No. 791,414. PATENTED MAY 30, 1905.

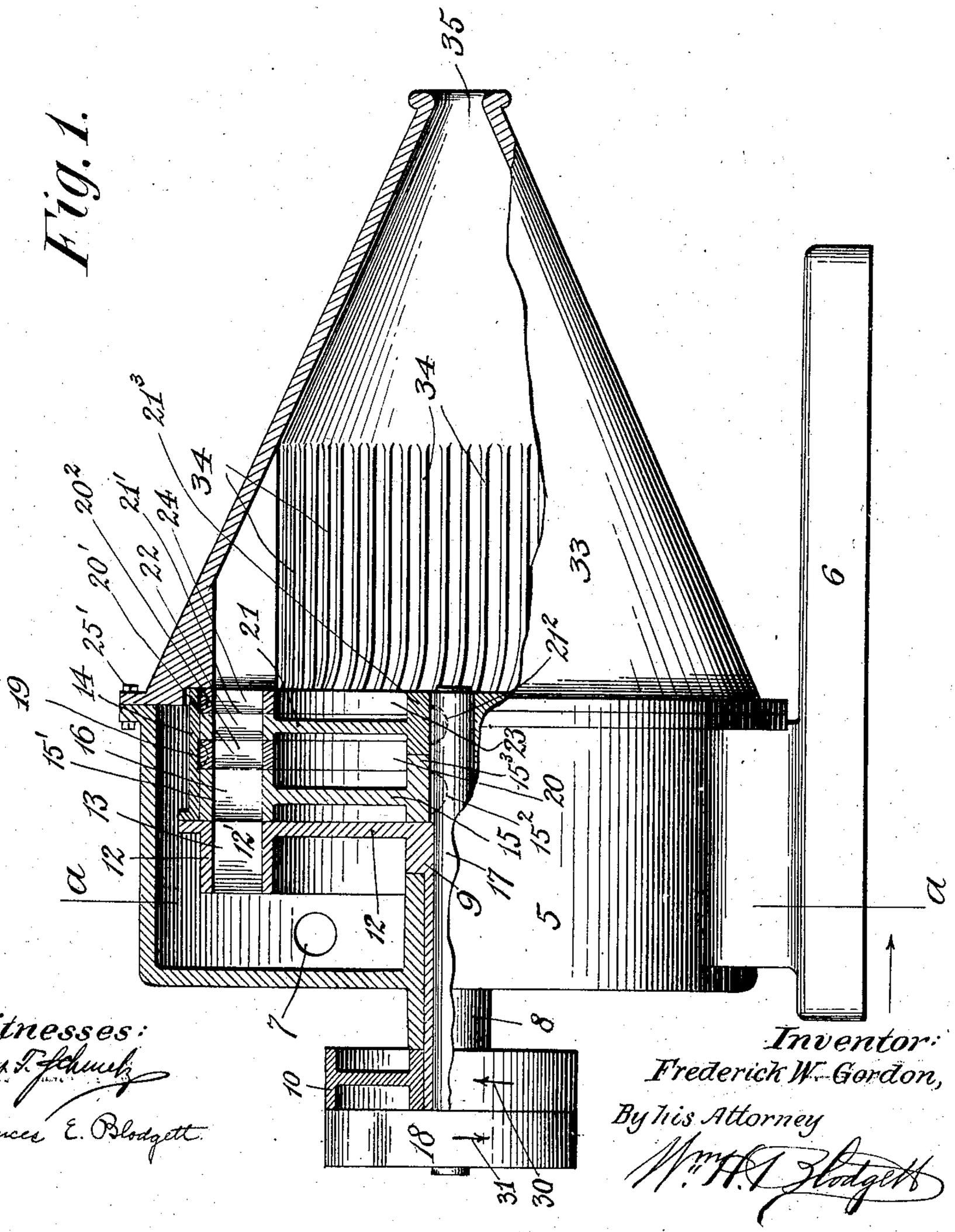
F. W. GORDON.

TURBINE.

APPLICATION FILED JUNE 19, 1903.

5 SHEETS—SHEET 1.

Fig. 1.



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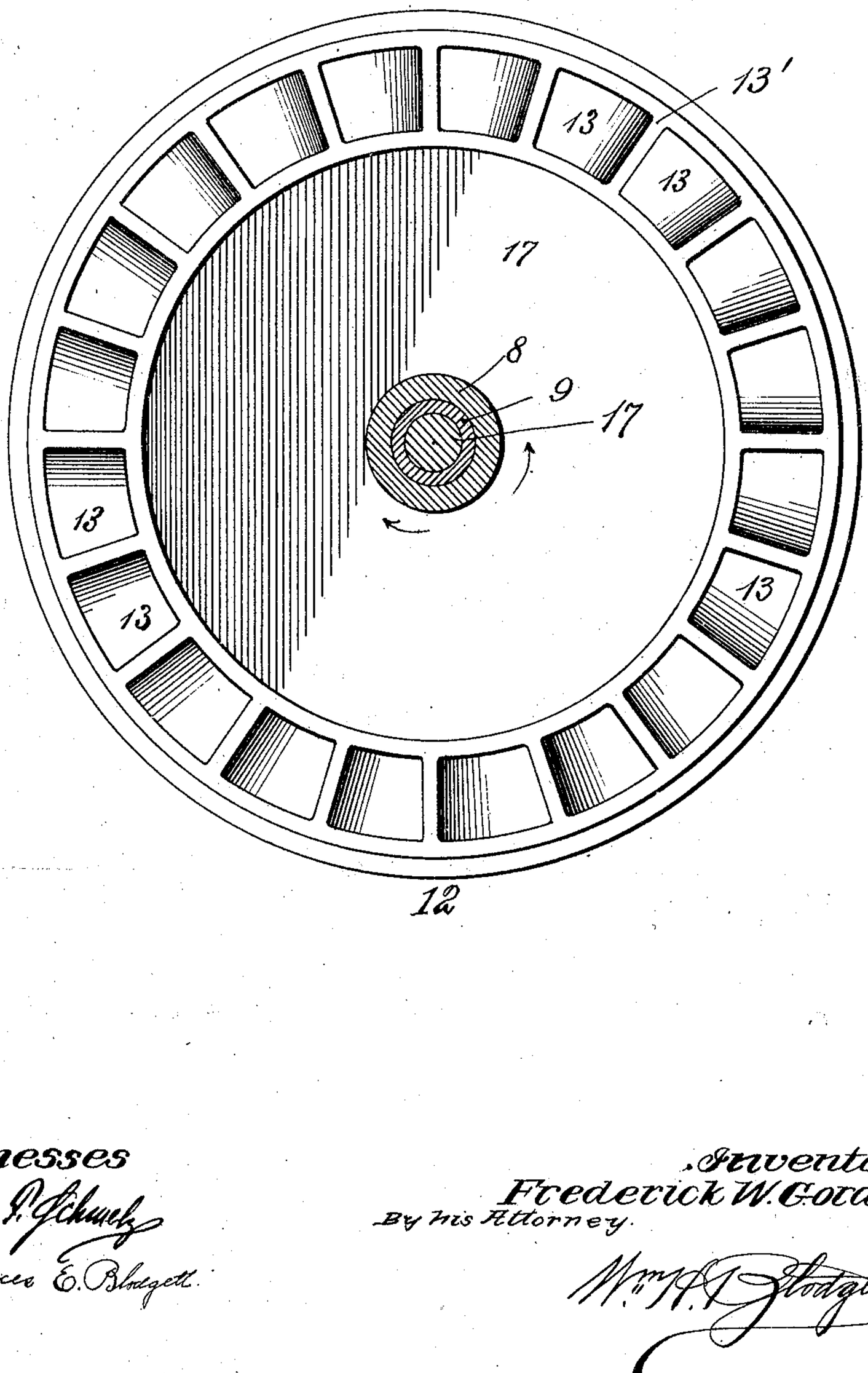
5 SHEETS—SHEET 2.

Fig. 2.



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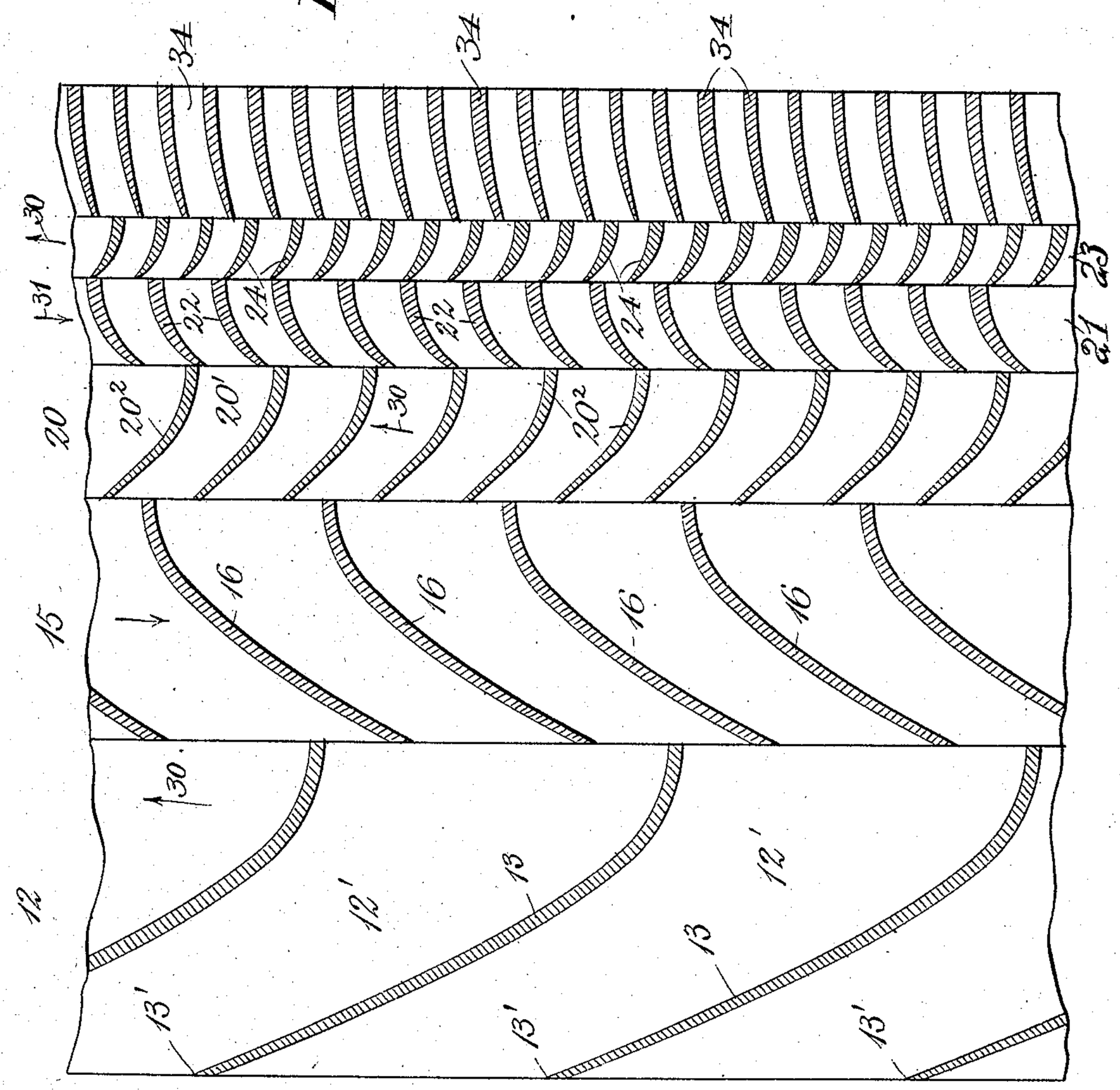
5 SHEETS—SHEET 3.

Fig. 3.



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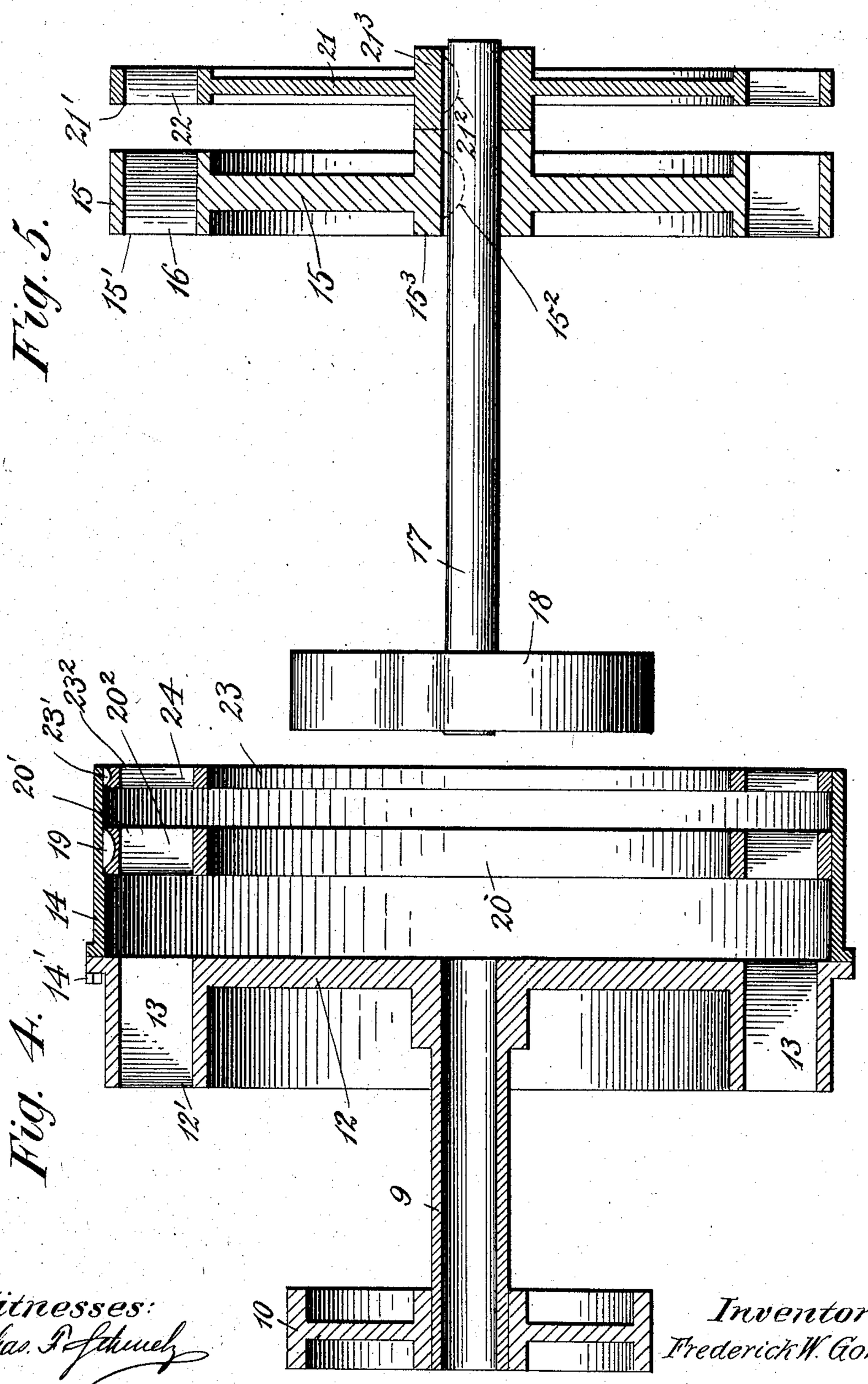
5 SHEETS—SHEET 4.

Fig. 4.



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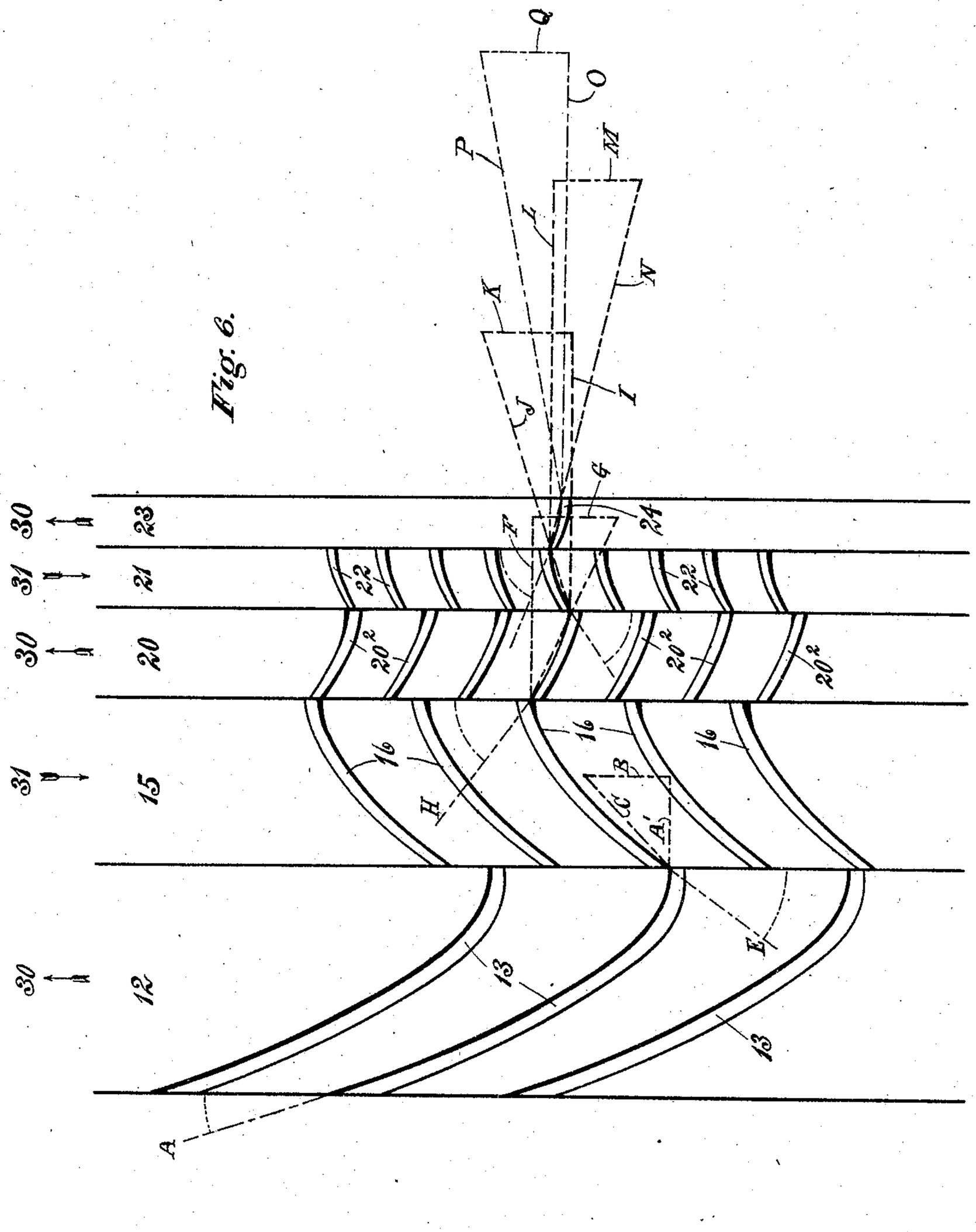
5 SHEETS—SHEET 5.

Fig. 6.



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UNITED STATES PATENT OFFICE.

FREDERICK W. GORDON, OF HARTFORD, CONNECTICUT, ASSIGNOR OF ONE-HALF TO ALEXANDER GORDON, OF ASBURY PARK, NEW JERSEY.

TURBINE.

SPECIFICATION forming part of Letters Patent No. 791,414, dated May 30, 1905.

Application filed June 19, 1903. Serial No. 162,268.

To all whom it may concern:

Be it known that I, FREDERICK W. GORDON, a citizen of the United States, residing at Hartford, in the county of Hartford and State of Connecticut, have invented certain new and useful Improvements in Turbines, of which the following is a specification.

My invention relates to improvements in turbines, and has for its object the provision of a machine of that class which will be simple in construction and reliable in operation.

A further object of the invention is the provision in a turbine of blades of parabolic form, whereby a great improvement in the result is effected.

A further object of the invention is the provision of a connected set of carriers having blades of parabolic form, said set rotating in one direction, and another connected set of carriers, the blades of which are also of parabolic form, said other set rotating in a direction opposite to that of the first-named set.

A further object of the invention is the provision of connected sets of blade-carriers alternately arranged with relation to each other, one set moving in one direction and the other set in an opposite direction.

Further objects of the invention will be hereinafter set forth.

In the accompanying drawings, Figure 1 is a longitudinal vertical section of a turbine embodying my improvements, parts being shown in elevation. Fig. 2 is a side elevation of one of the blade-carriers, taken on line *a a* of Fig. 1 looking in the direction of the arrow, the casing being omitted and the bearing and shafting being represented in section. Fig. 3 is a diagrammatic view representing the blade-carriers and the guiding-ribs, the ribs and blades being in section. Fig. 4 is a longitudinal vertical section of three of the blade-carriers of my improved turbine, showing the manner in which they are assembled. Fig. 5 is a longitudinal vertical section of two of the blade-carriers detached, showing them keyed to the shaft which is fitted in the tubular shaft of Fig. 4; and Fig. 6 is a diagram showing the mode of operation of the improved turbine.

Referring to the drawings, the numeral 5 designates a casing in which my improved machine is mounted, said casing rising from a base 6.

In the construction illustrated in Fig. 1 the invention is shown adapted for use as a rotary pump or as a blower to which fluid is supplied through a port 7, leading to a suitable source of supply.

In a bearing 8 of the casing is journaled a tubular shaft 9, to which a pulley or equivalent element 10 may be secured. Either integral with or secured to the shaft 9 is a carrier 12, having a chamber 12′, in which are blades 13 of parabolic form, each blade being brought to a sharp entrance end 13′ and terminating at its other extremity in a line substantially parallel to the axis of the carrier. Any requisite number of these blades may be employed; but I have found about twenty to be useful in accomplishing the result required. Designated by 14 is a drum which projects from the carrier 12, and this drum may either be integral with or detachably secured by bolts or otherwise, as at 14′, Fig. 4, to said carrier. Adjacent to the carrier 12 is a second carrier 15, having a chamber 15′ provided with a series of parabolic blades 16, preferably about forty in number, and having delivery ends substantially parallel to the axis of the carrier, but spaced at a less distance apart than are the blades 13 of carrier 12. This carrier 15 is keyed or otherwise secured at 15^2 to a shaft 17, mounted in the tubular shaft 9, said shaft being equipped with a pulley 18 or other element to which power may be applied, and said carrier is also provided with a projecting hub 15^3 for a purpose hereinafter stated. Keyed to drum 14 at 19 is a third annular carrier 20, having a chamber 20′ adjacent to its periphery, in which are located parabolic blades 20^2, preferably about eighty in number and spaced at a less distance apart than are the blades 16 of carrier 15, the delivery ends of said blades being substantially parallel to the axis of the carrier. Secured to shaft 17 by a key 21^2 is a fourth carrier 21, having a chamber 21′, in which is disposed a series (preferably about one hundred and

twenty) of downwardly-curved parabolic blades 22, the delivery ends of which are substantially parallel to the axis of the carrier. This carrier has a hub 21^3, which when the parts are assembled abuts against the hub 15^3 of carrier 15, thereby spacing said carriers 15 and 21 apart a sufficient distance to receive between them the carrier 20, as illustrated in Fig. 1. Designated by 23 is a fifth carrier, which is keyed to the drum 14 at 23′ and is provided with a chamber 23^2 adjacent to its periphery. In said chamber are located upwardly-curved blades 24 of parabolic form, preferably about one hundred and sixty in number, although the invention is not limited in this respect. The delivery ends of these blades are also substantially parallel to the axis of the carrier.

From the above description it will be seen that the connected carriers 12, 20, and 23 rotate in the direction of the arrows 30 and that the set of carriers 15 and 21 rotates in the direction of the arrows 31 and that the parabolic blades of the carriers 12, 20, and 23 are curved upwardly, while the parabolic blades of the carriers 15 and 21 are curved downwardly, the result being that two sets of oppositely-rotating blade-carriers are provided, the purpose of which will be set forth in the description of the operation of the machine hereinafter given.

Designated by 33 is a conical shell having a series of preferably curved fluid directing or guiding ribs 34 and a nozzle or outlet 35.

When my invention is employed for use as a pump or blower, power will be applied to pulley or other instrumentality 10 to rotate the tubular shaft 9 and carriers 12, 20, and 23, driven by said shaft in the direction of the arrow 30 in Fig. 1, and to pulley or other element 18 to rotate it and the carriers 15 and 21 in the opposite direction, or that of the arrow 31 in said figure. When the machine is started, the casing 5 is supplied with liquid through port 7, and, as will be observed, owing to the parabolic shape of the blades 13 of carrier 12, they will readily engage fluid within said casing, carry it upward and then downward and force it in an axial direction toward the outlet 35, while the parabolic blades 16 of carrier 15, which rotates in an opposite direction to that of carrier 12, will take the fluid delivered by the blades of said carrier 12, carry it downward and upward and force it axially forward at substantially double the velocity at which it is propelled by the blades 13. Then the blades 20^2 of carrier 20, rotating in the same direction as carrier 12, will receive the fluid from blades 13, will carry it upward and downward and forcibly deliver it axially of the casing at further augmented velocity. Then the blades 22 of carrier 21, rotating in unison with carrier 15 (see Fig. 5) and in an opposite direction to that of carriers 12 and 20, will engage the fluid, carry it downward and upward and forcibly expel it at greater velocity than it had when leaving carrier 20, and, finally, the parabolic blades 24 of carrier 23, rotating conjointly with carriers 12 and 20, as shown in Fig. 4, will seize the liquid, carry it upward and then downward and impel it axially forward at greater velocity than it issued from the blades 22, and from said carrier 23 the liquid is forced between the guide-blades 34 and to the conical shell 33, from which it escapes by the nozzle-opening 35. In this way the velocity of the fluid is constantly augmented as it travels to its discharge-opening, and while I have shown five alternately-arranged carriers, three of which rotate in one direction and two in the opposite direction, it is to be distinctly understood that the invention is not limited in this respect, for any desired number of said carriers may be employed; nor is it limited to the particular shape or specific number of blades in the carriers shown, for modifications may be made without departure from the invention.

Referring to the diagram Fig. 6, the line A represents the angle (approximately twenty degrees) at which the blades 13 of the first carrier 12 engage the fluid, the line A′ the speed and axial direction of the currents flowing from said blades, and the line B the speed of said flow circumferentially, the resultant being designated by C. Lines A′ and B are equal, and each designates the velocity of the first and all succeeding blades of the said carrier. By receiving the fluid in the first set of blades at an approximate angle of twenty degrees it will fill the space between every pair of blades when the carrier is rotating at high speed. Now by rotating in close proximity to the first carrier 12 a second carrier 15 in an opposite direction, said second carrier also having parabolic blades 16 of less height than the first set, the angle designated by line E, and of about thirty-six degrees, at which the fluid is entered by the blades of the second carrier will be such as will receive the fluid from the blades of the first carrier without shock or blow, and the blades of said second carrier will pick up the fluid at its already-attained velocity on the angle designated by said line E and will gradually force it axially until it is delivered by said second set of blades about on the line F of the diagram, the line G representing the speed and the direction of movement of said second carrier. In like manner the parabolic blades 20^2 of the third carrier 20, which are of less height than the blades 16 and rotate reversely to carrier 15, will enter the fluid on line H at an angle of about fifty-two degrees without shock and force it upward and axially along lines I and J, the speed and direction of movement of the third carrier being designated by the line K. Coming now to the fourth carrier 21, also having parabolic blades 22 less in height than blades 20^2 and rotating in an opposite direction to the third carrier, the lines L, M,

and N show the resultant effect of the flow of liquid from the blades of said carrier. So, too, the lines O, P, and Q illustrate the resultant effect of the fluid when delivered by the parabolic blades 24 of the fifth carrier 23, should it be employed. From what has been stated it will be seen that the current flowing from one carrier is picked up without shock or blow by the parabolic blades of the next carrier at its own velocity, and so on, constantly increasing in velocity by the parabolic blades of the succeeding carriers until it is delivered into the conical shell 33 by the last set of parabolic blades.

By arranging the blades in the manner described and by rotating the carriers in opposite directions the fluid at continually-accelerated velocity is picked up at gradually-increasing angles and is forced forward in an axial direction at increased speed until the final enhanced speed is obtained as said fluid leaves the blades of the last carrier and is forced by them between the guide-blades 34 and into the conical nozzle 35. In all prior constructions of which I am aware the resultant effect is different from that accomplished by my improved turbine. In said prior constructions, whether employed as blowers or as turbine water-wheels, parabolic blades have not been employed and the blades have either been so inclined or so curved that they cannot accomplish the result attained by the improved construction above set forth. Furthermore, the blades of these old constructions have neither differed in height nor in number, and consequently have been unable to accomplish the result herein set forth.

As will be observed from Figs. 1 and 3, the various blade or vane carriers are fitted closely together and yet with sufficient clearance to enable them readily to pass each other, and by surrounding the carriers 15, 20, 21, and 23 with the drum 14 leakage of fluid between the adjoining surfaces of said carriers is practically eliminated.

In assembling the parts of my improved turbine the tubular shaft 9 and its carrier 12, with drum 14, are first placed in position within the casing 5, and the shaft 17 is then inserted in said tubular shaft. Carrier 15 is then slipped upon said shaft 17 and is keyed or otherwise secured thereto. Carrier 20 is then inserted within drum 14 and is locked thereto by key 19 or otherwise. Carrier 21 is then slipped upon shaft 17 and secured in place. Carrier 23 is then keyed to drum 14 at 23′, and, finally, the conical shell 33 is attached to the open end of the casing.

Blades the working surfaces of which are drawn on parabolic curves cause an important improvement in the result, for the entrance ends 13′ of said blades cleave the liquid, and the delivery ends, being substantially parallel to the axis of the carrier, drive said liquid forward in an axial direction, whereby splashing is either entirely avoided or is reduced to a minimum.

While the blades are shown attached to carriers of wheel shape, any suitable modifications may be made in this respect. So, too, any means may be employed for driving the carriers, the invention not being limited to the shafts shown.

Any suitable means may be employed for imparting power to the shafts of the machine, and the invention may be employed as a pump, a blower, or for other uses, if desired.

Having thus described my invention, what I claim is—

1. A turbine comprising a casing; means for supplying fluid thereto; sets of connected carriers, each carrier having a series of parabolic blades, the delivery ends of which lie in planes substantially parallel to the axis of the carrier; and mechanisms for driving one set of carriers in one direction and the other set of carriers in an opposite direction.

2. A turbine comprising a casing; a carrier having blades of parabolic form, the delivery ends of which lie in planes substantially parallel to the axis of the carrier, means for rotating said carrier in one direction; a second carrier also having blades of parabolic form the delivery ends of which lie in planes substantially parallel to its axis; and means for rotating said second carrier in a direction opposite to that of the first carrier.

3. In a turbine, the combination, with connected carriers each having blades of parabolic form, and the delivery ends of which are substantially parallel to the axis of the carrier, of connected carriers each also having blades of parabolic form, and the delivery ends of which are substantially parallel to the axis of the carrier; means for independently rotating one set of carriers in one direction; and means for independently rotating the other set of carriers in a direction opposite to that of the first set.

4. In a turbine, a carrier comprising a wheel having a chamber adjacent to its periphery, and a series of blades of parabolic form crossing said chamber, and the delivery ends of which are substantially parallel to the axis of the carrier, combined with a second carrier having a chamber adjacent to its periphery, and a series of blades of parabolic form crossing said chamber, and the delivery ends of which are substantially parallel to the axis of said carrier; a driven shaft to which one carrier is connected; and an oppositely-driven shaft to which the other carrier is connected.

5. A turbine comprising a casing; a shaft mounted in said casing; a set of carriers secured to said shaft, each carrier having parabolic blades, the delivery ends of which are substantially parallel to its axis; means for rotating said shaft and carriers in one direction; a second connected set of carriers, each having parabolic blades, the delivery ends of

which are substantially parallel to its axis; a shaft to which said second set of carriers is secured; and means for rotating said shaft and second set of carriers in a direction opposite to that of the first-named shaft, the carriers of the two sets alternating with each other, substantially as set forth.

6. The combination, with a casing, of a pair of shafts, one mounted within the other, journaled in said casing; a series of independent carriers rigid with one of the shafts, and each having blades, the blades of one carrier differing in spacing from those of another carrier; and a series of carriers rigid with the other shaft, alternating with the first series, and having blades, the spacing of one set of which is different from that of another set.

7. The combination, with a casing, of a rotary series of connected carriers having blades of parabolic form pointing in one direction, and a second oppositely-rotary series of connected carriers having blades also of parabolic form pointing in the opposite direction, the blades of the respective carriers differing in spacing, and means for supplying fluid to said casing.

8. The combination, with two sets of carriers having blades or vanes spaced at different distances apart, of means for rotating one set of carriers in one direction and the other set of carriers in the opposite direction.

9. The combination, with sets of carriers, each carrier being independent and being provided with blades of parabolic form of different spacing from other carriers of the set, and the members of each set being connected, of means for rotating one set of carriers in one direction and the other set of carriers in the opposite direction.

10. The combination, with a casing, of a tubular shaft journaled therein; a carrier rigid with said tubular shaft, and having parabolic blades, the delivery ends of which are substantially parallel to its axis; a shaft mounted within the tubular shaft; a pair of carriers carried by said shaft; and each carrier having parabolic blades, the delivery ends of which are substantially parallel to its axis; and carriers controlled by the tubular shaft, and alternating with those carried by the shaft mounted within said tubular shaft, said carriers also having blades of parabolic form, and the delivery ends of which are substantially parallel to their axes.

11. The combination, with a casing, of a tubular shaft journaled in a bearing of said casing and having a carrier; a series of parabolic blades rigid with said carrier, and the delivery ends of which are substantially parallel to its axis; a shaft mounted within the tubular shaft; a carrier rigid with said shaft, and having a series of parabolic blades with their delivery ends substantially parallel to its axis, said carrier being located adjacent to the carrier of the tubular shaft; a carrier having a series of parabolic blades; a connection between said carrier and the carrier of the tubular shaft; another carrier also having a series of parabolic blades rigid with the shaft mounted within the tubular shaft; a final carrier having a series of parabolic blades, and located adjacent to the last-named carrier; means for connecting said final carrier with the carrier of the tubular shaft; and means for rotating the shafts in opposite directions.

12. In a turbine, the combination, with sets of carriers each having blades of parabolic form, the delivery ends of which are substantially parallel to the axis of the carrier, of means for rotating one set of carriers in one direction; and means for rotating the other set of carriers in an opposite direction, whereby fluid acted on by the blades will be forced in an axial direction from the casing.

13. In a turbine, the combination, with a carrier having blades of parabolic form the delivery ends of which are substantially parallel to the axis of said carrier, of a second carrier having like blades; means for rotating said carriers in opposite directions; a casing having a port for the admission of fluid; and a conical shell projecting from said casing, and having guide-blades on its inner side.

14. In a turbine, the combination, with a carrier having blades the delivery ends of which are substantially parallel to the axis of said carrier; of a second carrier having like blades; means for rotating said carriers in opposite directions; a casing having a port for the admission of liquid; and a conical shell having a series of curved guide-blades, said shell projecting from the casing.

15. The combination, with a casing, of a carrier having blades of parabolic form the delivery ends of which are nearly parallel to its axis; a second carrier arranged in close proximity to the first carrier, and also having blades of parabolic form, the delivery ends of which are nearly parallel to its axis said blades being so disposed that they will enter the fluid delivered from the first set of blades without shock or blow at an angle different from that at which it was entered by said first set of blades; and means for rotating the carriers in opposite directions.

16. The combination, with a carrier having blades of parabolic form, the delivery ends of which are nearly parallel to its axis, said blades entering fluid at a certain angle, of a second carrier having blades of parabolic form, the delivery ends of which are nearly parallel to its axis, and which enter fluid at an angle different from that of the blades of the other carrier; and means for rotating the carriers in opposite directions.

17. The combination, with a rotary carrier having parabolic blades, of a second oppositely-rotatable carrier having parabolic

blades differently spaced apart and of different height from those of the first carrier.

18. The combination, with a primary carrier having parabolic blades, of means for rotating said carrier; a second carrier having parabolic blades differing in spacing, in number and in height from the blades of the primary carrier; and means for rotating said second carrier in a direction opposite to that of the primary carrier.

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

FREDERICK W. GORDON.

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