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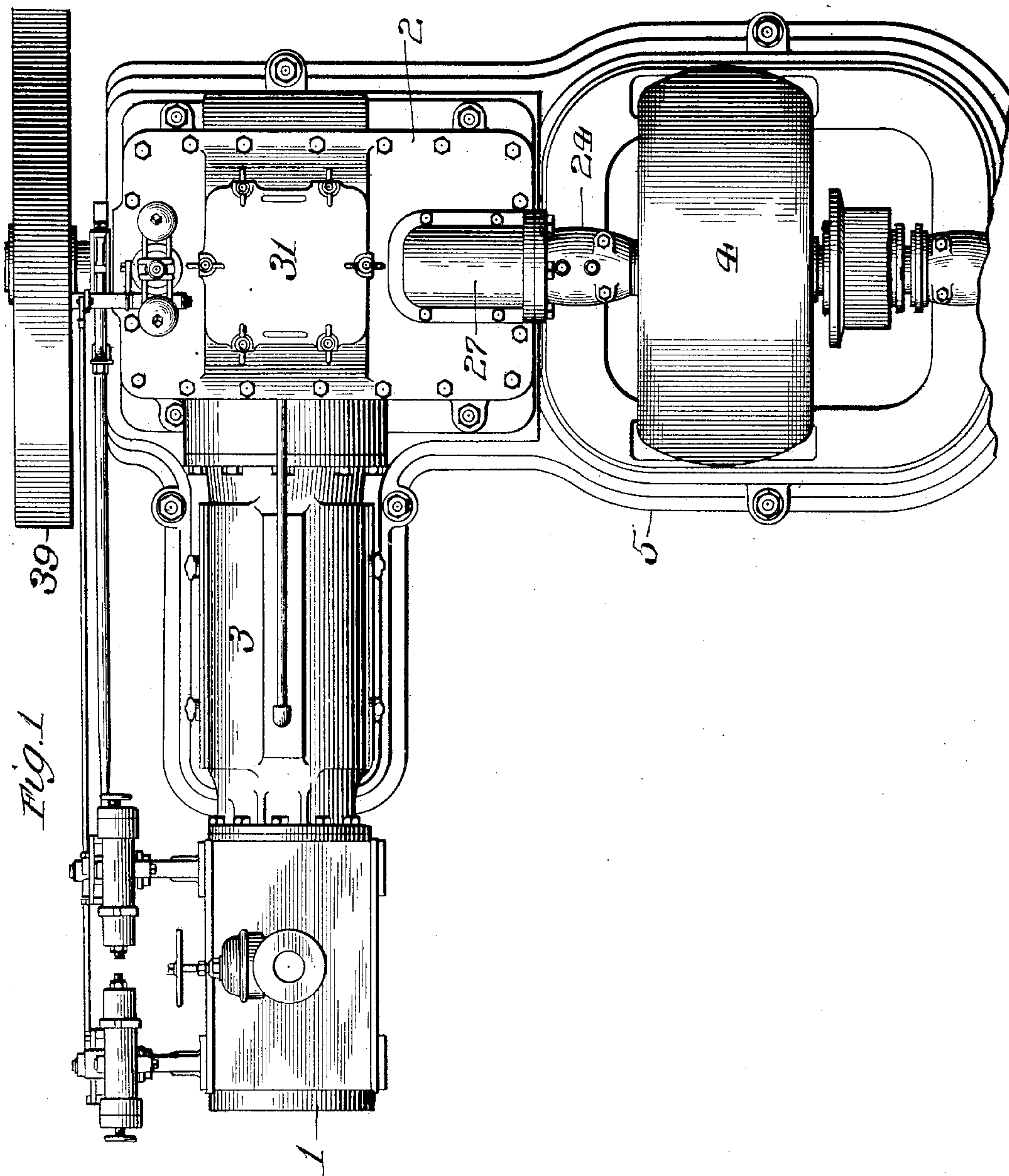
PATENTED MAR. 8, 1904.

N. A. CHRISTENSEN.  
ELECTRIC MACHINE.

APPLICATION FILED MAY 8, 1901.

NO MODEL.

5 SHEETS—SHEET 1.



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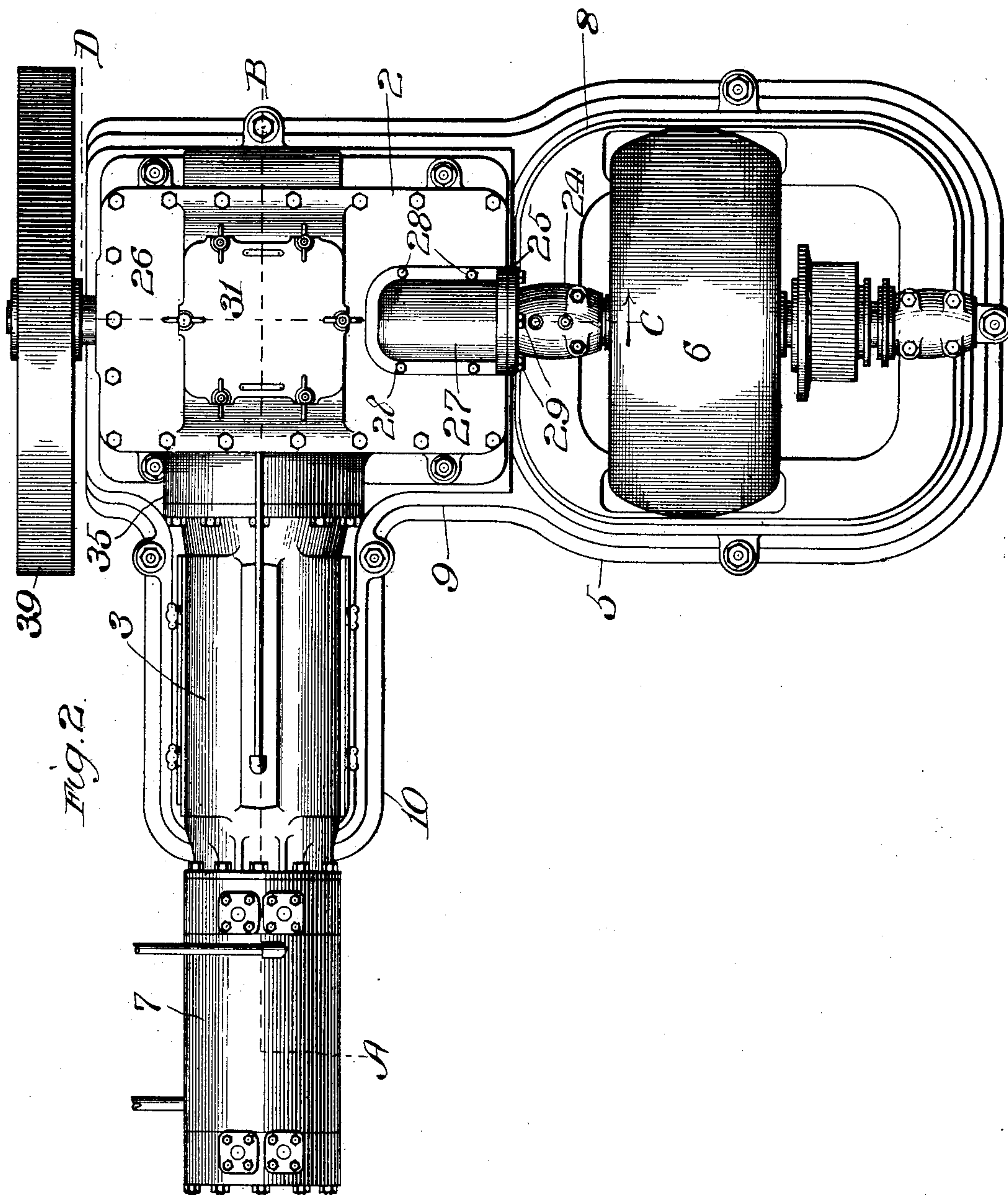
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5 SHEETS—SHEET 2.



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5 SHEETS—SHEET 3.

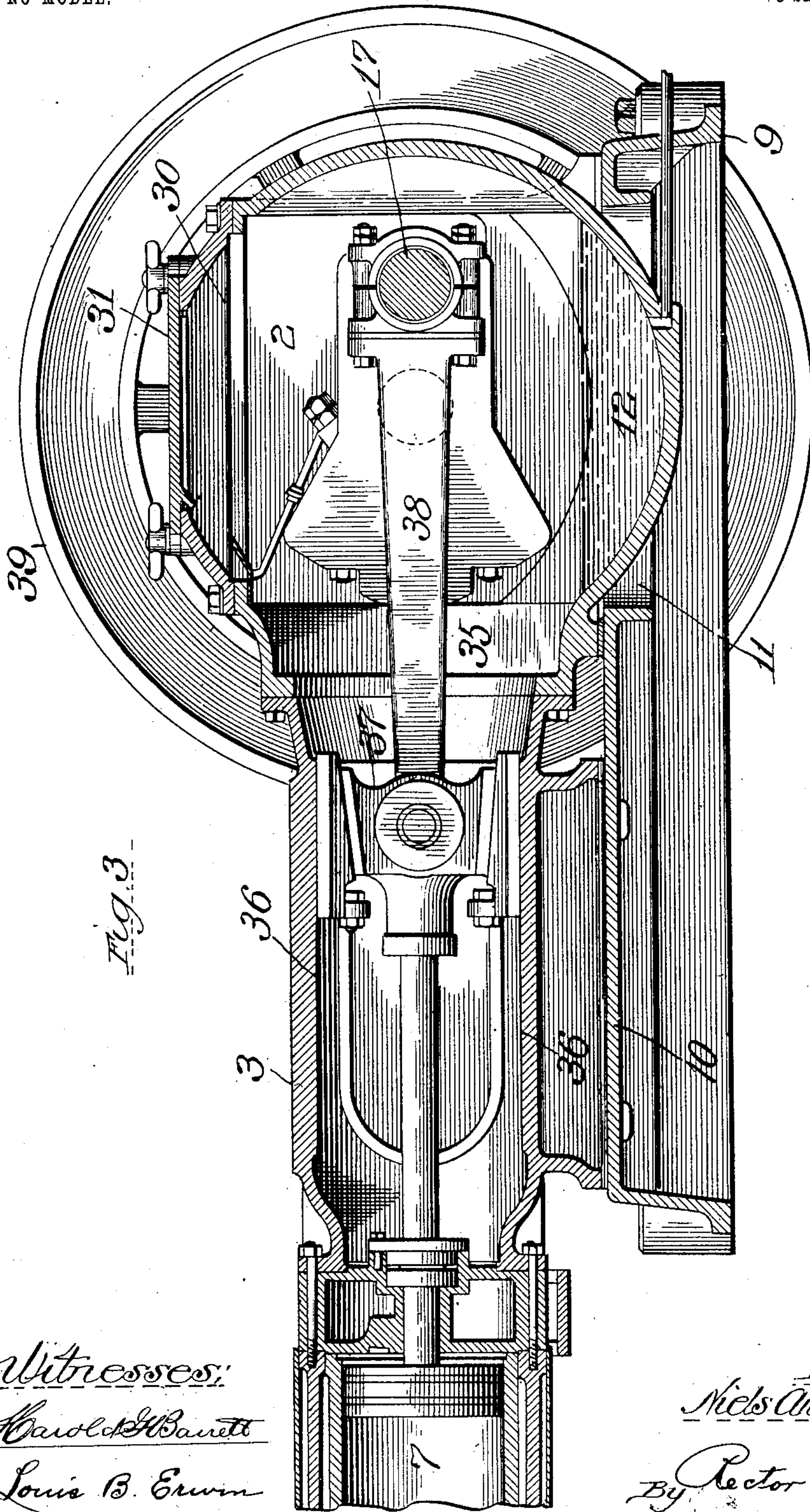


Fig. 3

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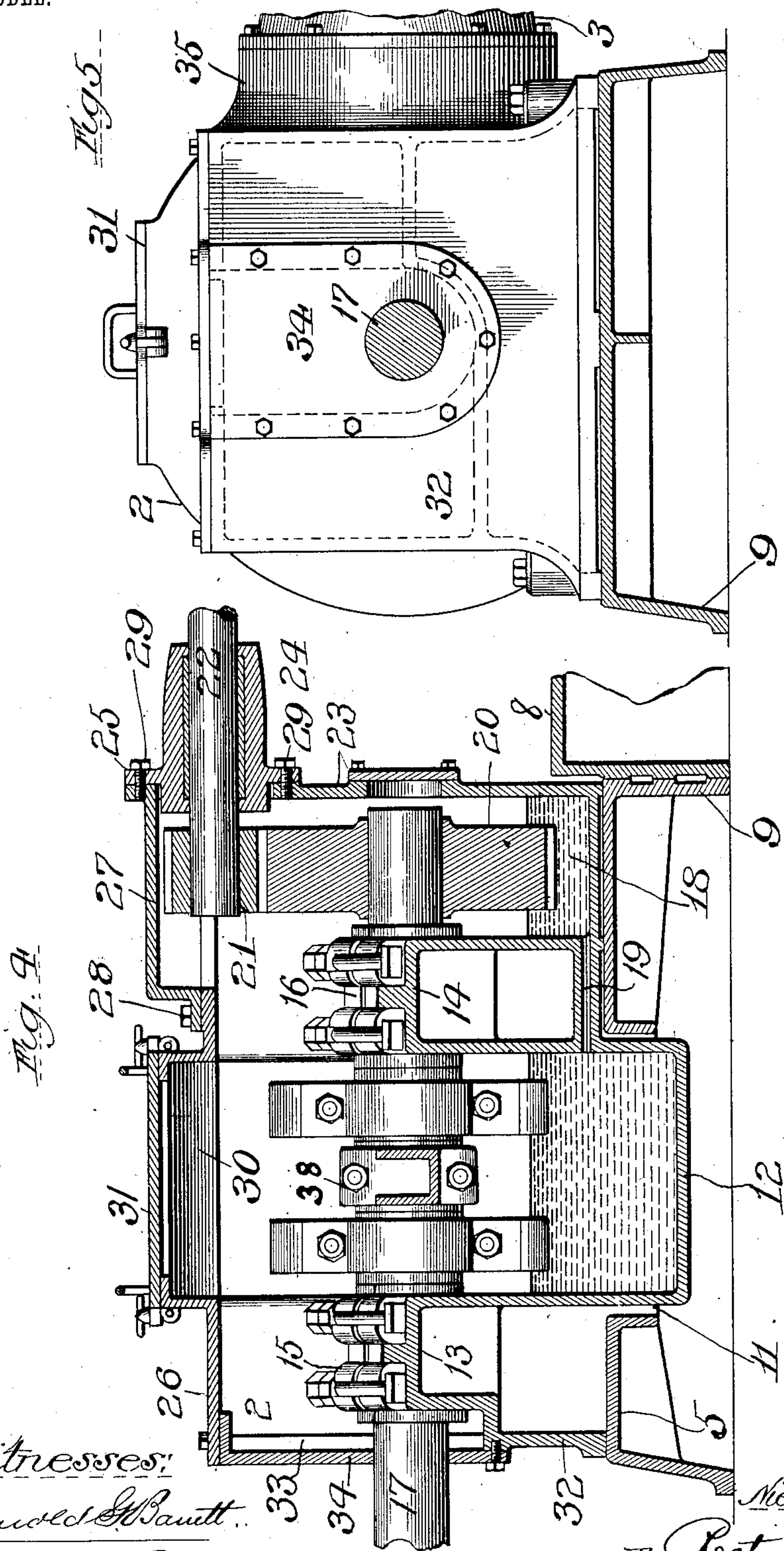
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APPLICATION FILED MAY 8, 1901.

NO MODEL.

5 SHEETS—SHEET 4.



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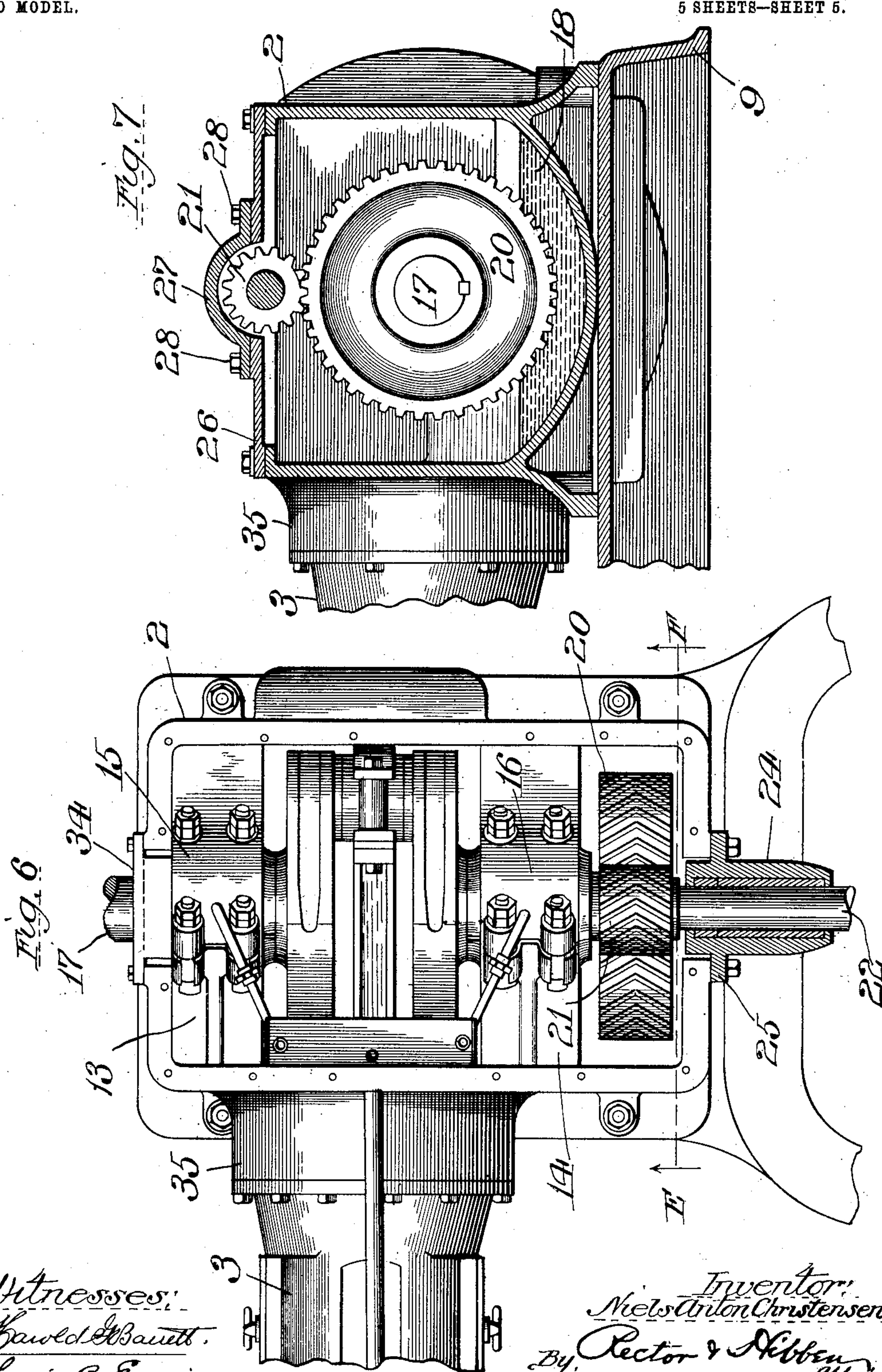
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APPLICATION FILED MAY 8, 1901.

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5 SHEETS—SHEET 5.



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# UNITED STATES PATENT OFFICE.

NIELS ANTON CHRISTENSEN, OF MILWAUKEE, WISCONSIN.

## ELECTRIC MACHINE.

SPECIFICATION forming part of Letters Patent No. 753,954, dated March 8, 1904.

Application filed May 8, 1901. Serial No. 59,257. (No model.)

*To all whom it may concern:*

Be it known that I, NIELS ANTON CHRISTENSEN, a subject of the King of Denmark, residing at Milwaukee, in the county of Milwaukee and State of Wisconsin, have invented certain new and useful Improvements in Electric Machines, of which the following is a specification.

My invention relates in general to a direct-connected unit system, which may be either a generating set or unit for generating electricity or a motor-compressor set or unit for the compression of air or the like, thus involving a reversal of operation; and its object is to provide a novel and efficient form of construction and general mode of operation whose advantages will be readily apparent from the description hereinafter set forth to those skilled in the art to which this invention appertains.

In the drawings, Figure 1 is a plan of a generating unit; Fig. 2, a plan of a motor-compressor unit; Fig. 3, a sectional elevation on line A B of Fig. 2; Fig. 4, a section on line C D of Fig. 2; Fig. 5, a side elevation of the crank-chamber; Fig. 6, a plan of the crank-chamber with the top removed, and Fig. 7 a sectional elevation on the line E F of Fig. 6.

My present invention is the same whether embodied in a generating set or a motor-compressor set, and for the purpose of showing some of the range of application of such invention I have herein illustrated it as applied to and embodied in these two different units. The detailed figures of the drawings, however, are all taken from Fig. 2, which shows the motor-compressor set or unit.

The generating unit will be described first, but only in general terms. This unit comprises, first, the steam-cylinder 1, the crank-shaft chamber 2, with intermediate casing 3, and the dynamo or generator 4, all mounted on or supported by the common base or bed plate 5. This construction represents a direct-connected steam unit, because the motive power here designed to be employed is steam and the generating of electricity is the result sought. The dynamo or generator is direct connected with the crank-shaft or equivalent mechanism in the same manner as the motor, as will be hereinafter fully understood from

a description given of the details of the motor-compressor set or unit.

Referring next to the motor-compressor set shown by the general plan view, Fig. 2, such unit comprises the chamber 2, casing 3, base 5, (same as the generating unit,) the motor 6, and a compressor or pump cylinder 7. The bed-plate, which may be cast in a single piece or in two pieces connected by bolts, as shown, comprises the electric-machine portion 8 and the crank-chamber portion 9 for supporting the motor and the crank-chamber, respectively. The forward extension 10 of the base-plate supports the intermediate casing. The bed-plate part 9 has a substantially rectangular opening 11 to receive the crank well or pit in the crank-chamber, as hereinafter described.

The crank-shaft chamber is formed by a casing whose general shape is shown in Fig. 4. The bottom is so shaped as to provide a crank well or pit 12, extending down through the opening 11 in the base-plate and adapted to be filled or partially filled with oil for the lubrication of the various working parts operating in such chamber. Two shelves 13 and 14 extend laterally from the top of the crank-well and constitute supports for the bearings 15 and 16 of the crank-shaft 17, whose crank and connecting-rod are adapted to dip into the oil in said well. To the right, Fig. 4, of the bearing 16 the casing is provided with what I will term a "main-gear oil-well" 18, preferably connected to and thereby receiving its supply of oil from the well 12 by means of a cross-passage 19 or otherwise. On the right-hand end, Fig. 4, of the crank-shaft is mounted a main-gear wheel 20, which is preferably of the herring-bone type and which is adapted to dip into the oil in the well 18 and also adapted to mesh at its top with the corresponding herring-bone pinion 21, fastened to the armature-shaft, which extends through the side or end plate 23 of the casing. As shown, this armature has bearings 24, whose flange 25 is bolted to the side of the casing, Fig. 4. The casing has a top covering-plate 26, which is cut away at a point directly above the pinion 21 in order to accommodate such pinion, as shown in Fig. 4, which opening is normally covered by a removable cover 27, secured to the main



cover by bolts 28 and to the bearings 24 by bolts 29 or otherwise. By simply removing the bolts which hold the armature-bearings and said cover 27 in place the armature and its pinion may be readily removed without interfering with or disturbing the parts relating to the compressor proper. The top cover 26 has a preferably flanged opening 30 immediately above the crank and normally closed by a suitable door or cover 31, which is made readily removable in order that the crank-shaft and its connecting-rod or other parts within the crank-chamber may be inspected with facility. The left-hand end 32, Fig. 4, of the crank-chamber casing has a U-shaped opening 33 extending from the top and closed by a correspondingly-shaped end plate 34, as clearly shown in Fig. 5. This end plate has a suitable opening to let the crank-shaft 17 pass through. This construction permits of the ready assembly of the parts, the crank-shaft being let down into the crank-chamber from above.

The intermediate casing 3 is bolted at one end to the partial extension 35, proceeding from one side of the crank-chamber, and at the other end to the cylinder 7. This casing 3 has guideways or slideways 36 for the cross-head 37, reciprocated by the rod 38, which is connected to the crank-shaft, Fig. 3. A fly-wheel 39 is preferably provided.

The parts of the generating unit, which are similar to those above described, have been marked with corresponding figures of reference in Fig. 1.

One of the main objects which I have accomplished by the construction hereinbefore described and shown in the drawings is to provide an apparatus in which the engine or motive portion runs at a proper speed and the generator also runs at its proper speed in the case of the generating unit and in the case of a motor-compressor unit an apparatus in which the motor and the compressor mechanism, respectively, run at their proper speed.

Referring to the generating unit, ordinarily in small units of up to, say, two hundred horsepower, the generator should run about three times faster than the engine. In most small direct-connected units now in the market the engine has altogether too high speed, while the generator has too low speed, thereby making a necessarily cumbersome generator, and thereby increasing the cost and making a necessarily high-speed engine, thereby decreasing the life of the latter and inviting trouble. With my construction I can so vary and modify the size of the gear and pinion as to obtain the exact commercial speed for generator and engine which have been found by long practice to be the best. Taking into consideration the reversal of operations, the same remarks apply with equal pertinency to the motor-compressor unit.

From the foregoing description it will be

observed that the various parts are thoroughly compacted without detracting from efficiency, and the electric machine is located at one side of the crank-chamber, with its armature-pinion extending into the crank-chamber, where it is thoroughly lubricated. The working parts should ordinarily be kept inclosed and free from the destructive action of dirt and grit, and consequently I have designed and herein shown that the crank-shaft, its crank, the main gear on said shaft, as well as the armature-pinion, should all be contained within and inclosed by the casing of the crank-chamber, so as to absolutely exclude the entrance of any injurious elements and permit of a perfect system of lubrication. At the same time means are provided whereby the armature-shaft and its pinion may be readily removed from the crank-chamber without materially disturbing such chamber or its contained working parts.

Inasmuch as the main gear 20 runs in oil as to its lower portion, at least, the oil is carried upward to the pinion 21, and sufficient oil will find its way across to the armature-bearing to properly lubricate the latter. This thorough lubrication, assisted by the use of herringbone gears, which are preferably used, insures a simple and practically-noiseless operation and means the greatest efficiency from the energy consumed.

By reason of the peculiar and novel construction of the crank-chamber, base, intermediate casing, and all the parts generally I am enabled to provide a complete, compact, and yet thoroughly-efficient arrangement of machinery. Furthermore, the cost of my machine will be less than other machines and less room will be taken up by it.

I claim—

1. In a machine of the class described, a casing forming an inclosed shaft-chamber, a shaft operating in said chamber, a gear on said shaft within the chamber, in combination with an electric machine placed laterally of and in the same horizontal plane as the chamber, said electric machine having an armature-shaft extending through a side wall thereof, a pinion on the armature-shaft meshing with said gear, and a bearing for the armature-shaft, which bearing is removably secured to the casing.

2. In a machine of the class described, a casing forming an inclosed shaft-chamber, a shaft operating therein, a gear arranged on the shaft and located within the chamber, in combination with an electric machine placed at one side of the chamber with its armature-shaft extending through a side wall thereof, a pinion on the armature-shaft also located within the chamber and meshing with said gear, a top cover for said casing which cover is cut away adjacent said pinion, a closure for said cut-away portion and removably secured to such cover, and an armature-shaft bearing



removably secured to said casing and to said closure.

3. In a machine of the class described, a casing forming an inclosed chamber, a shaft therein, a gear on the shaft, in combination with an electric machine arranged at the side of the chamber with its armature-shaft extending therein, a pinion on the armature-shaft and meshing with the gear, the top of the casing having an opening above the pinion, a cover secured to the casing and covering said opening and a bearing for the armature-shaft, which bearing rests in the sides of the casing and is secured to the casing and to said cover.

4. In a machine of the class described the combination of an inclosed crank-chamber, a crank-shaft operating therein, an electric machine located at one side of the chamber with the armature-shaft extending therein through a side wall, direct connections between said crank-shaft and armature-shaft, a cylinder having a piston connected to the crank-shaft and a common base for said cylinder, chamber and electric machine.

5. In a machine of the class described, the combination of a casing forming a crank-chamber having a crank-well 12, a crank operating in such chamber, a base or bed plate supporting the casing and having an opening through which the well extends and means for operating the crank-shaft.

6. In a machine of the class described, the combination of a crank-chamber in which a crank works and having a crank-well for oil and also a communicating main-gear oil-well, a main gear arranged on the shaft within the chamber and dipping into its oil-well, a pinion meshing with such gear and an electric machine on whose armature-shaft the pinion is mounted, said electric machine being arranged laterally of and in the same horizontal plane as the crank-chamber.

7. In a machine of the class described, the combination of a crank-chamber, a crank-shaft operating therein, said chamber having an oil well or pit in which the crank dips and also an auxiliary oil-well, means of communication between said wells, a gear arranged on such shaft and dipping into the oil in the auxiliary well, a pinion meshing with such gear and an armature-shaft of an electric machine on which shaft the pinion is secured, said electric machine being arranged laterally of and in the same horizontal plane as the crank-chamber.

8. In a machine of the class described the combination of a crank-chamber having shelves 13 and 14 forming supports for the crank-shaft bearings and dividing the chamber into an oil-well for the crank and an oil-well for a gear, an oil-passage between said wells, a crank-shaft in said chamber, a gear arranged on said shaft and working in its oil-well, a pinion meshing with such gear and an arma-

ture-shaft of an electric machine on which shaft the pinion is secured, said electric machine being arranged laterally of and in the same horizontal plane as the crank-chamber.

9. In a machine of the class described, the combination of an electric machine, a cylinder with its piston, direct connections between said parts, all arranged side by side, and a common base on which said mechanisms are mounted, said electric machine being arranged laterally of and in the same horizontal plane as the cylinder.

10. In a machine of the class described the combination of a casing forming a chamber having a shaft operating therein, a removable top plate on said casing and a door in said top plate removable independently of such plate for the inspection of the parts within the casing.

11. In a machine of the class described, the combination of a casing forming a crank-shaft chamber, a crank-shaft therein, a gear on such shaft, an electric machine arranged at the side of such casing and having its armature-shaft extending therein, a pinion meshing with said gear and secured to the crank-shaft, a top plate 26 arranged on the casing and having an opening over the crank and a second opening over the pinion and a cover 31 for the crank-opening and a cover 27 for the pinion-opening.

12. In a machine of the class described, the combination of a casing forming a chamber, a crank-shaft therein and extending through one side of the casing, said side having a slotted opening from the top and a removable cover secured to the casing over said opening and having an opening for the shaft to pass through.

13. In a direct-connected electric machine, the combination of an electric machine having an armature-shaft provided with a pinion, an inclosed chamber at one side of such machine, into which chamber said armature-shaft and its pinion extends, a shaft in said chamber, a gear on said shaft for driving, said pinion, said electric machine being arranged in the same horizontal plane as said chamber, said chamber having a top opening above the pinion and an arched cover secured to the chamber over said opening and removable without disturbing the parts in said chamber.

14. In a direct-connected electric machine, the combination of an electric machine having an armature-shaft provided with a pinion, an inclosed chamber located at one side of said machine into which chamber said armature-shaft and its pinion extends, said electric machine being arranged in the same horizontal plane as said chamber, a shaft working in said chamber, a gear on said shaft for driving said pinion, said chamber having an oil-well into which the gear dips and also having a top opening above the gear and an arched removable cover removably secured to said casing for closing such opening.



15. In a machine of the class described, the casing 2 having an oil-well 12, an auxiliary oil-well 18, a crank-shaft 17 with a crank and rod dipping in the well 12, a main gear 20, on shaft 17 and dipping into oil-well 18, in combination with an electric machine arranged by the side of said casing and having an armature-shaft 22 extending into casing 2 and provided with a pinion 21 meshing with gear 20.

16. In a machine of the class described, a casing having shelves 13 and 14 with an intermediate oil-well 12 and side adjacent well 18, a crank-shaft 17 in said casing and having a crank dipping in well 12, a gear 20 on the crank-shaft and dipping into well 18, a communicating oil-passage 19 in combination with an electric machine arranged at one side of the casing and adjacent thereto, the armature-shaft of which machine is extended into the said casing and a pinion 21 on the armature-shaft within the casing and meshing with gear 20.

17. In a machine of the class described, a casing having crank-shaft bearings, a crank-shaft journaled in said bearings, a gear on said shaft, and inclosed within the casing, in combination with an electric machine having an armature-shaft 22 extending into the casing, a pinion 21 on the end of the shaft within the casing and meshing with gear 20, a top plate 26 for the casing having an opening above the pinion, an arched cover 27 covering such opening, and armature-shaft bearings 24 fastened to the casing and to the said cover 27.

18. In a machine of the class described, the combination of a casing forming an inclosed chamber, a shaft operating therein, a gear-wheel arranged within the chamber and driven by said shaft, an electric machine arranged at one side of said casing but in proximity thereto, such machine having an armature-shaft extending through a side wall of the casing and into the chamber, a pinion mounted on said armature-shaft and within the casing, said pinion meshing with said gear, and means in said chamber for automatically lubricating the moving parts, said pinion and gear together

with its shaft being all arranged and concealed within the casing.

19. In a machine of the class described the combination of a single casing forming an inclosed crank-chamber having a crank-shaft operating therein, a gear-wheel also located and operating within the said chamber and secured on such shaft, an electric machine located at one side of and adjacent to said crank-chamber in the same horizontal plane as the latter and having an armature-shaft extending therein, and a pinion secured to such armature-shaft at a point within the crank-chamber and meshing with said gear-wheel.

20. In a machine of the class described the combination of a single casing forming an inclosed chamber, a crank-shaft operating therein, a gear-wheel also therein and secured to such shaft, an electric machine placed at one side of said chamber in the same horizontal plane and having an armature-shaft extending therein, a pinion secured on the inner inclosed end of such armature-shaft and driven by said gear-wheel, and a bearing secured in a side wall of the crank-chamber, in which bearing this extended end of the armature-shaft is journaled.

21. In a machine of the class described, the combination of an electric machine, having an armature-shaft provided with a pinion, a single casing forming a crank-chamber having a crank-shaft operating therein, a cylinder and guide-frame secured to said casing and projecting laterally therefrom, a piston and connections with the crank-shaft, a gear arranged on the crank-shaft and meshing with the pinion, the electric machine being arranged at one side of but in close proximity to said casing and having positive connections with the crank-shaft by said gear and pinion both arranged and concealed within said casing.

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