G. T. CARTER.

ROTARY ENGINE.

APPLICATION FILED JULY 18, 1917.

1,303,255.

Patented May 13, 1919.

2 SHEETS—SHEET 1.

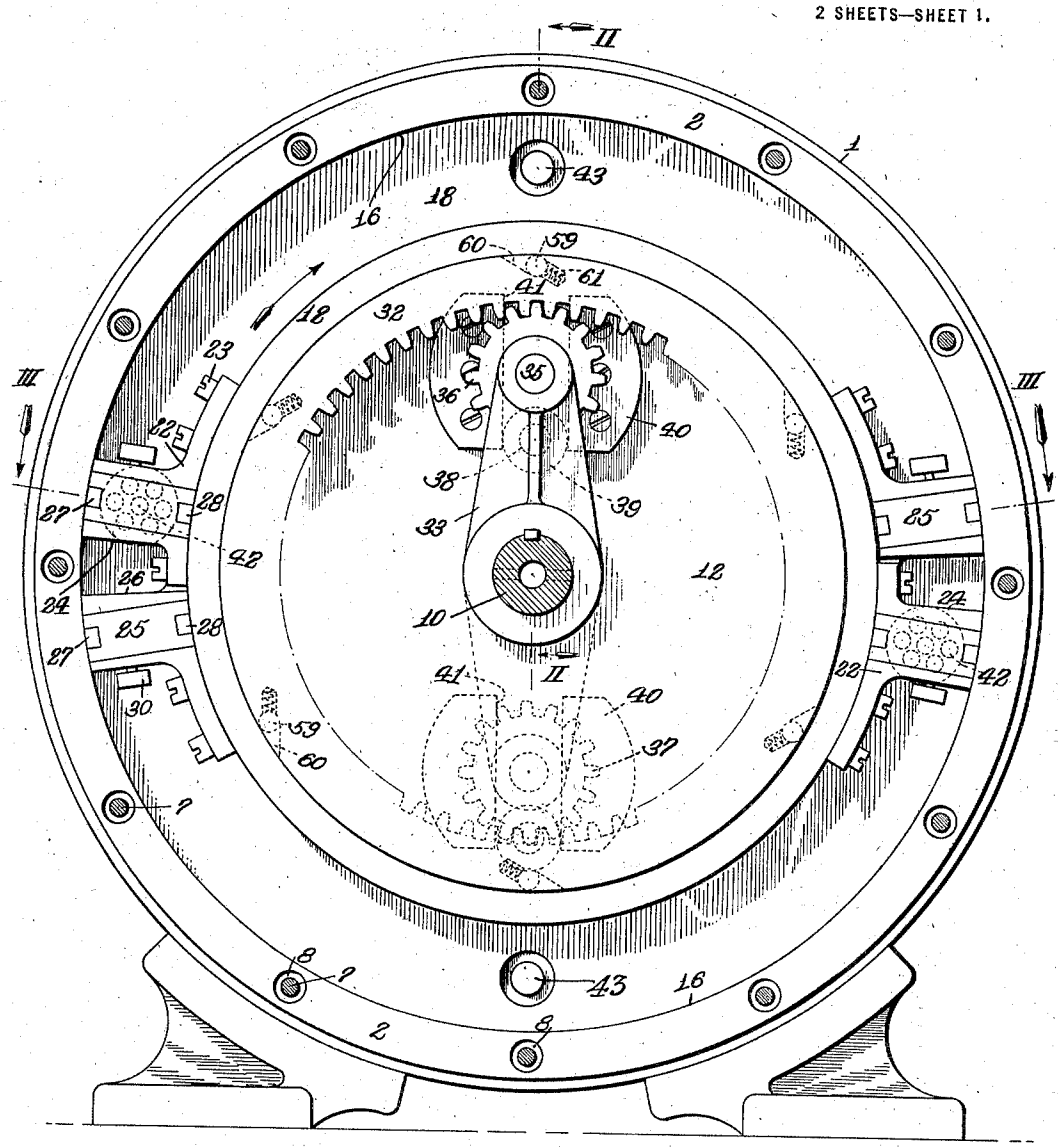


FIG. 1.

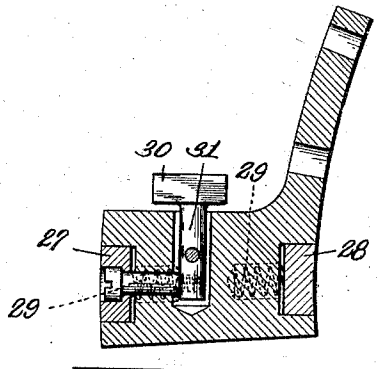


FIG. 4.

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2 SHEETS—SHEET 2.

Fig. 2.

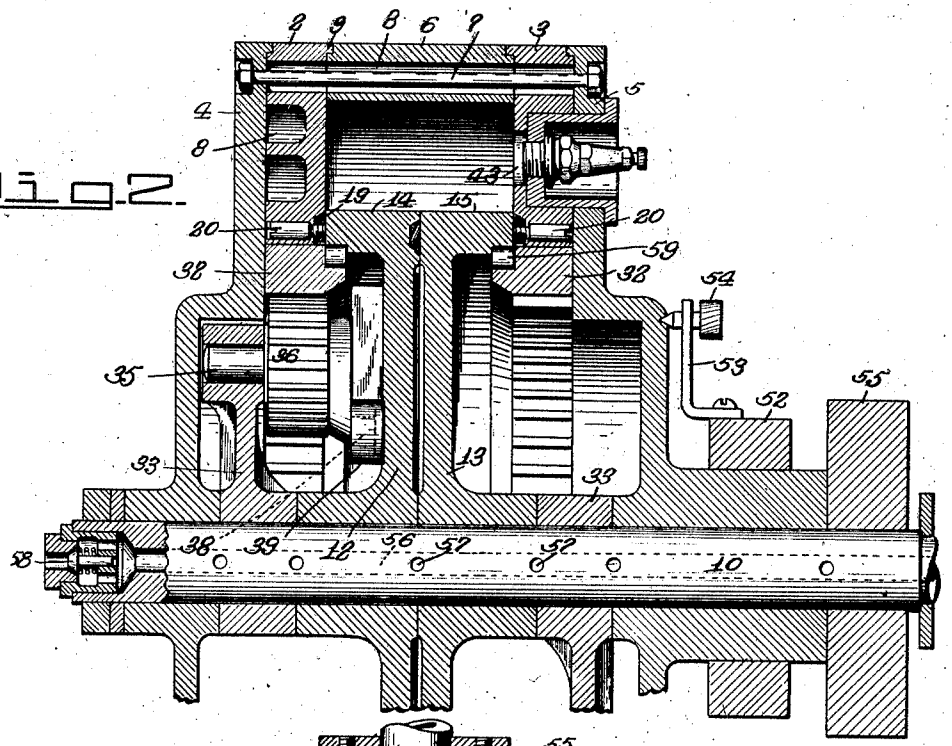
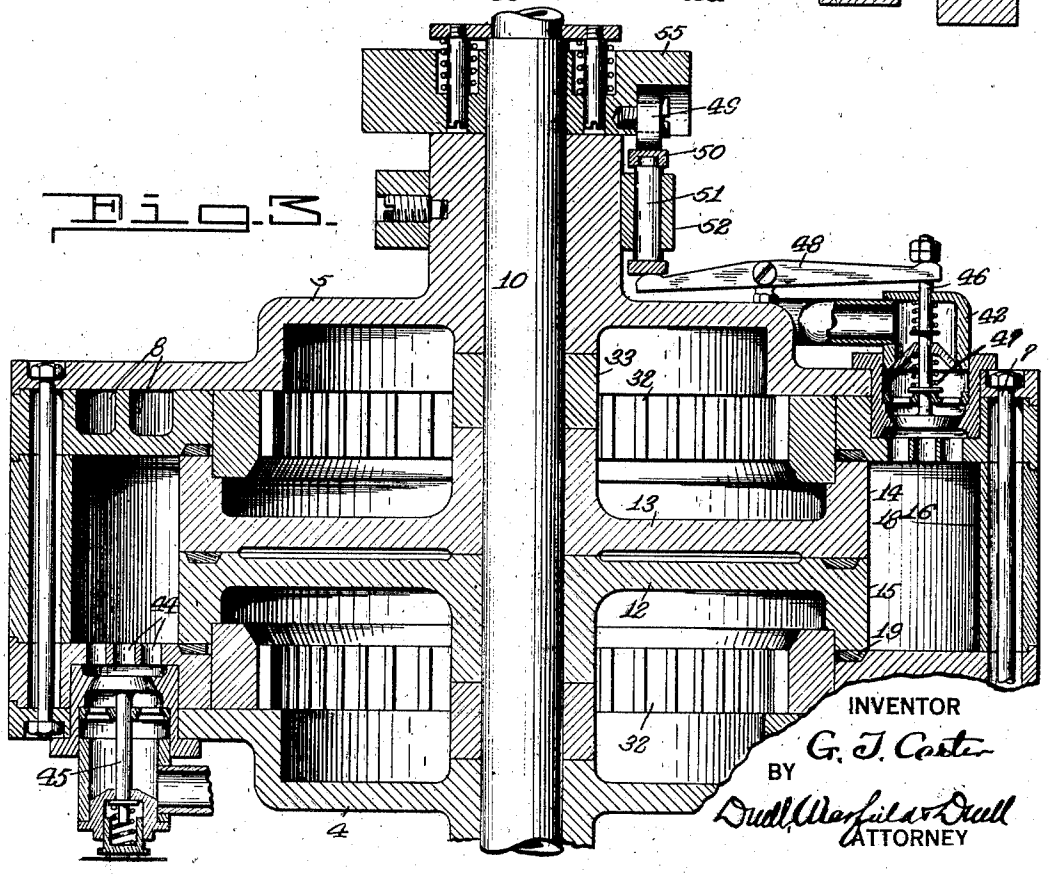


Fig. 3.



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ROTARY ENGINE.

1,303,255. Specification of Letters Patent. Patented May 13, 1919.

Application filed July 18, 1917. Serial No. 181,216.

To all whom it may concern:

Be it known that I, GEORGE T. CARTER, a citizen of the United States, residing at Elizabeth, in the county of Union and State of New Jersey, have invented certain new and useful Improvements in Rotary Engines, of which the following is a full, clear, and exact description, such as will enable others skilled in the art to which it appertains to make and use the same.

This invention relates to gas engines and with regard to its more specific features, to a device of the character described in which the power is exerted differentially upon the moving parts.

An object of this invention is to provide a device of the character described in which the moving parts move continuously in the same direction, whereby the jar incident to the reversing of the direction of the motion of moving parts is avoided.

A further object of the invention is to provide a device of the character described in which the power is transmitted to the rotating parts differentially whereby the largest amount of power is obtained with the minimum friction and wear on the bearings.

Other objects will be in part obvious and in part pointed out hereinafter.

The invention accordingly consists in the features of construction, combinations of elements and arrangement of parts, which will be exemplified in the construction hereinafter set forth, and the scope of the application of which will be indicated in the following claims.

In the accompanying drawings annexed to and forming a part of this specification, in which similar characters refer to similar parts throughout the several views,

Figure 1 is an elevation of the machine shown partly in section;

Fig. 2 is a sectional view along the line 2—2 of Fig. 1;

Fig. 3 is a central transverse sectional view of the device; and

Fig. 4 is a detail view of the counterbalance for certain piston packing.

In the drawings the numeral 1 represents a casing comprising two annular side members 2 and 3, and two caps 4 and 5, held in spaced relationship by a circumferential wall 6. Suitable bolts, as 7, circumferentially disposed around the casing may extend through the caps, the side members and the circumferential wall to hold the parts of the casing together.

As illustrated, the side members 2 and 3 are provided with passages 8 in which a circulation of a cooling medium may be maintained. In order to provide a tight joint between the circumferential wall and the side members, complementary rabbets may be provided on their meeting surfaces as shown at 9.

The numeral 10 indicates a shaft which is journaled in the caps 4 and 5 coaxially of the casing. Loosely journaled upon the shaft 10 on the interior of the casing are two disks 12 and 13. These disks 12 and 13 are so disposed and have their circumferential surfaces 14 and 15 of such size as to form between the circumferential surfaces and the inner surface 16 of the circumferential wall 6 an annular piston chamber 18, and in order that this chamber may be substantially gas-tight both between the disks and the side members 2 and 3 and between the disks themselves, suitable packing as 19 may be provided at the meeting surfaces. This packing may consist of an annular ring fitting within a recess in the members 2 and 3, and may be held in place by screws 20.

Mounted upon the surface 14 of the disk 12 at circumferentially spaced points are pistons 22 which may be attached to the disk 13 by suitable screws as 23. These pistons have the same shape in cross-section as the piston chamber 18 whereby they are adapted to move circumferentially in the piston chamber. Each of these pistons is provided with a working face as 24, and the working face of all of the pistons on the disk 13 will be disposed in position to oppose the same direction of rotation.

Mounted upon the surface 15 of the disk 13 is a second set of circumferentially spaced pistons 25 which may be attached to the disk 13 by suitable screws. These pistons will alternate with the pistons 22 around the circumference of the piston chamber and may be similar in construction to the pistons 22 but will be so disposed that the working face 26 thereof will be opposed to rotation in the opposite direction from that to which the faces 24 of the pistons 22 are opposed whereby the working faces 24 of each of the pistons 22 will stand in opposed relation to the working face 26 of one of the pistons 25.

Means are provided for communicating

motion from the piston 22 to the shaft 10, and from the shaft 10 to the pistons 25 in such manner that the pistons 22 and 25 will be caused alternately to approach and recede from each other during their movement around the circumference of the piston chamber and when the engine is to be operated as a gas engine on the Otto cycle this mechanism will preferably be such as to cause twice as many cycles of relative movement of the pistons for each revolution around the axis of the shaft as there are desired to be power impulses per power piston per revolution, because when this relationship exists, the greatest simplicity of construction is obtained, as will hereinafter appear.

In the embodiment illustrated there are designed to be two power impulses per revolution on each power piston. Consequently the train of mechanism connecting the pistons will cause the pistons to recede from and approach each other four times each revolution of the shaft.

In order to insure a tight engagement between the pistons and the walls of the piston chamber, each of the pistons may be provided with suitable piston strips as 27 on the peripheral face of the pistons and 28 on the lateral and inner faces thereof. Each of these strips will be urged toward the corresponding wall of the piston chamber by a suitable spring 29. In order to overcome the centrifugal force exerted on the strips 27 by reason of the high speed of the engine, suitable counterbalances may be provided as at 30, connected to the strips 27 by a pivoted lever 31 and the weight of the counterbalance and the ratio of the lever 31 may be such as to neutralize the centrifugal force.

Furthermore in the embodiment two pistons are employed on each disk so that the pistons are diametrically disposed.

The train of mechanism illustrated in the accompanying drawings for causing the motion of pistons is as follows: Mounted upon the interior of the casing 1 concentric with the shaft 10 are two annular gears 32, and mounted upon the shaft 10 are two crank arms 33, preferably disposed on opposite sides of the disks 13 and 14. These arms are tight upon the shaft and are illustrated as being disposed diametrically opposite to each other. Each carries at its outer end a stud, as 35, on which is journaled pinions 36 and 37 each meshing with one of the annular gears 32. The pitch diameter of the annular gears 32 bears to the pitch diameter of the pinions 36 and 37 a ratio equal to the number of cycles of relative motion between the pistons which it is desired to produce per revolution, and consequently in the machine illustrated the pitch diameter of the annular gears will be four times that of the pinions.

Means are provided for transmitting motion from a point eccentric to each pinion to its adjacent disk whereby as the pinions are rotated around the annular gears and simultaneously around their pivots an oscillatory motion relative to the axis of the pinions will be communicated to each disk. As illustrated, there is provided upon each pinion on the side adjacent the corresponding disk at a point eccentric to the axis of the pinion, studs 38 carrying anti-friction rolls 39 and there may be attached to the disks in position to coöperate with the rolls 39, suitable guides as 40 forming radially disposed channels 41 of width substantially equal to the diameter of the anti-friction roll. The pinions 36 and 37 carrying studs 38 will be so timed relative to their meshing annular gears that the stud 38 on one of these pinions will be at the extreme outer end of its travel while the stud 38 on the other pinion is at the extreme inner end of its travel. By this construction, the rotation of the shaft 10 carrying the arms 33 will cause a planetary movement of the pinions 36 and 37 which will carry the disk 13 and 14 around the shaft with a constantly increasing and decreasing speed somewhat in the nature of a sine wave movement. By reason of the fact that the studs 38 are disposed in opposite relation, the maximum speed of one disk will be at the time of minimum speed of the other disk so that the pistons will be given a relative movement toward and from each other, making in the particular arrangement shown four complete cycles of such movement for each revolution of the shaft.

For convenience of description, that point in the cycle of operations at which the pistons 25 have just ceased substantially to move and the pistons 22 have just substantially started to move, one position of which is illustrated in Fig. 1, may be termed the neutral position and in the embodiment illustrated, four such neutral positions will occur in each revolution. At one of these neutral positions, the intake of the motive fluid takes place and at the next of said neutral positions, the firing takes place. At the next neutral position intake again takes place, and at the next further firing, in repetition.

The intake port as 42 will be set just in advance in the direction of rotation of the neutral position and so located as to be uncovered by the piston 22 as it starts its motion. The firing mechanism, illustrated as a spark plug 43, will be disposed at the next neutral position in position to communicate with the space between the pistons as the piston 22 starts to move at the beginning of

the next cycle. Exhaust port 44 will be just in the rear of the neutral position in position to be uncovered by the piston 22 before it ceases to move at the close of its working cycle and preferably in position to be closed by the piston 25 as it ceases to move.

For the purpose of controlling the exit of the gases from the exhaust port 44, a suitable valve may be provided as, for example, the spring-pressed disk valve 45 and for the purpose of controlling the intake of the fuel through the intake port 42 a suitable valve as 46 may be provided which is preferably mechanically controlled by the rotation of the engine so as to secure the proper timing of the valve. As illustrated, the valve 46 is held inwardly against its seat by a spring 47 and is opened by being pressed outwardly against the action of the spring 47 by a lever 48 which is operated by a cam roller 49 through the medium of a cam 50 and a pin 51. The cam 50 and pin 51 are carried on a block 52 which is mounted upon the cap 5 so as to be able to be adjusted circumferentially thereon and the position of which is controlled by an arm 53 and a pin 54 engaging the surface of the cap 5.

The roller 49 is mounted on a block 55 which in turn is mounted upon the shaft 10 for rotation therewith so that the roller 49 will engage the cam 50 once for each rotation of the shaft, but the point in the rotation of the shaft at which the roller 49 will engage the cam 50 may be altered, and thus the timing of the valve may be changed by the rotation of the block 52 by means of the arm 53. The lower end of the pin 51 is of sufficient size to engage the end of the lever 48 at all times in spite of such angular adjustment of the block 52. It will be understood that one set of this valve operating mechanism will be provided for each inlet port and thus by reason of the fact that as many rollers 49 will be provided as there are inlet ports, the valve 46 will be operated as many times in each revolution as there are inlet ports.

For the purpose of procuring the proper lubrication of the interior portions of the engine, the shaft 10 may be bored out longitudinally to provide an oil chamber 56 and suitable lateral openings may be provided by means of which this oil chamber may communicate with the various bearing surfaces as shown at 57. A suitable self-closing valve may be provided at the entrance of the oil chamber through which oil may be inserted in the chamber, as shown.

For the purpose of preventing backward motion of the pistons 25 on the disk 13, should there be any tendency for it so to move at any time in the cycle of operations due to improper timing of the ignition or other contributing cause, a suitable ratchet mechanism may be provided comprising rolls 59 resting in inclined sockets 60 of one of the stationary parts of the machine, as for example, the internal gear 30, springs 61 being provided to urge the ball outwardly against a coöperating face of the disk 13. Because of the inclination of the sockets 60 to the radius of the gear, the disk 13 will be free to rotate in one direction, but will be locked against rotation in the reverse direction. A similar ratchet mechanism, as shown in Fig. 2, may be provided for the other disk, if desired.

From the above description the operation of the device will be evident. To start the engine, the shaft 9 is rotated in the direction of motion, which rotation will, through the train of mechanism above described, cause the piston 22 to move from the position shown in Fig. 1 in the direction indicated by the arrow, thus uncovering the intake port 45 and drawing into the space between the pistons the motive fluid. When the piston 22 has reached a position at right angles to the position shown for it in Fig. 1, the piston 25 will start to move, thus closing the intake port and compressing the gas between pistons until the piston 25 reaches the position in which it is shown in Fig. 1. Due to the train of mechanism, the continued rotation of the shaft will now start the piston 22 to move and immediately thereafter, or (after the parts have acquired their momentum substantially simultaneously therewith, if desired, or even before that), the spark may be discharged through the spark plug, causing ignition of the gases.

Thus by the above described construction are accomplished, among others, the objects hereinabove set forth.

As many changes could be made in the above construction and many apparently widely different embodiments of this invention could be made without departing from the scope thereof, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

It is also to be understood that the language used in the following claims is intended to cover all of the generic and specific features of the invention herein described, and all statements of the scope of the invention which, as a matter of language, might be said to fall therebetween.

Having described my invention, what I claim as new and desire to secure by Letters Patent is:

1. A device of the character described comprising, in combination, an annular piston chamber, a shaft coaxial therewith, pistons mounted for movement around said shaft in said chamber, means for connecting said pistons together adapted to cause them

to approach and recede from each other as they revolve around the axis of the shaft, including an annular gear coaxial with the piston chamber, an arm rigidly attached to the shaft and carrying a pinion in position to mesh with the annular gear, a pin eccentrically mounted on said pinion, and a member rotatable about said shaft and to which certain of said pistons are rigidly attached, said member being provided with a guideway extending in a radial direction with which said pin on said pinion is adapted to coöperate.

2. A device of the character described comprising, in combination, an annular piston chamber, a shaft coaxial therewith, pistons mounted for movement around said shaft in said chamber, means for connecting said pistons together adapted to cause them to approach and recede from each other as they revolve around the axis of the shaft including an annular gear coaxial with the piston chamber, an arm rigidly attached to the shaft and carrying a pinion in position to mesh with the annular gear, a pin eccentrically mounted on said pinion, and a member rotatable about said shaft and to which certain of said pistons are rigidly attached, said member being provided with a guideway extending in a radial direction with which said pin on said pinion is adapted to coöperate, said pin being at a distance from the axis of the pinion equal to the pitch radius of the pinion.

3. A device of the character described comprising, in combination, an annular piston chamber, a shaft coaxial therewith, pistons mounted for movement around said shaft in said chamber, means for connecting said pistons together adapted to cause them to approach and recede from each other as they revolve around the axis of the shaft including a gear coaxial with the shaft, an arm rigidly attached to the shaft carrying a pinion adapted to mesh with said gear, a pin mounted on an eccentric portion of said pinion, and a member mounted for rotation around said shaft to which certain of said pistons are rigidly connected, said member carrying a radially disposed guide adapted to coöperate with said pin.

4. A device of the character described comprising, in combination, an annular piston chamber, a shaft coaxial therewith, two sets of pistons mounted for movement around said shaft in said chamber, means for connecting the pistons together adapted to cause the pistons of one set to approach and recede from the pistons of the other set as the pistons revolve around the axis of the shaft, including two members mounted for rotation around the shaft to each of which one set of said pistons is rigidly connected, two pinions mounted for planetary movement around said shaft, and means for connecting an eccentric portion of one of said pinions with one of said members and an eccentric portion of the other of said pinions with the other of said members, said eccentric portions being so adjusted relative to each other that when one of said eccentric portions is nearest the shaft the other of said eccentric portions will be farthest therefrom.

5. A device of the character described comprising, in combination, an annular piston chamber, a shaft coaxial therewith, two sets of pistons mounted for movement around said shaft in said chamber, means for connecting the pistons together adapted to cause the pistons from one set to approach and recede from the pistons of the other set as the pistons revolve around the axis of the shaft including two members mounted for rotation around the shaft to each of which one set of said pistons is rigidly connected, two pinions mounted for planetary movement around said shaft, means for connecting an eccentric portion of one of said pinions with one of said members and an eccentric portion of the other of said pinions with the other of said members, said eccentric portions being so adjusted relative to each other that when one of said eccentric portions is nearest the shaft the other of said eccentric portions will be farthest therefrom, the distance between the eccentric portions of said pinions and the axis of said pinion being equal to the pitch radius of said pinions.

In testimony whereof I affix my signature, in the presence of two witnesses.

GEORGE T. CARTER.

Witnesses:

FRANK L. KRAEMER,

L. A. WATSON.