

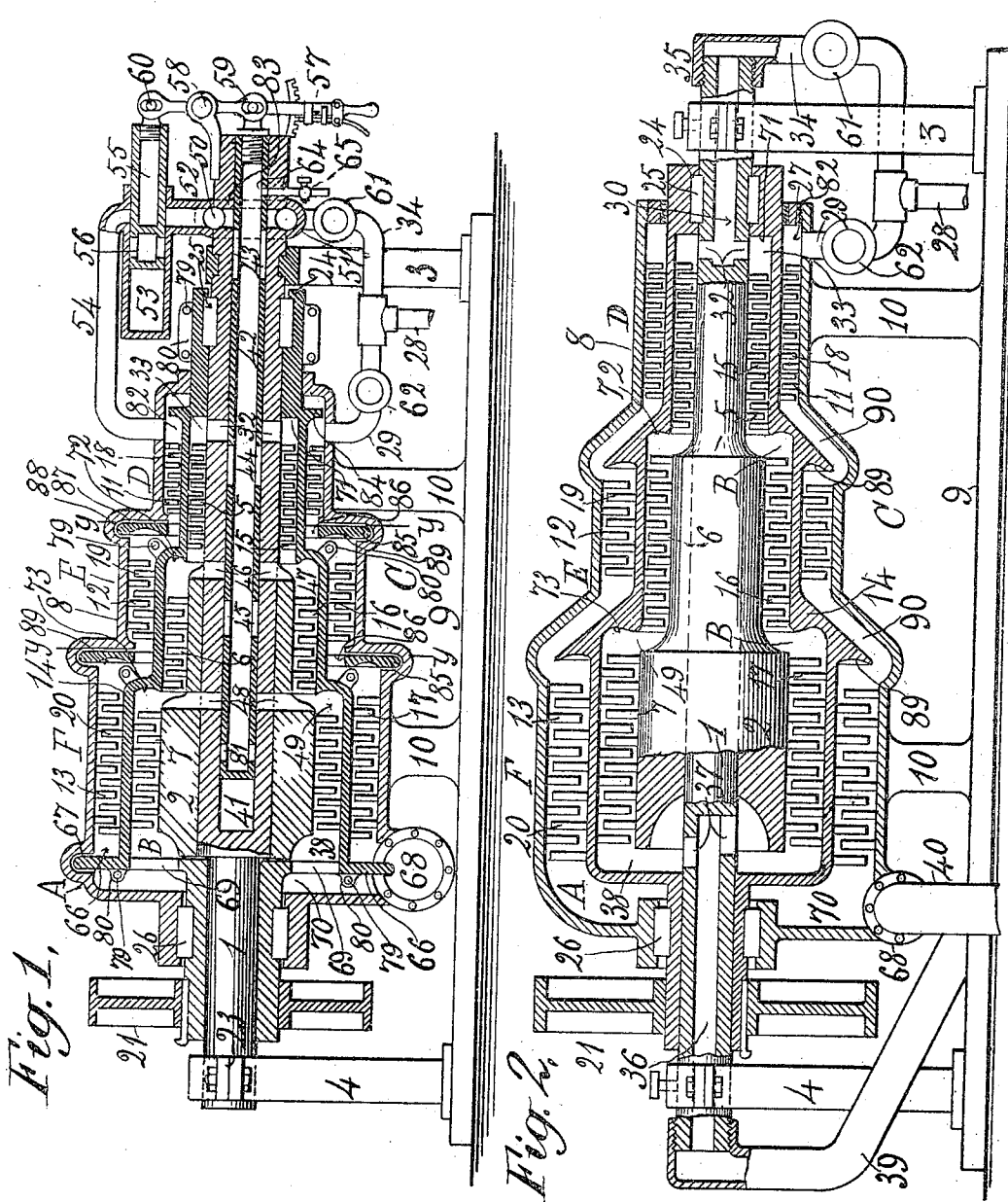
W. ROBINSON.
TURBINE.

APPLICATION FILED MAR. 29, 1905. RENEWED OCT. 1, 1909.

945,809.

Patented Jan. 11, 1910.

2 SHEETS—SHEET 1.



WITNESSES:
Harry S. Goss
H. Crocker

INVENTOR
Wm. Robinson

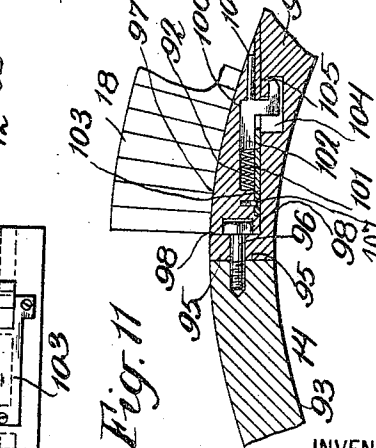
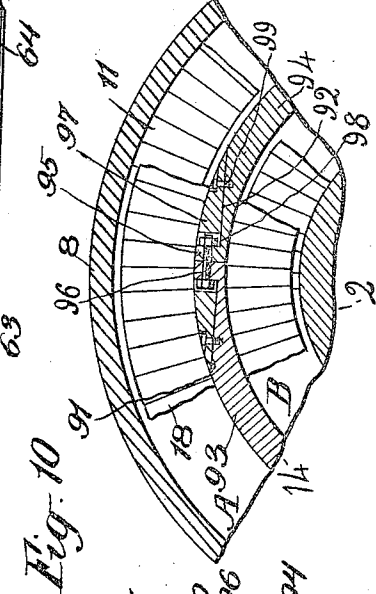
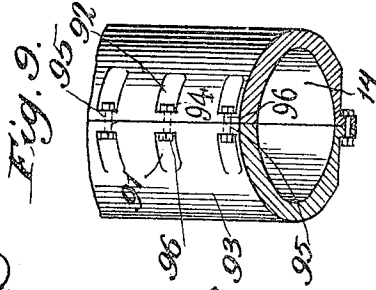
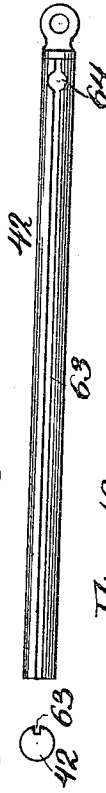
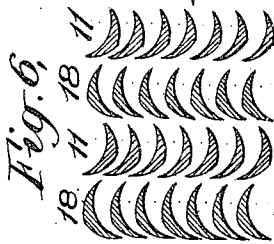
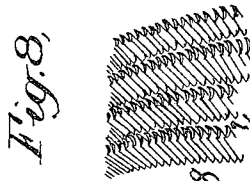
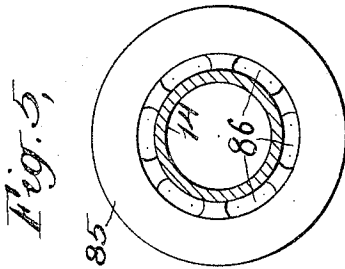
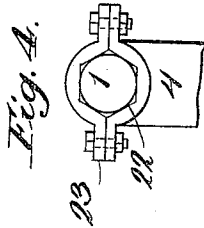
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2 SHEETS—SHEET 2.



WITNESSES:
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TURBINE.

945,809.

Specification of Letters Patent. Patented Jan. 11, 1910.

Application filed March 29, 1905, Serial No. 252,626. Renewed October 1, 1909. Serial No. 520,561.

To all whom it may concern:

Be it known that I, WILLIAM ROBINSON, mechanical engineer, a citizen of the United States, residing in Brooklyn, in the county of Kings and State of New York, have invented a new and Improved Turbine-Engine, of which the following is a specification.

My invention relates, especially, to means for reversing turbine or rotary engines, and embraces certain improvements relating to steam turbines in general.

The nature of my invention will be understood from the description which follows, reference being had to the accompanying drawings, which form a part of this specification, in which—

Figure 1 represents a longitudinal section of a steam turbine engine, illustrating the main features of my invention; Fig. 2 is a similar view showing an alternative construction in certain details; Fig. 3 shows a longitudinal, and 3^A, an end view, of the steam valve; Fig. 4 is an end view showing means for supporting and anchoring the fixed shaft; Fig. 5 is a cross section through the line Y Y, Fig. 1; Fig. 6 illustrates the relative arrangement of fixed and rotating blades or vanes for driving the engine in one direction, while Fig. 7 illustrates the relative arrangement of fixed and rotating blades or vanes for driving it in the opposite direction; Fig. 8 is a perspective view showing the relative position of the blades and rings of blades on the outside of the rotator sleeve; Fig. 9 is a perspective view illustrating means for securing the sections of the rotator sleeve together; Fig. 10 is an enlarged partial cross section of the turbine giving another view of said means for securing said rotator parts together; Fig. 11 is an enlarged detail showing, in cross section, means for connecting the rotator sleeve sections together and filling up the space, and Fig. 12 is a bottom view of the filling block.

The fixed shaft 1, provided with the sleeve or radial extension 2, shrunk thereon or otherwise rigidly secured thereto, is held in a fixed non-rotative position by the supports 3, 4. The shaft 1 is provided also with the fixed radial sets of blades 5, 6, 7. The outer shell 8 is also rigidly held in a fixed non-rotatable position by being anchored to the supporting or base plate 9, as by the supports 10, 10. The fixed outer shell 8 is provided

on its interior with parallel rings of fixed blades 11, 12, 13, projecting inwardly in a radial direction, as shown. Between the fixed axle 1 and the fixed outer shell 8, the sleeve 14 is mounted rotatably, and is capable of rotating on its bearings in either direction. Said sleeve 14 is provided on its interior with parallel rings of blades 15, 16, 17, fixed to said sleeve, and projecting inwardly in a radial direction. These rings of blades project inwardly between the fixed rings of blades, 5, 6, 7, and coact therewith.

In like manner, the rotating sleeve 14, is provided on its exterior with radial rings of blades, 18, 19, 20, projecting outwardly between the fixed rings of blades 11, 12, 13 of the outer fixed shell 8, and coacting with said fixed blades of said shell.

The operation will be understood on reference to Figs. 6 and 7. Assume that Fig. 6, for instance, illustrates the arrangement of blades in the outer chamber A: the first and third rows of blades, from the right, represent the fixed blades 11, secured to the outer shell 8, while the second and fourth rows represent the outer rings of blades, 18, on the rotating sleeve 14. Assume now that the steam is admitted from the right, in the direction of the arrow X, it strikes the first ring of fixed blades, 11, reacts, passes between the blades, impinges upon the rotatable blades of the second row, 18, and so continues throughout the length of the chamber A, reacting from the fixed blades, and impinging upon the succeeding rows of rotating blades. This sets the sleeve 14 in rapid rotation to the right, looking from the right hand end of the engine. Fig. 7 represents the arrangement of blades in the inner chamber B, between the fixed shaft 1, and the rotating sleeve 14. In this case the relative curves of the fixed and rotating blades is the reverse of the arrangement shown in Fig. 6; thus in Fig. 7 the first and third rows represent the fixed blades 5 and the second and fourth rows the rotating blades 15. It will be noted that in Fig. 6 the fixed blades 11 curve upwardly, and the rotating blades, 18, downwardly, whereas in Fig. 7 this arrangement is reversed, the fixed blades 5 curving downwardly, and the rotating blades 15, upwardly. Now admitting steam to Fig. 7, from the right, it strikes the fixed blades 5, reacts, passes through between said blades, impinges upon the rotat-

ing blades 15, and thus sets the sleeve 14, rotating to the left, looking from the right hand end of the engine. Thus, it will be seen the engine is caused to rotate in either direction accordingly as steam is admitted to the outer operative chamber A, or to the inner operative chamber B. The pulley 21, secured to the rotating sleeve 14, represents means for transmitting power from the engine C, to the mechanism or machinery to be driven by it. The connection, however, may be made in any suitable manner, direct or through gearing or otherwise.

As shown in Fig. 4 the shaft 1 is provided at or near its ends with angles 22, which are engaged by the clamps 23, whereby said shaft is held in a stationary position. The sleeve 14 is supported at one end, as shown at 24, upon bearings 25 located between said sleeve and shaft. At the opposite end, however, the sleeve is shown as rotatably supported on the bearings 26, located between said sleeve and the outer case or shell 8, the outer case supporting the sleeve 14 in this case. Either style of bearing may be used at both ends if desired, as may be found most convenient. 27 represents a stuffing box between the rotating sleeve 14 and the outer case or shell 8. Live steam from the boiler comes through the pipe 28, from which the branch 29 furnishes steam to the outer chamber A to drive the engine in one direction.

To bring steam to the inner chamber B for reversing, I provide the shaft with a longitudinal orifice 30 (see Fig. 2) and at the proper point bore through the shaft into this orifice as shown at 32, thus admitting steam into the annular space 33 at the beginning of the rows of blades, from the branch pipe 34, which is connected to the end of the shaft 1, as shown at 35. At the opposite end of the shaft (Fig. 2), the orifice 36 is formed, which is connected by the passages 37 with the annular space 38, whereby the exhaust steam is conducted from the chamber B through the fixed shaft 1, and the pipe 39 to the exhaust pipe 40, and thence to the condenser. By conducting the exhaust steam in this roundabout way, back pressure from one of the chambers A, B, to the other, is practically eliminated. The exhaust steam from the chamber B, however, may be conducted through an exhaust entirely independent of the exhaust pipe 40, if desired. It will be understood that the live steam in passing from one end of the motor to the other expands rapidly, losing heat, and power. To make up for this loss, and to utilize the expanded steam, the motor is increased in diameter and the blades in length in approaching the exhaust end of the engine. Thus the first stage D, where the live steam enters, is of minimum diameter; the second stage E, is of greater diam-

eter, to utilize more fully the partly exhausted steam, while the third stage F is of maximum diameter.

With the above explanation attention is now invited to Fig. 1, in which a method of admitting steam to the reversing chamber B, and exhausting therefrom, is illustrated, differing from that described in connection with Fig. 2.

In Fig. 1 the shaft 1 is provided with the longitudinal orifice or chamber 41, in which is located the hollow or tubular valve 42. This valve is closed at both ends to balance the pressure of steam therein, and is provided at proper intervals with slots or orifices 43, 44, 45, and 81, passing through opposite sides of said valve. As already described, openings, 32, pass from the center of the hollow shaft 1 to the annular recess 33 of the chamber B. In Fig. 1, in like manner, openings 46 pass through said shaft to the annular recess 47 of the chamber B, and openings 48 to the annular recess 49 of said chamber B. An annular groove is formed around the shaft 1 as shown at 50 and a corresponding inner groove in the ring 51, which passes around, and is secured to, the shaft, over said annular groove 50 thereon. The branch steam pipe 34 is secured to said ring 51, thus forming a passage for steam around said shaft. The tube 52 is secured to said ring 51 at the opposite side of said shaft, and this expands into the chamber 53, from which the steam pipe 54 leads to the annular recess 82, in the chamber A. The hollow valve 55, provided with the slots or openings 56, fits closely within the chamber 53. The lever 57 is fulcrumed at 58 and engages the hollow valves 42 and 55 at opposite sides of the fulcrum as shown at 59 and 60. The machine is now ready for operation. Opening the stop cock 61, permits the steam to pass around the annular channel 50, of the shaft 1, and to enter the tube 52, but it can go no farther, as all ports are closed by the hollow valves. Now drawing out the valve 42 one space, by the lever 57, brings the open passage 43 opposite the passage 50, surrounding the shaft, and at the same time brings the open passage 44 of said valve opposite the port 32, thus admitting live steam at high pressure to the first stage D of the inner chamber B, thus starting the sleeve 14 to revolve toward the left, that is, in the reversing direction. If now the machine be overloaded the drawing out of the valve 42 another space will bring the valve opening 45 opposite the ports 46, thus admitting high pressure steam to the second stage E of the chamber B. In like manner, by drawing out the valve 42 another space, steam at high pressure is admitted through the ports 48 to the third stage of the chamber B. By the simple means described, therefore, the normal

power of the machine may be more than doubled if occasion requires it.

When the lever 57 is in the position shown in the drawing, the machine is dead. When it is required, however, to start it in the opposite direction from that just described, the lever 57 is drawn to the left one space. This brings the ports 56 opposite the open end of the pipe 54, thus admitting steam to the annular space 82 of the chamber A, and starting the machine forward. Inspection will show that the valve 42, meantime, keeps steam shut off from the inner chamber B. It will be understood that with the valve 61 closed, the valve 62 may be opened, thus driving the machine in its normal direction, without using the lever 57, when quick changes of direction or conditions are not liable to be required.

It is evident that by closing the ends of the hollow valve 42, and making the respective slots or orifices 43, 44, 45, 81, in its walls opposite each other, the steam within said valve exerts an equal pressure in all directions, that is, the valve is perfectly balanced, and, as a consequence the valve may be readily actuated and controlled by the lever 57 without any resistance from the steam pressure within said valve. I make a longitudinal channel 63 in the bottom of the valve 42, between the valve and its seat, for the purpose of drainage. Near the outer end of said valve I make an orifice 64, extending through the fixed shaft and said valve when the machine is in its normal inert condition, as shown in Fig. 1. In this orifice in the shaft a drainage cock 65 is inserted, which may be opened or closed at pleasure. It will be noted that these orifices 64 are opposite each other only when the valve 42 is in its normal position and the machine inert. The movement of the valve in either direction closes the orifice in the shaft. At the opposite end of the machine the rotating sleeve 14 is provided with an annular outwardly extending web or flange, 66, extending into an annular recess 67, in the outer case 8, and its edge projecting into the general exhaust port 68, as shown. The spent steam from the outer chamber A is directed by said flange directly to said exhaust port 68. The spent steam from the inner chamber B passes through the orifices 69 into the annular chamber 70, and from there is directed in like manner by said flange 66 into said exhaust port 68, from which it passes to the condenser, or elsewhere. By thus keeping the two bodies of spent steam from the chambers A and B separated until they pass practically outside of the machine the liability of the exhaust steam from one of the chambers A, B, exerting back pressure upon the blades of the other chamber is practically eliminated. The steam in passing from one end of the chamber B to the other exerts

considerable parallel force upon the rotating blades, thus tending to produce a strong end thrust upon the sleeve 14. To obviate this end thrust I provide the said sleeve with the annular shoulders or abutments 71, 72, 73, against which the steam exerts an equal force in the opposite direction. Thus end thrust in either direction is entirely neutralized. The same principle of neutralizing end thrust I apply also to the outside of the rotating sleeve or "rotator" 14, whether a sleeve or not, as will be understood from the following description.

As illustrated in Figs. 1 and 5, I provide the rotator 14 at intervals, particularly where distinct stages in compounding are shown, with annular flanges 85, having the orifices 86 located at or near the peripheral surface of said rotator. These flanges extend outwardly and are backed up closely by vertical surfaces 87 on the interior of the fixed shell 8; said flanges preferably extending outwardly into recesses 88, formed in said shell. The object of this arrangement is to prevent steam passing over the outer periphery of said flanges 85. Now when the steam has reached the end of the stage D for instance, it passes through the orifices 86 and expands outwardly into the beginning of the stage E. Here said flange 85 presents an annular abutting surface 89, against which the partly exhausted steam exerts an end thrust upon said sleeve or rotator in one direction, and in passing through the fixed and rotating rows of blades in the stage E it exerts an equal end thrust upon said sleeve or rotator in the opposite direction. The partly exhausted steam in passing from the stage E to the stage F operates in the same manner. Thus the steam, whatever its pressure may be, will always exert an equal end thrust on the rotator in the opposite direction, thus absolutely neutralizing all vibration of the engine when running forward; and we have already shown that all vibration is neutralized in a similar manner when the engine is reversed and running backward.

As shown in Fig. 2, the partly exhausted steam passes from one stage to the next by way of the beveled passages 90, over the top of the abutments, 89, and having thus passed over, its pressure upon the rotator 14 is exerted equally as above described, in opposite directions, against the abutments 89 and the rows of blades in the respective stages of the outer chamber A, thus neutralizing, as above described, all vibration of the engine. The surfaces of the passages 90 are beveled in order to facilitate the passage of the steam from one stage to another with a minimum of back pressure. The arrangement for neutralizing vibration above described in connection with Fig. 1, permits the engine to be built more compactly than that shown in

Fig. 2, and to this extent at least, is preferable. The rotator sleeve 14 is made in two longitudinal sections for convenience in constructing and assembling, and these sections
 5 are secured together by bolts passing through the holes 79 in the flanges or lugs 80, forming a part of said sections. But it is not practicable to have a sufficient number of these lugs projecting outwardly to hold
 10 the sections securely together. I therefore form corresponding recesses 91, 92, at proper intervals in the sections 93, 94 of the sleeve 14, as shown in Figs. 9 and 10, leaving webs 95 adjacent to said recesses through which
 15 bolts 96 are passed, thus securely fastening said sections together.

An inspection of Figs. 10 and 11 will show that these bolts are below the outer periphery of said sections 93, 94, so that they
 20 may not interfere with the working blades. The rotating blades 18 in Fig. 10 are shown back of the recesses 91, 92, and the fixed blades 11 as in line with, or over said recesses. These recesses 91, 92 are shown in
 25 Figs. 10 and 11 as filled up by blocks 97, which are formed at their inner ends with recesses and projections 98 over and underlapping the heads or nuts of the bolts 96, thus forming a lock for said bolts and nuts
 30 and preventing them from becoming loose. At the same time said bolt heads and nuts form an anchorage or lock for the inner ends of said blocks 97, keeping them securely in place. The outer ends of the blocks 97 are
 35 shown in Fig. 10 as secured to the rotator sections 93, 94, by screw bolts 99. This is a simple arrangement, but, as unsecured bolts and nuts are always liable to get loose in moving machinery, I prefer the construction
 40 illustrated in Figs. 11 and 12. In Fig. 11 the bolt 96 is passed through the web 95 of the rotator section 94 and screwed into the sectional face of the corresponding section 93. Thus the peripheral surface of the
 45 section 93 is preserved intact. The block 97, in this case, has its underside provided with a recess 100, in which is inserted the spring 101 and the latch 102, pressed outwardly by said spring. The latch and spring are held
 50 in position relatively to said block 97 by the plate 103 secured thereto by screws 107 or otherwise. The rotator section 94 is provided with the undercut recess 104. Thus when the block 97 is placed in position the
 55 latch 102 drops into the recess 104. The spring 101 now forcing the latch 102 outwardly, it engages the undercut lug 105 of the rotator section 94. It will be seen that by the means described the block 97 is held
 60 firmly in position at both ends, completely filling up the space cut away for the accommodation of the bolts 96. The latch 102 is provided at its outer end with a slight shoulder or engageable surface 106, against which
 65 a suitable pin or tool may be pressed to push

the latch 102 back when it is desired to loosen or remove the block 97.

It is evident that the insertion and securing in place of the blocks 97, as described in connection with Figs. 10 and 11, render the
 70 peripheral surface of the rotator 14 practically uniform, leaving no room for steam to pass except through the operative blades. Thus, there can be no waste of steam at joints made as described. 75

It will be understood that rotator blades may be built upon the outer surface of the blocks 97, when found necessary as shown at
 80 18, Fig. 11, thus avoiding any interruption in the continuity of the rows of blades. 80

In vertically arranged turbine engines the annular abutments 72, 73 or 89, of the vertical rotator, are made of such extended surface that the steam, or other operative fluid, pressing thereunder, may be arranged to
 85 practically, or approximately, lift the weight of the rotator from its lower bearings, thus relieving friction and causing said rotator while revolving, to virtually, or approximately, float on a bed of steam or other operative fluid. In this case said annular abutments may be formed on, or secured to, said
 90 rotator at any point or points found most convenient for the purpose. In vertical turbines, it will be noted, it is an advantage to
 95 have the steam entrance ports at or near the lower end, and the exhausts toward the upper end, as in this case even the driving force of the steam is utilized to relieve the weight of the rotator from its bearings. 100

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

1. In a turbine engine, the combination with a rotor comprising a sleeve formed in
 105 longitudinal sections provided with inwardly projecting blades or buckets, of means for rigidly securing said sections detachably together. 105

2. In a turbine engine, the combination
 110 with a rotor comprising a sleeve formed in longitudinal sections provided with outwardly projecting blades or buckets, of means for securing said sections detachably together. 115

3. In a turbine engine, the combination with a rotor comprising a sleeve formed in
 120 longitudinal sections provided with blades or buckets projecting from both its inner and outer surfaces, of means for securing said sections detachably together. 120

4. In a turbine engine, the combination with a rotatable sleeve formed of two longitudinal sections, and provided with blades
 125 or buckets on its exterior, of means for securing said sleeve sections together by mechanical means sunk below the peripheral surface of said sections. 125

5. In a turbine engine, the combination with a rotator comprising two longitudinal
 130 sections, of means for securing said sections together by bolts passing through the sections and secured by blocks secured to the sections. 130

sections and provided with blades or buckets on its exterior, of means for securing said rotator sections together by means of bolts sunk below the peripheral surface of said sections, said sections being provided with recesses for the reception of said bolts, and means for filling up said recesses when said bolts are in position.

6. In a turbine engine, the combination with a rotator comprising a plurality of longitudinal sections and provided with blades or buckets on its exterior, of means for securing said sleeve sections together by means of bolts sunk below the peripheral surface of said sections, said sections being provided with recesses for the reception of said bolts, blocks for filling up said recesses when said bolts are in position, said blocks being provided with means for locking said bolts or

their nuts in position, and provided on their exterior surface with blades or buckets, and means for securing said blocks in position.

7. In a turbine engine, the combination with the rotator 14 formed of sections 93, 94 secured together by bolts 96, said sections being provided with recesses 92 for the reception of said bolts, of blocks 97 arranged to fill up said recesses, said blocks having projections or lugs 98 at one end arranged to lock said bolts or their nuts in position, said bolts or nuts reciprocally operating to secure one end of said blocks in position, and the latch 102 arranged to lock said block in position when inserted, in place.

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Witnesses:

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