No. 801,678. PATENTED OCT. 10, 1905.

M. NEUMAYER.

EXPANSION TURBINE.

APPLICATION FILED DEC. 8, 1904.

2 SHEETS—SHEET 1.

Fig. 1.

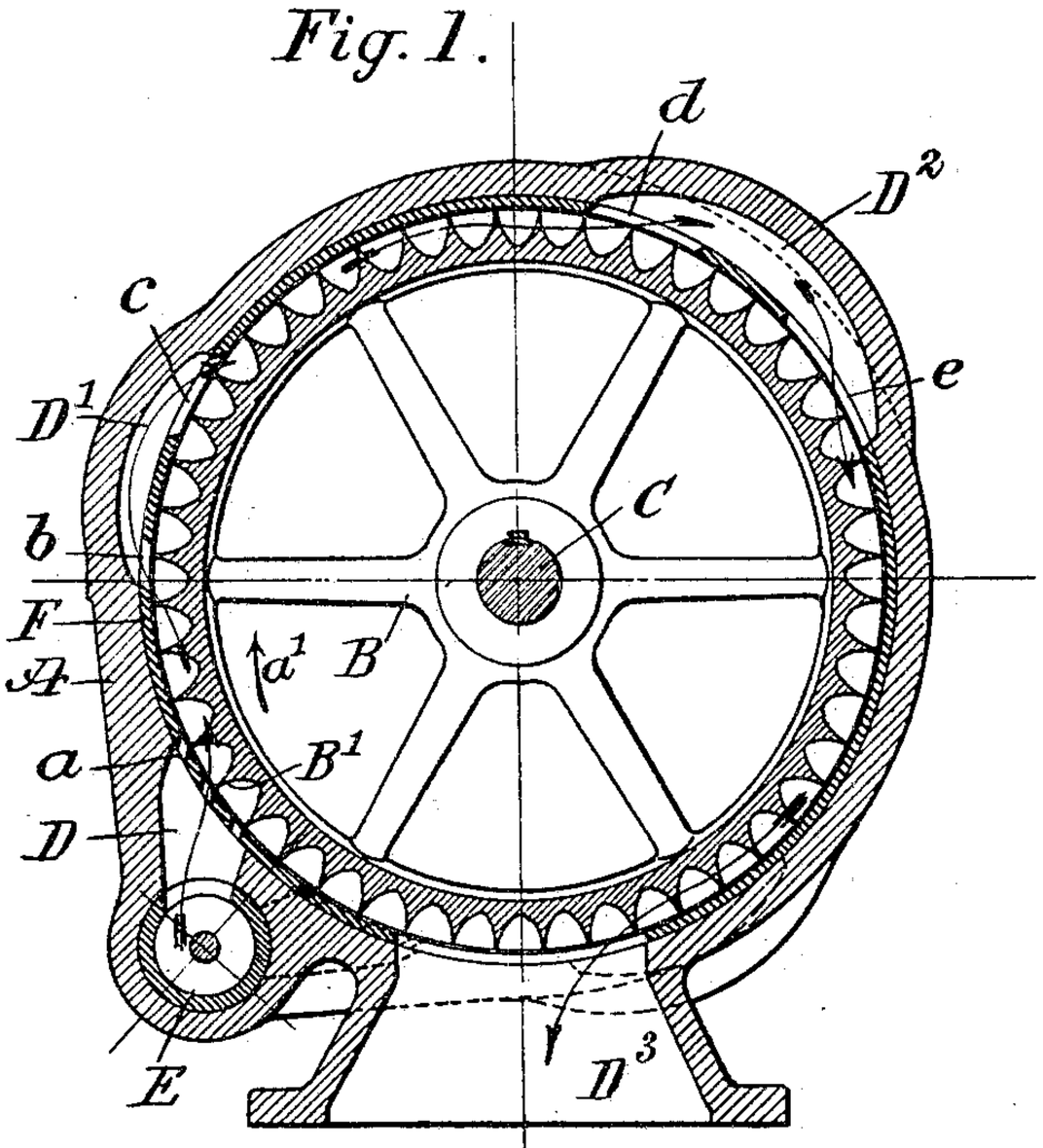


Fig. 2.

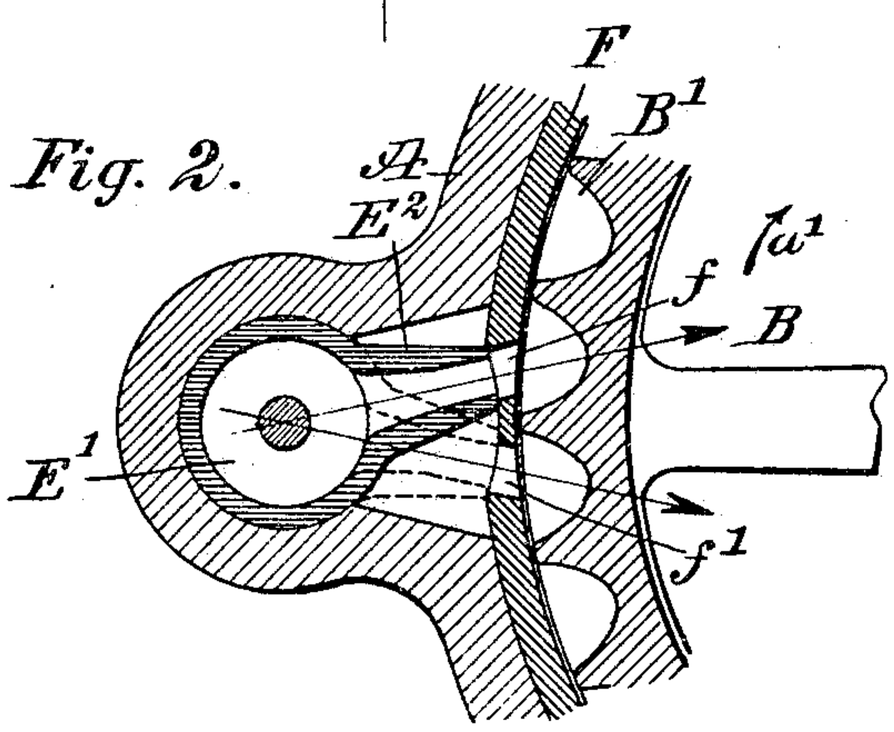
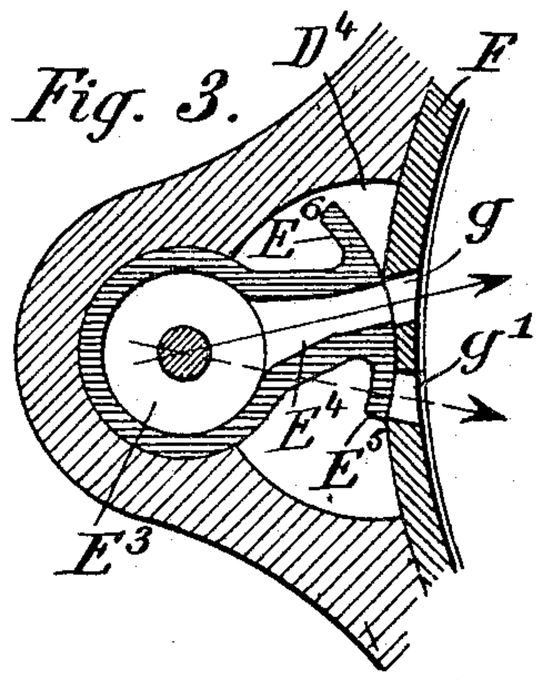


Fig. 3.



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ATTORNEYS

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2 SHEETS—SHEET 2.

Fig. 4.

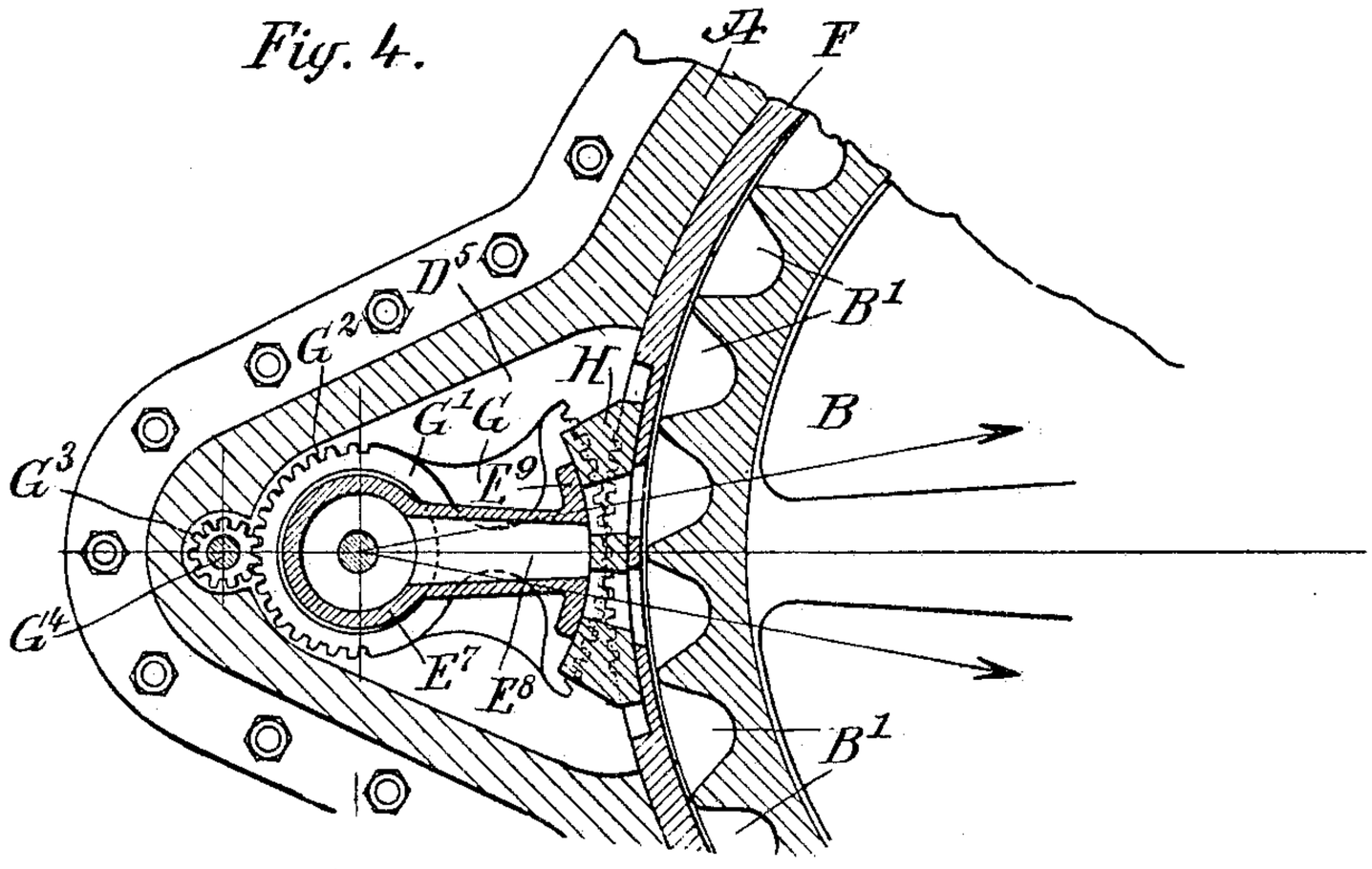
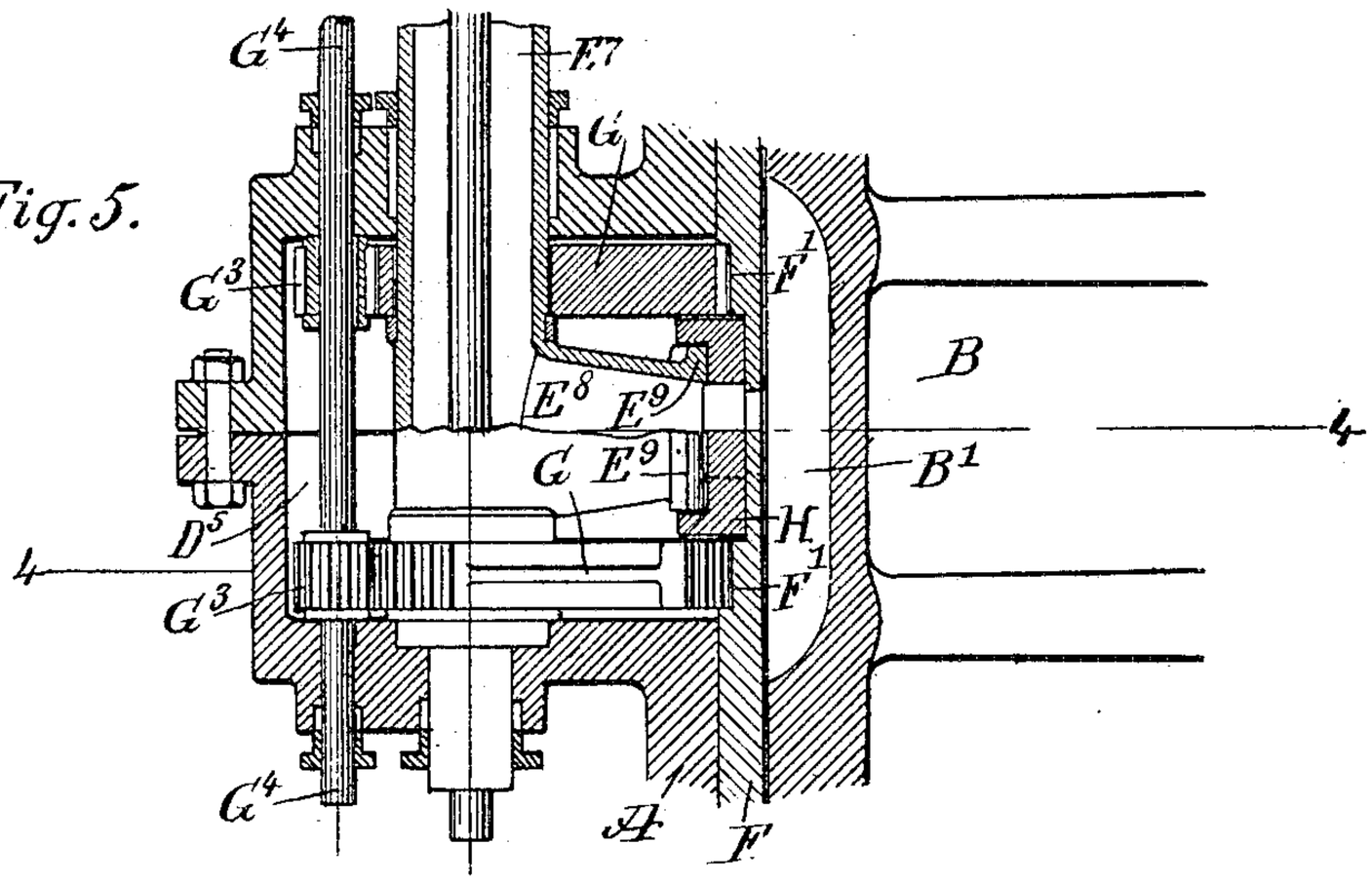


Fig. 5.



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UNITED STATES PATENT OFFICE.

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EXPANSION-TURBINE.

No. 801,678. Specification of Letters Patent. Patented Oct. 10, 1905.

Application filed December 8, 1904. Serial No. 235,964.

To all whom it may concern:

Be it known that I, MAXIMILIAN NEUMAYER, a subject of the Emperor of Austria-Hungary, and a resident of East Orange, in the county of Essex and State of New Jersey, have invented a new and Improved Expansion-Turbine, of which the following is a full, clear, and exact description.

The object of the invention is to provide a new and improved expansion-turbine arranged to drive a rotary piston by impact both under initial pressure and by the expansive force of the motive agent, thus utilizing the motive agent to the fullest advantage without requiring complicated mechanical means in the construction of the turbine.

The invention consists of novel features and parts and combinations of the same, as will be more fully described hereinafter and then pointed out in the claims.

A practical embodiment of the invention is represented in the accompanying drawings, forming a part of this specification, in which similar characters of reference indicate corresponding parts in all the views.

Figure 1 is a sectional side elevation of the improvement. Fig. 2 is an enlarged sectional side elevation of a modified form of controlling-valve for the motive agent. Fig. 3 is a similar view of another modified form of the controlling-valve. Fig. 4 is an enlarged sectional side elevation of the means for actuating the cut-off valve, the section being on the line 4 4 of Fig. 5; and Fig. 5 is a sectional plan view of the same.

In the cylinder A of the turbine is mounted to rotate the body B in the form of a cylindrical piston, provided on its peripheral face with impact members B′, preferably in the form of buckets, as plainly indicated in Fig. 1. The rotary body B is secured on a shaft C, journaled in suitable bearings and connected with other machinery to be driven.

In the wall of the cylinder A is formed an initial-pressure chamber D, expansion-chambers D′ and D^2, and an exhaust D^3 for carrying off the exhaust motive agent. The initial-pressure chamber D is provided with a valve E, connected with a motive-agent supply, such as steam, and this valve controls the amount of steam passing from the supply into the initial-pressure chamber D.

The initial-pressure chamber D is connected by one or more ports *a* with the peripheral face of the rotary body B, so that the motive agent under initial pressure is directed by the said ports *a* against the impact members B′ to rotate the body B in the direction of the arrow *a*′. The ports *a* are preferably formed in a ring F, forming a lining for the inner face of the cylinder A, as plainly illustrated in Fig. 1. The first expansion-chamber D′ is spaced a distance from the initial-pressure chamber D, and the said expansion-chamber D′ is provided with an inlet-port *b* and an outlet-port *c*, the ports being spaced apart and the port *b* being somewhat larger than the port *a*, but smaller than the outlet-port *c*, both ports *b* and *c* registering with the peripheral face of the rotary body B. The second expansion-chamber D^2 is also provided with ports *d* and *e* in register with the peripheral face of the rotary body B, and the said ports *d* and *e* are spaced apart, the port *d* being somewhat larger than the port *c*, but smaller than the port *e*. The space between the chambers D′ and D^2 is considerably in excess of that between the initial-pressure chamber D and the first expansion-chamber D′, and the space between the second expansion-chamber D^2 and the exhaust D^3 is in excess of the space between the expansion-chambers D′ and D^2.

When the motive agent under initial pressure acts on an impact member and causes a rotation of the rotary body B in the direction of the arrow *a*′, as previously mentioned, then the bucket formed between adjacent impact members is filled with the motive agent and is carried forward, confined in the bucket, during the travel from the initial-pressure chamber D to the beginning of the port *b* for the first expansion-chamber D′. The several buckets are similarly filled as they register with the port *a*, and the said buckets when reaching the port *b* allow the motive agent to pass by way of the said port into the first expansion-chamber D′, in which the motive agent can expand, and the expanded motive agent can pass through the outlet-port *c* into the buckets at an advanced point to give a second impact to the rotary body B. The motive agent delivered to the buckets from the port *c* is confined in the buckets until it reaches the port *d* Then the motive agent passes by way of the said port into the second expansion-chamber D^2, which is of larger dimensions than the first expansion-chamber D′, and hence allows the motive agent again to expand. The

expanded motive agent in the second expansion-chamber D^2 passes by way of the port *e* into the buckets to give a third impact to the rotary body B, the motive agent being confined in the buckets during the passage from the port *e* to the exhaust D^3.

By reference to the drawings it will be seen that the port *a* fills the buckets in succession, while the port *b* is sufficiently large to cover more than one bucket at a time, thus allowing the free passage of the confined motive agent into the chamber D′ for the motive agent to expand therein and be directed forward in the direction of the travel of the body B, to pass by the enlarged port *c* again to the buckets, to act on the same by impact, to assist in rotating the body B in addition to the first impact given the rotary body B by the motive agent under initial pressure by the ports *a* directed against the impact members. The port *d* is larger than the port *c*, so that a number of the buckets can discharge simultaneously into the chamber D^2, which, owing to its increased dimensions, allows a further expansion of the motive agent, the chamber also directing the expanded motive agent forward in the direction of the travel of the body B to direct the expanded motive agent through the port *e* against a large number of impact members at the same time, the buckets finally carrying off the exhaust volume of motive agent to the exhaust D^3.

It is understood that any desired number of expansion-chambers may be arranged in the wall of the cylinder A, the said expansion-chambers being spaced from each other and increased in dimensions in the order above described and shown in Fig. 1. It is further understood that the expansion-chambers D′ and D^2 are so arranged that the motive agent during its forward travel in an expansion-chamber gradually expands and leaves the expansion-chamber D′ or D^2 by way of the port *c* or *e* and under the maximum expansion the motive agent is capable of attaining in this expansion-chamber.

By reference to Fig. 1 it will be seen that the buckets are so arranged that the motive agent can be directed against either side of the bucket to allow of driving the rotary body B either in a forward direction, as indicated by the arrow *a′*, or in the reverse direction, it being understood that for this purpose an additional chamber D is provided and extended in an opposite direction, as indicated in dotted lines in Fig. 1, and additional sets of expansion-chambers D′ and D^2 are provided in the wall of the cylinder A but in the reverse direction to the one previously described. The valve E on being turned directs the motive agent to the additional chamber D and cuts it off from the original chamber, so that the body B now rotates in the reverse direction. The result described may be accomplished in different ways. For instance, as shown in Fig. 2, the valve E′, connected with the motive-agent supply, is provided with a nozzle E^2, adapted to be moved in register with either of the ports *f* or *f′*, extending in opposite directions, so as to direct the motive agent to either side of the buckets B′ to rotate the rotary body B either in the direction of the arrow *a′* or in the reverse direction thereto. The ports *f* and *f′* are formed in the lining F, the same as the ports *a*.

In the modified form shown in Fig. 3 the valve E^3 is provided with a nozzle E^4, having extension-flanges E^5 and E^6, of which the flange E^5 is adapted to close the port *g′* while the nozzle E^4 is in register with the port *g*, and when the valve E^3 is turned to swing the nozzle E^4 in register with the port *g′* then the flange E^6 closes the port *g*. If desired, the valve E^3 may be turned in such a manner that the nozzle E^4 is in partial register with the port *g*, and the flange E^5 slightly opens the port *g′* to allow a portion of the motive agent, which passes by way of the nozzle E^4 into the initial-pressure chamber D^4, to pass from the latter through the port *g′* into a preceding bucket, with a view to retard the forward movement of the body B. This action is sometimes desirable, especially when starting the turbine or when reversing the same.

As indicated in the drawings, the terminals of the impact members B′ are spaced a distance from the inner surface of the lining F, so as to provide an annular space between the peripheral face of the body B and the inner surface of the said lining, and this space is filled with the motive agent and practically forms a compensating space, which is reduced on the expansion of the body B and increased on the contraction thereof. Thus when the engine is rotating and the body B is expanded by the heat of the motive agent it is evident that this annular space is very much reduced, and as it is filled with the motive agent an undue condensation of the motive agent, if such is steam, is not liable to take place in the buckets, and hence the steam retains its force to the fullest extent. It will also be noticed that by having the annular space referred to any water of condensation is free to follow the space to its lowest point—that is, to drain into the exhaust D^3.

In order to permit the use of a number of gradually-increasing expansion-chambers on a cylinder of comparatively small diameter, it may be found advisable to arrange the expansion-chambers in a spiral line around the cylinder.

Although I have shown and described a preferred form of my invention, I do not limit myself to the construction illustrated, as the turbine may be varied in form, style, and size without deviating from my invention.

If desired, the lining F may be shifted to act

as a cut-off valve at the several chambers. For this purpose the lining F (see Figs. 4 and 5) is preferably provided with sets of gear-teeth F′ in mesh with segmental gear-wheels G, mounted to turn loosely on the hub E^7 of the valve E^8, similar to the nozzle-valve E^3, above referred to and shown in Fig. 3. The hubs G′ of the segmental gear-wheels G are provided with gear-teeth G^2 in mesh with pinions G^3, secured on a transverse shaft G^4, journaled in suitable bearings in the sides of the chamber D^5, and the said shaft is under the control of the operator to allow the latter to turn the shaft G^4, the pinions G^3, and the segmental gear-wheels G with a view to shift the lining F for the latter to form the cut-off valve referred to. In order to allow the proper working of the lining F as a cut-off valve, it is desirable to interpose a port-block H between the lining and the segmental end E^9 of the nozzle-valve E^8, the opposite sides of the block being concave to fit the flange E^9 and the peripheral face of the lining to prevent the port-block from shifting when turning either the valve E^8 or the lining F.

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

1. An expansion-turbine comprising a cylinder, a rotary body in the said cylinder and provided with peripheral impact members for the motive agent to act on by impact, and a plurality of motive-agent chambers, of which the first is an initial-pressure chamber and the following one is an expansion-chamber, the chambers being spaced apart and the said initial-pressure chamber having an opening for directing the motive agent under initial pressure against the said impact members, and the said expansion-chamber having an inlet and an outlet spaced from the said inlet, both the inlet and the outlet registering with the said impact members, the said inlet registering with an area of impact surface less than that of the said outlet.

2. An expansion-turbine comprising a cylinder, a rotary body in the said cylinder, provided with peripheral impact members for the motive agent to act on by impact, and a plurality of motive-agent chambers, of which the first is an initial-pressure chamber and the following one is an expansion-chamber, the chambers being spaced apart and the said initial-pressure chamber having an opening for directing the motive agent under initial pressure against the said impact members, and the said expansion-chamber having an inlet and an outlet spaced from the said inlet, both the inlet and the outlet registering with the said impact members, for the inlet to receive the motive agent from the buckets and the outlet to direct the expanded motive agent against the said impact members, in the direction of the travel of the said rotary body the said inlet registering with an area of impact surface less than that of the said outlet.

3. An expansion-turbine comprising a cylinder, a rotary body in the said cylinder, provided with peripheral impact members for the motive agent to act on by impact, and a plurality of motive-agent chambers, of which the first is an initial-pressure chamber and the following one is an expansion-chamber, the chambers being spaced apart and the said initial-pressure chamber having an opening for directing the motive agent under initial pressure against the said impact members, and the said expansion-chamber having an inlet and an outlet spaced from the said inlet, both the inlet and the outlet registering with the said impact members, for the inlet to receive the motive agent from the buckets and the outlet to direct the expanded motive agent against the said impact members, in the direction of the travel of the said rotary body, the said inlet registering with an area of impact surface in excess of that of the said opening and less than that of the said outlet.

4. An expansion-turbine comprising a cylinder, a rotary piston within the cylinder and provided with peripheral buckets, means for conducting the motive agent under initial pressure against the buckets, for impact action, and means for receiving the motive agent from the buckets and redirecting it under maximum expansion against the buckets for another impact action, the said receiving means registering with an area of buckets less than that of the redirecting means.

5. An expansion-turbine comprising a cylinder, a rotary body in the said cylinder, provided with peripheral impact members for the motive agent to act on by impact, an initial-pressure chamber having means for directing the motive agent under initial pressure against the said members in succession, and an expansion-chamber having an inlet and an outlet in register with the impact members at points spaced apart in the direction of the travel of the said body, the inlet being spaced from the said means, also in the direction of the travel of the said body, the inlet extending over a larger area of impact-member surface than the said means and the outlet extending over a larger impact-member surface than the said inlet.

6. An expansion-turbine comprising a cylinder, a rotary body within the said cylinder, provided with impact members, inlet means for conducting the motive agent against the said impact members, for impact action, and means, spaced from and independent of the said inlet means, for taking off the motive agent from the said impact members, expanding it and redirecting it against the said impact members under maximum expansion for a second impact action, the said taking-off means reg-

istering with a smaller area of the impact members than that of the said redirecting means.

7. An expansion-turbine comprising a cylinder, a rotary body within the said cylinder, provided with impact members, initial inlet means for conducting the motive agent under initial pressure against the said impact members, taking-off means spaced from and independent of the said initial inlet means, for taking the motive agent expansively off the impact members, expansion means connected with the said taking-off means for receiving the motive agent therefrom and allowing it to expand and travel separate from and in the direction of the rotation of the said body, and redirecting means connected with the said expansion means, for redirecting the motive agent under its maximum expansion to the said impact members for another impact.

8. An expansion-turbine comprising a rotary body provided with impact members for the motive agent to act on by impact, a cylinder in which rotates the said body and having a motive-agent-entrance opening for directing the motive agent to the impact members, to drive the said rotary body by impact, and an expansion-chamber spaced from the said opening, in the direction of the travel of the said rotary body, the said chamber having an inlet for allowing the motive agent to pass from the said impact members into the said expansion-chamber, to expand therein, the said chamber having an outlet spaced from the said inlet in the direction of the travel of the said body and in register with the said impact members, the outlet being arranged to direct the expanded motive agent against the said impact members in the direction of the travel of the said rotary body, to give a supplemental impact thereto, the area of the outlet being in excess of that of the said inlet and the area of the said inlet being in excess of the said opening.

9. An expansion-turbine comprising a cylinder, a rotary body within the said cylinder, provided with impact members, initial inlet means for conducting the motive agent under initial pressure against the said impact members, taking-off means spaced from and independent of the said initial inlet means, for taking the motive agent expansively off the impact members, expansion means connected with the said taking-off means for receiving the motive agent therefrom and allowing it to expand and travel separate from and in the direction of the rotation of the said body, and redirecting means connected with the said expansion means, for redirecting the motive agent under its maximum expansion to the said impact members for another impact, the said taking-off means registering with a smaller area of the impact members than that of the said redirecting means.

10. An expansion-turbine comprising a rotary body provided with impact members for the motive agent to act on by impact, a cylinder in which rotates the said body and having a motive-agent-entrance opening for directing the motive agent to the impact members, to drive the said rotary body by impact, a cylinder in which rotates the said body and having a motive-agent-entrance opening for directing the motive agent to the impact members, to drive the said rotary body by impact, an expansion-chamber spaced from the said opening, in the direction of the travel of the said rotary body, the said chamber having an inlet for allowing the motive agent to pass from the said impact members into the said expansion-chamber, to expand therein, the said chamber having an outlet spaced from the said inlet in the direction of the travel of the said body and in register with the said impact members, the outlet being arranged to direct the expanded motive agent against the said impact members in the direction of the travel of the said rotary body, to give a supplemental impact thereto, and a second expansion-chamber spaced from the said first-named expansion-chamber in the direction of the travel of the said rotary body, the said second expansion-chamber having an inlet and an outlet spaced apart and registering with the said impact members, the said second expansion-chamber being of larger dimensions than the first-named expansion-chamber.

11. An expansion-turbine comprising a rotary body provided with impact members for the motive agent to act on by impact, a cylinder in which rotates the said body and having a motive-agent-entrance opening for directing the motive agent to the impact members, to drive the said rotary body by impact, an expansion-chamber spaced from the said opening, in the direction of the travel of the said rotary body, the said chamber having an inlet for allowing the motive agent to pass from the said impact members into the said expansion-chamber, to expand therein, the said chamber having an outlet spaced from the said inlet in the direction of the travel of the said body and in register with the said impact members, the outlet being arranged to direct the expanded motive agent against the said impact members in the direction of the travel of the said rotary body, to give a supplemental impact thereto, and a second expansion-chamber spaced from the said first-named expansion-chamber in the direction of the travel of the said rotary body, the said second expansion-chamber having an inlet and an outlet spaced apart and registering with the said impact members, the said second expansion-chamber being of larger dimensions than the first-named expansion-chamber and the space between the said expansion-chambers being in excess of the space between the said opening and the first expansion-chamber.

12. An expansion-turbine comprising a rotary body provided with impact members for the motive agent to act on by impact, a cylinder in which rotates the said body and having

a motive-agent-entrance opening for directing the motive agent to the impact members, to drive the said rotary body by impact, an expansion-chamber spaced from the said opening, in the direction of the travel of the said rotary body, the said chamber having an inlet for allowing the motive agent to pass from the said impact members into the said expansion-chamber, to expand therein, the said chamber having an outlet spaced from the said inlet in the direction of the travel of the said body and in register with the said impact members, the outlet being arranged to direct the expanded motive agent against the said impact members in the direction of the travel of the said rotary body, to give a supplemental impact thereto, and a second expansion-chamber spaced from the said first-named expansion-chamber in the direction of the travel of the said rotary body, the said second expansion-chamber having an inlet and an outlet spaced apart and registering with the said impact members, the inlet of the first expansion-chamber being less in area than that of the inlet of the second expansion-chamber.

13. An expansion-turbine comprising a rotary body provided with impact members for the motive agent to act on by impact, a cylinder in which rotates the said body and having a motive-agent-entrance opening for directing the motive agent to the impact members, to drive the said rotary body by impact, an expansion-chamber spaced from the said opening, in the direction of the travel of the said rotary body, the said chamber having an inlet for allowing the motive agent to pass from the said impact members into the said expansion-chamber, to expand therein, the said chamber having an outlet spaced from the said inlet in the direction of the travel of the said body and in register with the said impact members, the outlet being arranged to direct the expanded motive agent against the said impact members in the direction of the travel of the said rotary body, to give a supplemental impact thereto, and a second expansion-chamber spaced from the said first-named expansion-chamber in the direction of the travel of the said rotary body, the said second expansion-chamber having an inlet and an outlet spaced apart and registering with the said impact members, the inlet of the first expansion-chamber being less in area than that of the inlet of the second expansion-chamber, and the outlet of the said first expansion-chamber being in excess of the inlet of the first expansion-chamber and less than the inlet of the second expansion-chamber, and the outlet of the second expansion-chamber being in excess of the inlet of the second expansion-chamber.

14. An expansion-turbine comprising a rotary body provided with impact members for the motive agent to act on by impact, a cylinder in which rotates the said body and having a motive-agent-entrance opening for directing the motive agent to the impact members, to drive the said rotary body by impact, an expansion-chamber spaced from the said opening, in the direction of the travel of the said rotary body, the said chamber having an inlet for allowing the motive agent to pass from the said impact members into the said expansion-chamber, to expand therein, the said chamber having an outlet spaced from the said inlet in the direction of the travel of the said body and in register with the said impact members, the outlet being arranged to direct the expanded motive agent against the said impact members in the direction of the travel of the said rotary body, to give a supplemental impact thereto, and a second expansion-chamber spaced from the said first-named expansion-chamber in the direction of the travel of the said rotary body, the said second expansion-chamber having an inlet and an outlet spaced apart and registering with the said impact members, the inlet of the first expansion-chamber being less in area than that of the inlet of the second expansion-chamber, and the outlet of the said first expansion-chamber being in excess of the inlet of the first expansion-chamber and less than the inlet of the second expansion-chamber, and the outlet of the second expansion-chamber being in excess of the inlet of the second expansion-chamber.

15. An expansion-turbine comprising a rotary body provided with impact members for the motive agent to act on by impact, a cylinder in which rotates the said body and having a motive-agent-entrance opening for directing the motive agent to the impact members, to drive the said rotary body by impact, an expansion-chamber spaced from the said opening, in the direction of the travel of the said rotary body, the said chamber having an inlet for allowing the motive agent to pass from the said impact members into the said expansion-chamber, to expand therein, the said chamber having an outlet spaced from the said inlet in the direction of the travel of the said body and in register with the said impact members, the outlet being arranged to direct the expanded motive agent against the said impact members in the direction of the travel of the said rotary body, to give a supplemental impact thereto, and a second expansion-chamber spaced from the said first-named expansion-chamber in the direction of the travel of the said rotary body, the said second expansion-chamber having an inlet and an outlet spaced apart and registering with the said impact members, the inlet of the first expansion-chamber being less in area than that of the inlet of the second expansion-chamber, and the outlet of the said first expansion-chamber being in excess of the inlet of the first expansion-chamber and less than the inlet of the second expansion-chamber, and the outlet of the second expansion-chamber being in excess of the inlet of the second expansion-chamber,

and the space between the said expansion-chambers being in excess of that between the said opening and the first-named expansion-chamber.

16. An expansion-turbine comprising a rotary body provided with impact members for the motive agent to act on by impact, a cylinder in which rotates the said body and having a motive-agent-entrance opening for directing the motive agent to the impact members, to drive the said rotary body by impact, an expansion-chamber spaced from the said opening, in the direction of the travel of the said rotary body, the said chamber having an inlet for allowing the motive agent to pass from the said impact members into the said expansion-chamber, to expand therein, the said chamber having an outlet spaced from the said inlet in the direction of the travel of the said body and in register with the said impact members, the outlet being arranged to direct the expanded motive agent against the said impact members in the direction of the travel of the said rotary body, to give a supplemental impact thereto, a second expansion-chamber spaced from the said first-named expansion-chamber in the direction of the travel of the said rotary body, the said second expansion-chamber having an inlet and an outlet spaced apart and registering with the said impact members, the inlet of the first expansion-chamber being less in area than that of the inlet of the second expansion-chamber, and the outlet of the said first expansion-chamber being in excess of the inlet of the first expansion-chamber and less than the inlet of the second expansion-chamber, and the outlet of the second expansion-chamber being in excess of the inlet of the second expansion-chamber, and the space between the said expansion-chambers being in excess of that between the said opening and the first-named expansion-chamber, and an exhaust in the said cylinder, in register with a number of the said impact members and located intermediate the said second expansion-chamber and the said opening for the entrance of the motive agent.

17. An expansion-turbine comprising a cylinder, a rotary body within the said cylinder, provided with impact members, initial inlet means for conducting the motive agent under initial pressure against the said impact members, taking-off means spaced from and independent of the said initial inlet means, for taking the motive agent expansively off the impact members, expansion means connected with the said taking-off means for receiving the motive agent therefrom and allowing it to expand and travel separate from and in the direction of the rotation of the said body, and redirecting means connected with the said expansion means, for redirecting the motive agent under its maximum expansion to the said impact members for another impact, the said taking-off means registering with a smaller area of the impact members than that of the said redirecting means and the said taking-off means registering with a larger area of impact members than that of the said initial inlet means.

18. An expansion-turbine comprising a cylinder having spaced recesses and an annular interior lining forming with the said recesses an initial pressure-chamber, a series of expansion-chambers of increasing dimensions, the said lining having a port opening into the said initial pressure-chamber and sets of ports, one set for each expansion-chamber, to form an inlet and an outlet for the same, the sets of ports of succeeding expansion-chambers increasing in size, and a rotary body revolving within the said lining and having peripheral impact members in register with the said ports.

19. An expansion-turbine comprising a cylinder having spaced recesses and an annular interior lining forming with the said recesses an initial pressure-chamber and an expansion-chamber, the said lining having ports communicating with the said chambers, the said lining being movable to form a cut-off valve, and a rotary body revolving within the said lining and having peripheral impact members in register with the said ports.

20. An expansion-turbine comprising a rotary body having peripheral impact members, a cylinder in which rotates the said body, a single initial pressure-chamber connected with a motive agent and connected by ports with the said impact members, the ports extending in opposite directions to direct the motive agent in a forward or backward direction against the said impact members, the said cylinder having a series of gradually-increasing expansion-chambers, each taking the motive agent from the impact members, allowing it to expand and redirecting it under maximum expansion against the said impact members, and a single valve controlling said ports, to direct the motive agent to either of the said ports.

21. An expansion-turbine comprising a rotary body having peripheral impact members, a cylinder in which rotates the said body, an initial pressure-chamber connected with a motive-agent supply and connected by ports with the said impact members, the ports extending in opposite directions to direct the motive agent in a forward or backward direction against the said impact members, and a valve controlling the said ports to direct the motive agent to both ports simultaneously.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

MAXIMILIAN NEUMAYER.

Witnesses:
THEO. G. HOSTER,
EVERARD BOLTON MARSHALL.