C. V. KERR.

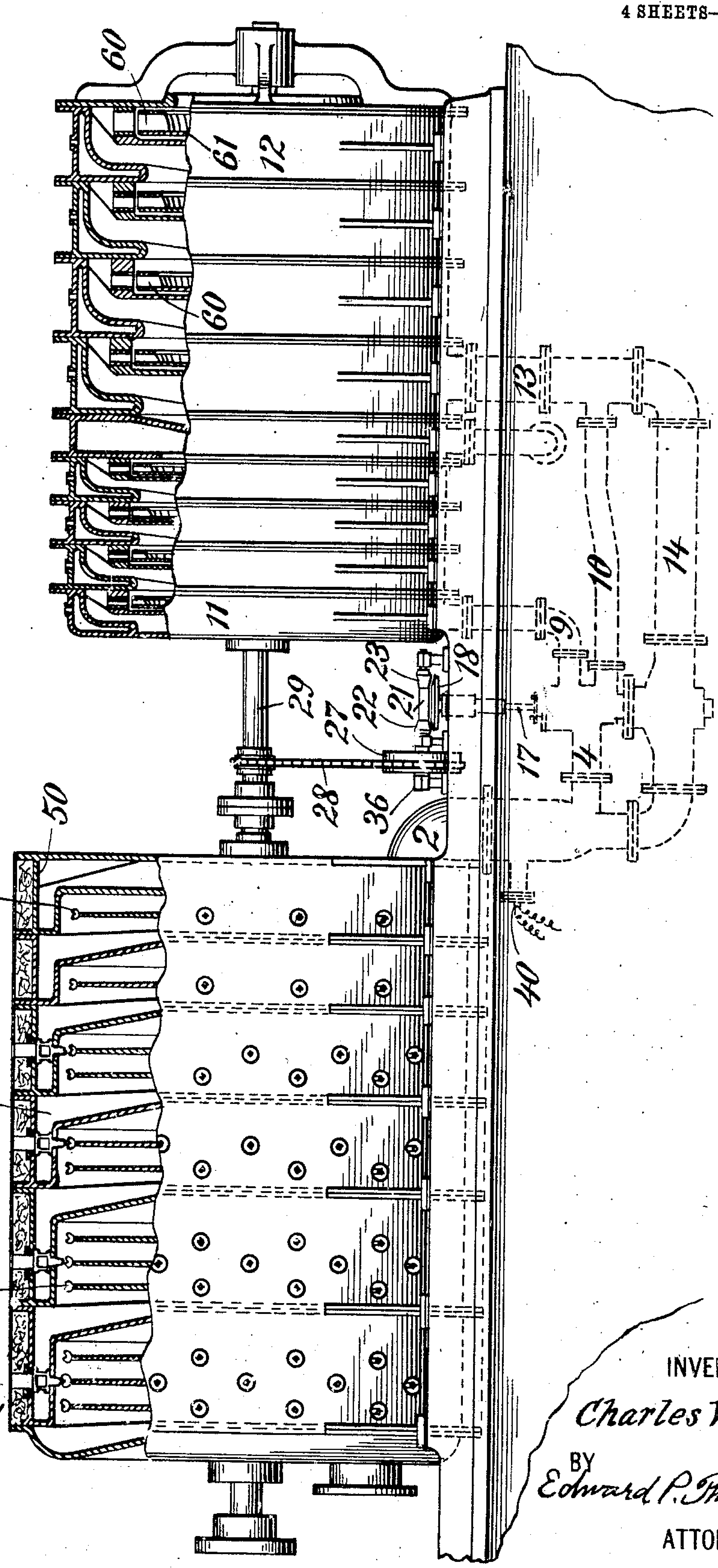
ELASTIC FLUID ENGINE.

APPLICATION FILED JULY 9, 1904.

940,162. Patented Nov. 16, 1909.

4 SHEETS—SHEET 1.

FIG. 1.



WITNESSES:

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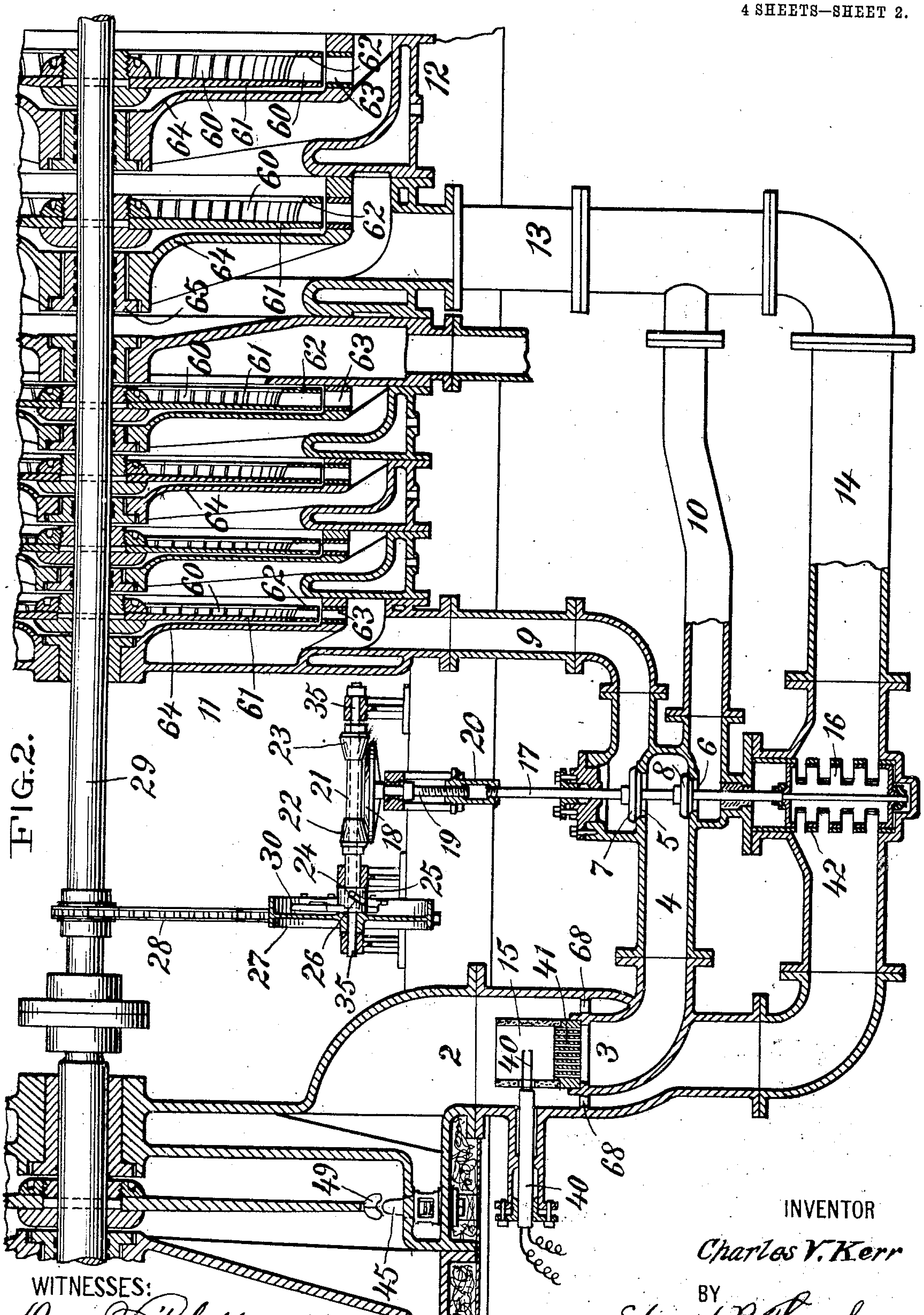
4 SHEETS—SHEET 2.

FIG. 2.



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4 SHEETS—SHEET 3.

FIG. 3.

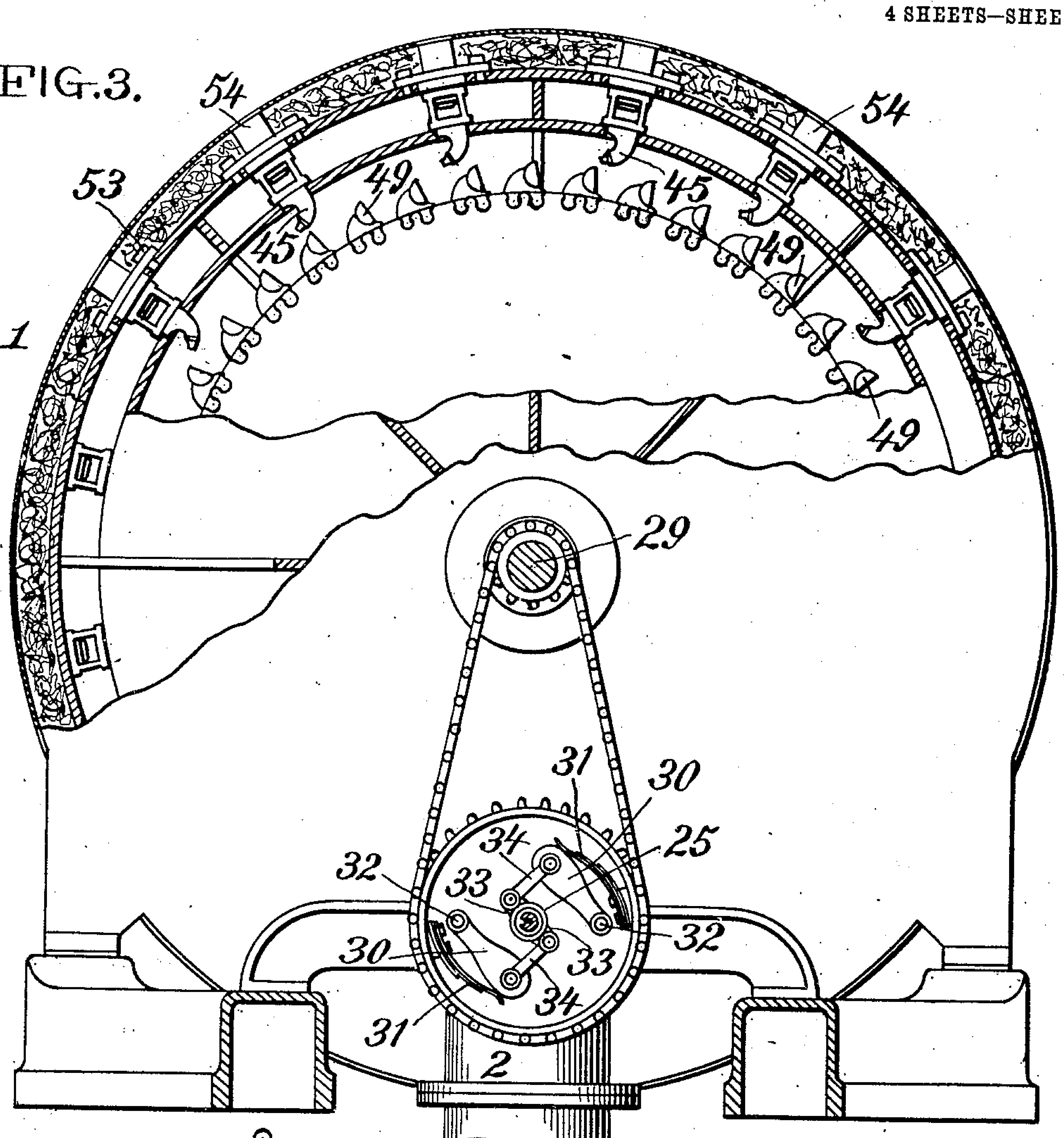
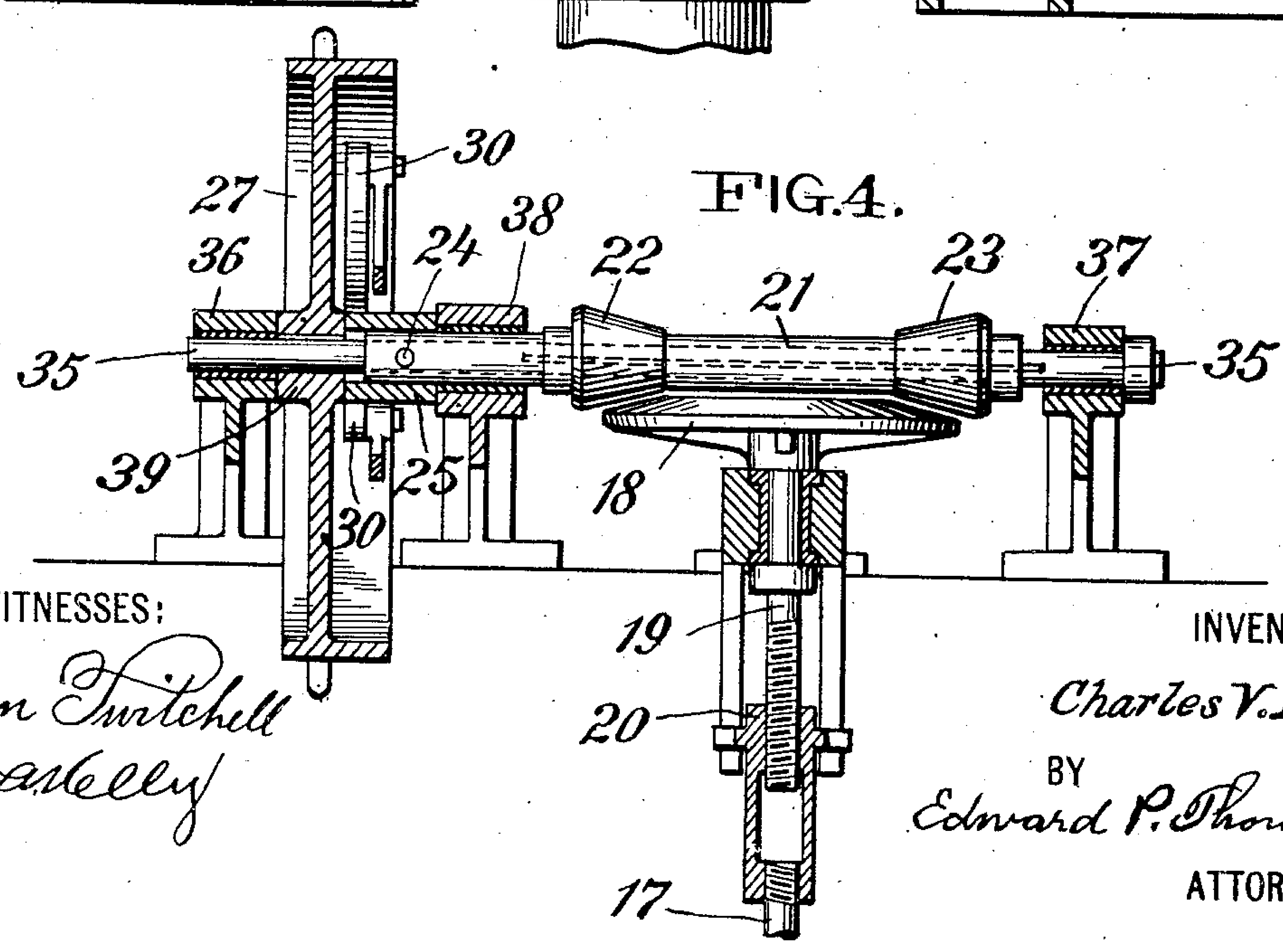


FIG. 4.



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4 SHEETS—SHEET 4.

FIG. 5.

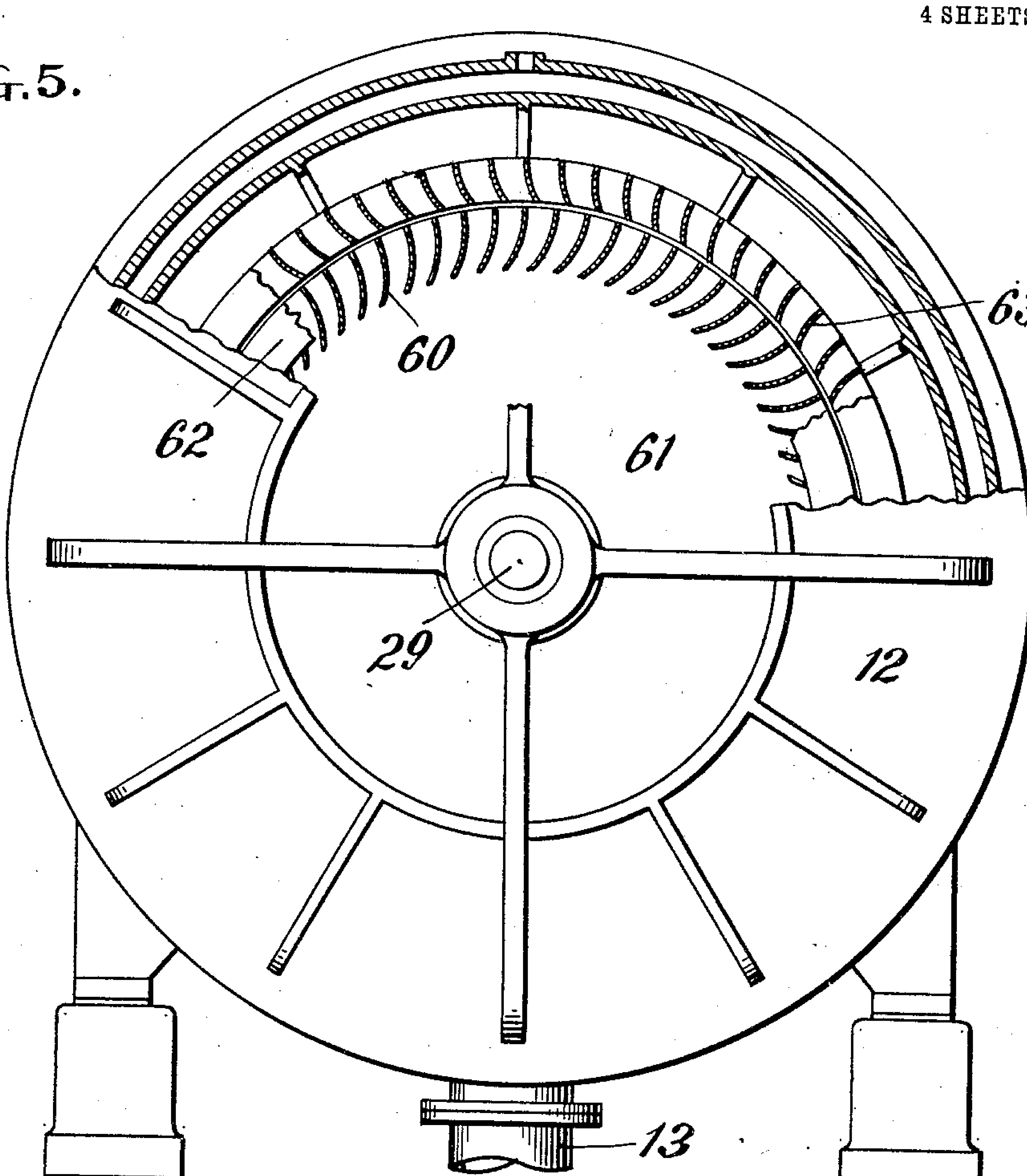


FIG. 6.

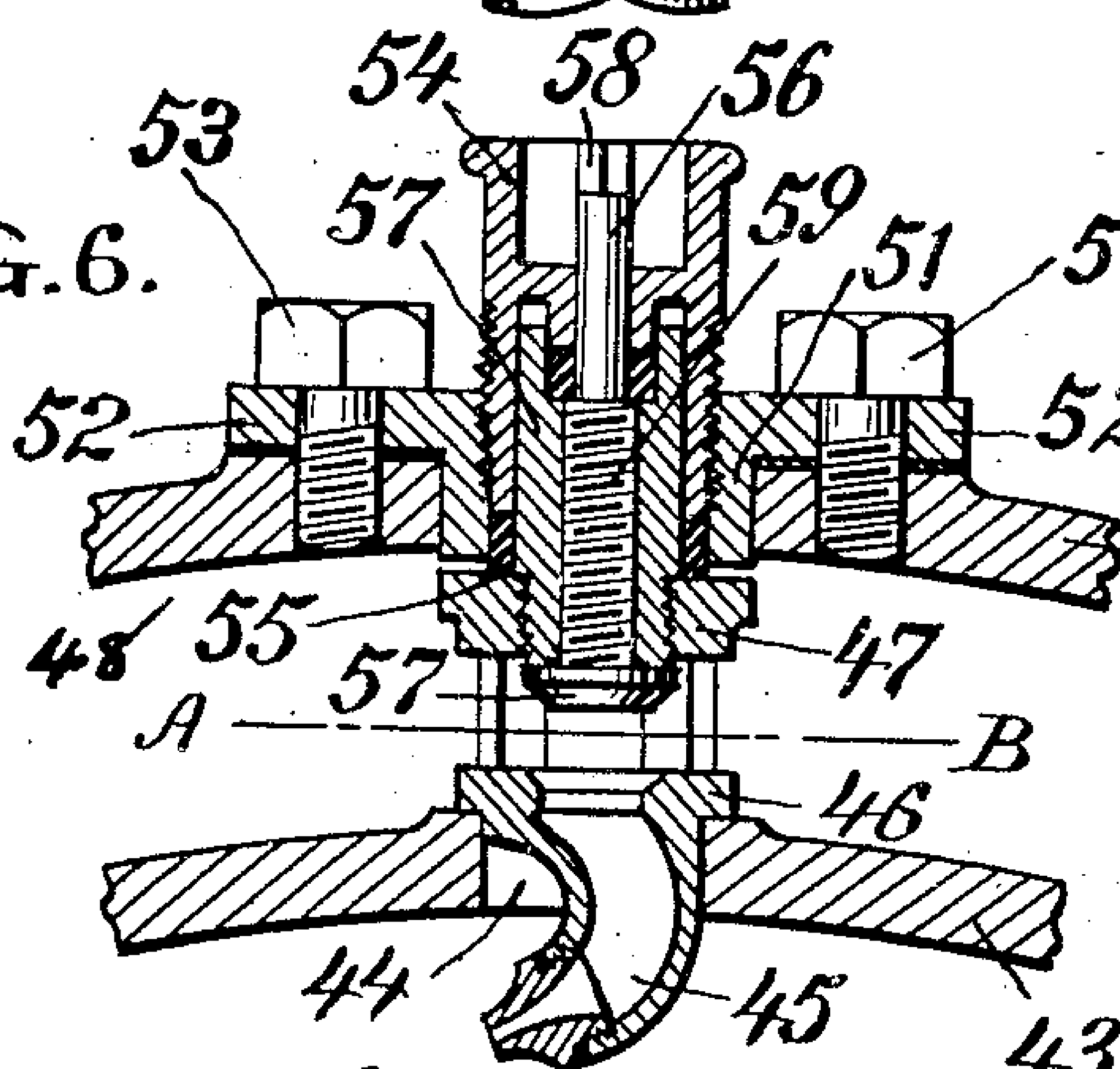


FIG. 7.

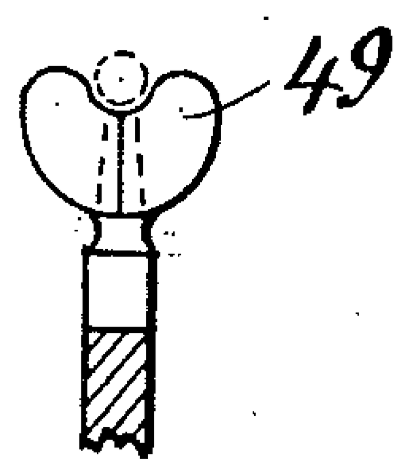
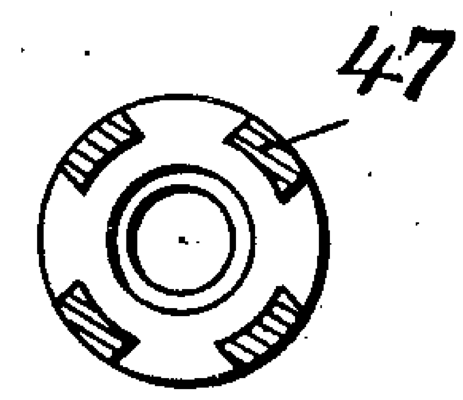
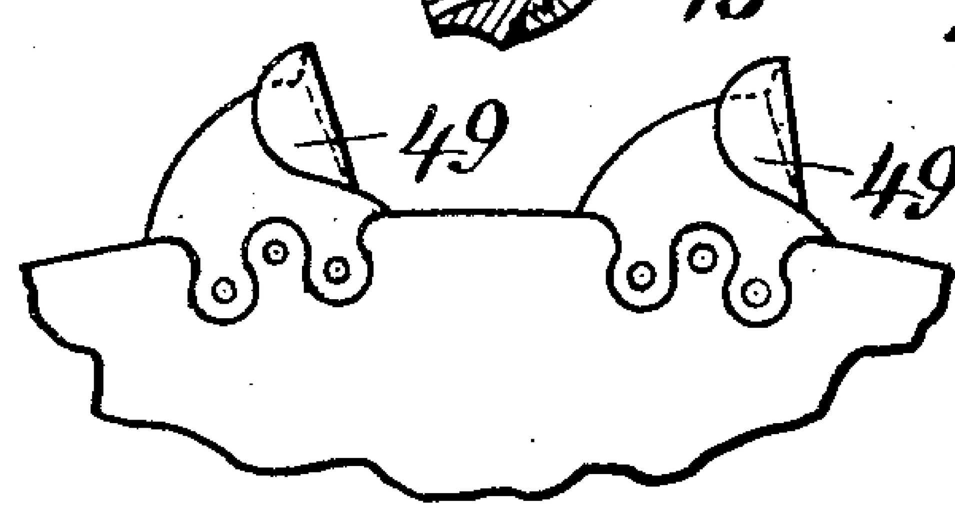


FIG. 8.





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UNITED STATES PATENT OFFICE.

CHARLES V. KERR, OF RUTHERFORD, NEW JERSEY.

ELASTIC-FLUID ENGINE.

940,162. Specification of Letters Patent. Patented Nov. 16, 1909.

Application filed July 9, 1904. Serial No. 215,879.

To all whom it may concern:

Be it known that I, Charles V. Kerr, a citizen of the United States of America, and resident of Rutherford, in the county of Bergen and State of New Jersey, have invented certain new and useful Improvements in Elastic-Fluid Engines, of which the following is a specification.

My invention relates to elastic fluid engines.

Without regard to the various scopes of invention, which are attended to in the claims, the statement of my invention is as follows: The general organization consists of an elastic fluid turbine, a cooling chamber communicating therewith, a combustion chamber within said cooling chamber, pipes for conveying gas and air to said chambers, fluid compressors coupled to said turbine and connected with said pipes, valves across said pipes, and a governor driven by said turbine for operating said valves only during changes of load, and provided with means for holding said valves rigidly in the position to which said governor adjusts them.

The invention is shown in all of its details in the accompanying drawings.

Figure 1 is a side elevation of the general organization, partly broken away to exhibit the interior. A portion of the system below the floor is indicated in diagram by dotted lines. Fig. 2 is a central longitudinal vertical section on an enlarged scale of the construction shown in Fig. 1, with certain repeated portions omitted, and with some portions not in section, such as the shaft and some of the pipes. Fig. 3 is a cross section of the upper part of Fig. 1, on an enlarged scale, looking toward the left with portions broken away to show the interior construction. Fig. 4 is a greatly enlarged longitudinal vertical section of the governor. Fig. 5 is an end view of the air compressor, partly showing the interior and exterior. Fig. 6 is a sectional view of the means for attaching the nozzles. Fig. 7 is a view of a bucket by itself. Fig. 8 is a horizontal section of a portion of Fig. 6, at the line A. B.

Referring to the drawings, the device consists of an elastic fluid turbine 1, a cooling chamber 2, communicating with the turbine 1, a burner 3 in a combustion chamber 15, in the cooling chamber 2, a pipe 4, for feeding a mixture of combustible gases to said burner and having two inlet ports 5 and 6, valves 7 and 8, controlling said ports, tubes 9 and 10, respectively communicating with said ports, a gas compressor 11, connecting with the tube 9, an air compressor 12 connecting with the other tube 10, a pipe 13 extending from the air compressor to the tube 10, and communicating with the cooling chamber by an independent pipe 14 at a point to meet the products of combustion issuing from a heat proof combustion chamber 15 surrounding the burner 3, a valve 16 for closing and opening the pipe 14, a rod 17 carrying the valves 7, 8 and 16, a bevel wheel 18, on the rod 17 and adjustable thereon by a screw 19 and a nut 20, the screw 19 being fastened to the wheel, and the nut 20 being fastened to the rod 17, a sleeve 21 connecting two beveled pinions 22 and 23, adapted to be moved, so that both are out of engagement with the bevel wheel 18, or so that one or the other may operate the bevel wheel, a pin 24 fixed to and projecting from said sleeve radially, a loose collar 25 surrounding the sleeve 21, and having a slot 26, through which passes the pin 24, the slot 26 passing obliquely or spirally around the collar, which can not travel longitudinally of the sleeve 21.

The sleeve 21 is mounted on a shaft 35 which turns in bearings 36 and 37, an intermediate bearing 38 being provided about the sleeve 21 for supporting the shaft against lateral strain. The sleeve 21 is splined upon the shaft 35 so that it rotates therewith and is driven thereby, while at the same time having a longitudinal movement relative thereto, causing the bevel pinions 22 and 23 to engage alternately with the bevel-gear 18 as above described. On the shaft 35 between the bearings 36 and 38 is mounted a sprocket-pulley 27, also keyed to the shaft 35 and driving it, and being itself driven from the turbine-shaft 29 by a sprocket chain connection 28. The pulley 27 carries a pair of weights 30 pivoted upon pins 32, and connected to the collar 25 by means of links 34 having pivotal-connections with lugs 33 on said collar. The centrifugal action of the weights 30 is opposed by springs 31 mounted on the pulley 27 and pressing inward upon the free ends of the weights. The hub 39 of the pulley 27 acts in connection with the bearing 38 to confine the collar 25 against longitudinal motion. The action of this device obviously is to cause the collar 25 to be turned through a definite angle relative to the pulley 27 depending on the speed at which the latter is rotated, that is to say, at which the main shaft 29 rotates, and this in turn, through the action of the collar, upon the pin 24 moving in the oblique slot 26, will cause the sleeve 21 to be shifted longitudinally and assume a position relative to the bevel-gear 18 likewise depending upon its rate of rotation; and the disposition is such that when the pulley rotates at its normal velocity the shaft 21 will occupy a central position so that neither of the pinions 22 and 23 engages with the gear 18 and the latter therefore remains stationary; and when the pulley 27 rises above its normal velocity the sleeve 21 is moved in such direction that one of said pinions engages with the gear 18 and rotates the gear in such direction as to depress the nut 20 and stem 17, thus closing the gas and burning-air valves, and diminishing the fuel supplied to the engine; while when the pulley 27 falls below its normal velocity the sleeve 21 is moved in the opposite direction and the other pinion engages with the gear 18 and necessarily rotates it in the opposite direction, thus raising the nut 20 and stem 17, and thus opening the gas and burning-air valves and increasing the supply of fuel to the engine.

A spark device 40 terminates within the combustion chamber 15 for igniting the mixture of gas and air from the pipe 4.

The shaft 29 runs all the way through the turbine and the air and gas compressors.

The burner 3 is terminated by a perforated plate 41, to prevent back firing, which however could not injure the compressors, as the combustible mixture extends only to the valves, 7 and 8.

The valve 16 is represented as a slotted sliding valve inside of the similar stationary slotted seat 42.

The mountings for the vane-disks and the packing devices between the different stages of compression may be considered as not a part of the subject matter of this specification, as they are described in a separate application, together with some other details not necessarily involved in the general organization.

An important construction of the nozzle support is shown in Fig. 6. The shell 43, separating one stage of dynamic action from the next, has a hole 44 large enough for the bent nozzle to pass through, the latter having a flange 46 resting around the hole 44 on the shell 43. This flange supports a cage 47 for the entrance of the propelling fluid from the chest 48 to the vanes 49. The outer shell or casing 50, of the chest 48 has a hole big enough for the entrance of the cage 47. This cage is held against the shell 43 by a flanged collar 51 extending into the hole in the casing 50, the flange 52 of the collar 51 being held down by bolts 53. A tube 54 is screwed into the flange 52, to hold down packing 55, and this tube 54 carries a valve stem 56, having a valve 57 for closing or opening the nozzle 45. The upper end of the tube 54 is closed around the valve stem 56 to form a bearing. Around the lower end is packing 55. The upper end of the stem 56 is squared at 58 for receiving a key, the stem 56 being threaded externally at 59, and the tube 54 being internally threaded. By unscrewing the bolts 53, all these elements can be removed jointly, including the nozzle 45. 57′ is a bearing for the stem 56, screwed into the cage 47.

It is unnecessary to enter into a detailed description of the remaining portions. I will simply identify the parts by reference numerals. These remaining elements consist of vanes 60, in the compressors held between disks 61, and rings 62; guides 63, circularly arranged around the vanes 60, and carried by the shells 64, between the various stages of compression, packing bushings 65, for permitting the shaft 29, to efficiently pass through the shells 64, without leakage; vanes 49, opposite the nozzles 45, in the turbine, and similar packing, shells and passage ways, as in the compressors.

I will now explain the *modus operandi.* By my invention, I am enabled to operate the ordinary steam turbine, without the usual accessories of boilers, injectors, furnaces, chimneys and grates. I employ directly the increased volume of gases produced by combustion, the temperature of which may be as high as 3,000 degrees F. As this temperature, when produced by a massive burner would injure the packing, joints, the plate iron, and the mechanism generally, I cool this intensely hot expansive fluid to about 800 degrees by the action of compressed air, which although heated by compression, will together with the cooling produced by radiation, bring down the temperature to safe, practical limits. This compressed cooler air need not be constant, nor need it be variable with the load on the turbine, as the temperature of the expansive fluid need not be kept at any particular constant; but the pressure of the air supplied to the combustible gas should be maintained approximately constant.

Having explained the general principles of operation, I will point out their application by reference to the drawings. The flame is located inside of the heat proof combustion chamber 15, and the compressed air for cooling the gases issuing from the combustion chamber 15, is supplied through the ports 68, arranged around the foot of the combustion chamber 15, at the end of the large air pipe 14, from the air compressor 12. The burner at 3, is also fed by gases under high pressure and velocity from the compressors 11, and 12. If it were not for combustion of the gases entering the cooling chamber 2, of course the turbine would not operate, therefore the compressors would not be propelled. Assuming that the prime mover, considered as a whole, is at rest and supposing that the valves 7, and 8, are open, the gas passes through the valve 8 and mingles with air coming through the tube 10 and valve 6 so that the mixture may be ignited in the chamber 15, by means of the sparking device 40. The turbine being unloaded, the heated products of combustion being increased in volume, and the air from the pipe 14, cooling the burned gases, the pressure of the final fluid entering the turbine is not materially increased, for it expands through the turbine, with sufficient *vis viva* to accelerate both the turbine and the compressors, which latter of course, are much less in capacity, although of comparatively large diameter for the sake of higher compressing efficiency. Consequently, the burner rapidly becomes a furnace of large capacity, and therefore the temperature and volume of expansive gases are greatly increased. Jointly this increase of temperature and volume by addition of heat, and power of the turbine, and higher compression, produce the full working power of the whole system.

I provide for a practically accurate regulation under variation of load. For example, if the shaft 29, increases in speed, the governor, already described, and the same in general principles as well known governors, will partly close the ports 5 and 6, thereby reducing the heat, and the consequent expansive force of the fluid in the turbine. In order to graduate the regulation more desirably, the valve at 16 is opened more as the ports 5, and 6, are more and more closed. At the maximum openings of ports 5, and 6, the minimum amount of cooling air is furnished, and yet the pressure of air in the tube 10, is maintained at about the same pressure as the gas in the tube 9, so that the proportion of air and gas at the burner will be correct for combustion within the combustion chamber 15.

I claim as my invention:—

1. The combination of an elastic fluid engine, an air compressor, a combustion chamber, a burner therein, a pipe for feeding a mixture of combustible gases to said burner and having two inlet ports, valves controlling said ports, two tubes respectively communicating with said ports, a gas compressor communicating with one of said tubes, a pipe extending from the air compressor, and communicating with the other of said tubes and separately also beyond said combustion chamber at a point to meet the products of combustion from said combustion chamber, a valve across the last named pipe and means controlled by the load on said engine for regulating all of said valves, said means consisting of a rod carrying all of said valves, and a governor connected up with said rod and with said engine.

2. The combination of an elastic fluid engine, an air and a gas compressor driven thereby, a combustion chamber, of sufficient capacity to permit of complete combustion before the products of combustion leave said chamber, pipes connecting said air and gas compressors to said chamber for feeding compressed gas and air to said chamber, another pipe carrying compressed air to the products of combustion at a point beyond said chamber, a valve across each pipe, and a single stem for operating said valves.

3. The combination of an elastic fluid turbine, a cooling chamber communicating therewith, a combustion chamber within said cooling chamber, pipes for conveying gas and air to said chambers, rotary compressors coupled to said turbine and connected with said pipes, valves across said pipes, and a governor driven by said engine for operating said valves only during change of load, and provided with means for holding said valves rigidly in the position to which said governor adjusts them.

4. The combination of an elastic fluid engine, an air compressor, a gas compressor, a shaft common to the above named elements for permitting said compressors to be driven by a portion of the power of said engine, valves for maintaining the correct proportion of air and gas for complete and continuous combustion and adapted to be opened and closed or partly opened and closed for varying the quantity of the mixture of said air and gas without destroying the proportion of the elements of said mixture, a third valve for admitting and gradually regulating the quantity of cooling compressed air, as an independent supply from that for mixing with said gas, a burner receiving and continuously combining said mixture, a combustion chamber in which said mixture begins and finishes its combustion, means for igniting said mixture for continuous combustion, a cooling air pipe for said cooling compressed air terminating beyond said combustion chamber at a point where it opens only to the products of complete combustion, a cooling chamber in which said pipe terminates, and of greater cross section than that of said combustion chamber through all the distance from the latter's outlet to the inlet port of said engine, and an automatic regulator driven by said engine, and operating each of the said three valves for controlling automatically the speed of the engine by controlling the quantity of gas and the quantity of air supplied both for combustion and cooling, the cross section of said cooling chamber being of the dimensions stated to permit the admitted compressed cooling air to form a cooling

jacket for the walls of the cooling chamber while at the same time in contact with the products of combustion, with which said cooling air gradually intermingles, the three valves being mounted upon the same stem, and driven to different positions by said common stem and said regulator being provided with means for locking the three valves in the position to which the regulator adjusts them, said regulator unlocking and engaging with said valves only during a change of load on the engine.

5. In an engine driven by a working fluid, the combination of means for supplying to the engine compressed air and gas, a burner for continuously combining the air and gas, means for supplying additional air for reducing the temperature of and mingling with the products of combustion, a centrifugal device continually driven by said engine, and mechanism for causing said device to be connected to and to regulate both of the above named means at each variation of speed of said device.

6. In an engine driven by a working fluid, the combination of means for supplying to the engine compressed air and gas, a burner for continuously combining the air and gas, means for supplying additional air directly to the products of combustion for mingling therewith and reducing the energy of the same, a centrifugal device continually driven by said engine, and mechanism governed by said centrifugal device for invariably maintaining both of said means disconnected from said device during all the time that the speed of the engine remains constant.

7. In combination with an elastic-fluid engine, a gas compressor and an air-compressor driven thereby, a combustion-chamber, conduits leading from said gas-compressor and air-compressor respectively to said combustion-chamber where the mixture is burned, a second conduit leading from said air-compressor, a chamber 2 into which said second conduit and said combustion-chamber debouch, separate valves regulating the flow of air and gas in each of said conduits, and a regulating device driven by said engine and connected with said valves to simultaneously open and close the same, in accordance with the load upon said engine.

8. In combination with an elastic-fluid engine, a gas-compressor and an air-compressor driven thereby, a combustion-chamber, conduits leading from said gas-compressor and air-compressor respectively to said combustion-chamber where the mixture is burned, a second conduit leading from said air-compressor, a chamber 2 into which said second conduit and said combustion-chamber debouch, separate valves regulating the flow of air and gas in each of said conduits, and a regulating-device driven by said engine and normally out of connection with said valves said regulating-device being actuated by a rise above the normal speed thereof to connect with said valves so as to move them in one direction and by a fall below the normal speed to connect with said valves so as to move them in the opposite direction.

9. In combination with an elastic-fluid engine, a gas-compressor and an air-compressor driven thereby, a combustion-chamber, conduits leading from said gas-compressor and air-compressor respectively to said combustion-chamber where the mixture is burned, a second conduit leading from said air-compressor, a chamber 2 into which said second conduit and said combustion-chamber debouch, separate valves regulating the flow of air and gas in each of said conduits, and a regulating-device operating at a speed proportional to that of the engine and actuating the valves supplying said combustion-chamber to close or open the same according as said device rises above or falls below the normal speed; said device being also connected with the valve regulating the flow of air in said second air-conduit so as to move it in an opposite sense, that is, to close it when said first named valves are opened and vice versa.

10. The combination of an elastic-fluid engine, a gas-compressor and an air-compressor driven thereby, a combustion-chamber, air and gas-conduits leading from the respective compressors to said combustion-chamber, a regulating valve or valves adapted to regulate the flow of air and gas in said conduits, a reciprocating stem adapted to operate said valve or valves, a rotating stem carrying a bevel-gear and having a threaded connection with said reciprocating stem whereby the rotation of the former causes the longitudinal movement of the latter, a shaft driven by said engine and at a speed proportional to that of said engine, a pair of bevel pinions splined upon said shaft so as to move longitudinally thereon and engaging with opposite sides of said bevel gear but spaced apart in such manner that either alternately or neither can be engaged therewith, an independent air-conduit leading from said compressor, a chamber 2 into which said last named conduit and said combustion-chamber, debouch, and a valve in said last-named conduit operated by said reciprocating stem.

11. The combination of an elastic-fluid engine, a gas-compressor and an air-compressor driven thereby, a combustion-chamber, air and gas-conduits leading from the respective compressors to said combustion-chamber, a regulating valve or valves adapted to regulate the flow of air and gas in said conduits, a reciprocating stem adapted to operate said valve or valves, a rotating stem carrying a bevel-gear and having a threaded connection with said reciprocating stem

whereby the rotation of the former causes the longitudinal movement of the latter, a shaft driven by said engine and at a speed proportional to that of said engine, a pair of bevel pinions splined upon said shaft so as to move longitudinally thereon and engaging with opposite sides of said bevel-gear but spaced apart in such manner that either alternately or neither can be engaged therewith, an independent air-conduit leading from said compressor, a chamber 2 into which said last named conduit and said combustion-chamber debouch, and a valve in said last-named conduit operated by said reciprocating stem, said valve being so arranged as to open to admit more air when the fuel supply is being contracted and vice versa.

In testimony whereof I have hereunto signed my name this 18th day of June, 1904.

CHARLES V. KERR. [L. S.]

Witnesses:

GEO. B. WILCOX,

A. J. APPLEBEE.