No. 876,870. PATENTED JAN. 14, 1908.

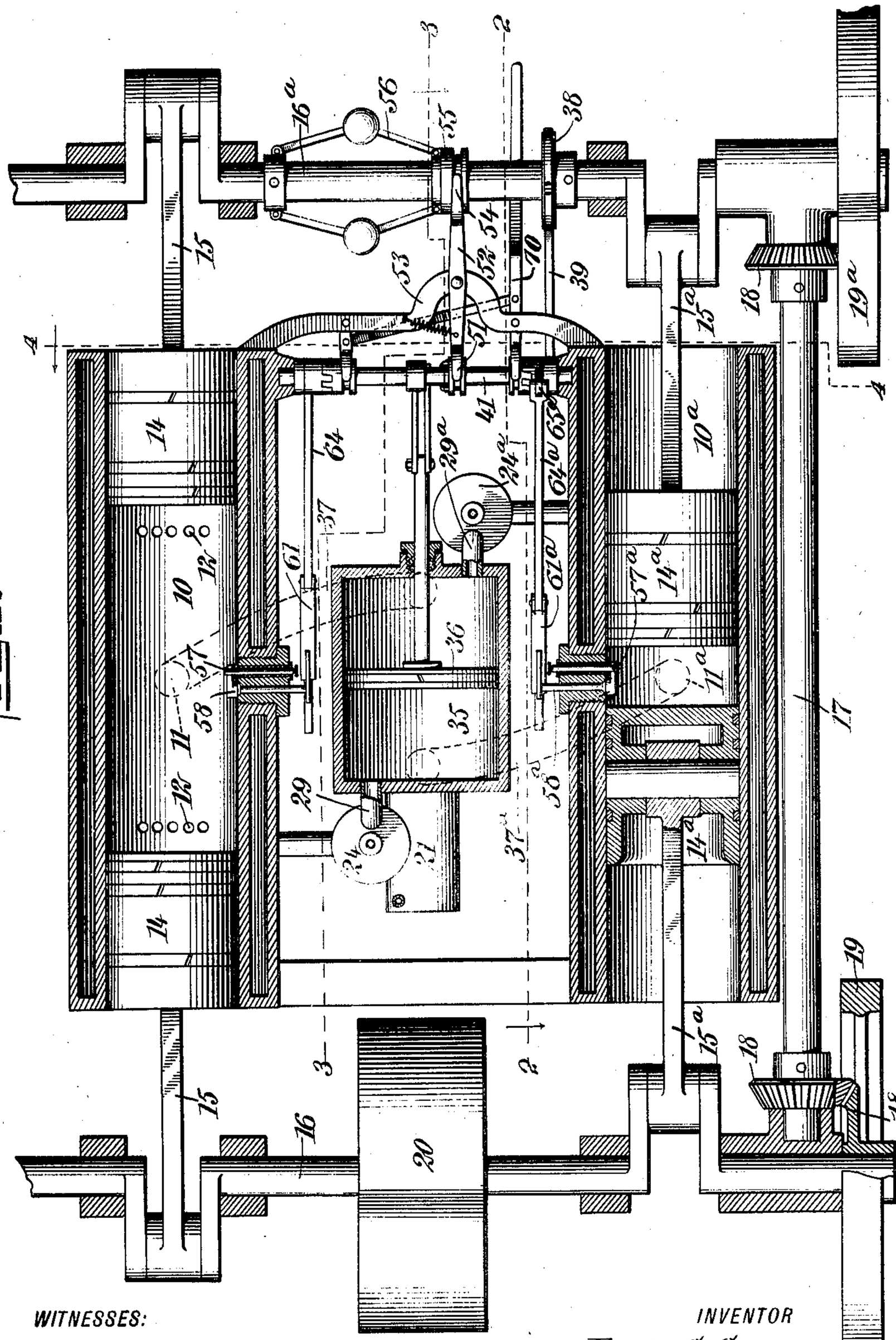
F. C. GORDON.

INTERNAL COMBUSTION ENGINE.

APPLICATION FILED NOV. 9, 1905.

5 SHEETS—SHEET 1.

FIG. 1.



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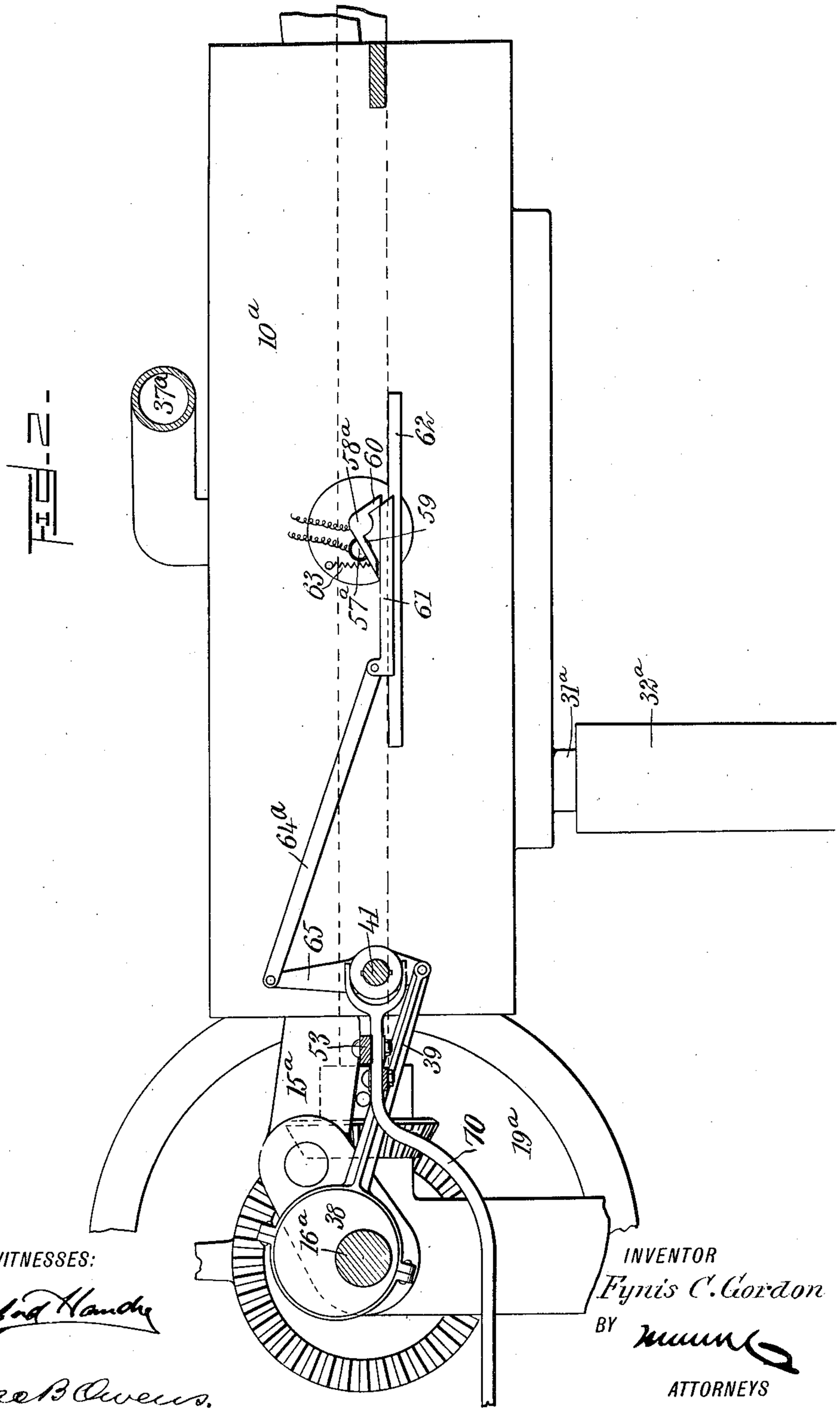
5 SHEETS—SHEET 2.

FIG. 2.



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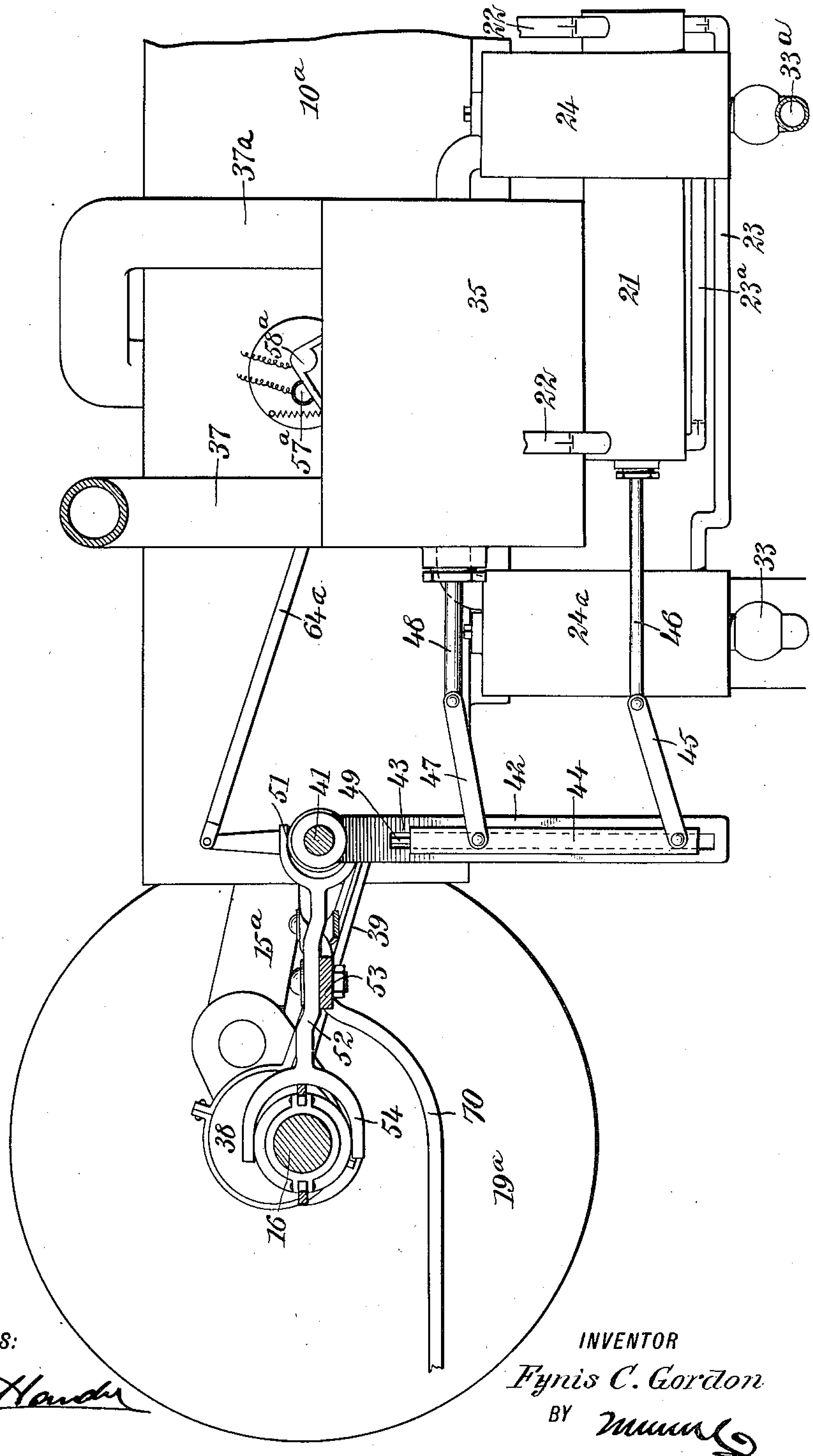
5 SHEETS—SHEET 3.

FIG. 3.



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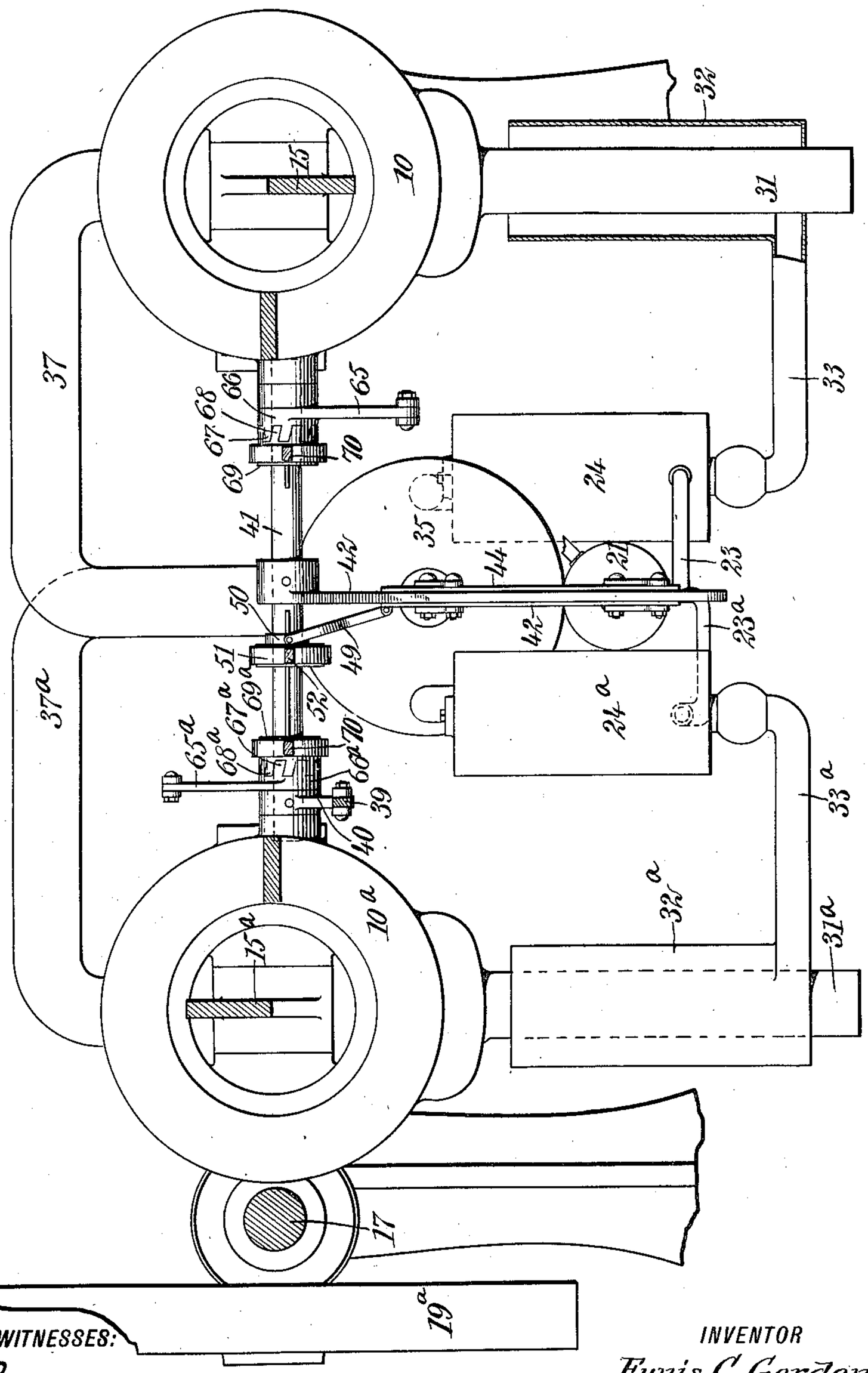
5 SHEETS—SHEET 4.

FIG. 4.



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5 SHEETS—SHEET 5.

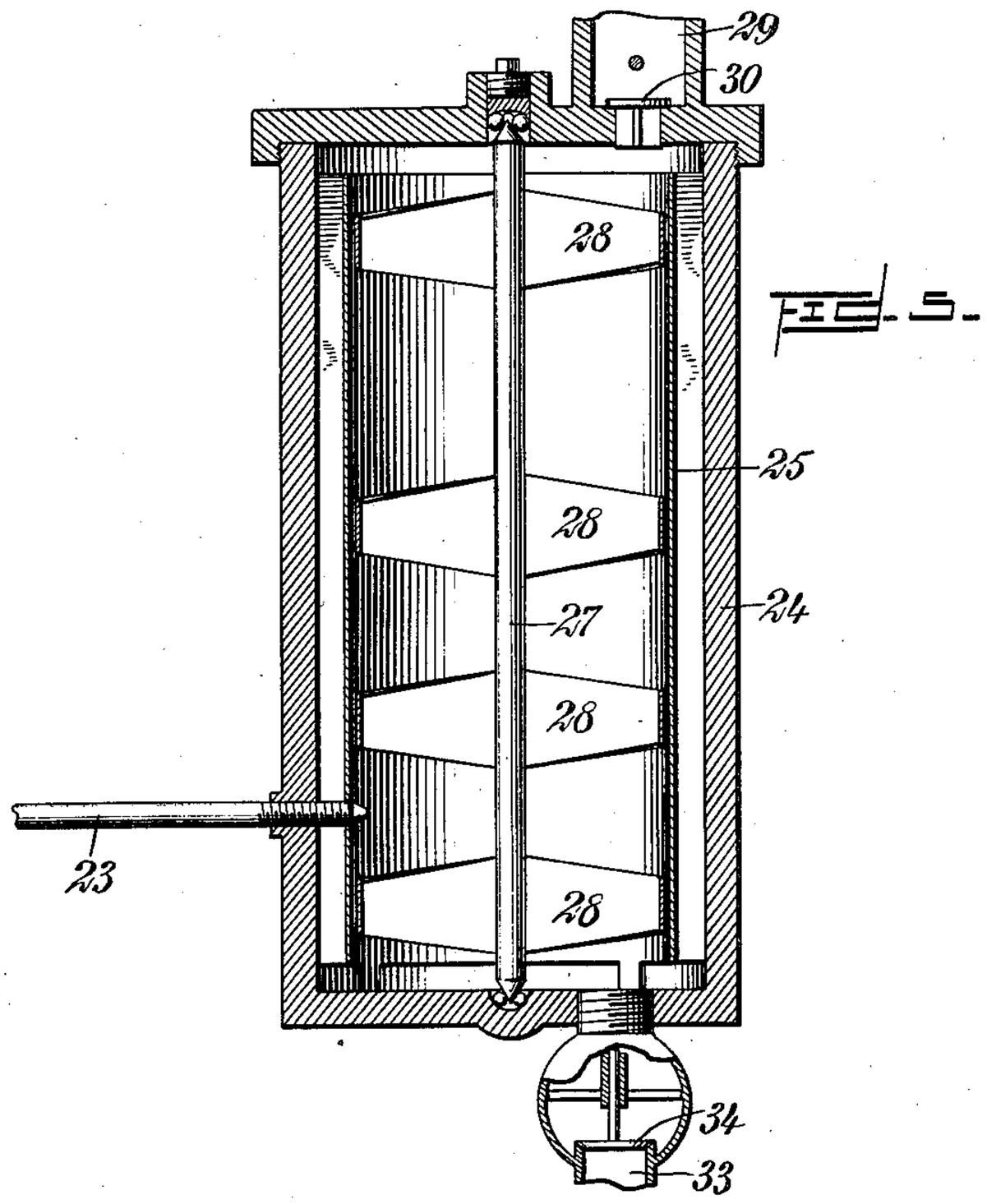

FIG. 5.

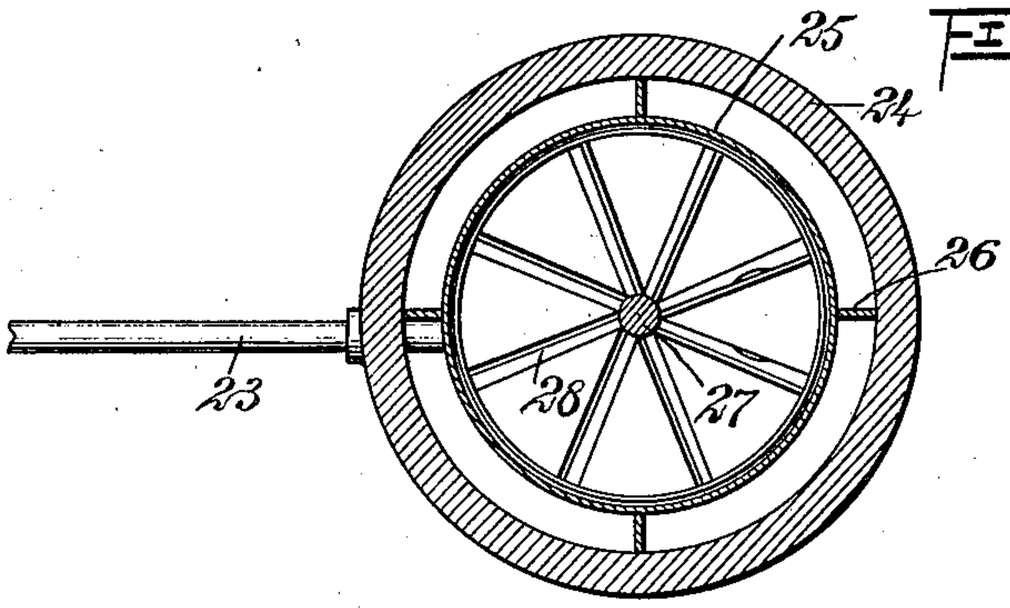

FIG. 6.

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UNITED STATES PATENT OFFICE.

FYNIS COLWELL GORDON, OF ASOTIN, WASHINGTON.

INTERNAL-COMBUSTION ENGINE.

No. 876,870. Specification of Letters Patent. Patented Jan. 14, 1908.

Application filed November 9, 1905. Serial No. 286,523.

To all whom it may concern:

Be it known that I, FYNIS COLWELL GORDON, a citizen of the United States, and a resident of Asotin, in the county of Asotin and State of Washington, have invented a new and Improved Internal-Combustion Engine, of which the following is a full, clear, and exact description.

The invention relates to an improved two cycle internal combustion engine, in which one or more cylinders are employed and in each of which cylinders opposed pistons operate, driving two crank shafts having connection with each other to maintain them in fixed relation, and it involves various novel features concerned with the vaporizers of the liquid fuel and the supply of the combustible mixture to the cylinders, the ignition of the charge and the regulation of governing of the engine.

The invention involves various other features of major or minor importance, all of which will be fully set forth hereinafter and particularly pointed out in the claims.

Reference is had to the accompanying drawings which form part of this specification; in which drawings like characters of reference indicate like parts in the several views, and in which

Figure 1 is a horizontal section of the engine showing its two working cylinders, and the combustible mixture pump in section; Fig. 2 is a sectional elevation on the line 2—2 of Fig. 1; Fig. 3 is a sectional elevation on the line 3—3 of Fig. 1; Fig. 4 is a sectional elevation on the line 4—4 of Fig. 1; Fig. 5 is a vertical section of the vaporizer; and Fig. 6 is a horizontal or cross section of the same.

The two cylinders 10 and 10ª of the engine are arranged in parallel, and are open at each end, as shown. Said cylinders are provided with intermediately situated inlet ports indicated by broken lines 11 and 11ª in Fig. 1. Said ports are provided with the usual spring seated or automatic valves (not shown) which seat against the pressure developed within the working cylinders. Each cylinder is also provided with two sets of exhaust ports located respectively adjacent to its end portions. In Fig. 1 the ports 12 of the cylinder 10 are visible, but the corresponding ports of the cylinder 10ª are covered by the pistons.

14 and 14ª indicate the pistons which are two for each cylinder, the pistons being opposed to each other and arranged to travel from the ends of the cylinders to the center thereof, exhausting the charge when the ports 12 are uncovered, as illustrated with respect to the cylinder 10 in Fig. 1, and compressing the charge when the pistons are at the center position, as indicated in the cylinder 10ª in Fig. 1. To the said pistons connecting rods 15 and 15ª are joined, and the said rods are in turn connected to the crank shafts 16 and 16ª, which shafts are maintained in fixed relative position by means of a cross shaft 17 connected by gears 18 with the respective crank shafts 16 and 16ª.

19 and 19ª indicate balance wheels on the crank shaft, and 20 indicates a means, for example, a band wheel, for transmitting the motion of the engine.

As shown in Figs. 1, 3 and 4, I provide a liquid fuel pump 21, here shown as of the reciprocating type. 22 indicates supply pipes (see Fig. 3) leading respectivelyto the ends of the pump 21 and fitted with check valves, as shown. From the ends of the pump 21 outlet pipes 23 and 23ª pass respectively to the vaporizer shells 24 and 24ª. The pump operates to force through the pipes 23 and 23ª jets of oil alternately into the vaporizer shells. The vaporizers 24 and 24ª are duplicates in construction, and as shown in Figs. 5 and 6 each is provided with an interior shell or liner 25 spaced from the walls of the outer shell 24 by means of longitudinal ribs 26. The inner shell 25 is open at the top and bottom, so that circulating space is provided between the two shells. The oil pipe 23 extends through both shells and into the lower portion of the inner shell. Located centrally in the vaporizer is a revolubly mounted spindle 27 which carries fan blades 28 adapted to revolve by the current of air drawn through the vaporizer. 29 indicates the outlet from the vaporizer, and 30 a check valve seating to prevent the return of pressure into the vaporizer. As shown in Fig. 4 the pipes 31 and 31ª carry off the exhaust gases from the working cylinders, and have drums 32 and 32ª surrounding them. From these drums pipes 33 and 33ª pass respectively to the vaporizers. 34 (see Fig. 5) indicates a lightly seated valve which is placed in the air receiving inlet orifice of the vaporizer and seats against the return of pressure into the pipe 33. Heated air is thus drawn into the vaporizer, and as the jet of liquid fuel is forced into the same the fuel is atomized, and the mixture circulating past the revolv-

ing fans 28 and between the shells 24 and 25 is transformed into a combustible vapor and passes from the vaporizer through the pipe 29.

As best shown in Fig. 1, I provide a double acting combustible mixture pump, comprising a cylinder 35 and a piston 36. To the respective ends of the cylinder 35 the discharge pipes 29 and 29[a] pass, so that upon the reciprocation of the piston 36 the ends of the cylinder 35 are alternately filled with the combustible vapor from the vaporizers. From each end of the cylinder 35 outlet pipes 37 and 37[a] pass respectively to the inlet ports 11 and 11[a] of the cylinders 10 and 10[a]. Consequently by this arrangement the mixture is formed in the vaporizers 24 and 24[a] and distributed to the two cylinders, one vaporizer serving one cylinder exclusively and the other vaporizer serving the other cylinder exclusively. Attached to the crank shaft 16[a] is an eccentric 38, the rod 39 of which is joined to an arm 40 keyed to a rock shaft 41 extending between and suitably mounted on the cylinders 10 and 10[a], the arrangement being such as to impart to the shaft 41 an unvariable rocking movement from the shaft 16[a]. Depending from the shaft 41 is an arm 42 which is slotted as indicated at 43 to receive a slide 44 movable along the arm toward and from the center thereof. To this slide 44 is joined a link 45 in turn joined to the piston rod 46 of the fuel pump 21. The slide 44 has also attached thereto a link 47 joined to the rod 48 of the piston 36. In connection with the slide 44 at the upper end thereof is a link 49 which is forked at its upper end and pivoted to a collar 50 splined on the rock shaft 41. To this collar 50 is joined the forked end 51 of a lever 52. Said lever is fulcrumed on a suitable support 53 extending between the cylinders 10 and 10[a], and has its other end formed with a fork 54 engaging the collar 55 loose on the crank shaft 16[a]. Said collar 55 forms part of a centrifugal governor 56 mounted on said crank shaft. It will, therefore, be observed that the position of the governor will determine the position of the slide 44 on the arm 42, and as this slide is moved toward or from the center of the shaft 41 it will diminish or increase the stroke of the pistons of the fuel and combustible mixture pumps. In this manner the governor determines the quantity of fuel that is injected into the vaporizer, and the quantity of air that is drawn in to form with said fuel the combustible mixture. This provides for the production of a mixture of unvarying ratio of air and fuel, the volume of which mixture is, however, varied according to the load on the engine.

The compressed charge is ignited according to the preferred embodiment of my invention by an electric spark. In Fig. 1 57 and 57[a] indicate the stationary electrodes of the sparking devices, and 58 and 58[a] indicate the moving electrodes. As shown best in Fig. 2, the moving or rocking electrodes of the sparking devices are provided with fingers 59 and 60 projecting from the electrode at an angle to each other, and coacting with a cam slide 61 mounted to reciprocate on a suitable track or support 62. 63 indicates a spring for holding the electrode in the position shown in Fig. 2, in which the movable electrode contacts with the stationary electrode. As the slide 61 engages the finger 60 it imparts a rocking movement to the electrode breaking its contact, this rocking movement being limited by the finger 59 striking the top of the slide. As the slide returns and disengages the finger 60 the spring 63 returns the electrode in contact with the stationary electrode. In this manner the spark is produced within the cylinders. The slides 61 61[a] of the sparking devices are connected to the links 64 64[a] which are joined to arms 65 65[a]. These arms are carried by collars 66 66[a] loose on the rock shaft 41. Said collars are provided with diagonal fingers 67 67[a] which coact with correspondingly disposed fingers 68 68[a] on collars 69 69[a]. These latter collars are splined on the rock shaft 41 and are joined to any suitable means 70, by means of which the collars may be shifted along the shaft. It will be observed that the collars 66 66[a] are made fast to the shaft 41 through the medium of the fingers 67 67[a] and 68 68[a], and the collars 69 69[a], and that in this manner the slides 61 61[a] of the sparking devices are regularly driven. It will also be observed that upon shifting the collars 69 69[a], the collars 66 66[a] will be turned slightly on the shaft 41, thus advancing or retarding the position of the slides 61 61[a], and consequently changing the time of the spark so as to suit the speed at which the engine is running and to permit the reversal of the engine, if desired.

The organized operation of the engine may be traced as follows: A suitable lever or crank may be provided if desired for turning over the engine in starting the same. Upon starting the movement of the shafts 16 and 16[a] a quantity of fuel will be injected into each vaporizer, and the mixture pump will cause the mixture to be formed in the vaporizers and drawn into the respective ends of the pump cylinder 35. From this cylinder the mixture is forced respectively to the working cylinders 10 and 10[a], the inlet of the fuel charge taking place the instant that the exhaust ports are uncovered by the pistons. Upon the injection of the fuel charge the same is compressed within the working cylinder, and the spark is passed when the pistons are at their inner positions, or as far previous thereto as may be necessary for the propagation of flame thus igniting the charge, after which it is expanded against both pistons forcing them out and imparting power

strokes to both of the crank shafts 16 and 16ª. It will be observed that expansion strokes are being executed in one cylinder while the other cylinder is compressing the charge, and in this manner each crank shaft receives two impulses per revolution. The governor operating in synchronism with the engine lengthens or shortens the strokes of the fuel and mixture pumps, and consequently varies the volumes of fuel admitted to the cylinders. Since the inlet ports are in the center of the cylinders and the exhaust ports at each end, the entering charge divides the burned gases lying in the cylinder into two bodies, forcing said bodies respectively toward the exhaust ports and preventing any injurious admixture of the old and new charges, and insuring that the new charges always lie adjacent to the sparking devices, thus preventing failure to ignite the charge.

Having thus described the preferred form of my invention, what I claim as new and desire to secure by Letters Patent is:

1. In an internal combustion engine, two working cylinders, a vaporizer for each cylinder, a double-acting fuel pump having its ends respectively in connection with the vaporizers, a double acting mixture pumd having its ends respectively in connection with the vaporizers and the corresponding working cylinders, and a governor controlled means for operating said pumps.

2. An internal combustion engine having, in combination, two working cylinders, pistons operating therein, a crank shaft connected to both of said pistons, two vaporizers, one for each of said cylinders, a double acting fuel pump delivering to each of said vaporizers, a double acting mixture pump connecting said vaporizers with their respective cylinders, a rock shaft, an arm attached thereto, means operatively connected to said crank shaft for oscillating the arm, and means connected to said arm for operating both of said pumps.

3. In an internal combustion engine, a working cylinder, a crank shaft, a rock shaft, an arm attached to said rock shaft, means connecting said crank shaft and said rock shaft for oscillating the latter, a liquid fuel pump, an explosive mixture pump, means connecting said arm to both of said pumps for operating the latter, and a governor for varying the effective length of said arm.

4. In an internal combustion engine, a working cylinder, a crank shaft, a rock shaft, an arm attached to said rock shaft, means for oscillating said rock shaft and arm from the crank shaft, a liquid fuel pump, a vaporizer receiving fuel therefrom, an explosive mixture pump delivering to said cylinder, means connecting said arm to both of the pumps for operating the same, and a governor for varying the points of connection between the arm and said pumps.

5. In an internal combustion engine, a working cylinder, a piston operating therein, a crank shaft connected to said piston, a vaporizer, a liquid fuel pump delivering to said vaporizer, a mixture pump connected to said vaporizer and delivering to said cylinder, and a single governor-controlled means for operating both of said pumps.

6. In an internal combustion engine, a working cylinder, a piston operating therein, a crank shaft connected to said piston, a vaporizer, a liquid fuel pump delivering to said vaporizer, a mixture pump connected to said vaporizer and delivering to said cylinder, a rock shaft, an arm attached thereto, means operatively connected to said crank shaft for oscillating the arm, and means connected to said arm for operating both of said pumps.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

FYNIS COLWELL GORDON.

Witnesses:

W. G. WOODRUFF,

GEO. S. WARREN.