No. 742,493. PATENTED OCT. 27, 1903.

L. ROEDEL.

INTERNAL COMBUSTION ENGINE.

APPLICATION FILED MAR. 9, 1903.

NO MODEL. 6 SHEETS—SHEET 1.

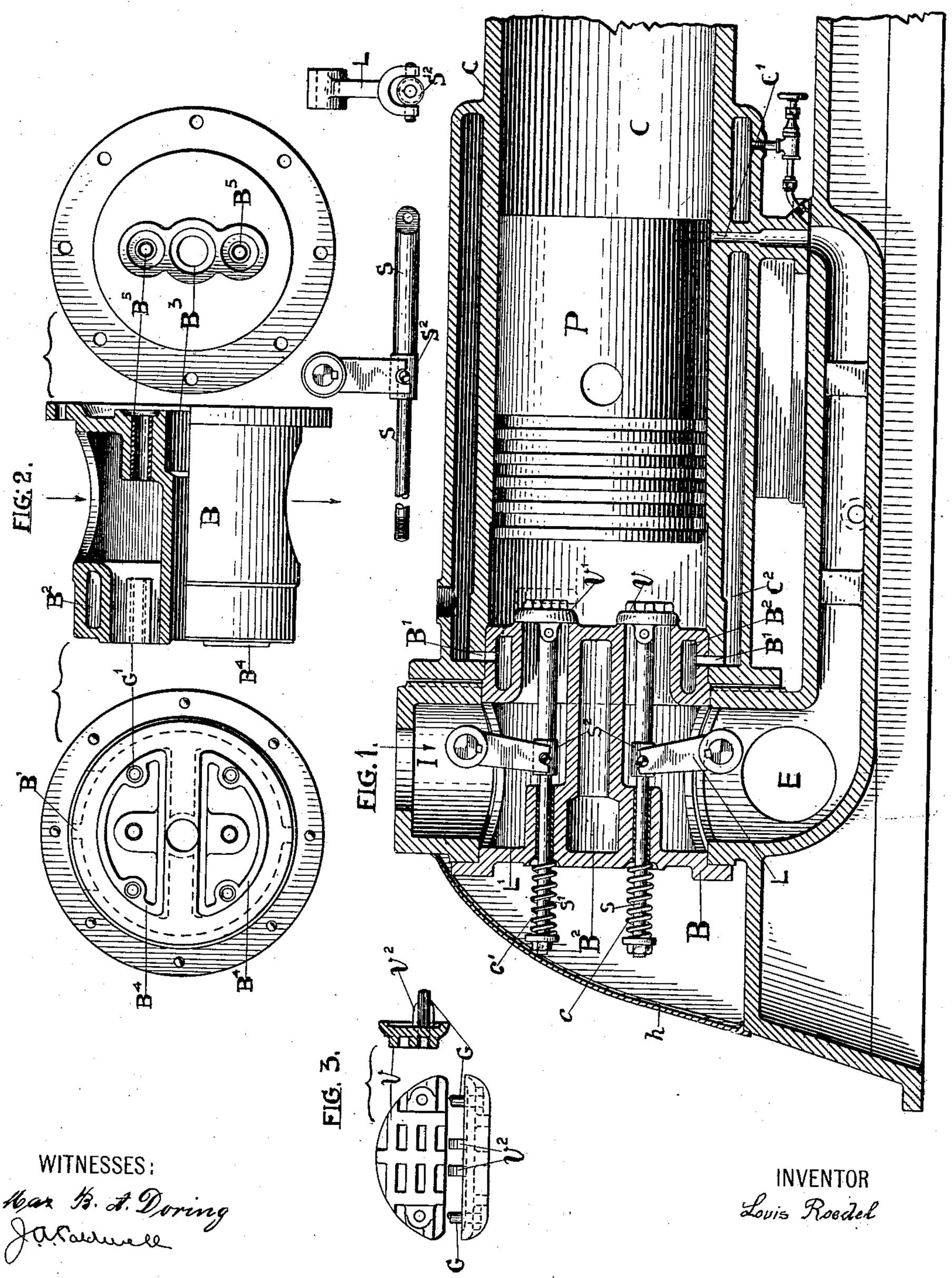

FIG. 2.

FIG. 1.

FIG. 3.

WITNESSES:

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NO MODEL. 6 SHEETS—SHEET 2.

FIG. 7.

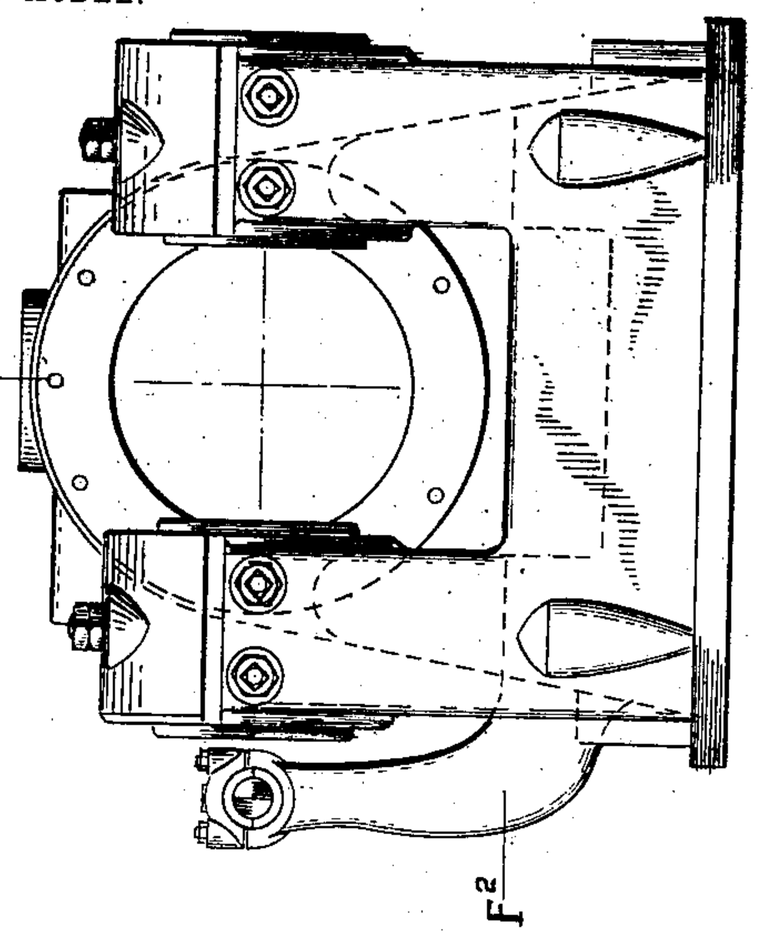


FIG. 4.

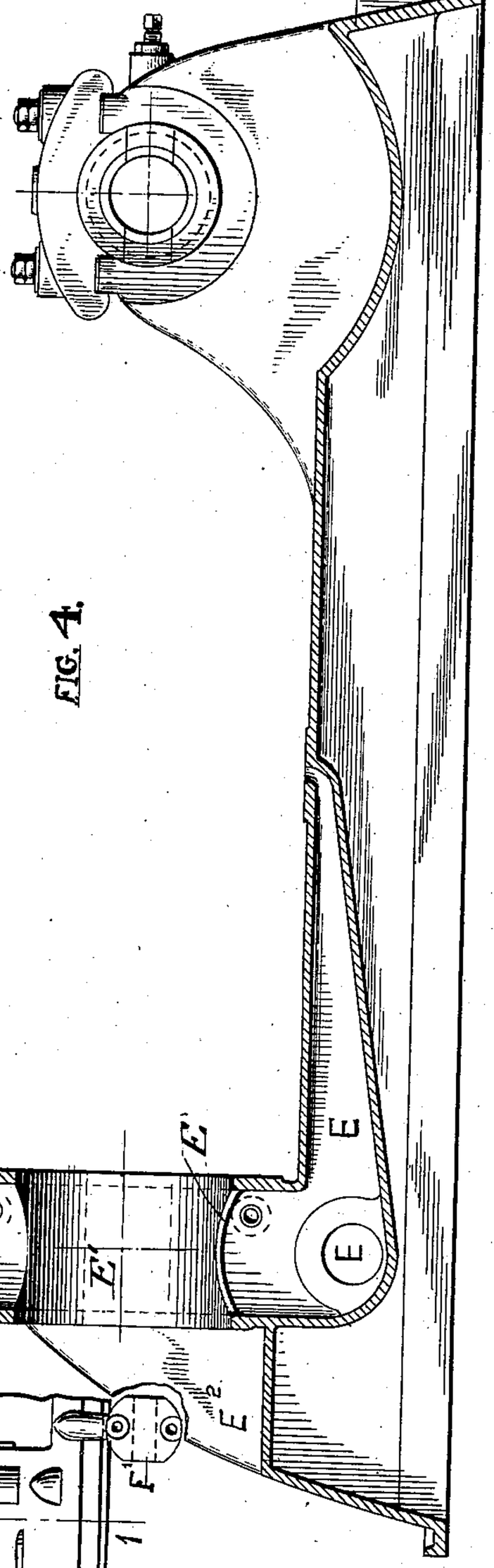


FIG. 5.

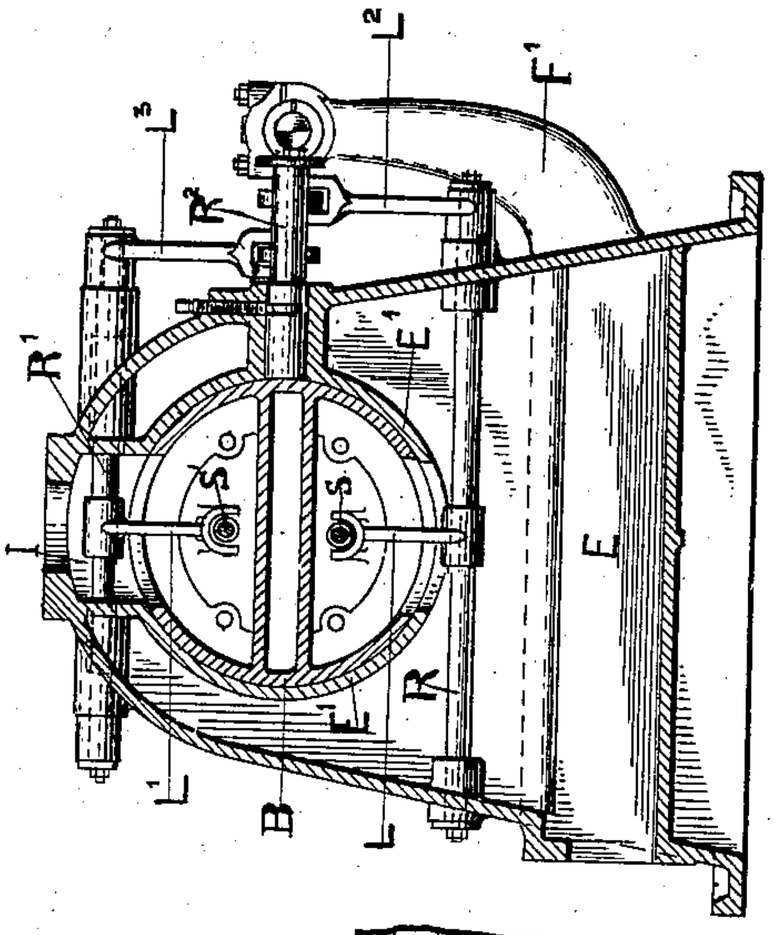
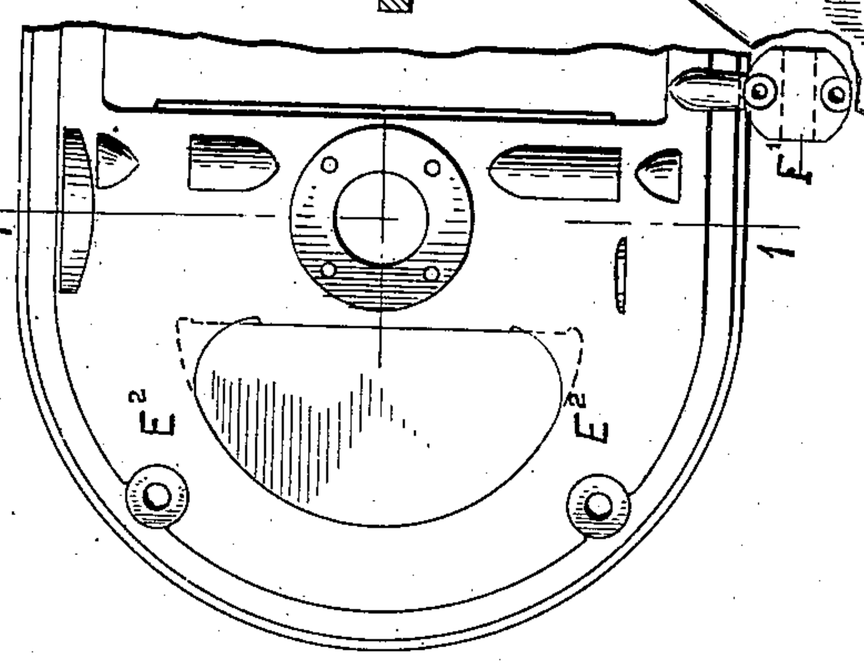


FIG. 6.



WITNESSES:

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NO MODEL. 6 SHEETS—SHEET 3.

FIG. 8.

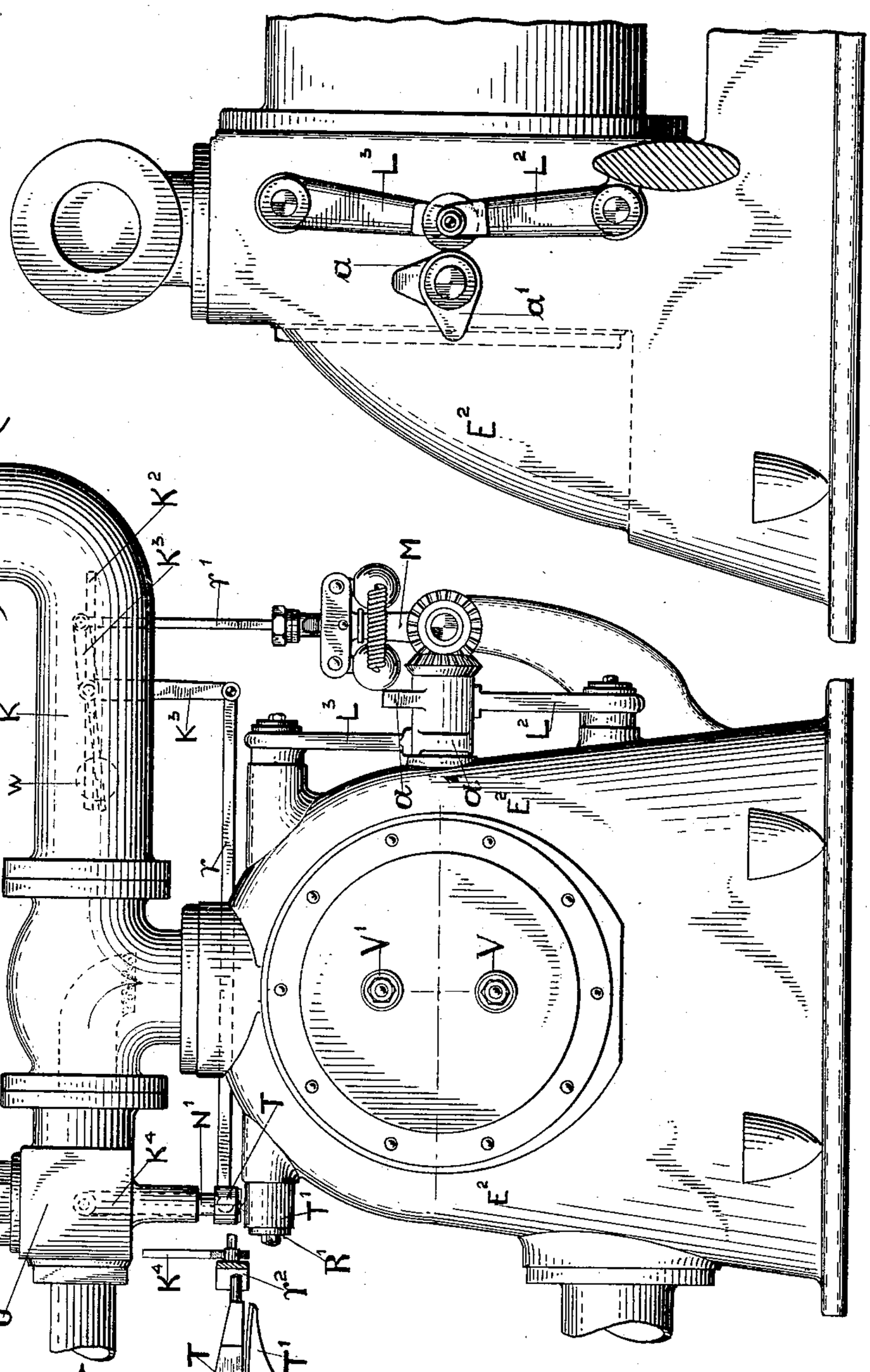

FIG. 11.

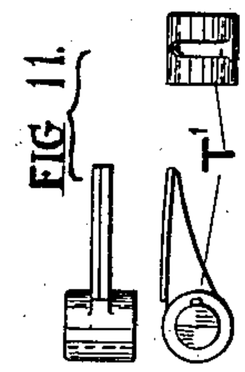

FIG. 10.

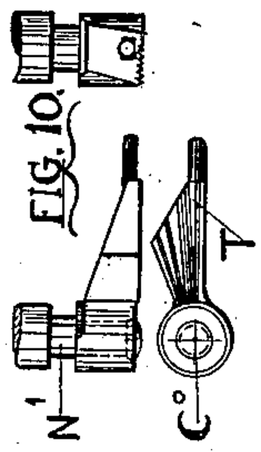

FIG. 9.

FIG. 12.

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NO MODEL.

6 SHEETS—SHEET 4.

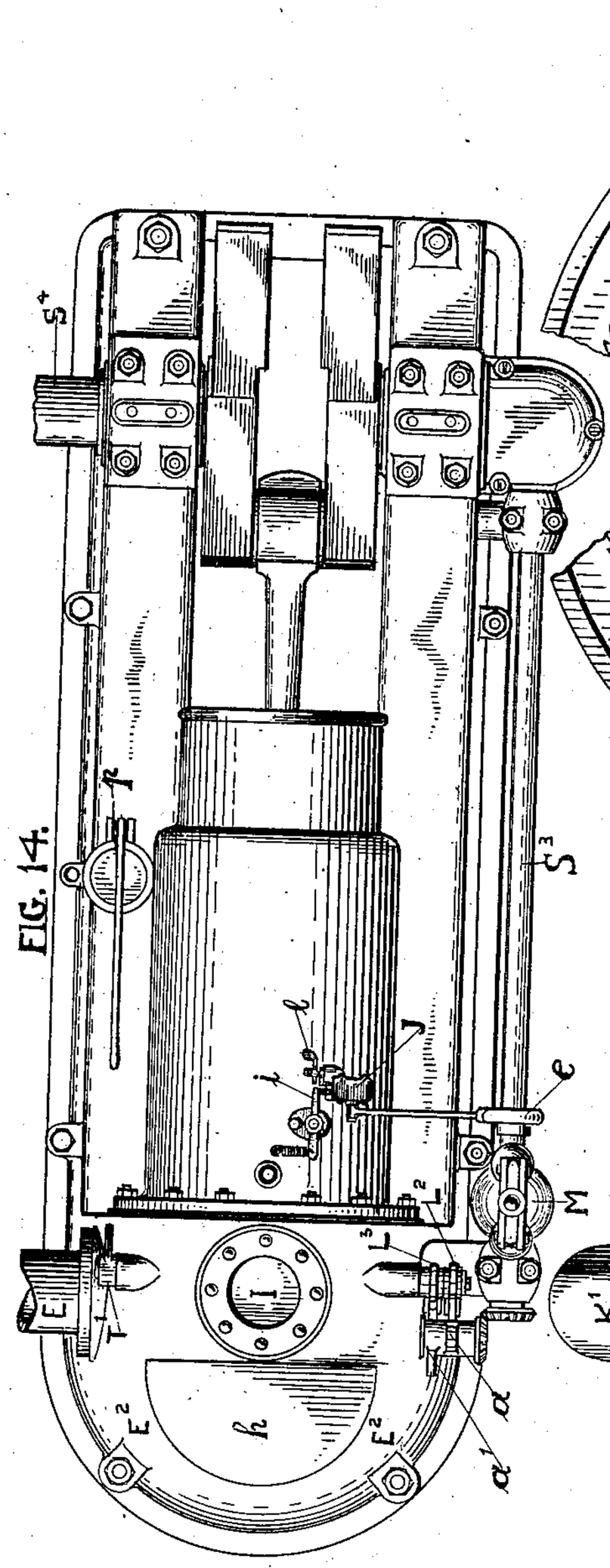

FIG. 14.

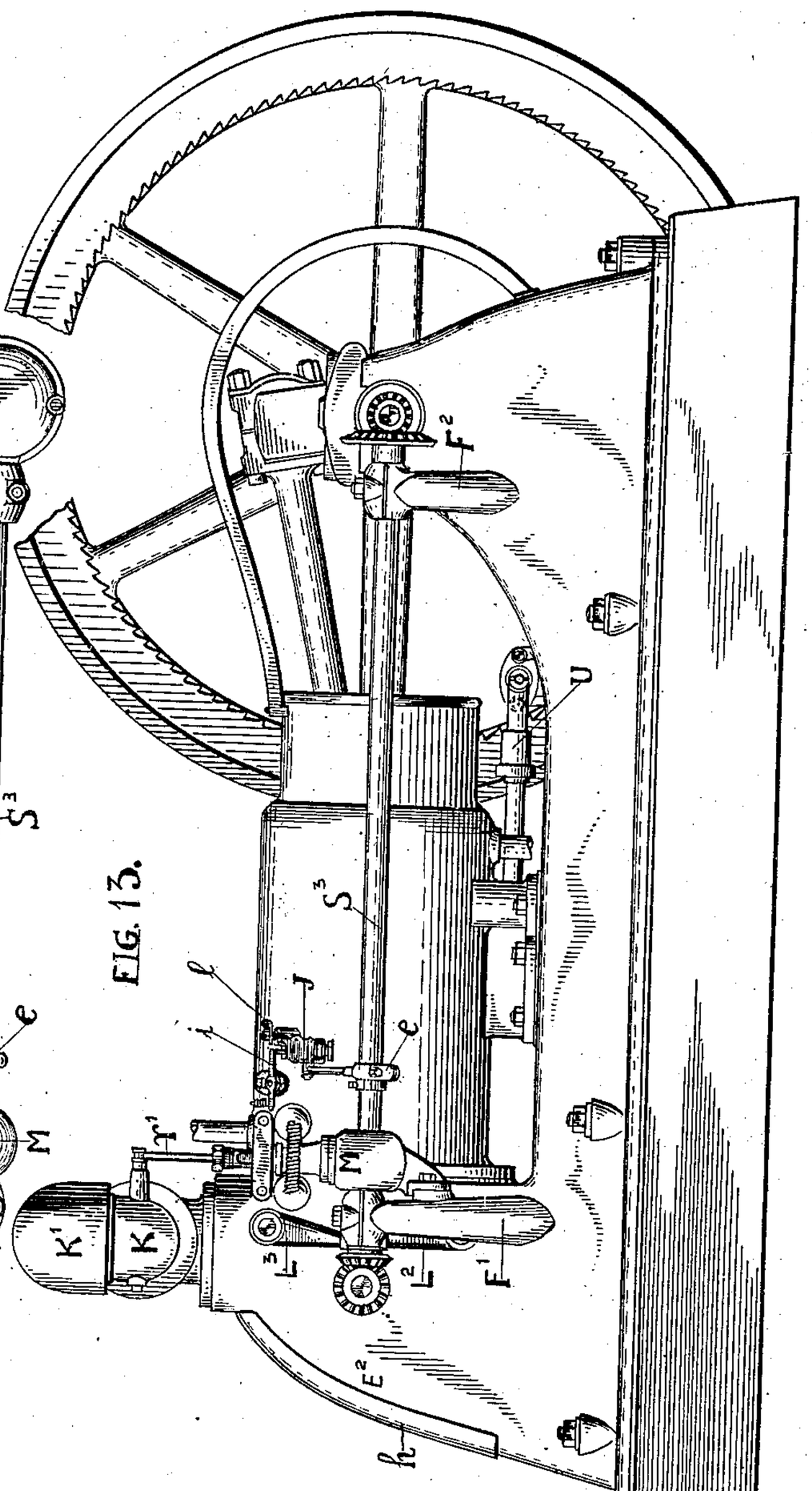

FIG. 13.

WITNESSES:

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APPLICATION FILED MAR. 9, 1903.

NO MODEL. 6 SHEETS—SHEET 5.

FIG. 18.

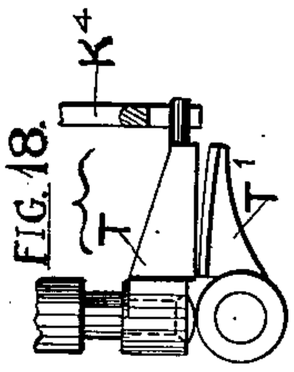


FIG. 19.

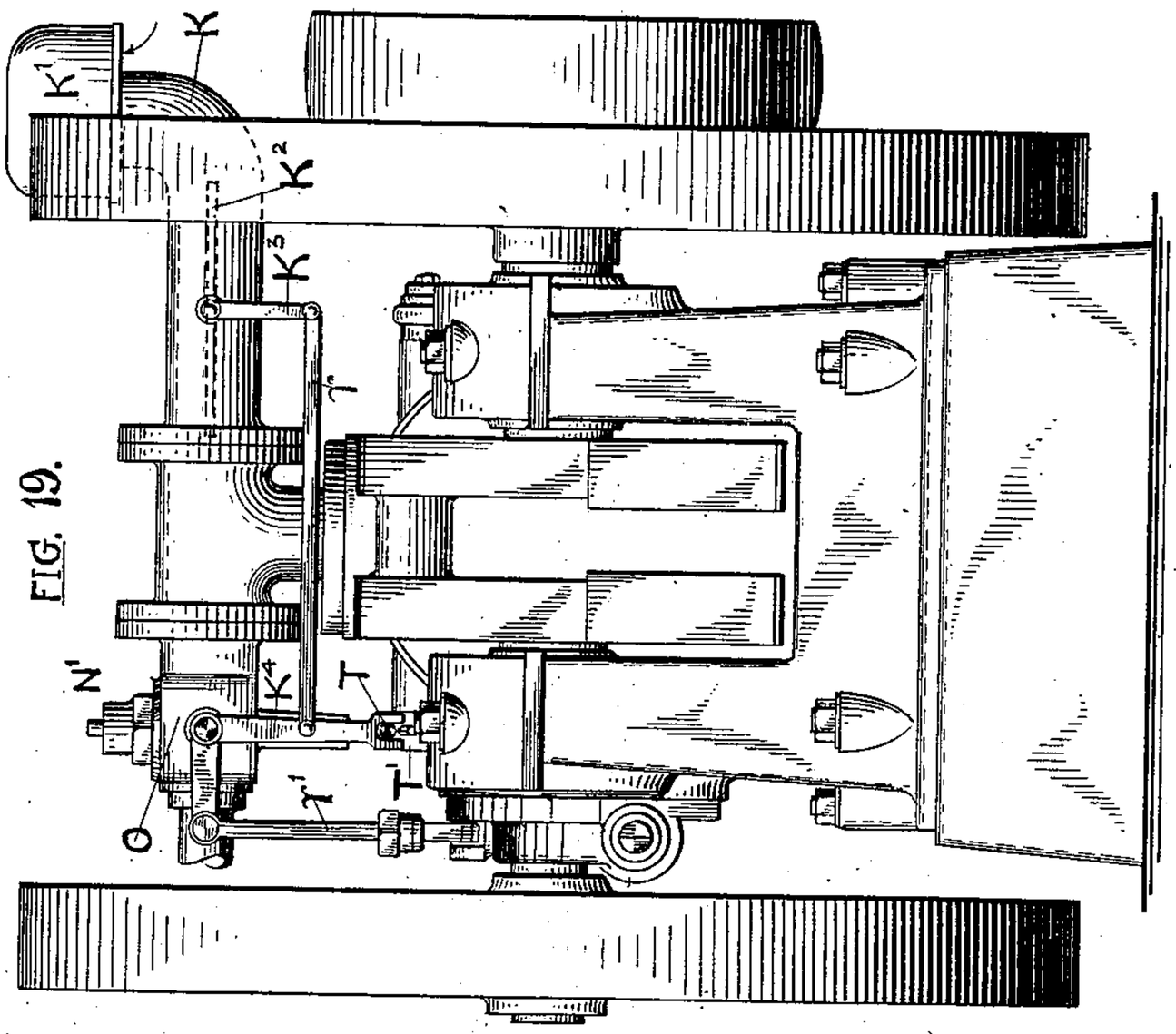


FIG. 17.

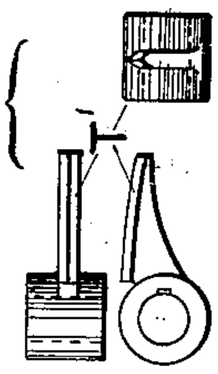


FIG. 16.

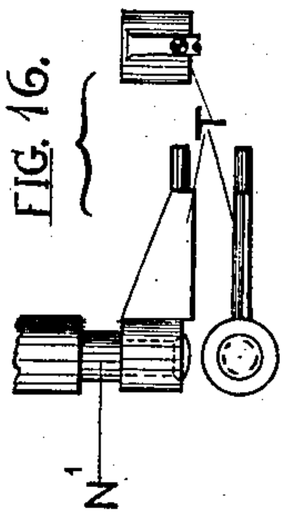
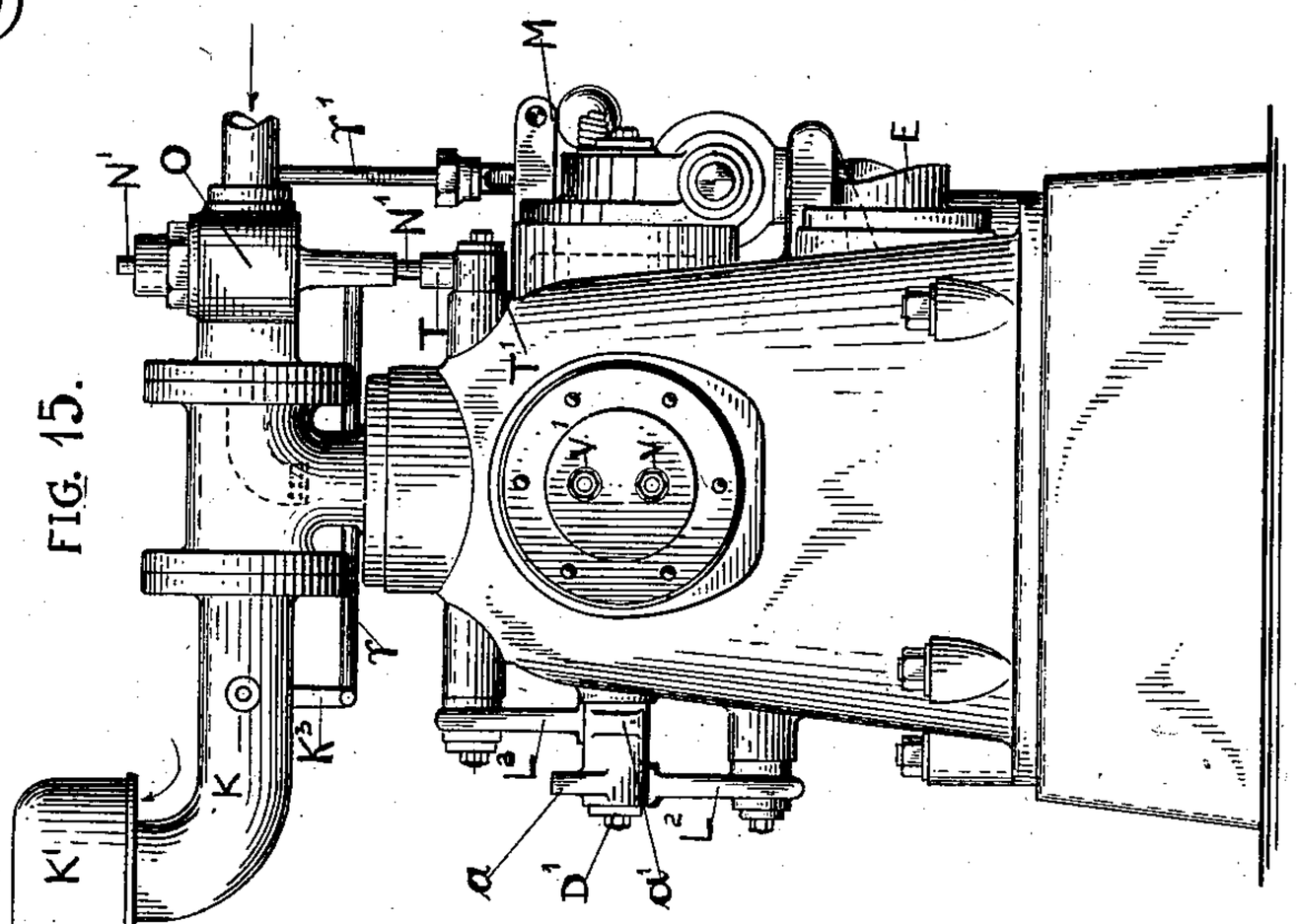


FIG. 15.



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NO MODEL. 6 SHEETS—SHEET 6.

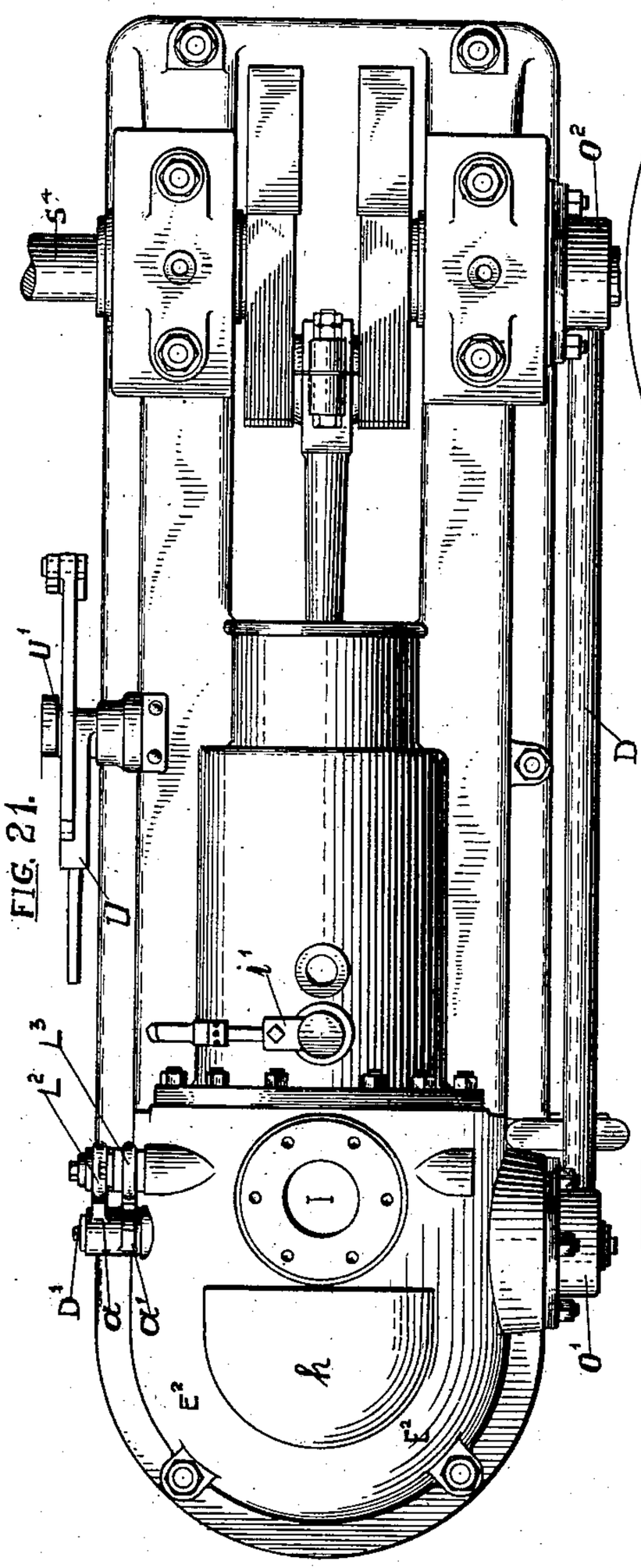

FIG. 21.

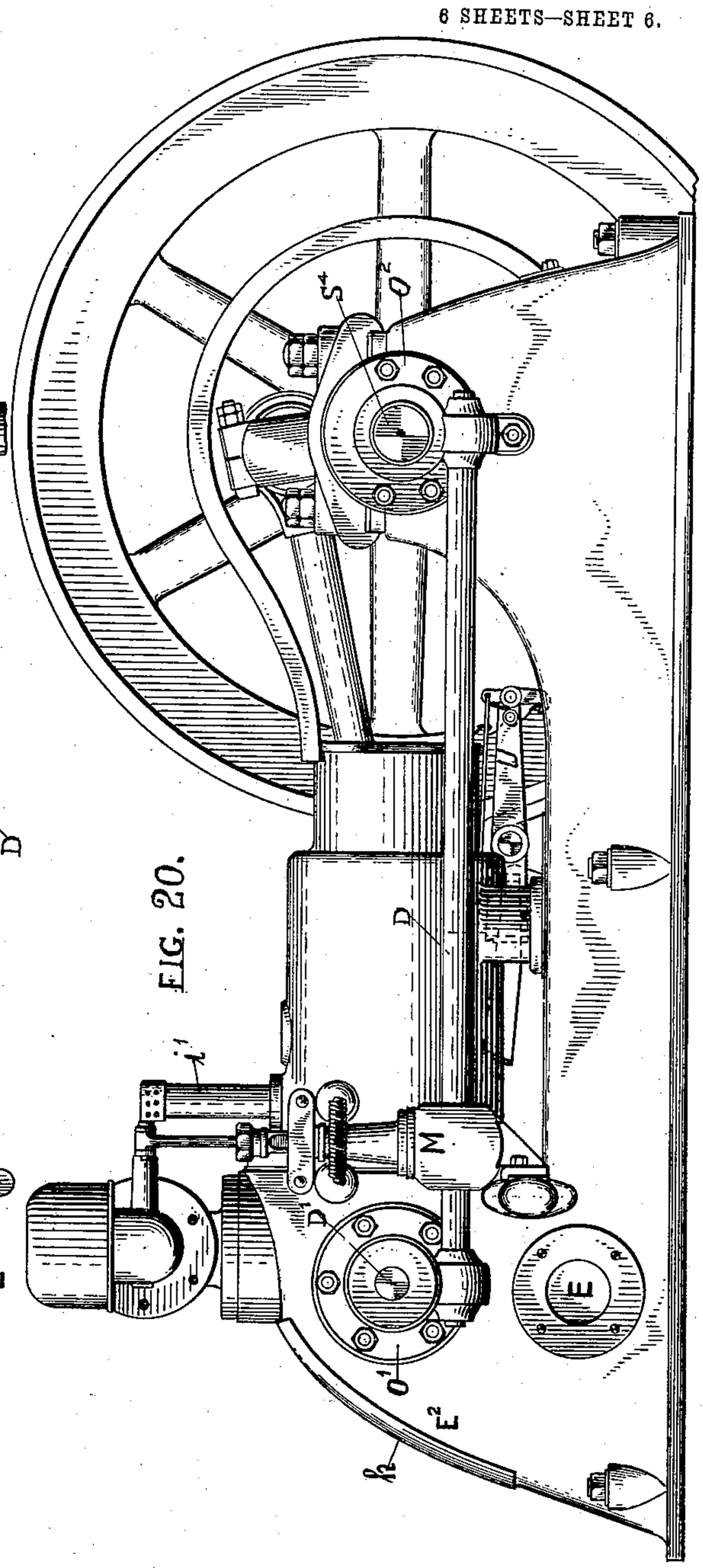

FIG. 20.

WITNESSES:

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J. A. Caldwell

INVENTOR

Louis. Roedel.

No. 742,493. Patented October 27, 1903.

UNITED STATES PATENT OFFICE.

LOUIS ROEDEL, OF PASSAIC, NEW JERSEY.

INTERNAL-COMBUSTION ENGINE.

SPECIFICATION forming part of Letters Patent No. 742,493, dated October 27, 1903.

Application filed March 9, 1903. Serial No. 146,867. (No model.)

To all whom it may concern:

Be it known that I, LOUIS ROEDEL, a citizen of the United States, residing at Passaic, in the county of Passaic and State of New Jersey, have invented certain new and useful Improvements in Internal-Combustion Engines, which improvements are fully set forth in the following specification.

This invention relates to improvements in structures of that class employed for generating power through the ignition of a confined power medium, such structures being commonly known as "internal-combustion engines."

The object of this invention is to provide an engine of the character above indicated which shall be simple and inexpensive as regards construction, durable, efficient, and reliable in operation, and which shall possess certain well-defined advantages over prior analogous structures, particularly in connection with the production, assembling, relatively adjusting, fitting, and interchanging of the principal parts thereof, such parts being each specially formed with a view to facilitating the work of machining the same, and particularly with respect to the ratio of the piston-stroke to the diameter of the cylinder employed, said ratio being materially greater than heretofore obtained and the valve area being increased accordingly.

The invention consists in the employment of certain parts novel as to form, in the novel disposition and relative arrangement of the various parts thereof, in certain combinations of the latter, and in certain details of construction, all of which will be specifically referred to hereinafter and set forth in the appended claims.

The invention is clearly illustrated in the accompanying drawings, wherein similar reference-letters denote corresponding parts throughout the several views.

In said drawings, Figure 1 is a vertical longitudinal section taken through the center of the cylinder and frame or bed employed. Fig. 2 is a detail view, partly in section, showing the valve-box which constitutes an element of my improved engine. Fig. 3 is a detail view showing the form and construction of the valves which I employ for controlling the inlet and outlet ports of the cylinder. Fig. 4 is a vertical longitudinal section taken through the center of the frame or bed. Fig. 5 is a vertical section along the line 1 1 of Fig. 6. Fig. 6 is a fragmentary plan view of the rear end of the frame or bed. Fig. 7 is a view in elevation of the front end of the frame or bed, showing the main bearings with the caps therefor in place. Fig. 8 is a view in side elevation of the rear portion of the frame or bed, showing certain minor parts conjoined therewith. Fig. 9 is a view in elevation of the rear end of said engine, the inlet and outlet pipes made use of being included in this view. Figs. 10, 11, and 12 are detail views, respectively, showing the form and relative arrangement of the regulating device. Fig. 13 is a side elevation of the engine as a whole. Fig. 14 is a plan view of the construction shown in Fig. 13. Fig. 15 is an elevation of the rear end of an engine embodying my said improvements, though somewhat modified as compared with the construction illustrated in Figs. 9, 13, and 14. Figs. 16, 17, and 18 are detail views, respectively, showing the regulating parts employed in connection with the engine last referred to. Fig. 19 is an elevation of the front end of the engine last referred to, the same showing the various parts as they appear when assembled for service. Fig. 20 is a side elevation of the engine illustrated in Figs. 15 and 19. Fig. 21 is a plan view thereof.

In a general sense my invention comprises a frame, a cylinder conjoined therewith, said cylinder having a valve-controlled inlet-port, a like main exhaust-port, and an auxiliary port, the latter in communication with said main port, and a piston moving in said cylinder.

It further comprises a frame, a jacketed cylinder conjoined therewith, and a jacketed valve-box removably conjoined with said frame and cylinder, said valve-box having a valve-controlled inlet-port and a like main outlet or exhaust port, both of said ports being in communication with said cylinder and said frame being provided with an exhaust-chamber leading from said main exhaust-port forwardly along the frame and terminating in an auxiliary exhaust-port communicating with the interior of said cylinder at a point forwardly therealong.

In carrying out my present invention I make use of a cylinder C, here shown as having a water-jacket C^2, all of ordinary construction. The cylinder C is provided with an auxiliary exhaust-port C', the purpose of which is to reduce the expansion-pressure near the end of the power-stroke to that of the atmosphere and accordingly balance the pressure on the exhaust-valve V, so that the latter may be opened with a force sufficient only to nicely overcome the spring *c*, which elastically controls the action of said valve. A further advantage to be derived from the foregoing construction will be hereinafter pointed out. The walls which inclose the auxiliary exhaust-port serve also to support the cylinder C.

The flanged end of the cylinder C is provided with a counterbore bearing conical faces which are ground and fitted to similar faces formed on the exterior of valve-box B, as clearly shown in Fig. 1 of the drawings, where also said valve-box is shown as extending into the cylinder C. The object of this construction is to establish communication between the water-jacket C^2 of the cylinder C and the water-jacket B^2 of the valve-box B, as by way of a suitable port B', thus obviating the use of packing and insuring a permanently-tight joint. Valve-box B is provided with two non-communicating chambers—one an inlet-chamber and the other an outlet or exhaust chamber. Said valve-box consists of an outer shell, within which are arranged two separated transverse partitions, forming the inlet and outlet chambers aforenamed, with the water-jacket B^2 between them and extending circumferentially of said valve-box at the forward end thereof, thereby permitting the circulation of a cooling medium, as water, at the valve-seats, with which said valve-box is provided. The inlet-chamber aforenamed is in communication with the mixture inlet-space I, and the outlet-chamber aforenamed is in communication with the exhaust-space E, as shown in Figs. 1 and 5 of the drawings. Valve-box B is provided with a stuffing-box B^3, which permits the connection of an extension-rod from a pump or compressor with piston P in cylinder C in tandem.

Valve V is preferably formed from iron by the process of casting, is segmental in general contour, is strengthened with ribs, substantially as shown, and is provided with guides G, which operate in bushings G', suitably arranged in valve-box B, as indicated in Fig. 2, the said guides and bushings being formed from steel by preference. The object in giving valve V the form mentioned is to provide an increased valve area, thereby obtaining a larger ratio of piston-stroke to the diameter of the cylinder employed than heretofore secured. The uniform thickness of the metal of the valve-body prevents any warping or distortion of the same through the action of heat.

The statements thus far made relative to the valve V apply also to the valve V', and said valves V and V' are ground and fitted to the raised portions B^4. (Shown in Fig. 2.) Valve-stem S is provided with an eye, by means of which it is connected to lugs V^2. (Shown in Fig. 3.) The bushing S^2, provided with trunnions fitting into the jaws of lever L, serves to actuate the valves, as clearly shown in Figs. 1 and 5. Valve-stems S and S' also operate in a bushing B^5, preferably of steel and shown in Fig. 2. When both valves V and V' are in position, with the springs *c c'* conjoined therewith, respectively, the valve-box B is inserted in the rear portion of the frame and bolted or otherwise secured thereto. The advantage of this construction lies in its permitting the ready exchange of a defective or leaky valve-box for an operative one, the latter being kept in reserve for cases of emergency. Another advantage thereof is the securing of a direct ingress of the mixture of gas and air and accordingly obviating a one-sided pressure on the valve-stem and disk, to which fractures of the valve-stem may not rarely be traced in engines and analogous structures of the prior art. Furthermore, the incoming mixture tends to cool the surface of the exhaust-valve V, as the latter is located adjacent to the inlet-valve V'.

The frame represented in Fig. 4 is provided with the usual bearings at the front end thereof, said bearings being rigidly connected with the frame and being provided with adjustable boxes and caps, as in common practice. There is arranged at the rear end of said frame a cylindrical shell E', which is bored to correspond with the outside diameter of the valve-box B, as shown in Figs. 4 and 5. This shell has an opening at its top by way of which the power medium, as a mixture of gas and air, may be directed into the inlet-chamber of the valve-box B, and has another opening at its bottom by way of which the exhaust from the exhaust-chamber of said valve-box may be directed outwardly therefrom, as to and into the space E, all as clearly shown in Fig. 5. The shell last referred to is surrounded by the rear portion of the frame, to which the cylinder C and valve-box B are bolted. The rear end of the frame is substantially supported by an extension E^2, as indicated in the drawings.

The arms F' and F^2 are provided with bearings for the cam-shaft S^3. (Shown in Figs. 13 and 14.) They are also shown in the drawings as formed each integral with the frame; but they may be cast as separate parts and thereafter bolted or otherwise secured to the frame. The cam-shaft S^3 actuates the cams revolving on pin R^2, which is secured to the frame in any appropriate manner, pressed into the bore, or otherwise rigidly fixed in position. The cams in turn actuate the levers L^2 and L^3, thereby giving movement through shafts R and R', levers L and L', and valve-stems S and S'. The foregoing is clearly illustrated in Figs. 5, 8, 9, 13, and 14. The angular velocity of the cam-shaft S^3 is only one-

half that of the main shaft S^4, as is the case in a four-cycle motor.

Fig. 9 shows the regulating device, the mixture inlet-pipe, and gas-valve of a comparatively large motor, (ninety horse-power to one hundred horse-power.) The air-inlet pipe K is provided with a suction-head K′, the object of which is to eliminate the noise of the suction-stroke by an increased inlet area and at the same time cause the air to precipitate dust or other foreign matter because of the decrease of velocity in the vertical passages of the suction-head aforenamed. The dotted lines on suction-pipe in Fig. 9 indicate a butterfly valve or damper K^2, the same having conjoined therewith a lever K^3, which in turn connects with governor M and valve-toe T by means of rods r r' and thimble r^2, held by lever K^4, which is pivoted on valve-casing O. The gas-valve is inclosed by a casing O, its stem N′ protruding through a cap at the top of said casing and through a guide at the bottom of the casing O, and there is attached to its lower end a movable toe T, which can be turned laterally on the valve-stem, but may not be detached therefrom. The toe T, Fig. 10, is provided with V-grooves diverging radially from the valve-stem center C^0 and decreasing successively in length, as shown. The lifter T′, Fig. 11, has a V-shaped top which fits the grooves of the toe T. Lifter T′, said valve-stem N′, and toe T are shown in Fig. 12 each as occupying its lowermost position, gas-valve N being accordingly closed.

The operation of the regulating device in maintaining a more or less constant speed may be explained as follows: When the motor runs at normal speed and full load, the inlet-valve cam lifts the roller carrying lever L^3, which, in connection with lever L′, opens valve V′ and simultaneously oscillates lifter T′ (the latter being fixed on valve-rod R′) at the beginning of each inlet-stroke. Lifter T′ raises the gas-valve to the maximum height of its lift by coming in contact with the longest V-groove of toe T and gradually brings it back to its original position, as shown in Fig. 12, and somewhat in advance of the closure of the inlet-valve. This latter feature is accomplished by adjusting valve-stem N′ at a suitable distance from the center of valve-rod R′ by means of a nut and threads on the valve-stem just above the valve-disk, so the former can be raised or lowered. The gas-valve accordingly closes a little before the end of the suction-stroke, and the inlet-valve is adjusted to close somewhat after the commencement of the compression-stroke. The object of this delay in closing the inlet-valve is to take advantage of the acquired momentum of the mixture toward the end of the suction-stroke, thereby increasing the density of the charge when the crank passes the center and to drive the exhaust-gases entirely out of the cylinder into the auxiliary exhaust-passage. Thus the new charge is not fouled by the spent gases, and greater thermal efficiency is obtained. The butterfly K^2 remains in a horizontal position, giving the air the full area of the pipe as long as the engine is kept running at full load and normal speed. Should the load be reduced and the motor accordingly increase its speed, the governor-balls will change their position and draw rod r' downward, thereby moving rod r, which turns toe T, by means of thimble r^2 and lever K^3 to one side, thus presenting a shorter groove to the top of lifter T′. The latter can now only lift the gas-valve as high as the length of the groove will permit, as the arc described by lifter T′ at the point corresponding to the length of the groove is smaller and the supply of gas becomes less. The supply of air, on the other hand, is reduced by the butterfly assuming an oblique position. Upon further reduction of the load the next groove is presented to the lifter, which groove is still shorter than the first one referred to, and the gas-supply is still further reduced, and so on. If the load becomes quite small or the engine runs without a load, toe T is brought out of contact with lifter T′ altogether, thereby preventing very small charges, which would affect the economy unfavorably, because the small volume cannot be compressed to a suitable pressure and the charge ignites and explodes without raising the pressure to any appreciable height. In this connection the advantage of closing the gas-valve sooner than the admission-valve becomes apparent. If this advance closure is not adopted, there is probability that a certain amount of gas will be lost, as any gas left in the inlet-chamber will be swept into the cylinder at an idle stroke and out into the exhaust.

Fig. 13 shows a side elevation, and Fig. 14 a plan view, of a comparatively large motor, (ninety to one hundred effective horse-power.) The frame and cylinder thereof correspond with those previously described. The camshaft S^3 is geared two to one to the main shaft and one to one to the cams a a' for inlet and outlet, respectively, as indicated in Fig. 14. The cams aforenamed and the bevel-gear shown are cast in one piece and provided with a brass bushing in the bore. Governor M is mounted on arm F′ and driven by a bevel-gear and pinion inclosed in the governor-casing. Igniter i is operated by an eccentric e, which in turn actuates a device to make and break contact with an induction-coil. The lead of the igniter can be adjusted by catch l. It will be noticed that the igniter is not located in a vertical but in an inclined plane in order to conform with the center line of shaft S^3. A starting-lever U is fixed to the frame to bring the piston to a convenient position for starting. Hand-pump p is provided to force a charge of air and gasolene vapor or the regular fuel-gas used by the motor into the cylinder. In order to keep the piston stationary when the pump is charging, a contrivance of any appropriate construction to hold the fly-wheel against the

pump-pressure should be provided. This device (not shown) automatically releases the fly-wheel when the ignited charge forces the piston outward, as in common practice, and it is bolted or otherwise secured to the foundation. The rear end of the frame is covered by a hood *h*, which is fastened thereto by bolts or the like, and the same gives the motor a more attractive appearance.

Fig. 15 represents a rear view of a small motor, (eight to eleven effective horse-power.) Figs. 16, 17, and 18 show the details of the governing device. It is practically the same as the one hereinbefore described for the larger motor, except that there is no graduation for the lift of the gas-valve. It will be noticed that the gas-valve toe T contains but one groove to fit the lifter T′, and on that account the governor turns the toe T out of the path of the lifter altogether, and accordingly no gas is admitted when the motor exceeds its normal speed. On the other hand, the air is throttled also, so that the cylinder may not receive a full charge of air, with the consequent excessive cooling of the cylinder-walls.

Fig. 19 illustrates the connection of the regulating device to the governor and also represents a front view of the motor.

Figs. 20 and 21 represent a side elevation and a plan of same, the frame, cylinder, and valve-box being substantially the same in construction as the corresponding elements already described for the larger motors. The lay-shaft D, however, is driven by helical gears, the object of which is to eliminate the noise which attends the operation of bevel-gears at high speed. The helical gears are inclosed in oil-casings O′ and O², and the short cam-shaft D′ is extended through a cored hole in the valve-box to the opposite side of the motor, as shown in plan in Fig. 21. The object of this construction is to keep the lay-shaft D as near as possible to the main bearings in order to keep the fly-wheel on the end of the main shaft within the proper distance from the center of the main bearing, as shown in Fig. 19. Cam-shaft D bears the cams *a* and *a′*, cast or forged in one piece, the same being secured to the cam-shaft by means of a feather-key. Governor M is supported on an arm which is cast onto the frame and driven by a bevel-gear and pinion inclosed by the casing, to which the governor is secured.

A hot-tube igniter *i′* is used on the small unit-motors, which are shown in Figs. 20 and 21. A starting-lever U serves to impart sufficient momentum to the fly-wheel, so that the motor can take up the cycle, thereby enabling the operator to readily start the motor. An eccentric U′ is arranged on the fulcrum of the starting-lever to keep the fly-wheel from turning back when starting. The hood *h* serves to cover the valve-stems and also the springs conjoined therewith and which project beyond the valve-box, thereby giving the structure a neater appearance.

Among the advantages of my improved internal-combustion engine over engines of the same class now made use of the following may be mentioned: First, the pattern-work, molding, machining, and fitting and adjusting of the elementary parts of my improved engine are less complicated and less expensive than in engines of the same thermal and mechanical efficiency now in use and of the class described; second, the ratio of piston-stroke to the cylinder diameter is greater than in engines of the same cylinder diameter and of the same angular velocity now in operation and of the class described; third, the interchanging of the integral parts may be accomplished with greater convenience and with less loss of time than in engines now in use and of the class described; fourth, the auxiliary exhaust, in connection with the delay in closure of the inlet-valve, prevents the fouling of the fresh charge by the spent gases, and this is accomplished more effectually than in engines now in use and of the class described.

It will be seen that my improved engine is particularly well adapted for the purposes for which it is intended and, further, that the same may be modified to some extent without materially departing from the spirit and principle of my invention.

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

1. In an internal-combustion engine the combination with a cylinder and piston moving therein, a frame and a valve-box conjoined to said cylinder and frame, the latter being surmounted by standards or bearings for the main shaft at one end and by a hoof-shaped structure at the other end, such structure being provided with a cylindrical perforation or bore to journal said valve-box, substantially as described.

2. In an internal-combustion engine the combination with a cylinder, a frame and a valve-box conjoined therewith, said frame being surmounted and forming an integral part thereof, by a hoof-shaped structure at one end and by standards or bearings at the other end, said hoof-shaped structure having two chambers, communicating with corresponding chambers in said valve-box, one of these chambers serving as a receiver for the combustible gases and is called the inlet-chamber, one serving as a receiver for the outgoing, spent gases in the way of an exhaust-chamber, the latter extending forward within said frame and terminating at a suitable point to communicate with the interior of said cylinder substantially as described.

3. In an internal-combustion engine the combination with a jacketed cylinder, a frame and a jacketed valve-box conjoined therewith, said cylinder and valve-box being respectively faced and ground to insure per-

manently-tight junctures therebetween, jacket-spaces of said cylinder and valve-box being arranged so as to communicate with each other within such junctures substantially as and for the purpose set forth.

4. In an internal-combustion engine the combination with a cylinder, a frame and a valve-box conjoined therewith, the latter comprising a cylindrical outer shell, having partitions arranged therein, so as to form an inlet-chamber, an outlet-chamber and a jacket-space, the latter being situated partially between the chamber specified and also extending circumferentially at one end thereof substantially as and for the purpose set forth.

LOUIS ROEDEL.

Witnesses:
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ALBERT C. TANNER.