J. F. SANDELL.

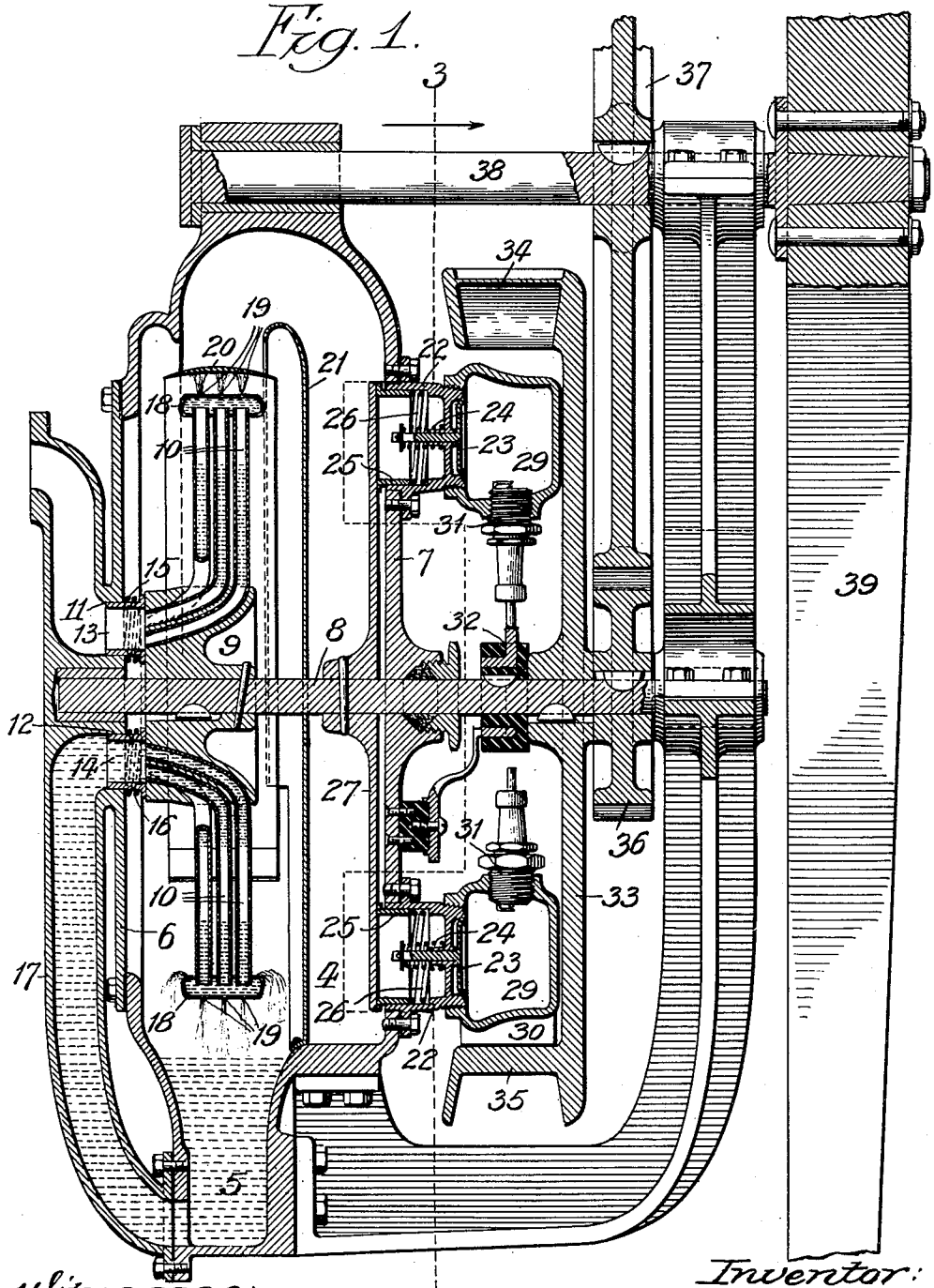
EXPLOSIVE TURBINE.

APPLICATION FILED JAN. 3, 1911.

1,067,555. Patented July 15, 1913.

3 SHEETS—SHEET 1.

Fig. 1.



Witnesses:
John Enders
Ralph A. Schaefer

Inventor:
John F. Sandell,
by Dyrenforth, Lee, Chrittons & Wiles.
Attys.

J. F. SANDELL.

EXPLOSIVE TURBINE.

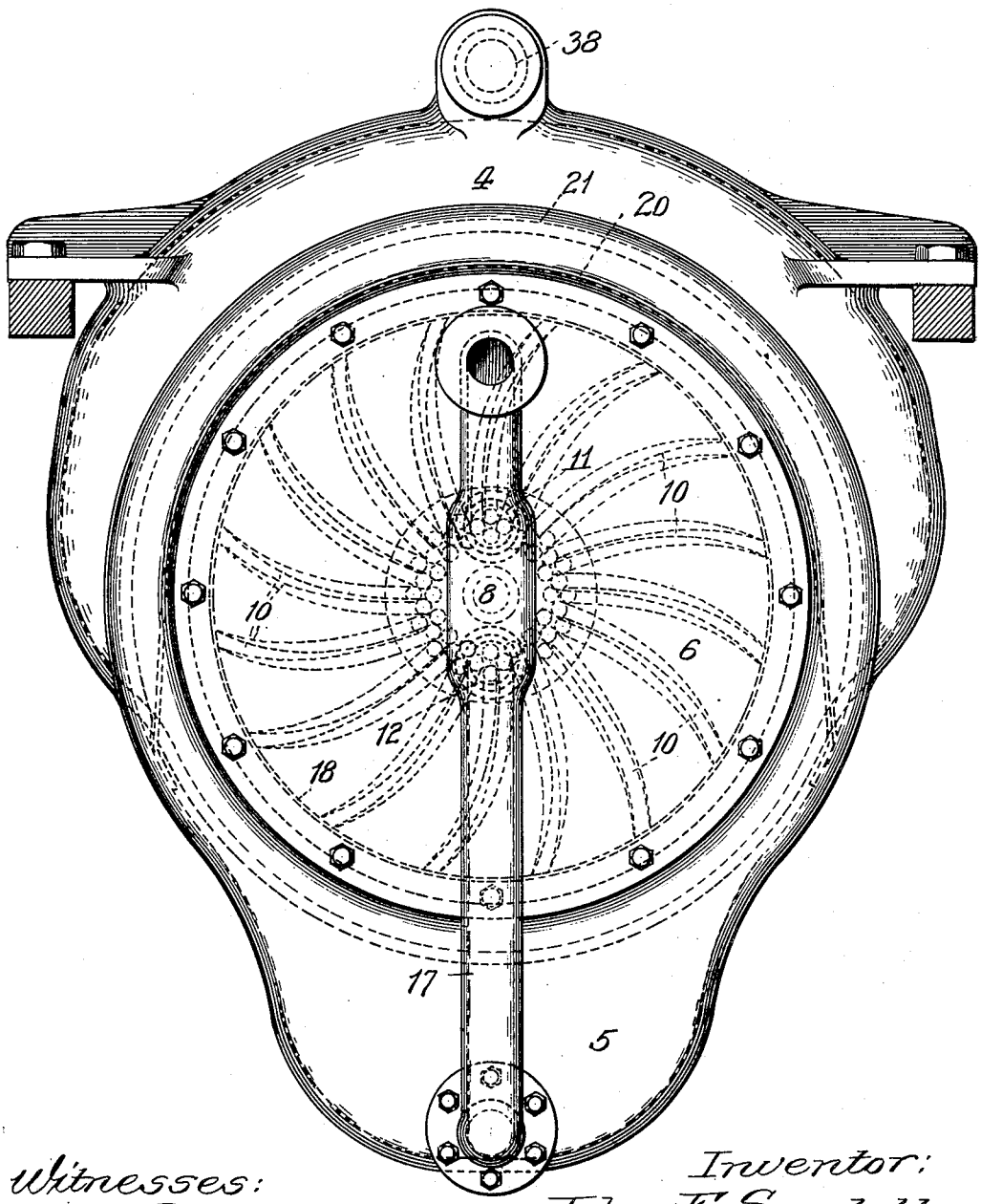
APPLICATION FILED JAN. 3, 1911.

1,067,555.

Patented July 15, 1913.

3 SHEETS—SHEET 2.

Fig. 2.



Witnesses:
John Enders
Ralph A. Schaefer

Inventor:
John F. Sandell,
by Dyrenforth, Lee, Chritton & Wiles.
Attys

J. F. SANDELL.

EXPLOSIVE TURBINE.

APPLICATION FILED JAN. 3, 1911.

1,067,555. Patented July 15, 1913.

3 SHEETS—SHEET 3.

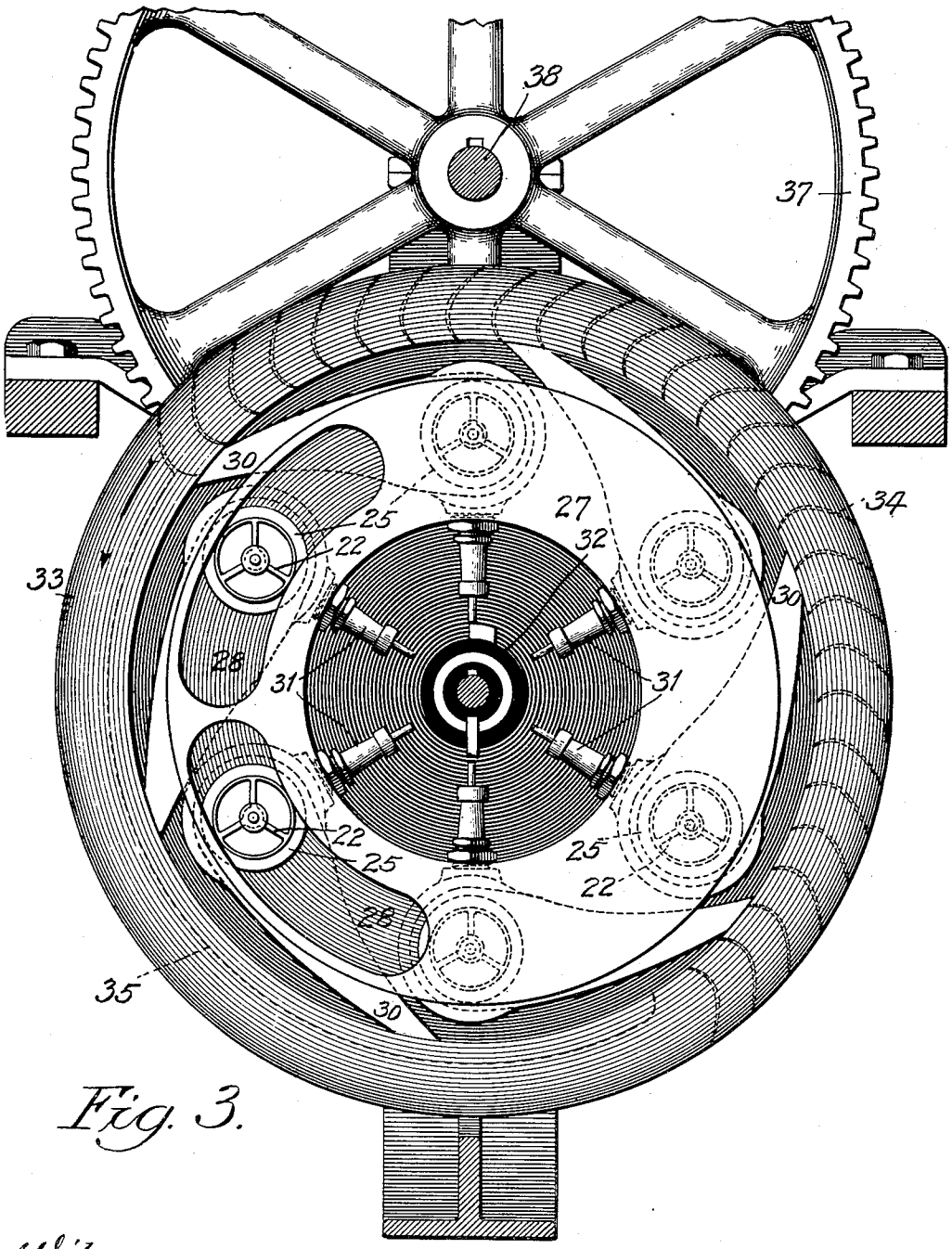


Fig. 3.

Witnesses:
John Enders.
Ralph A. Schaefer.

Inventor:
John F. Sandell,
by Dyrenforth, Lee, Chritton & Wiles,
Attys.

UNITED STATES PATENT OFFICE.

JOHN F. SANDELL, OF CHICAGO, ILLINOIS.

EXPLOSIVE-TURBINE.

1,067,555. Specification of Letters Patent. Patented July 15, 1913.

Application filed January 3, 1911. Serial No. 600,380.

To all whom it may concern:

Be it known that I, JOHN F. SANDELL, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented a new and useful Improvement in Explosive-Turbines, of which the following is a specification.

My invention relates to a certain new and useful improvement in an explosive turbine, and is fully described and explained in the specification and shown in the accompanying drawings, in which:

Figure 1 is a vertical section through my improved device; Fig. 2 is an elevation looking from the left of Fig. 1, and Fig. 3 is a section on the broken line 3 of Fig. 1.

Referring to the drawings, 4 is a pump-casing which is generally disk shaped and provided with a pocket 5 in its lower portion. The pump-casing is closed at its rear by a plate 6 and at its front by a plate 7, the plate 6 being bolted to the remainder of the casing and the plate 7 being preferably integral therewith. Journaled in the pump-casing is a shaft 8, upon which is keyed a hub 9. The hub 9 carries a plurality of sets of tubes 10, which extend outward radially from the hub, in the manner illustrated, each set containing three tubes the outer ends of which are brought into the same angular plane and the inner ends of which are staggered and which, after their entrance into the hub are curved forward and extend to the front face of the hub, the three tubes of any given set having their inner and forward ends arranged in triangular relation, as shown in Fig. 2. The front plate 6 has two intake openings 11 and 12 in each of which is a bushing, 13 and 14, pressed backward or into contact with the front face of the hub by springs 15 and 16. The intake opening 11 communicates with the gas supply and the intake opening 14 is connected by a pipe 17 with the pocket 5 at the bottom of the pump-check. The pipe 17 may be separate from the front plate but it is preferably made integral therewith, in the manner illustrated, the front plate, pipe 17 and the intake communicating with the gas-supply being all formed in one integral plastic. Outside the ends of the tubes 10 and rotatable therewith is an annulus 18 in the form of an inwardly-facing trough having perforations 19 in its outer face. A baffle plate 20 surrounds the upper part of the tubes of the front and a second vertical baffle plate 21 separates the front of the pump-chamber from the rear portion thereof so as to confine the liquid within the pump to the forward portion thereof.

The operation of the pump, as such, takes place in an obvious manner.

Water is placed in the pump-chamber, in the manner illustrated, and as the shaft rotates the contents of the tubes is thrown outward by centrifugal force. It will be understood, of course, that the tubes will be primed in any suitable manner at the commencement of operation. This outward movement sets up a suction at the inner and forward ends of the tubes so that, as they pass by the two intake openings 11 and 12 successively, they draw in alternate charges of gas and water. The speed of rotation will be such that there are alternate columns of gas and water in each tube, as shown, so that a water-charged tube in passing the gas-opening takes in an increment of gas behind the water but still leaving enough water to suck in a fresh increment of water as the inner end of the tube passes the water-inlet 12. By this means, in a very simple manner, gas or a combustible mixture is drawn into the pump-chamber and compressed, so that ultimately a considerable pressure of gas is accumulated within the pump-chamber. It will be understood that the intake-opening 11 is connected with any suitable source of explosive mixture. The explosive mixture in passing through the pump and the outer part of the pump-chamber becomes thoroughly mixed with water in the form of spray and thereby becomes saturated with water so that a considerable capacity for expansion after explosion is obtained.

The rear plate 7 of the pump is pierced by a plurality of openings, here shown as six in number, each of which has a valve-cage 22, in each of which is an outwardly-opening check-valve 23 normally held shut by a spring 24. Each valve-cage has at its rear end a bushing 25 normally spring-pressed backward by means of a spring 26 so as to contact with a cut-off plate 27 fast on the shaft 8. This cutoff plate has what is in effect a single opening of sufficient length to register with two of the valve-cages at the same time, although for greater strength of the plate under high speed a strengthening bridge crosses the single open-

ing, but this bridge it will be noted, is a smaller size than the face of the valve-cage so that it offers no resistance to the passage of gas. It is therefore in substance a single elongate arc-like opening which is indicated in the drawings by the numeral 28. The valve-cages 22 open into and support a series of explosion-chambers 29, each of which is of generally wedge-shaped form with a cross-section illustrated in Fig. 1, and each terminating in a nozzle 30. Each explosion-chamber is also provided with a spark-plug 31. The shaft 8 carries an insulated high-tension terminal 32 which passes successively in close proximity to the ends of the spark-plug but without touching the same. The spark takes place when the high-tension terminal passes the end of the spark-plug in the same manner in which it occurs in any ignition system having an outside spark-gap, with the additional advantage that there is no necessity for any actual contact in the system. The shaft 8 carries a turbine-wheel 33, the periphery of which consists of two parts, a bladed arc 34 and a closed arc 35. The blades in the bladed arc are arranged in the general relations shown in the drawings, and the turbine-wheel is open from the inside to the outside between the blades. The closed arc, on the contrary, has a solid web of metal lying in the same cylindrical surface as that of the inner ends of the blades. The curve of the inner part of the turbine-wheel lies immediately outside the ends of the nozzles with only sufficient clearance to avoid friction. This clearance between the ends of the nozzles and the closed arc of the turbine-wheel, is made just as small as is possible for the purposes which will presently appear.

The foregoing description of the construction of the turbine will make the arrangement and operation of the apparatus quite plain, except for the statement of the timing of the parts which can probably be better understood if set forth incidentally in connection with the explanation of the operation. The manner in which pressure is maintained within the pump-casing has been already set forth. The moment the opening 28 comes in registration with any one of the valve-cages 22, the explosive mixture rushes in and fills the explosion-chamber 29, in an obvious manner. The parts are timed so that the opening 28 reaches the valve-cage a very short time before the closed arc of the turbine-wheel reaches the nozzle of said explosion-chamber. This condition will be seen at the lower-most of the explosion-chambers in Fig. 3 where the opening 28 in the cutoff plate is just about to reach the corresponding valve-cage while the nozzle will obviously be open for some short time. The result of this construction is that the mixture under pressure rushes into and through the explosion-chamber completely scavenging it of burnt gas and filling it with a fresh mixture. Thereupon the closed arc in the turbine-wheel reaches the nozzle and closes the same substantially tight so that the gas within the explosion-chamber will rise to a pressure equal to that within the pump-chamber during the remainder of the passage of the opening 28 in the cutoff plate past the corresponding valve-cage.

It doubtless has been noted that any mixture which passes through the explosion-chamber will impinge upon the blade so that its expansive force will be utilized, although, obviously, its energy in heat units will not be. Just before the closed arc in the turbine-wheel passes from any given nozzle the high circuit terminal 32 comes into sufficiently-close proximity with the spark-plug of that explosion-chamber to cause an explosion. This condition can be best understood by reference to the upper explosion-chamber in Fig. 3, although the parts have advanced a slight distance beyond the point of explosion. It will readily be observed, however, that at the time the high-tension terminal approaches the spark-plug of this explosion-chamber near enough to cause an explosion, the nozzle is closed but just about to be opened. The result is that ample time is given for the explosion to travel through the entire mass of mixture in the explosion-chamber and yet at the time of maximum pressure the bladed arc of the turbine-wheel reaches the nozzle with obvious results. The expansive force of the burning and burnt gas exhausts itself upon the blades until, just at the end of the bladed arc, the fresh charge is admitted.

It will be observed that the construction illustrated and described is peculiarly simple, is entirely free from reciprocating parts and gives a compressed charge. Furthermore, the connection between the pump and the explosion-chambers is of such a character that a tight-joint is maintained with the relatively little friction caused by pressure. The cutoff plate is made stiff and does not yield to pressure and the bushings of the valve-cages are obviously perfectly balanced so that the only friction to be overcome is that caused by the light pressure of the spring 26 against said bushing.

Power may be taken from the turbine in any obvious manner, a construction here shown for that purpose being two intermeshing gears 36 and 37, the gear 37 being on a shaft 38 from which power is taken. The form of turbine here illustrated is particularly adapted for use in connection with aeroplanes by reason of its lightness, the high speed at which it can be driven and high power for the weight. The shaft 38 is shown as attached to a propeller 39.

It will be also understood that in connec-

tion with aeroplanes the fact that some of the combustible mixture may be wasted in scavenging is of relatively small importance, the one essential feature of a prime-mover for aeroplane use being high power and light weight.

I realize that considerable variation is possible in the details of the construction, without departing from the spirit of my invention; therefore I do not intend to limit myself to the specific form herein shown and described.

What I claim as new and desire to secure by Letters Patent, is—

1. In combination a turbine-wheel having a bladed arc and a solid arc, a series of explosion-chambers provided with nozzles in position to discharge their contents against the wheel, walls inclosing a chamber in one of which walls said explosion-chambers have their inlet-openings, means for supplying mixture under pressure to the explosion-chambers while their nozzles are closed by the solid arc of the wheel and means for igniting the contents of the explosion-chambers before the closed arc leaves the nozzles.

2. The combination with a turbine-wheel having a bladed arc and a solid arc, of a series of explosion-chambers having their nozzles adjacent to the wheel, walls inclosing a chamber in one of which walls said explosion-chambers have their inlet-openings, means for supplying mixture under pressure to said explosion-chambers immediately before the nozzles are closed by the solid arc of the wheel and thereafter to establish pressure in said chambers, and means for igniting the contents of said chambers before the closed arc leaves the nozzles.

3. In combination a turbine-wheel having a bladed arc and a solid arc, a series of explosion-chambers having nozzles positioned adjacent to the turbine-wheel to discharge their contents against the same, walls inclosing a chamber in one of which walls said explosion-chambers have their inlet-openings, means for maintaining pressure of explosive mixture in said chamber, a rotating cut-off plate having openings registering successively with the intake openings of the explosion chambers and means for igniting the contents of the explosion chambers.

4. In combination a turbine-wheel having a bladed arc and a solid arc, a series of explosion-chambers having nozzles adjacent to the turbine-wheel adapted to discharge their contents against the same, walls inclosing a chamber in one of which walls said explosion-chambers have their inlet-openings, means for maintaining a pressure of mixture in said chamber, a rotating-cut-off plate having an opening registering successively with the intake openings of the explosion chambers in time to close said explosion-chambers before the closed arc of the wheel leaves the nozzles thereof respectively, and means for igniting the contents of the explosion chambers.

5. In combination a turbine-wheel having a bladed arc and a solid arc, a series of explosion-chambers having nozzles lying adjacent to the wheel and adapted to discharge their contents against the same, walls inclosing a chamber in one of which walls said explosion-chambers have their inlet-openings, means for maintaining a pressure of the explosive mixture in said chamber, a rotating-cutoff plate having an opening registering successively with the inlet-openings of the explosion-chambers in time to close said explosion chambers before the closed arc of the turbine-wheel leaves the nozzles thereof respectively, and to open the same before the closed arc reaches the nozzles thereof respectively, and means for igniting the contents of the explosion chambers.

6. In combination a turbine-wheel having a bladed arc and a solid arc, a series of explosion-chambers having nozzles adjacent to the turbine-wheel adapted to discharge their contents against the same, walls inclosing a chamber in one of which walls said explosion-chambers have their inlet-openings, means for maintaining a pressure of mixture in said chamber, a rotating-cut-off plate having an opening registering successively with the intake openings of the explosion chambers in time to close said explosion-chambers before the closed arc of the wheel leaves the nozzles thereof respectively, and means for igniting the contents of the explosion-chambers before the closed arc leaves the nozzles of the respective chambers.

7. In combination a turbine-wheel having a bladed arc and a solid arc, a series of explosion-chambers having nozzles lying adjacent to the wheel and adapted to discharge their contents against the same, walls inclosing a chamber in one of which walls said explosion-chambers have their inlet-openings, means for maintaining a pressure of the explosive mixture in said chamber, a rotating-cutoff plate having an opening registering successively with the inlet-openings of the explosion-chambers in time to close said explosion-chambers before the closed arc of the turbine-wheel leaves the nozzles thereof respectively and to open the same before the closed arc reaches the nozzles thereof respectively, and means for igniting the contents of the explosion chambers before the closed arc leaves the nozzles of the respective explosion chambers.

8. In combination a turbine-wheel having a series of blades, a series of explosion-chambers having nozzles positioned to discharge the contents on the blades, means

for supplying explosive mixture to said explosion-chambers, a spark-plug in each explosion-chamber and a traveling high-tension terminal carried by a turbine-wheel shaft to pass the plug successively in close proximity but not in contact so as to produce a spark in the chambers successively without actual contact.

9. In combination a turbine-wheel, having a series of blades, a series of explosion-chambers having nozzles positioned to discharge their contents on the blades of the wheel, walls inclosing a chamber in one of which walls said explosion-chambers have their inlet-openings, a series of radial tubes carried by the turbine-shaft and revoluble in said chamber, gas and water openings past which the inner ends of said tubes move alternately, a pocket in said chamber in which the water accumulates, a connection between the water opening and the pocket and means for igniting the contents of the explosion-chambers.

10. In combination a turbine-wheel having a bladed arc and a solid arc, a series of explosion-chambers having nozzles adjacent to the turbine-wheel to discharge their contents against the same, walls inclosing a chamber in one of which walls said explosion-chambers have their inlet-openings, a series of radial tubes carried by the turbine-wheel shaft and revoluble in said chamber, gas and water openings past which the inner ends of said tubes move alternately, a pocket in said chamber in which the water may accumulate, a connection between the water-opening and the pocket, a cutoff plate having an opening registering successively with the inlet-openings of the chambers and means for igniting the contents of said chambers.

11. In a turbine, a turbine-wheel having a series of blades, a series of explosion-chambers having nozzles positioned to discharge their contents on the blades of the wheel, walls inclosing a chamber in one of which walls said explosion-chambers have their inlet-openings, means for maintaining a pressure of explosive mixture in said chamber, a rotating-cutoff plate having an opening registering successively with the inlet-openings of the explosion chambers, a bushing in each explosion chamber having a yielding bearing against the cutoff plate, and means for igniting the contents of the explosion chambers successively.

12. In combination a turbine-wheel, a series of explosion-chambers having nozzles positioned adjacent to the turbine-wheel to discharge their contents against the same, walls inclosing a chamber in one of which walls said explosion-chambers have their inlet-openings, means for maintaining pressure of explosive mixture in said chamber, a rotating cutoff plate having openings registering successively with the intake openings of the explosion chambers and means for igniting the contents of the chambers.

13. In combination a turbine-wheel, having a series of blades, a series of explosion-chambers having nozzles positioned to discharge their contents on the blades of the wheel, walls inclosing a chamber in one of which walls said explosion-chambers have their inlet-openings, a series of radial tubes carried by the turbine-shaft and revoluble in said chamber, means for supplying gas and water to the inner ends of said tubes, a pocket in said chamber in which the water accumulates, means for leading the water in said pocket to the water-supply means, and means for igniting the contents of the explosion-chambers.

14. In combination a turbine-wheel, a series of explosion-chambers having nozzles positioned adjacent to the turbine-wheel to discharge their contents against the same, walls inclosing a chamber in one of which walls said explosion-chambers have their inlet-openings, means for maintaining pressure of explosive mixture in said chamber, a rotating cut-off plate having openings registering successively with the intake openings of the explosion-chambers and means for igniting the contents of the explosion-chambers.

15. In combination a turbine-wheel, having a series of blades, a series of explosion-chambers having nozzles positioned to discharge their contents on the blades of the wheel, walls inclosing a chamber in one of which walls said explosion-chambers have their inlet-openings, a series of radial tubes carried by the turbine-shaft and revoluble in said chamber, means for supplying gas and water to the inner ends of said tubes, a pocket in said chamber in which the water accumulates, means for leading the water in said pocket to the water supply means, and means for igniting the contents of the explosion-chambers.

JOHN F. SANDELL.

In presence of—
R. A. SCHAEFER,
JOHN WILSON.