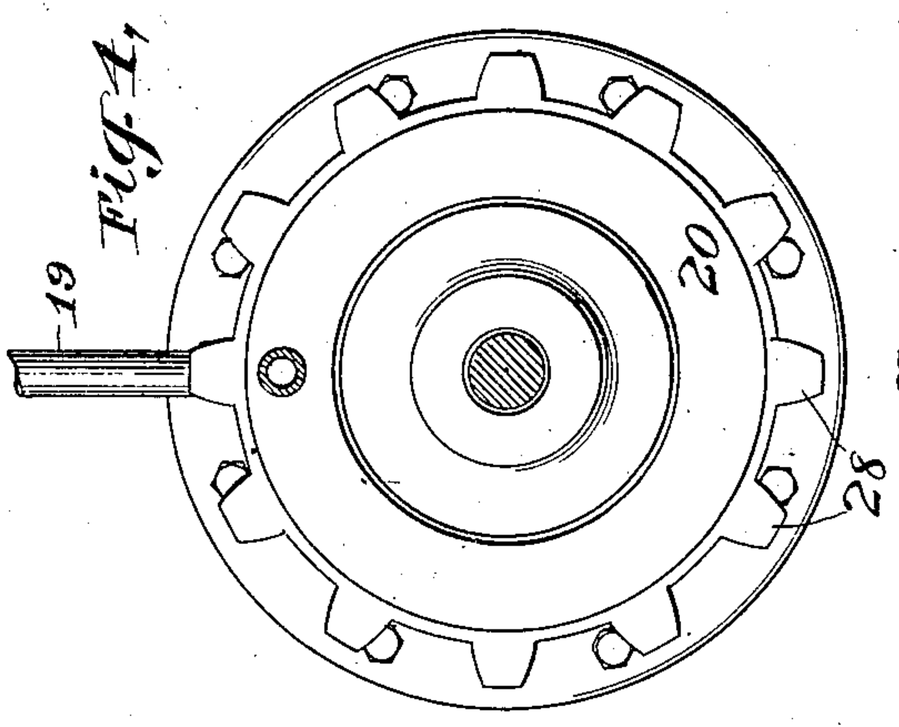


Fig. 6.

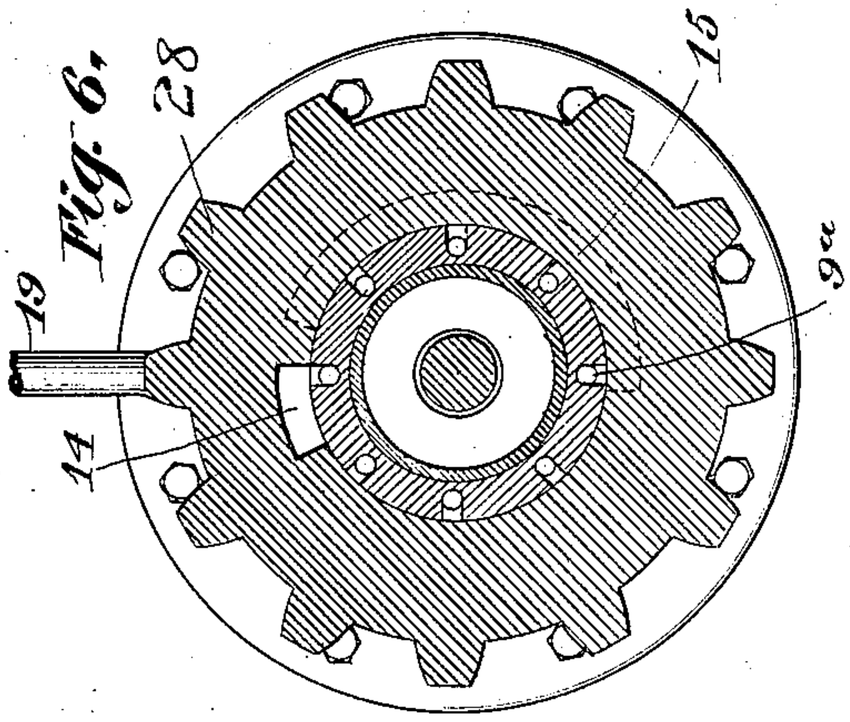
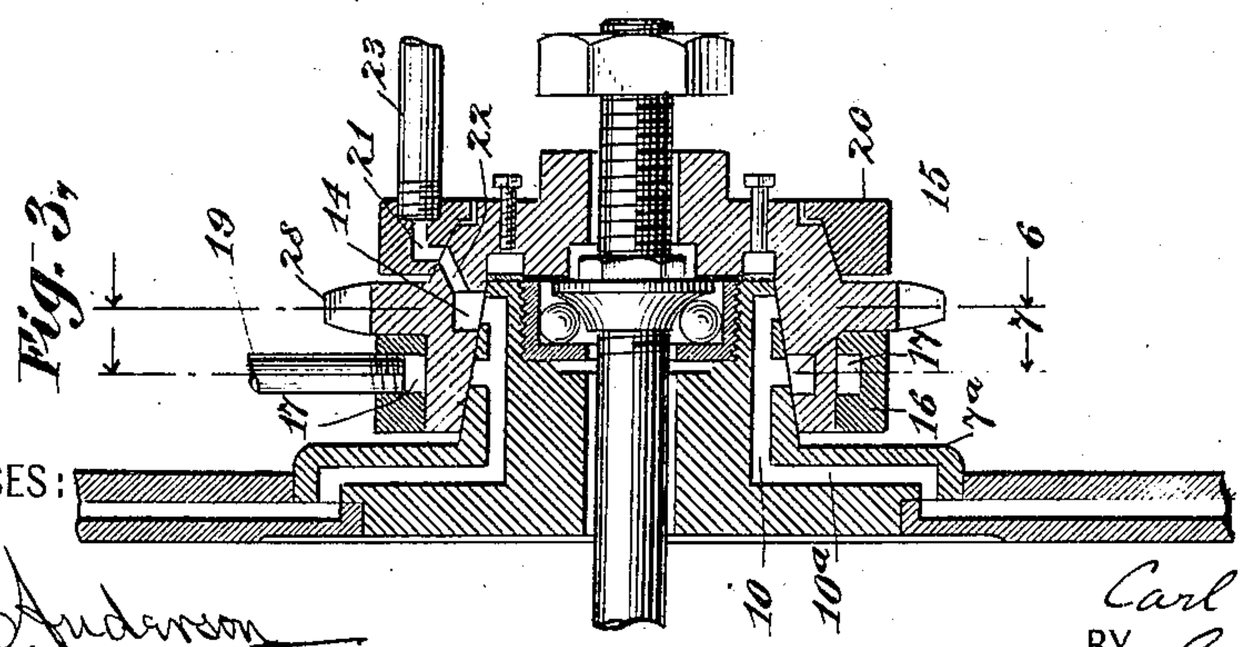


Fig. 3.



WITNESSES:

Chas. J. Anderson

Charles J. Rathjen

INVENTOR

Carl F. Bergmann

BY Gifford & Buell

ATTORNEYS.

No. 665,849. Patented Jan. 8, 1901.

C. F. BERGMANN.

INTERNAL COMBUSTION MOTOR.

(Application filed Sept. 5, 1899.)

(No Model.) 4 Sheets—Sheet 3.

Fig. 10,

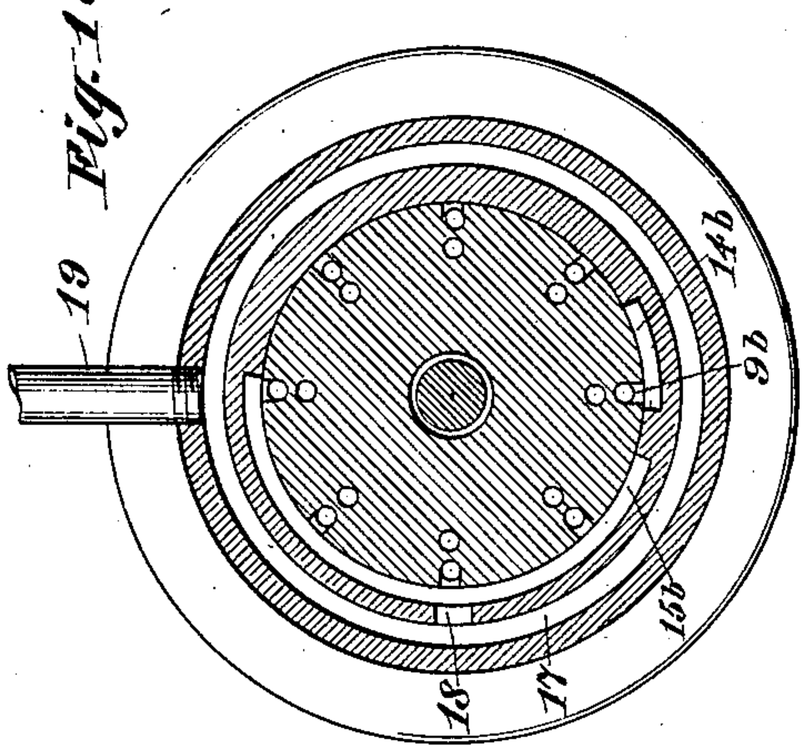


Fig. 11,

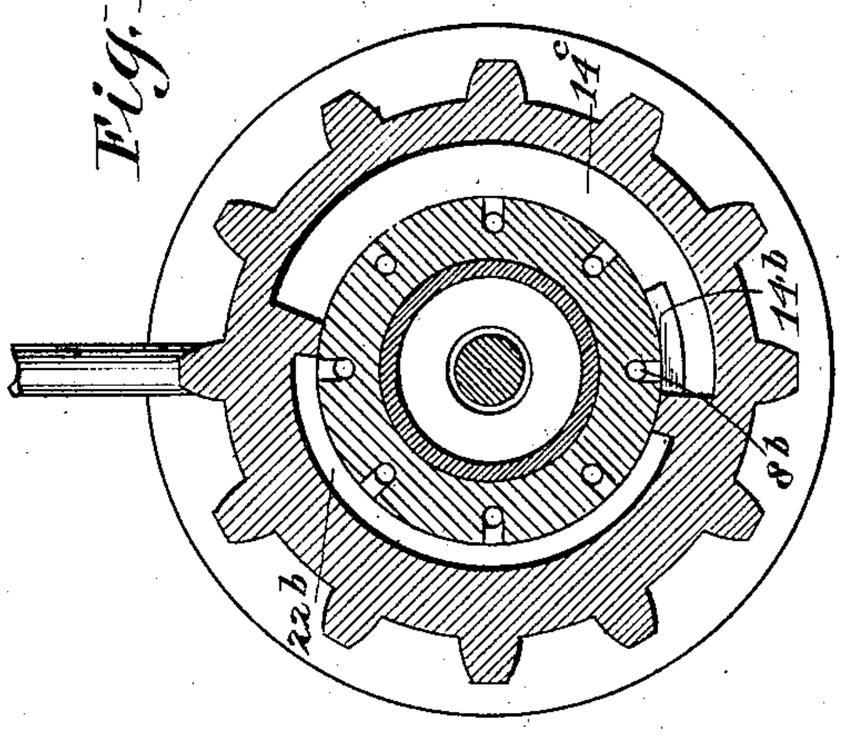


Fig. 9,

WITNESSES:

Chas. J. Anderson.

Charles J. Rathjen

INVENTOR

Carl F. Bergmann

BY Eyford & Bell

ATTORNEYS.

No. 665,849. Patented Jan. 8, 1901.

C. F. BERGMANN.

INTERNAL COMBUSTION MOTOR.

(Application filed Sept. 5, 1899.)

(No Model.) 4 Sheets—Sheet 4.

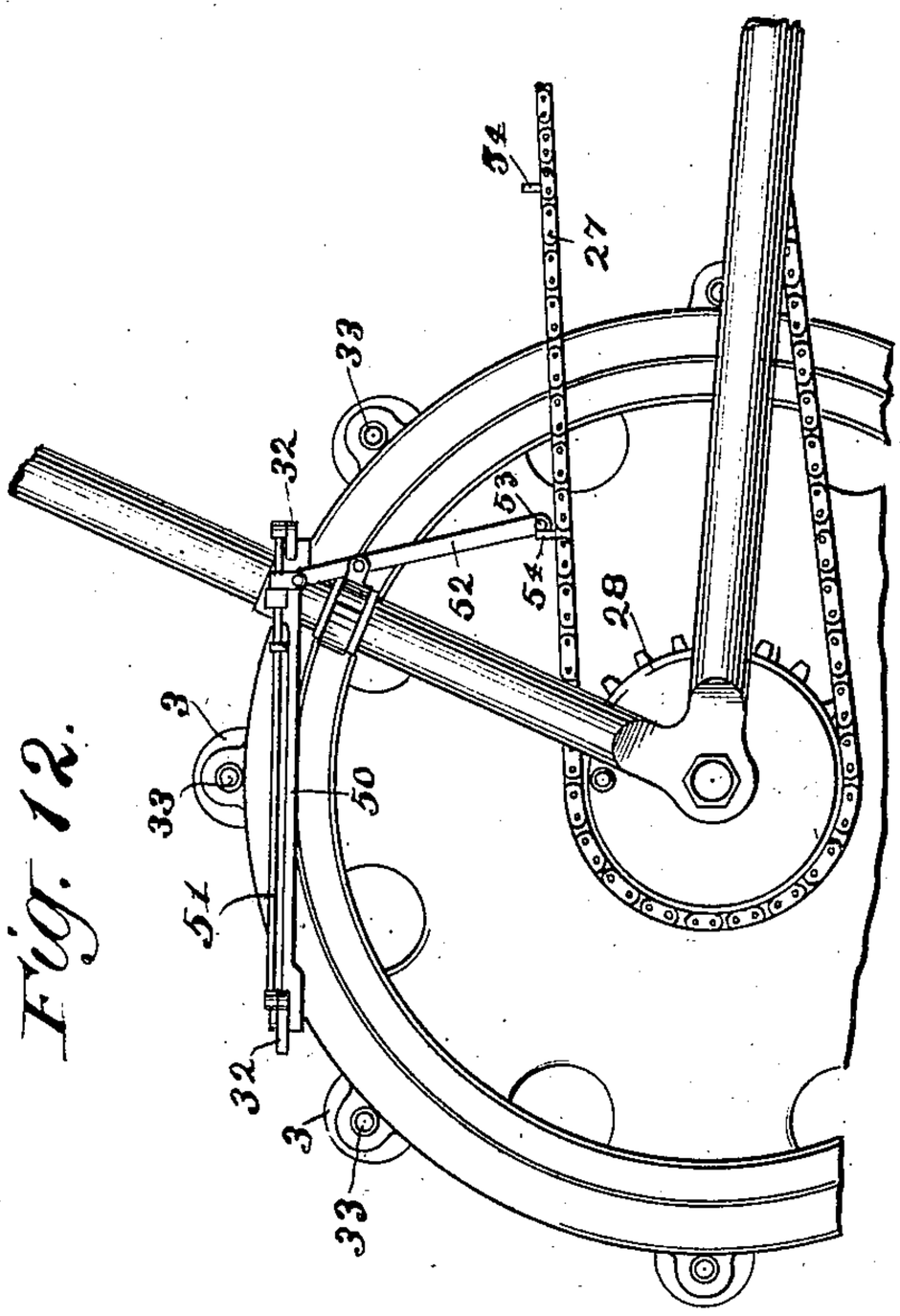


Fig. 12.

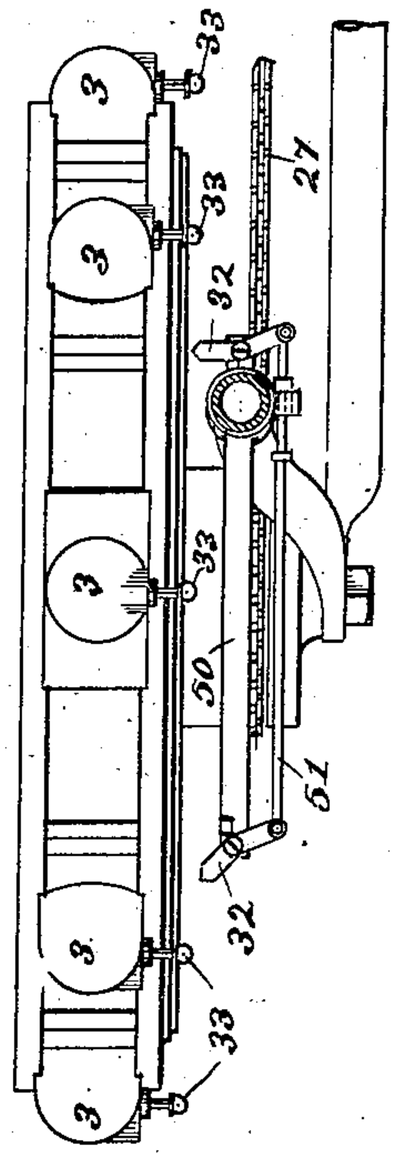


Fig. 13.

WITNESSES:

D. H. Hayward

H. L. Reynolds

INVENTOR

Carl F. Bergmann

BY

Gifford & Rule

ATTORNEYS

UNITED STATES PATENT OFFICE.

CARL F. BERGMANN, OF JERSEY CITY, NEW JERSEY, ASSIGNOR, BY DIRECT AND MESNE ASSIGNMENTS, TO THE FOYE HUB MOTOR AND AUTOMOBILE COMPANY, OF NEW JERSEY.

INTERNAL-COMBUSTION MOTOR.

SPECIFICATION forming part of Letters Patent No. 665,849, dated January 8, 1901.

Application filed September 5, 1899. Serial No. 729,467. (No model.)

To all whom it may concern:

Be it known that I, CARL F. BERGMANN, a citizen of the United States, and a resident of Jersey City, in the county of Hudson and State of New Jersey, have invented certain new and useful Improvements in Internal-Combustion Motors, of which the following is a specification.

The object of this invention is to construct an internal-combustion motor which is particularly adapted to be combined with a vehicle-wheel and also in the combination of the same with such wheel.

In the accompanying drawings, forming part of this specification, Figure 1 is a side elevation of the motor, partly in section, in position in the center of the motor-wheel. Fig. 2 is a vertical sectional elevation of Fig. 1 through the centers of opposite cylinders. Fig. 3 is a section of the mechanism by which the supply and exhaust are controlled. Fig. 4 is a front view of the same. Fig. 5 is a detail. Fig. 6 is a sectional front view on the line 6 6 of Fig. 3. Fig. 7 is a sectional front view on the line 7 7 of Fig. 3. Fig. 8 is a sectional detail. Fig. 9 is a vertical section of another form of motor. Figs. 10 and 11 are sectional details of the last taken, respectively, on the lines 10 10 and 11 11 of Fig. 9. Fig. 12 is a side elevation; and Fig. 13 is a plan of a part of the wheel, showing the means employed for reversing the engine.

In the construction shown in Figs. 1 to 8, inclusive, which illustrate a single-acting motor, 1 is a circular casting or disk mounted on the axle of the vehicle, so as to revolve thereon, to the outer edge of which are attached the spokes of the wheel, connecting the same with the rim thereof. 2 are cylinders arranged radially in the disk, each having its outer end closed by a combustion-chamber 3 and open at their inner ends. These cylinders are preferably bored within the material of the disk, but may be constructed in any other suitable manner. In each of the cylinders is a piston 4, to which is attached a piston-rod 5. The outer end of each piston-rod is secured by suitable connections to a stationary pin 6, which is eccentric to the axis of rotation and corresponds with the usual crank-pin.

The charge, consisting of a proper mixture of air and hydrocarbon vapor or gas under compression, enters through the pipe 23 from any suitable source and is then directed and controlled by the following mechanism: On one side of the motor, concentrically attached to the disk 1, is a cone-shaped hub 7, which revolves, with the disk, around the axle. Around the side or face of the cone, arranged in pairs, one in front of the other, are two rows of ports or openings 8 and 9, the former or front row of which forms the intake-ports, through which the charge enters the cylinders, and the other or rear row 9 of which forms the exhaust-ports. Each pair of ports or openings 8 and 9 open into a channel or duct 10 10^a, formed in the cone and its flange 7^a and so arranged as to communicate with channels 11 in the disk 1 when in front of each of the series of cylinders. One of these channels and its connected port is provided for each cylinder. Each channel 11 opens into the combustion-chambers 3 at the outer end of the cylinder to which it belongs through the opening 12. The cone-hub 7 revolves in a movable ring 13, held in place on the axle, the inner surface of which is shaped to conform to the side of the cone. In this inner face are formed a nearly-semicircular groove 15, which is adapted to register with the row of ports 9, and a groove 14 of about one-eighth circumference, which is adapted to register with the row of ports 8. Obviously now the exhaust-port 9 corresponding with each cylinder will register with the groove 15 during nearly one-half of a revolution and will be closed on the other one-half of the revolution. During said other half of the revolution the intake-port 8 leading to the same cylinder will for about one-eighth of a revolution register with the groove 14. Both the intake-port 8 and the exhaust-port 9 leading to each cylinder will be closed during about three-eighths of a revolution. These are the conditions existing where the motor contains eight cylinders, as shown in the drawings, but obviously the length of the intake-groove 14 would be varied if the

number of cylinders employed should be different. The ring 13 is capable of a half-revolution around the cone 7, whereby the grooves 14 and 15 are brought into communication with the intake and exhaust ports, respectively, on the opposite side of the cone and the channels 10, 10ª, and 11, and the respective cylinders connected therewith which before communicated with the intake-ports and received the explosive mixture are now brought into connection with the exhaust-ports, and the motor is reversed. Around the rear part of the ring 13, next to the cone-flange 7ª, is a fixed ring 16, having a circular groove 17 on its inner surface corresponding in position with the groove 15 in the ring 13 and communicating with the latter groove through the opening 18. 19 is a pipe through which the exhaust escapes from the groove 17. At the front edge of the ring 13 is another fixed ring 20, having a channel 21 communicating with the channel 22 in the ring 13 which opens into the groove 14 during about one-eighth of the revolution. 23 is the pipe through which the gaseous charge is supplied suitably compressed. This compression may be accomplished in any suitable apparatus by power taken in any suitable manner from the motor itself or other source of power.

The operation is as follows: Supposing the several parts are in the position shown in Fig. 3, the gas, suitably mixed and compressed for combustion, passes through the inlet-pipe 23 and through the channels 21 and 22 into the groove 14 in the ring 13, and thence enters the intake-port 8 which is at the time communicating with it. Thence it passes through the channels 10 10ª 11, which connect with said port 8, to the combustion-chamber 3 of the cylinder connected therewith. The piston of this cylinder is at about the outermost point of its stroke in the cylinder, as shown in Fig. 1. A little in advance of this action the opposite port 9 has registered with the exhaust-groove 15, so as to exhaust the gases from the opposite cylinder. As the motor continues its rotation the port 8 maintains communication with the intake-groove 14 for about one-eighth of a revolution or until the piston has been drawn in by the eccentric-pin 6 about one-eighth of its stroke, thus filling the combustion-chamber and a portion of the cylinder with the charge of combustible gas. Then the port 8 passes beyond the end of the intake-groove 14, and the combustion-chamber and cylinder remain cut off from both the intake and the exhaust until the port 8 has advanced about three-eighths of a revolution and has reached the commencement of the exhaust-groove 15. As soon as this cut off is initiated an electric spark is produced to ignite the mixture between the terminals 30 and 31 by the action of a fixed cam-surface 32 against the head of the firing-pin 33, which forces said firing-pin forward against the force of the spring 34, and the expansive force of the gases due to combustion is exerted to force the piston through the balance of its stroke, whereupon just before it reaches the inner end of its stroke its combustion-chamber and cylinder are connected with the exhaust-groove 15 by the registering therewith of its port. The pistons on one side of the motor are being forced inward by the pressure of the exploded gases, thus exerting power to turn the motor, while those on the opposite side are moving outward, forcing out the spent gases. To reverse the direction of the motor, the ring 13 is revolved on the cone 7 half-way around by any suitable means. The means herein shown consists of a sprocket-chain 27, which engages with the teeth 28 on the rim of the ring and which may be conducted to another sprocket-wheel located at any convenient point and provided with any means for turning it. At the same time it is necessary that the member 32, which actuates the firing device, be shifted to the opposite side of the dead-point or the point where the pistons are at their extreme outer position. This dead-point in the device, as shown in the drawings, is directly over the wheel-axle. This shifting may be done in many ways, one way for doing this being shown in Figs. 12 and 13. In these figures the cam-surfaces are formed upon the ends of short levers 32, which are pivoted upon a bar 50, which in turn is secured upon the frame and extends an equal distance upon each side of the dead-point above mentioned. The two levers 32 are connected by a link 51, which holds them at a different angle, so that when one is projecting so as to engage the firing-pins the other is withdrawn from engagement therewith, as is shown in Fig. 13. The link is connected with the lever 52, which is engaged by projecting arms upon pins 54, carried by the chain 27 used for turning the valves 28, and is thereby swung so as to shift the cams or tappets 32, which constitute the firing member.

I will next describe the construction and operation of the form shown in Figs. 9, 10, and 11 in so far as it differs from that before described. The pistons and cylinders are here of differential form, so that the piston presents the major surface 4ª, against which the explosion occurs, and the minor surface 4ᵇ, which compresses the charge. In these figures the parts are arranged so that the explosion will take place at the end of about one-eighth of a revolution after the combustion-chamber has passed its lowermost position. Thus in Fig. 9 the combustion-chamber 3ᵇ is at its lowermost position and its piston is at the outer dead-center and its port 9ᵇ is commencing to communicate through the passage 14ᵇ (one-eighth circumference in length) with a compression-space 14ᶜ, (nearly one-half circumference in length,) into which the combustible mixture has been compressed by the minor piston-surface 4ᵇ during the previous one-half revolution. During the succeeding one-eighth revolution a part of the

compressed combustion mixture in 14^c will pass through 14^b, 9^b, 11^b, and 12^b into the combustion-chamber 3^b. As soon as the port 9^b passes beyond the end of passage 14^b the combustion-chamber 3^b is cut off and the charge therein is ignited by the spark between the terminals 30^b and 31^b. During the succeeding nearly three-eighths revolution the compression-space 14^c communicates with the minor cylinder portion 2^b, so that the combustion mixture contained in the minor cylinder portion 2^b is forced through the passages 40 41 and the port 8^b into the compression-space 14^c, wherein the combustion mixture will be simultaneously compressed from four cylinders. When the piston has nearly reached the inner end of its stroke, its port 8^b will pass beyond the end of the compression-space 14^b and will next connect with the nearly semicircular groove 22^b, which receives a supply of combustible mixture from the supply-passages 23, 21, and 22. At the same time the combustion-chamber 3^b is connected with the exhaust-passages 17, 18, and 19 through the passages 12^b, 11^b, 9^b, and 15^b. During the succeeding nearly half-revolution as the piston is advancing from its innermost position toward its outermost position the minor piston-face 4^b is drawing a new supply of combustion mixture into the cylinder-space 2^b, and the major piston-face 4^a is forcing the spent gases through the exhaust.

From the above description of Figs. 9, 10, and 11 it will be seen as follows: During nearly one-eighth revolution the minor surfaces 2^b of four of the pistons will be compressing the combustion mixture into the compression-chamber 14^c through their ports 8^b, while the minor surfaces 2^b of the other four pistons are cut off from said compression-chamber 14^c and are drawing in new supplies of combustion mixture. During the same nearly one-eighth revolution the major surface 4^a of one piston is receiving a new charge of compressed combustion mixture through its port 9^b from the compression-chamber 14^c while the major surfaces of three pistons are receiving their explosions and while the major surfaces of the other four pistons are expelling their spent gases through the exhaust. Each piston during its travel toward the outer end of its cylinder has the space between its inner surface 4^b and the inner end of the cylinder connected with the supply of hydrocarbon mixture and fills said space with the explosive mixture. During the inward travel of the piston in the cylinder the connection is shifted by the valve, so that the mixture is compressed before the piston and discharged into the space 14^c in the valve, from which it is discharged through one of the passages 11^b into that one of the combustion-chambers 3^b which is at the time in communication with the space 14^b in the valve. Each combustion-chamber receives its charge separately and in succession, while compression of the mixture takes place in several cylinders at once and in those which are located upon the opposite side of the wheel from the cylinder which receives the compressed charge. The annular surface 4^b of the pistons and the inner end of the cylinders thus act as compressors for the explosive mixture, delivering the same successively to the combustion-chambers 3. As the space 14^b extends through only about one-eighth of the circumference and there are eight cylinders, each cylinder in succession receives the mixture discharged from the four cylinders which are on their compression-stroke. It will thus be seen that the cylinders work on the two-cycle plan and serve the double function of compressor and power development. The compression of the mixture is accomplished in the inner end of the cylinder and the power of the exploded mixture exerted in the outer end of the cylinder.

I claim—

1. An internal-combustion motor comprising a series of rotating cylinders and pistons therein connected with a common crank-pin, said motor being provided with ports leading from both ends of the cylinders toward the crank-center, and a valve having ports adapted to communicate with the cylinder-ports to alternately connect one end of the cylinders with the supply of combustion mixture and with the opposite end of one of the cylinders whereby one end of the cylinders is used to compress the combustion mixture and the other for its ignition, means for igniting the mixture in the latter end of the cylinders, and means for shifting the valve and the igniting mechanism to introduce the combustion mixture to and ignite it in the cylinders upon opposite sides of the dead-center, substantially as described.

2. An internal-combustion motor having a series of rotating cylinders each of two diameters, and pistons therein of corresponding diameters, said cylinders having ports leading from each end to a common central valve-seat, and a valve common to all the cylinders and provided with means for connecting the annular end of each cylinder with the supply of combustion mixture during the outward or suction travel of said pistons, and for momentarily connecting the outer ends of each cylinder in succession at the beginning of its inward travel with the inner ends of those cylinders in which the combustion mixture is being compressed by the inward travel of their pistons, and for exhausting the exploded gases on the return or outward travel of the pistons, substantially as described.

3. An internal-combustion motor having a series of rotating cylinders each consisting of two parts of different diameters, and pistons therein of corresponding diameters, said cylinders having ports extending from each end to a common central valve-seat, and a valve common to all the cylinders and provided with means for connecting the annular end of each cylinder with the supply of combustion mix-

ture during the outward or suction travel of said pistons, and for momentarily connecting the outer ends of each cylinder in succession at the beginning of its inward travel with the inner ends of those cylinders in which the combustion mixture is being compressed by the inward travel of their pistons, means for exhausting the exploded gases on the return or outward travel of the pistons, and means for shifting the valve to introduce the compressed combustion mixture to the ignition end of the cylinders on opposite sides of the dead-center whereby the engine may be reversed.

CARL F. BERGMANN.

Witnesses:
CHAS. E. ANDERSON,
CHARLES J. RATHJEN.