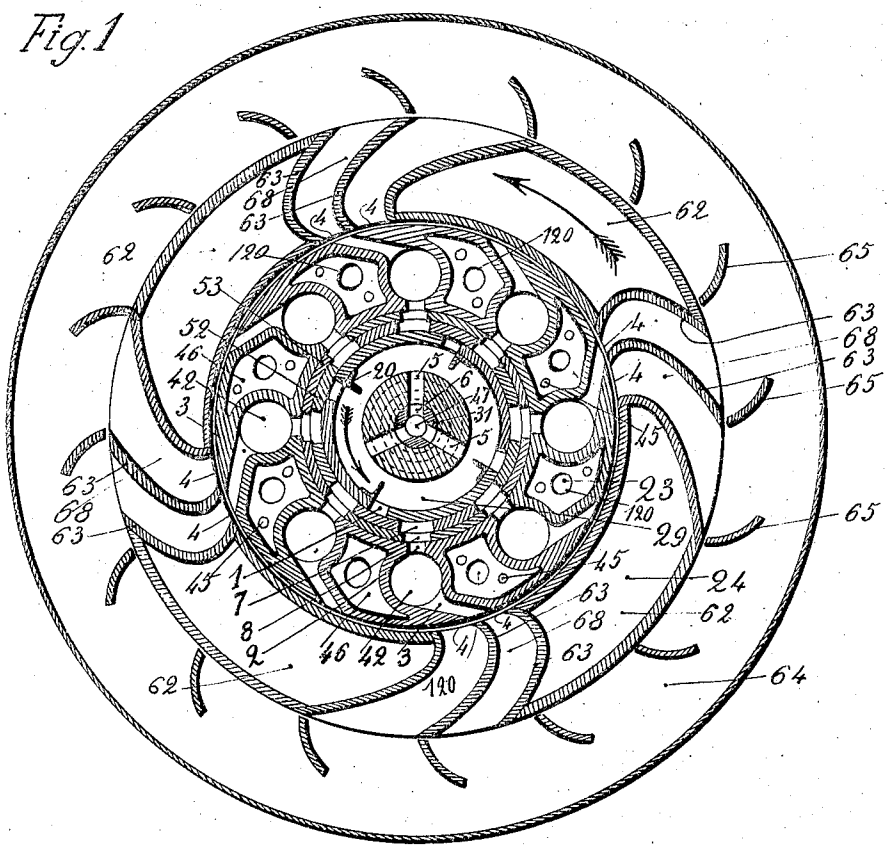
May 11, 1926. 1,584,346

L. L. ARDIN

INTERNAL COMBUSTION TURBINE

Filed May 23, 1922 8 Sheets-Sheet 1

Fig. 1



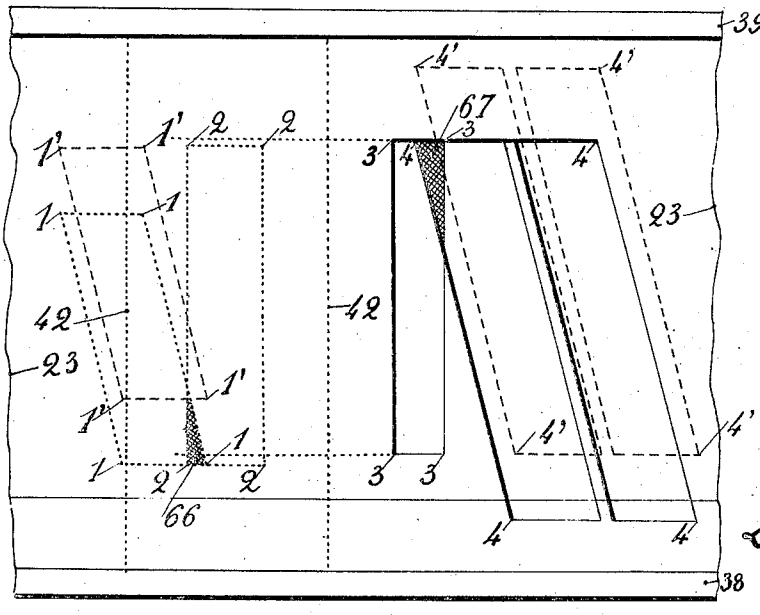


Fig. 5

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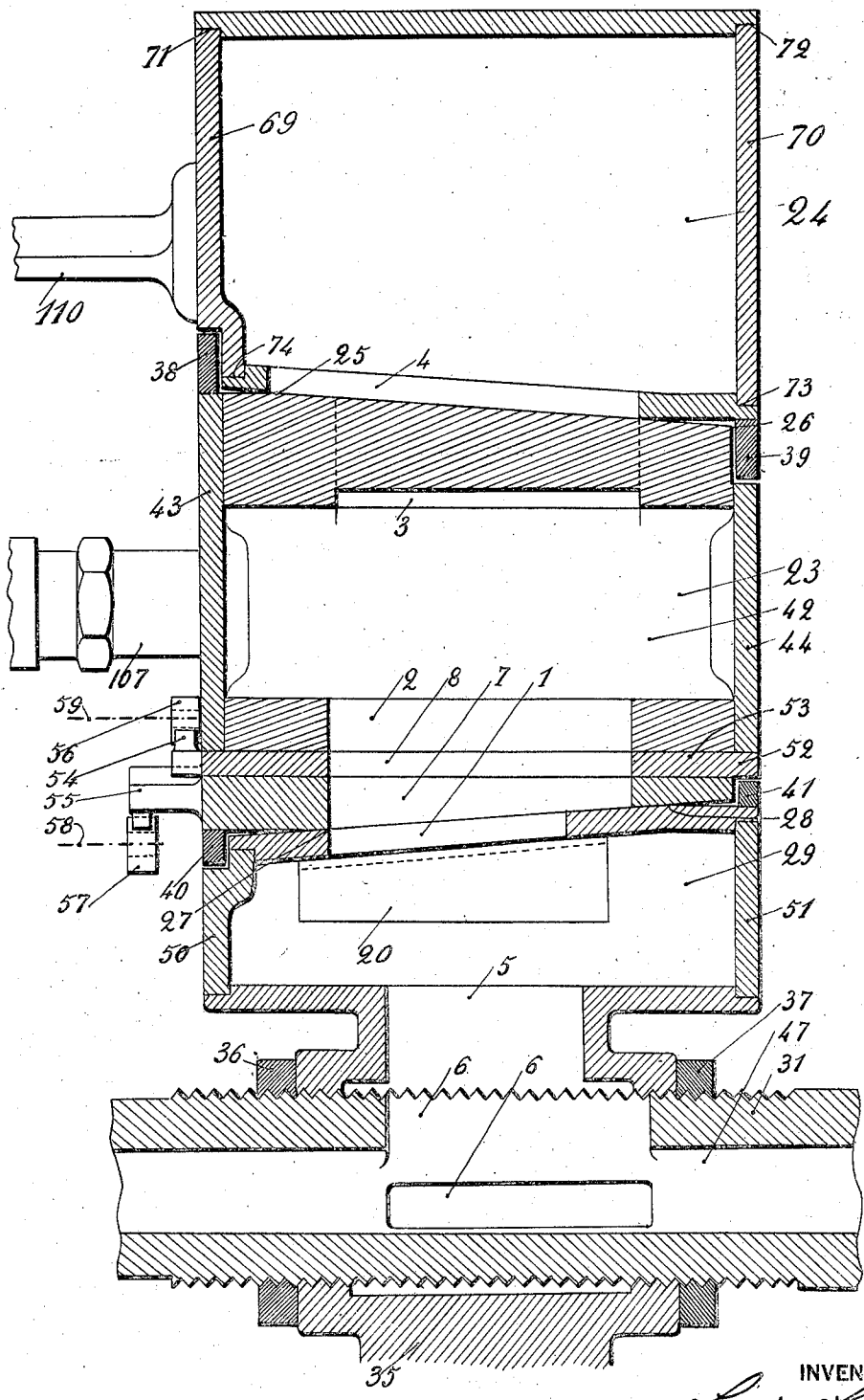


Fig. 2

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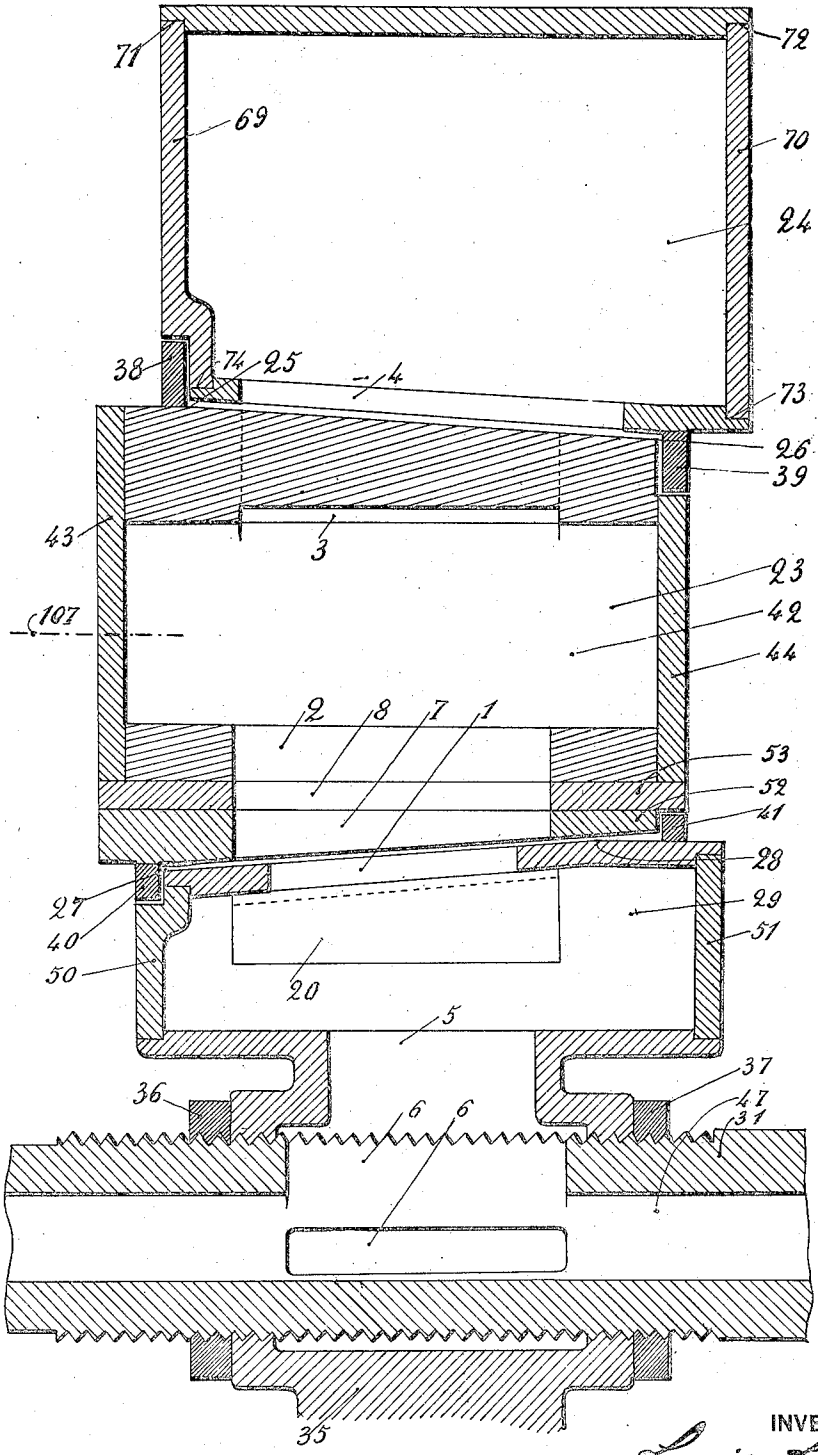


Fig. 3

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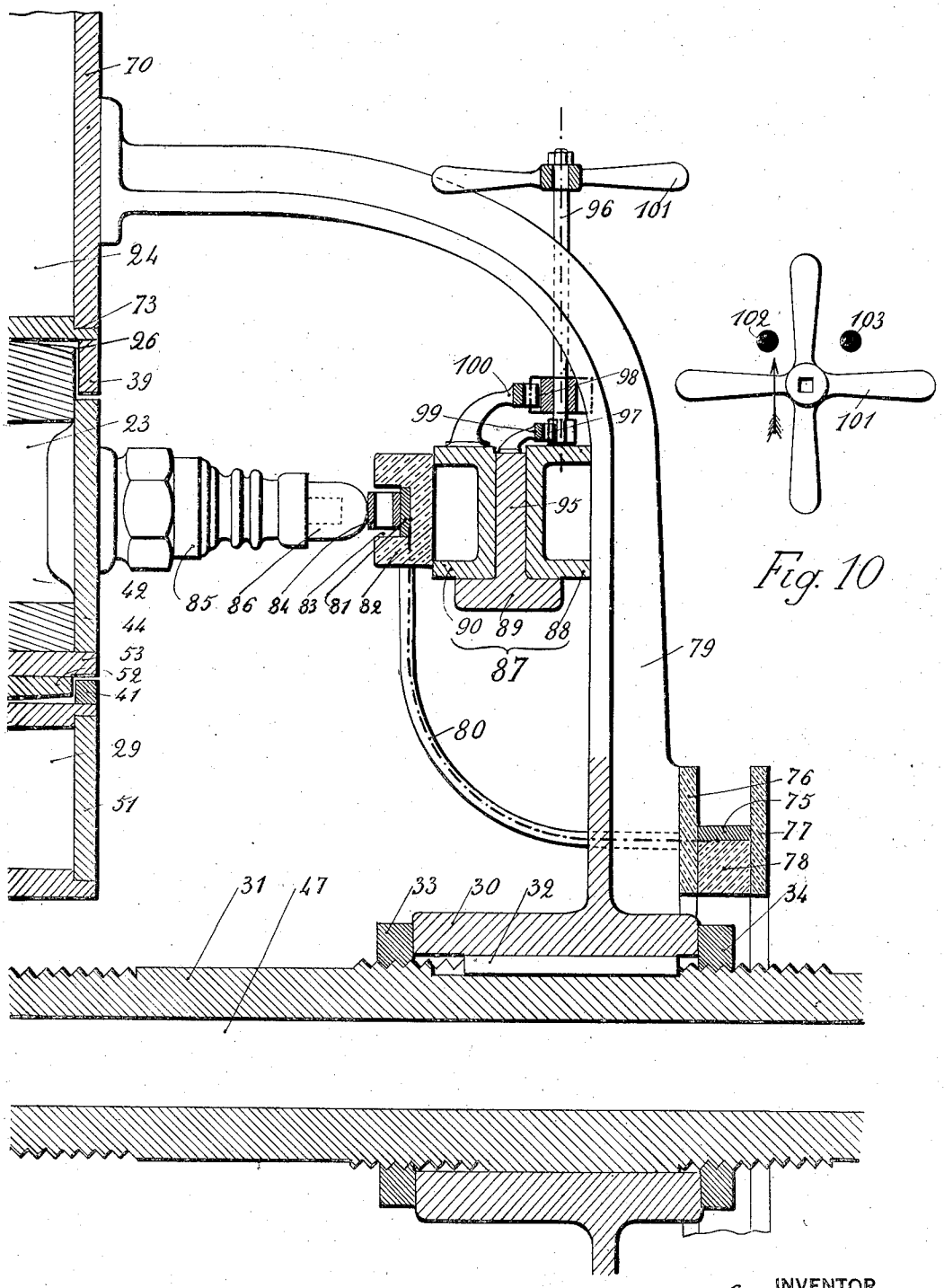


Fig. 4

Fig. 10

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Filed May 23, 1922 8 Sheets-Sheet 5

Fig. 6

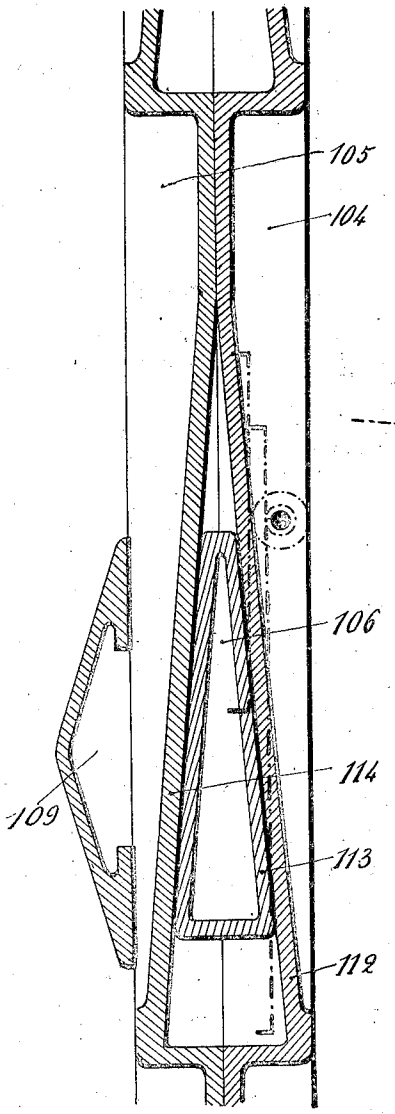
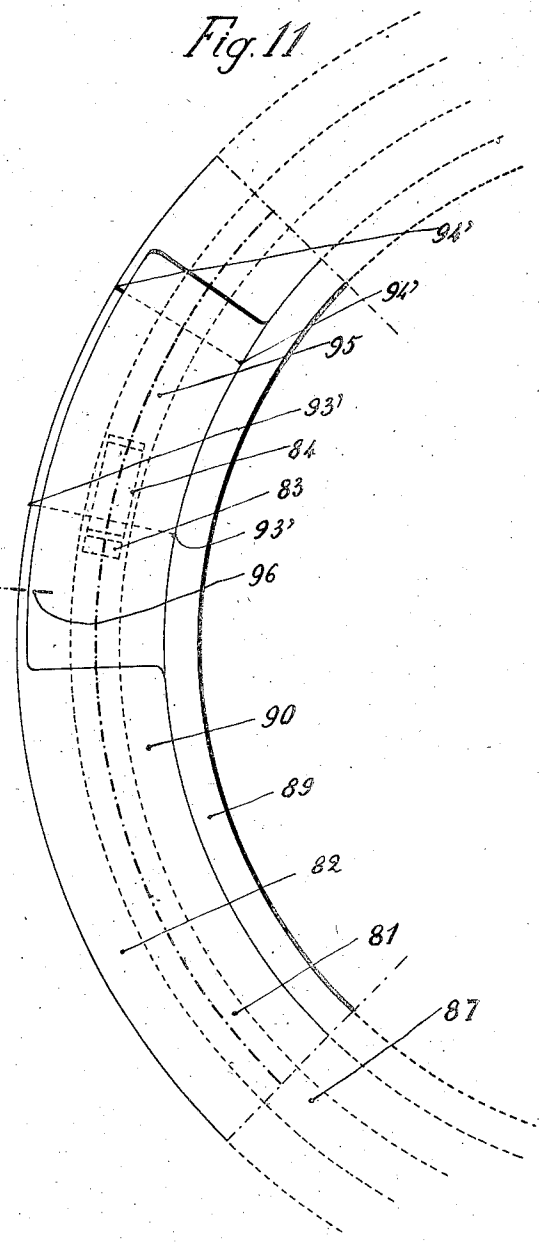


Fig. 11



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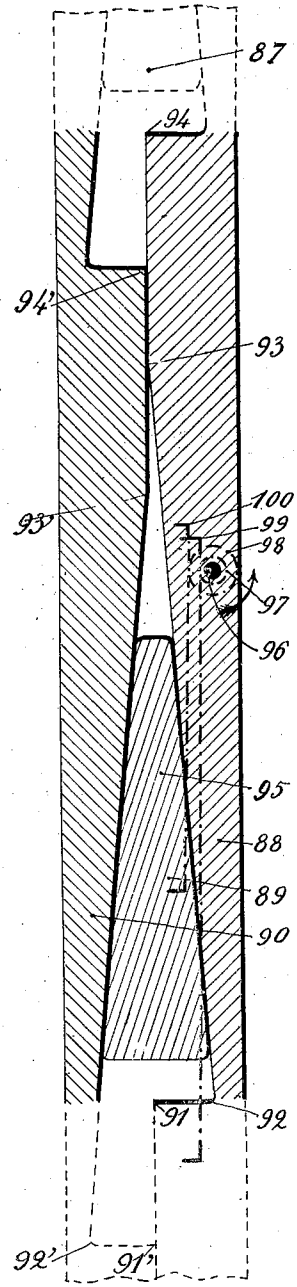


Fig. 9

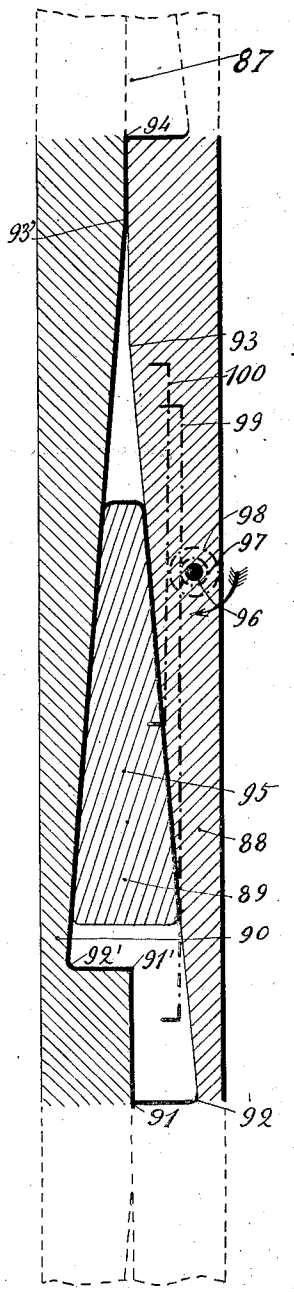


Fig. 8

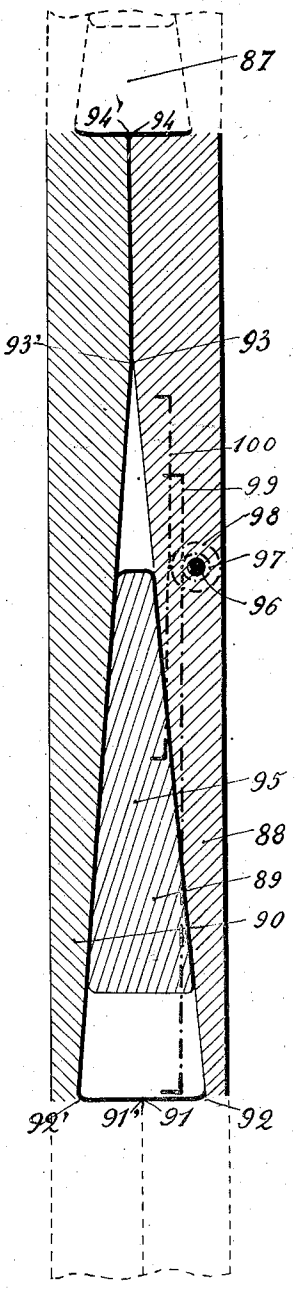


Fig. 7

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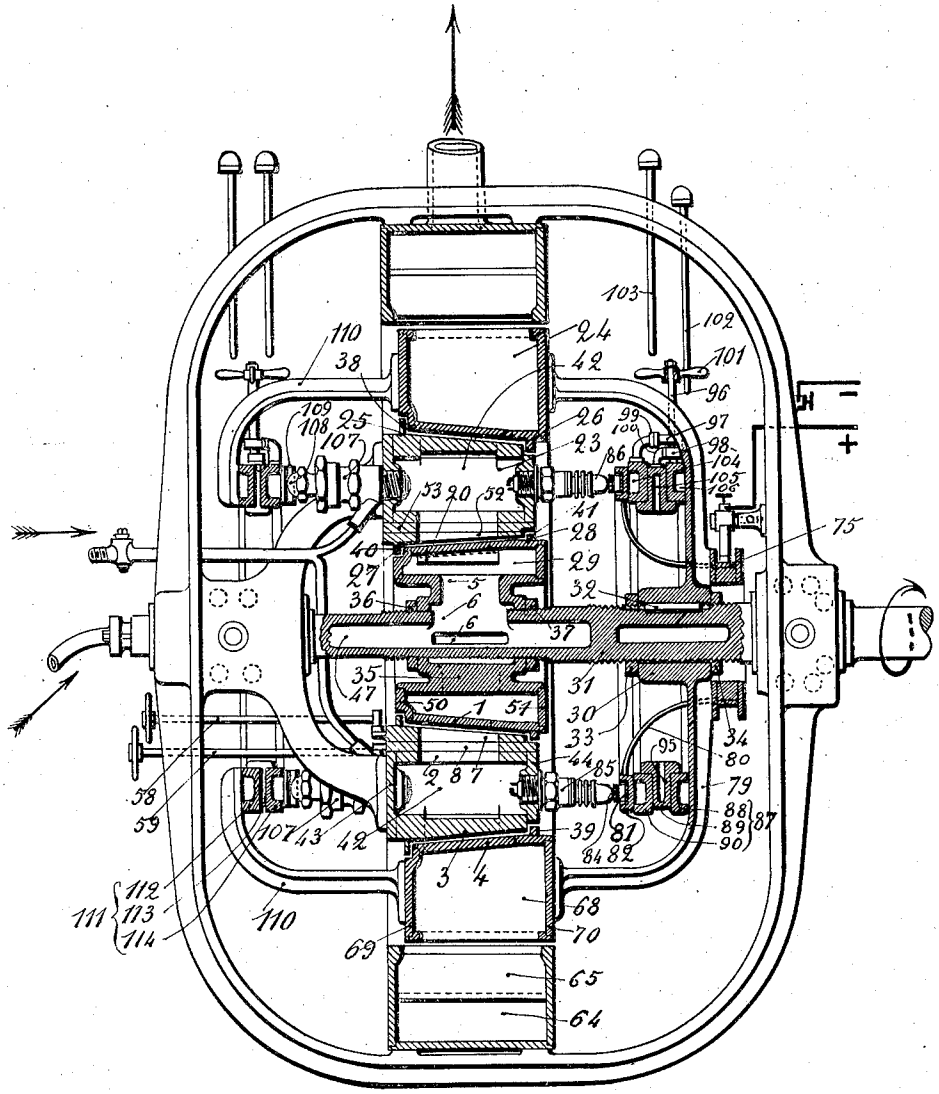
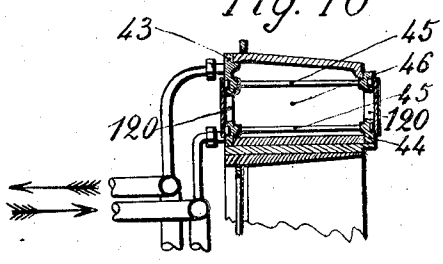


Fig. 12

Fig. 16



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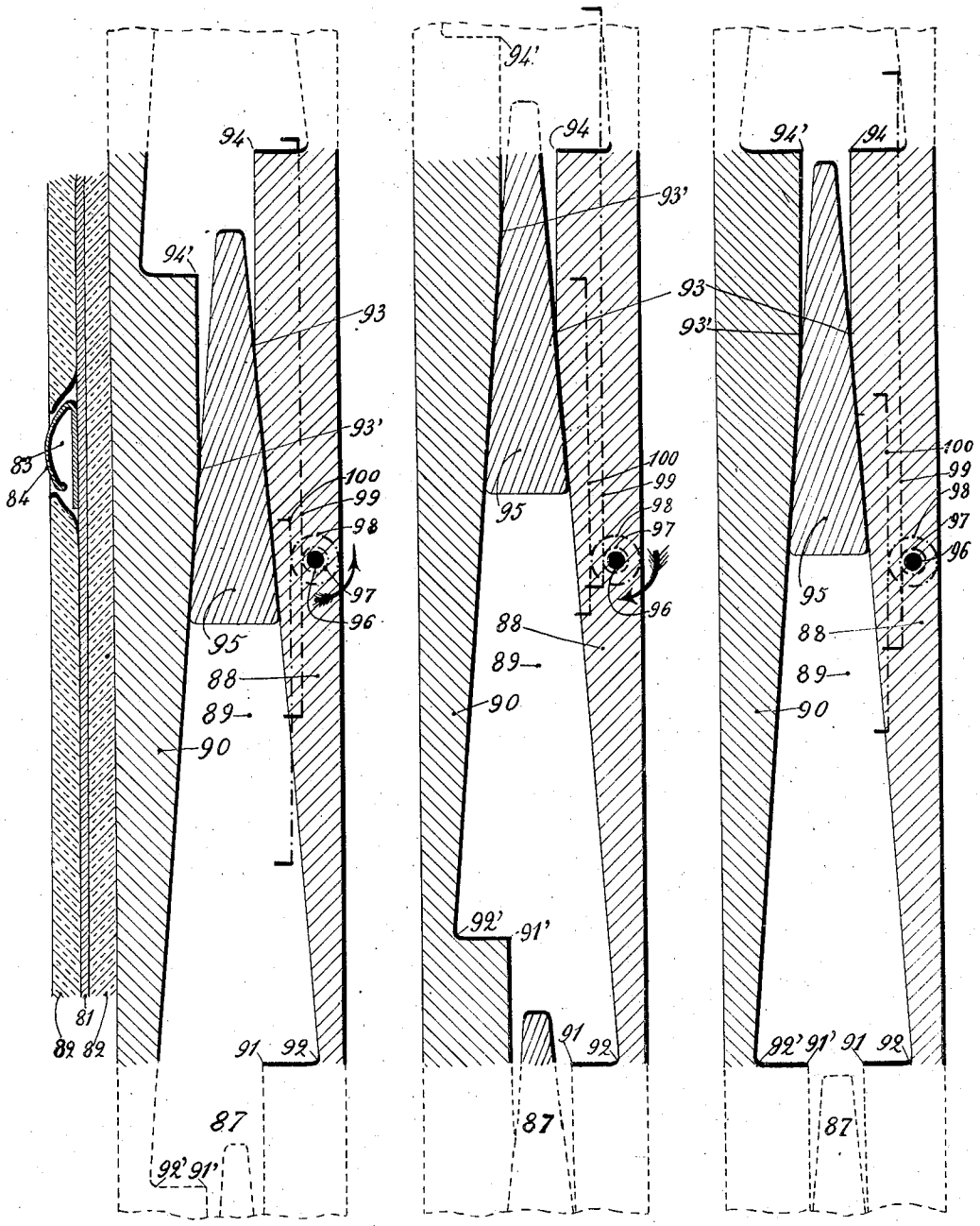


Fig 15 Fig 14 Fig 13

INVENTOR

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Patented May 11, 1926. 1,584,346

UNITED STATES PATENT OFFICE.

LUCIEN L. ARDIN, OF NEW YORK, N. Y.

INTERNAL-COMBUSTION TURBINE.

Application filed May 23, 1922. Serial No. 563,015.

The present invention relates to internal combustion turbines, particularly adaptable for medium powers. One of the objects of the invention is to provide improved regulating means for supplying gas and fuel to the turbine, this application presenting certain improvements over the construction embodied in my prior application, Serial No. 427,365, filed Nov. 30, 1920.

In the accompanying drawings:

Figure 1 is a section of the motor, the section passing at right angles to the shaft of the motor;

Fig. 2 is a half section of the principal parts of the motor, the plane of section passing thru the shaft of the motor;

Fig. 3 shows a different regulation of the rotating parts;

Figs. 4 and 10 illustrate in detail the means for distributing the current for ignition;

Fig. 5 is a fragmentary view showing the ports for supplying air to the combustion chambers and the ports for supplying the fuel to the turbine;

Fig. 6 shows a detail of the parts for controlling the distribution of the fuel;

Figs. 7, 8, 9, 11, 13, 14 and 15 illustrate in detail the parts which permit the control of the ignition;

Fig. 12 is a section of the motor, thru the axis of the shaft; Fig. 16 is a detail in section of one of the spacing members.

The principal parts of the motor comprise the fixed member 23 which carries the explosion chambers, and the rotor 24 which encircles the fixed member or rotor and receives the impulse from the explosions.

Means are provided for regulating or adjusting the play between the fixed member and the movable member, a conical member 25—26 being utilized for this purpose.

Means are also provided, comprising a cone 27—28 for regulating the play between the fixed member and the air distribution means.

Fig. 2 illustrates the movable conical pieces 24 and 29 engaging each other at their limit, surrounding the member 23. This is not a working or operating condition but merely illustrates the extreme movement and is the first position to be given to the cone when setting up the apparatus. This permits obtaining accurate fit, accurate conicality and if there are slight defects they can be corrected by grinding parts into each other. This having been accomplished, the two movable parts 24 and 29 are slightly separated by moving them lengthwise of the shaft so as to produce between them and the fixed part 23, the necessary play. The amount of the play must be small enough to reduce the loss or escape of gas to an insignificant quantity. The play must be large enough so that there will be no friction between the members even after the motor has reached its working temperature and the members have expanded. The hottest and most expanded member is the fixed member 23. The air distributor 29 will always be much cooler and the play when cold must be as slight as possible because it will increase when the motor is running.

The rotor 24 will be a little cooler than the member 23. The play when the parts are cold will tend to decrease and when cold the play will be somewhat greater than when the rotor is running. This is indicated in Figure 3. The air distributor 29 is shown projecting a little less than rotor 24. The one is illustrated in the position of maximum play and the other in the position giving intermediate play. In practice it will never be necessary to make use of these amounts of play which are, relatively speaking, somewhat large.

The rotor is adjusted by sliding its hub 30 (see Figure 4) on the shaft 31 and on the key 32 and in stopping it in the desired position by means of two screw-threaded rings 33 and 34. This adjusting mechanism includes a key and is built upon the most enlarged part of the motor shaft because it is the hub 30 which transmits the entire power of the motor.

The adjustment of the air distributing means 29 takes place (see Figs. 2 and 3) by screwing its hub 35 more or less along a part of the motor shaft of smaller diameter, it being fixed in position by two screw-threaded rings 36 and 37. As but slight power is transmitted by this shaft to the air distributor there is no need of a key for the air distributor hub.

The escape or leakage of gas through the joints existing between the parts may be prevented to the greatest extent by the use of suitable members 38 to 40 which latter are conveniently fixed to the parts in such a manner as to most effectively guard against leakage.

It is to be understood that there is no

adjustment of the play between the fixed and rotating members, while the motor is turning. This occurs while the motor is at rest during the preliminary trials and may take place again when the wear of the bearings is being compensated, for example.

The fixed member 23 carries eight combustion chambers 42 in the form illustrated upon the drawings. These explosion chambers are closed at both ends by two rings 43—44 compressed by bolts 45 placed in the spacing member 46, this arrangement facilitating the construction of the motor.

The spaces 46 can be open at both ends in order to permit air to circulate somewhat for cooling purposes. Owing to the absence of pistons, segments, etc., the water cooling may be done away with and the motor may become heated, thus enabling it to be actuated by cheap low-grade fuel instead of gasoline.

The compressed air introduced into the hollow portion 47 of the shaft 31, passes thru the ports 6 made in the shaft.

The air enters by the ports 5 into the distributor 29. This distributor is provided with two lateral plates 50, 51, which facilitates the construction of the parts and the accuracy and balance of its different members. There are four ports 1—1—1—1 with wings 20. The ports 1—1—1—1 supply air to ports 2—2—2—2 of the combustion chambers, these being longer so that the ends of the port supplying the air do not exceed the ends of the port receiving the air, no matter what may be the position of the regulating device regulating the play between the members (see Fig. 5 where the extreme possible position is indicated in dotted lines).

The air does not pass directly from the ports 1 into the port 2. Between the members 23 and 29, two rings 52 and 53 are interposed which do not turn with the distributor 29. They are not, however, rigidly secured to the fixed member 23 but turn in it under friction. They carry two small toothed sectors 54, 55 driven by pinions 56 and 57 carried by shafts 58, 59 which project from the motor and which can be driven while the motor is running by the operator. Because of this type of mounting, the rings 52 and 53 may be slightly adjusted and the eight ports 7 and 8 which each carries, may be moved between the ports 1 and 2. In this way, the time when the air is introduced can be determined by moving the ring 52. The cross section of the air stream can also be adjusted from zero to maximum and consequently the pressure of the air entering the explosion chambers. This is done by moving the ring 53.

The gaseous products of the explosion leave the chambers 42 by relatively narrow passageways which are given the desired direction and which discharge at 3—3—3—3 on the conical exterior surface of the fixed member. They enter into the chamber 68 of the rotor by inclined ports 4—4—4—4. The ends of the port which discharge the products of the explosion do not extend beyond the ends of the port receiving them, no matter what may be the position of the devices regulating the play between the fixed member and the rotor.

The products of combustion in passing through the discharge ports act against surfaces which may be curved as has been indicated at 63, it having been found that the operation of the motor is in most instances more effective when surfaces of this nature are employed. These passages are of increasing cross-sectional area towards their outlet ends and as a consequence the heated gases are free to expand in their flow through the discharge passages from whence they emerge into the fixed reservoir 64, which serves as an exhaust. It is here to be noted that, if desirable, fixed wings 65 may be provided in this exhaust and adjacent the outlet ends of the passages so that the heated gases may strike against these wings upon emerging from the discharge passages, the foregoing having been best illustrated in Fig. 1.

In the form illustrated there are eight explosion chambers in the fixed member and four expansion chambers in the rotor and the number of explosions for each revolution of the motor is 32.

The distributor 29 and the rotor 24 are adjusted on the motor shaft in such a way that in the same explosion chamber, the air introduction ports 1 and 2 open a little earlier than the explosion chamber discharge port for the preceding explosion closes. This position is indicated by the shaded parts in Fig. 5. In this way the air which begins to enter 66 (see shading) sweeps out the products of the explosion which remain in the chamber in travelling toward 67 (see shading) and then fills them. The rotor is provided between the expansion chambers with spacing members 62 whose interior conical surfaces serve to seal the combustion chambers while air and fuel are being introduced into the chambers.

The sides 69 and 70 of the rotor consist of two rings joined at 71—72—73—74 which are compressed by bolts, this permitting easy construction, making the parts symmetrical around their axis, which is an advantage in securing balance of the rotary member.

The ignition is preferably electric; the current comes from any desired source as for example from a storage battery furnishing low tension current. The electricity is supplied to the coil which furnishes high tension current. One of the poles of the coil is connected with the metallic frame of the

motor. The other pole ends at a brush spring-mounted upon the frame of the motor and which is constantly in contact with the metallc ring 75 (see Fig. 4). This ring is insulated by means of insulating rings 76, 77, 78 and is carried by means of arms 79 of the rotor with which it turns. A little copper cable 80 which is insulated for high tension, connects the ring 75 with another metallic ring 81. The cable 80 is long enough and flexible enough so as to permit a relative motion of the two rings, which is required when making the adjustments described below.

The ring 81 is insulated and encased in an insulating ring 82 which carries four openings 83 from which project four springs 84 secured to the ring 81. Each combustion chamber carries an ignition plug 85. The springs are constantly charged with electricity; each time one of them touches the button 86 of a plug, the spark is formed which ignites the explosion mixture. This takes place four times for each revolution for each cylinder. The rings 81 and 82 are secured to the arms of the rotor so that the spark is formed a little before the ports 4—4—4—4 of the rotor begin to open the ports 3—3—3—3 of the fixed member. This position of the rings 81, 82 with relation to the rotor is not absolutely necessary and one can change it while the motor is running to advance or retard the spark. To accomplish this result an annular member 87 is mounted between the ring 82 and the arms of the rotor, the annular member 87 consisting of three rings 88, 89, 90. The ring 88 is rigidly secured to the arms of the rotor. The ring 82 is secured to the ring 90. The two rings 88 and 90 are provided with teeth on their inner surfaces whose profiles are indicated at 91—92—93—94; and 91′—92′—93′—94′. These profiles are indicated in a projection developed on a cylinder in Figs. 7, 8, 9, 13, 14 and 15. Each part shown in full lines in these figures, represents the portion of the parts corresponding to one quarter of the circle and the beginnings of the neighboring quarters are represented in dotted lines.

Between the teeth of rings 88 and 90 the four projections 95 move, these being parts of a single member, namely the ring 89. This construction has the following mode of operation:

When the play between the fixed member and the rotor is adjusted and the position of the latter upon the shaft is fixed, a space more or less large remains between the buttons 86 of the ignition plugs 85 and the spring 34. This space is reduced to a minimum for producing sparks by moving the ring 89 between the two rings 88 and 90, the latter remaining opposite to each other. These two last rings are separated the necessary amount to give the desired position to the springs 84 according to the position of the rotor. For example, Fig. 7 represents the position of the members when the play between the fixed member and the rotor is reduced to nothing. Fig. 13 represents the position when the play is a maximum. It is to be understood that all intermediate positions are possible and it is clear that an intermediate position is chosen while the motor is at rest, at which time one determines the best position of the rotor and the best play.

The same mechanism is utilized while the motor is running to advance or retard the spark at will, as follows:

The ring 88 carries at a suitable part in its circumference, the end of the shaft 96 which carries two little toothed pinions 97 and 98. These pinions have a pitch diameter, one double the other. They are in engagement with two toothed sectors 99 and 100 carried by rings 89 and 88 when the play and the position of the rotor have been fixed. The position of the shaft 96 is preferably arranged near one arm of the rotor. The shaft passes beyond the arm and carries a star 101 with four branches. Two projections 102, 103 slide in a fixed part of the frame of the motor. When running, their ends are outside of the star, but the operator may move either one or the other of these projections so as to make it enter into the circle of rotation of the star 101. At each turn of the motor, therefore, this star will make a one-quarter turn in one direction or the other, depending on which projection, 102 or 103, has been selected. Each time the rings 89 and 90 will be moved a small distance with relation to ring 88. Since the movements of ring 90 are twice as great as the movements of ring 89, these movements take place without changing the total width of the three rings, i. e., the overall width is not changed. To accomplish this result, the edges of the rings 89 are provided with two inclined faces and ring 90 has only one inclined face. The electric contact springs 84 can thus be advanced or moved back without changing their alignment with the button 86 of the spark plug.

Figs. 8 and 9 show the positions of the parts corresponding to the maximum advance position or the maximum retarded position when the rotor is adjusted for zero play, the two pinions being rotated in the direction of the arrows.

Figs. 14 and 15 show the positions of the parts corresponding to the maximum advance or retarded position when the motor is adjusted for maximum play and the two pinions have been turned in the direction of the arrows.

It is understood that all intermediate positions are possible for the difference in distance which corresponds to a quarter turn

of the pinion when the play of the fixed member and of the rotor have been fixed. This is the total thickness of the three rings constituting the annular member 87.

Fig. 11 shows the rings 89, 90, the rings 81, 82 and the springs 84 in a position corresponding to Fig. 15, the ring 88 being considered removed.

Rings 88, 89 and 90 are of a suitable size and thickness and are strong enough to stand the strain so that they may be made of a light metal such as aluminum and may be suitably cut away as at 104, 105 and 106 (see Fig. 6).

Each combustion chamber receives the combustible fluid by means of a distributor 107 of fixed output which is adjustable and intermittent.

The buttons 108 of these distributors are projected by four cams 109 which are carried by half arms 110 attached to the rotor. These are called half arms because they are secured to the rotor at the side opposite the hub and stop in front of the distributors where they are connected by ring 111 which has an opening around the shaft. Into this opening the shafts for regulating the air 58 and 59 enter as well as the supply pipes for supplying fuel.

The ring 111 which is inserted between the half arm of the rotor and the four cams 109, consists of three rings 112, 113 and 114 which have the same effect in controlling the fuel supply that the rings 88, 89 and 90 have for electricity. That is to say, they permit the advance or the retarding of the cams 109 according to the position and the play given to the rotor and they also permit for each of these positions to adjust or regulate the time for the introduction of the fuel, to retard it or to advance it, while the motor is running.

Fig. 6 shows the rings 112, 113 and 114 in the position corresponding to the condition of operation where the rotor enters least and where the play is the maximum and to the condition where fuel is supplied at the mean time, i. e., the intermediate time, at the instant which may be called normal between the moment for closing the air admission port and the spark.

It will be understood that the invention is not limited to details and that numerous changes may be made in the position and construction of the parts in carrying it into effect without departing from the principle thereof.

What I claim and desire to secure by Letters Patent is:

1. In an internal combustion turbine, having a fixed member carrying a plurality of explosion chambers, a rotor surrounding said fixed member, said rotor receiving the impulse from the explosions, said fixed member being provided with an external conical surface, and with a cylindrical portion at the base of the cone, said rotor being provided with a co-operating internal conical surface, and with a cylindrical portion at the narrow end of the cone, each of said cylindrical portions carrying a ring and means for adjusting one of said members axially with relation to the other, thereby regulating the play between the fixed member and the rotor.

2. In an internal combustion turbine, having a fixed member carrying a plurality of explosion chambers, a rotor surrounding said fixed member, said rotor receiving the impulse from the explosions, said fixed member being provided with an external conical surface, said rotor being provided with a co-operating internal conical surface, means for supplying air to the explosion chambers, said means comprising a hollow cone, said cone provided with ports for supplying air to the explosion chambers, a shaft on which the rotor is mounted and means for adjusting said hollow cone on said shaft.

3. In an internal combustion turbine, having a fixed member carrying a plurality of explosion chambers, a rotor surrounding said fixed member, said rotor receiving the impulse from the explosions, a shaft on which said rotor is mounted, said fixed member being provided with an external conical surface, said rotor being provided with a co-operating internal conical surface, means for supplying air to the explosion chambers, said means comprising a hollow cone carried by the rotor shaft, said cone provided with ports for supplying air to the explosion chambers, a hub for said cone, said hub and shaft being screw-threaded to permit the adjustment of said cone on said shaft.

4. In an internal combustion turbine, having a fixed member carrying a plurality of explosion chambers, a rotor surrounding said fixed member, said rotor receiving the impulse from the explosions, a shaft on which said rotor is mounted, said fixed member being provided with an external conical surface, said rotor being provided with a cooperating internal conical surface and means for supplying air to the explosion chambers, said means comprising a hollow cone carried by the rotor shaft, said cone provided with ports for supplying air to the explosion chambers, the said fixed member having a conical sectional surface terminating in a cylindrical end portion and provided with a cylindrical base surrounding said hollow cone, and a pair of rings, one carried by the cylindrical portion of the hollow cone and the other by the interior cylindrical portion of the fixed member.

5. In an internal combustion turbine having a fixed member carrying a plurality of explosion chambers, a rotor surrounding said fixed member, a shaft carrying said rotor, air distributing means carried by said shaft

within said fixed member, a pair of ported rings between the air distributing means and the fixed member and means for adjusting said rings.

6. In an internal combustion turbine having a fixed member carrying a plurality of explosion chambers, a rotor surrounding said fixed member, a shaft carrying said rotor, air distributing means carried by said shaft within said fixed member, a pair of ported rings between the air distributing means and the fixed member and a toothed sector and pinion for each ring for adjusting said rings.

7. In an internal combustion turbine, having a fixed member carrying a plurality of explosion chambers, a rotor surrounding said fixed member, said rotor receiving the impulses from the explosions, a spark plug for each explosion chamber, a shaft carrying the rotor, an electric contact for said spark plug, and means for circumferentially adjusting said contact, said means comprising three circular rings, one secured to the rotor shaft, the second carrying the contact and the third mounted between the other two, the intermediate ring being provided with wedge-shaped teeth cooperating with the adjacent faces of the other two rings.

8. In an internal combustion turbine, having a fixed member carrying a plurality of explosion chambers, a rotor surrounding said fixed member, said rotor receiving the impulses fom the explosions, and means for supplying fuel to the explosion chambers, said means comprising a distributor for each explosion chamber, a cam for each distributor and means for adjusting said cams axially and circumferentially, said means comprising three rings, one ring secured to the rotor shaft, another carrying said cams and the third being arranged intermediate the other two rings, the outside rings having wedge-shaped teeth and the intermediate ring carrying a plurality of wedges cooperating with said teeth and means for adjusting the intermediate rings.

9. In an internal combustion turbine having a fixed member carrying a plurality of explosion chambers, a rotor surrounding said fixed member, said rotor receiving the impulses from the explosions, a spark plug for each explosion chamber, a shaft carrying the rotor, an electric contact for said spark plug, and means for circumferentially adjusting said contact, said means comprising three circular rings, one secured to the rotor shaft, the second carrying the contact and the third mounted between the other two, the outer rings being provided with equal and opposite tooth faces, the intermediate ring being provided with co-operating wedges, the intermediate ring and the ring carrying the contact being each provided with a toothed sector, the ring secured to the shaft carrying a pair of pinions, one of double the diameter of the other.

In testimony whereof, I have signed my name to this specification..

LUCIEN L. ARDIN.