No. 764,817. PATENTED JULY 12, 1904.

D. McARTHUR.

TURBINE.

APPLICATION FILED SEPT. 15, 1903.

NO MODEL. 4 SHEETS—SHEET 1.

Fig. 2

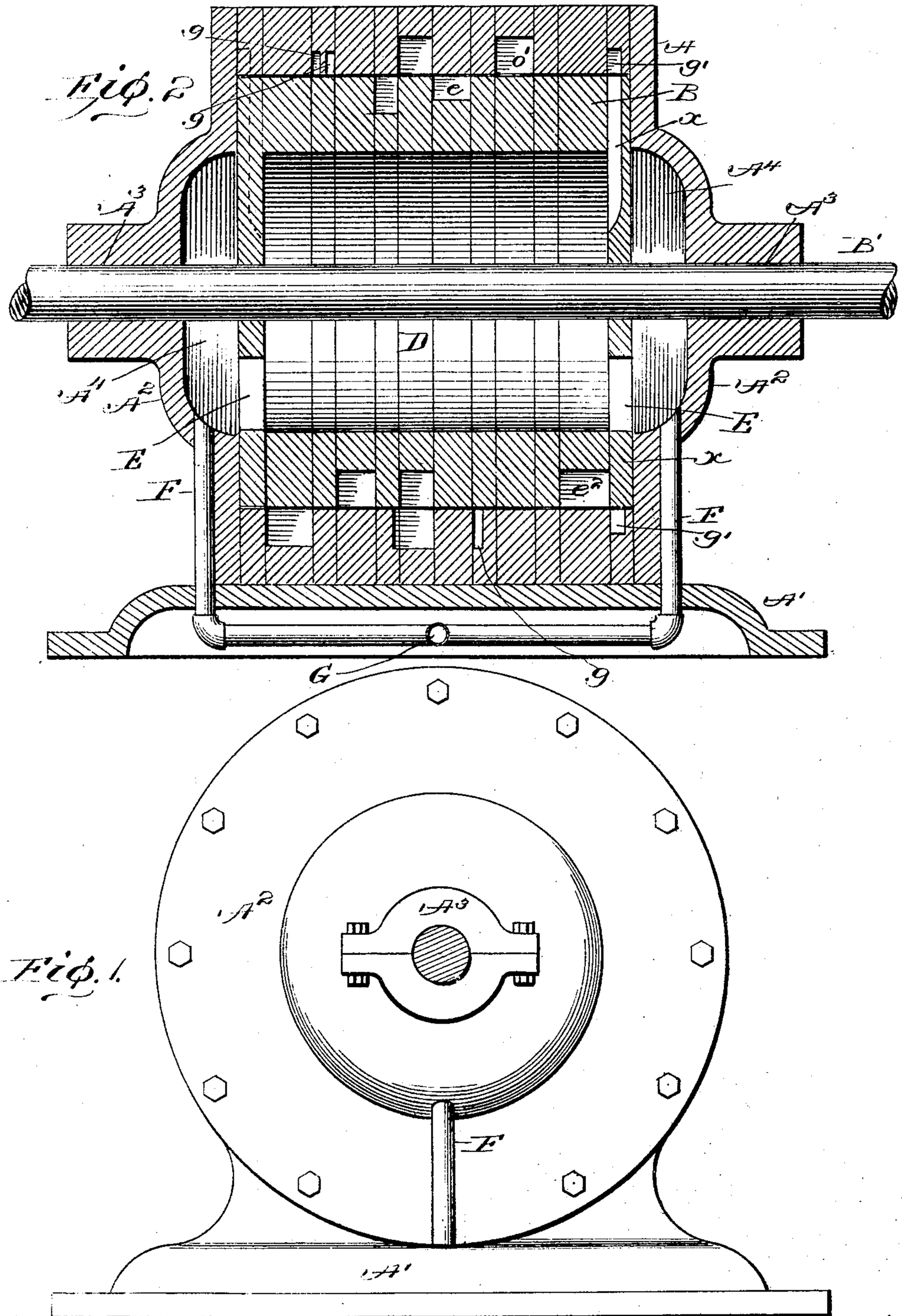

Fig. 1.

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NO MODEL. 4 SHEETS—SHEET 2.

Fig. 3.

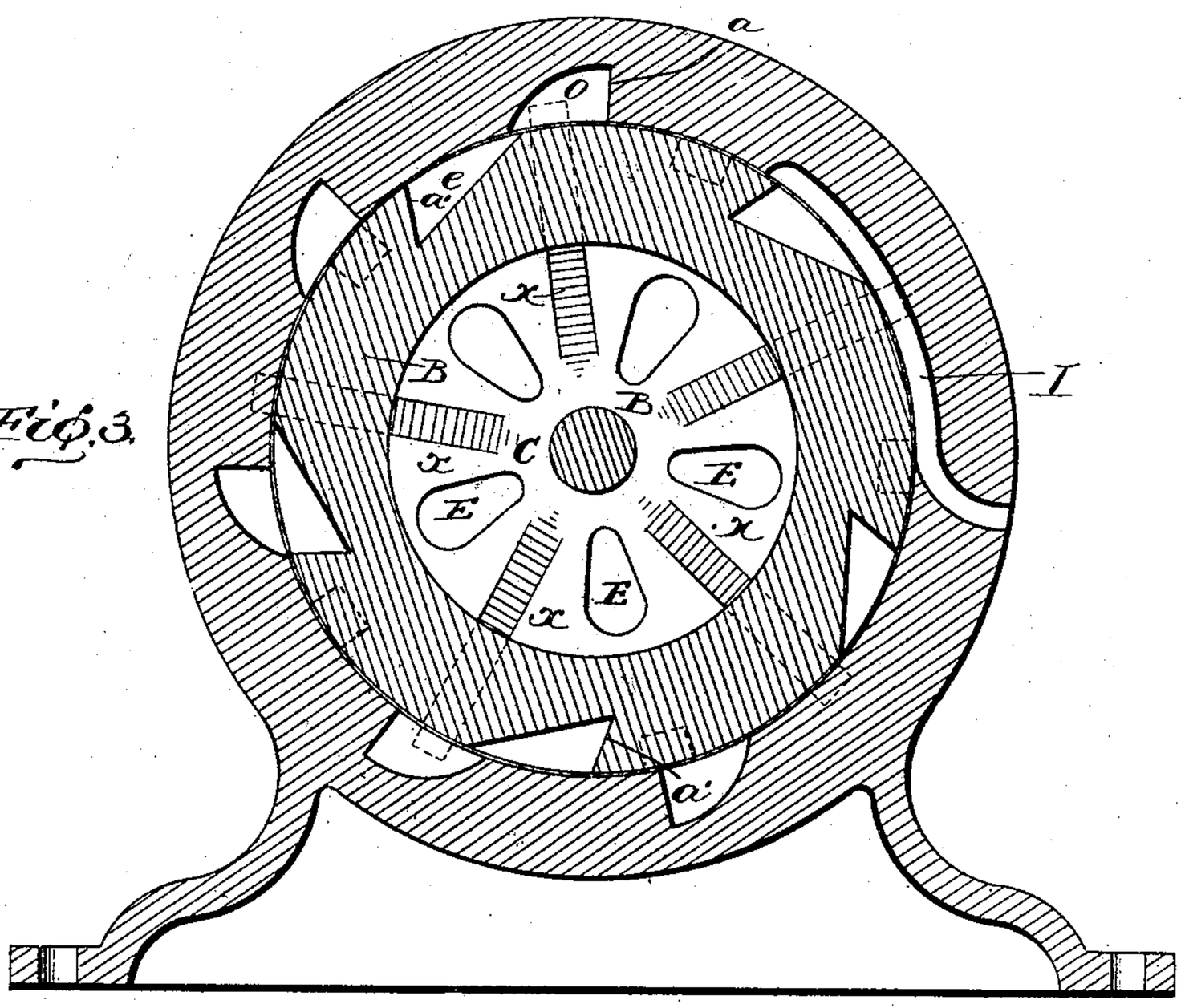


Fig. 7.

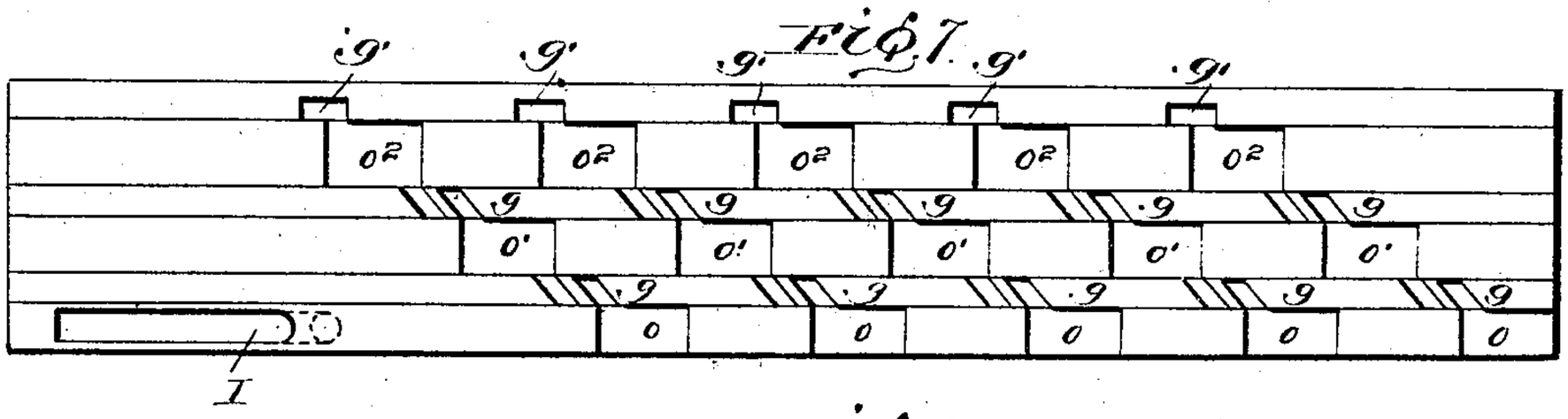
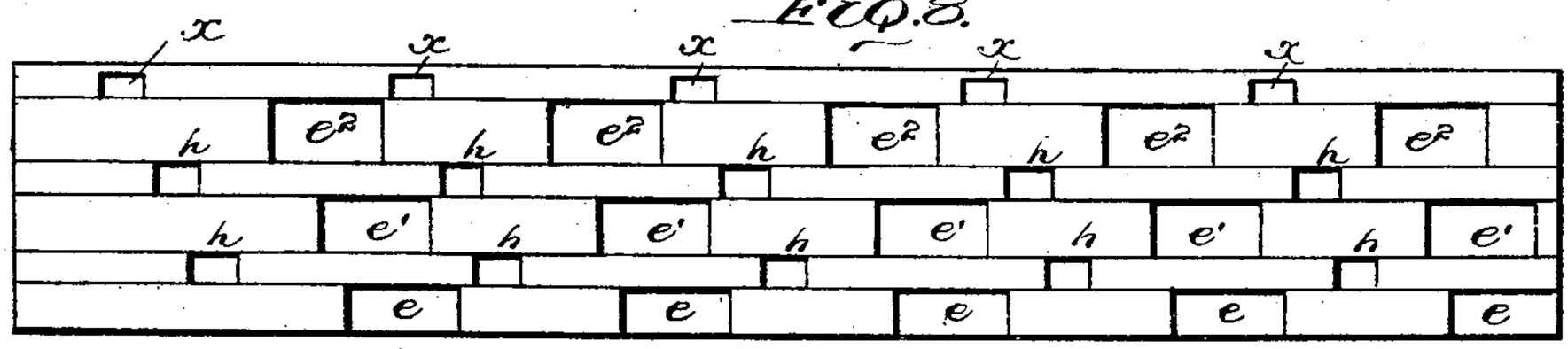


Fig. 8.



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NO MODEL. 4 SHEETS—SHEET 3.

Fig. 4.

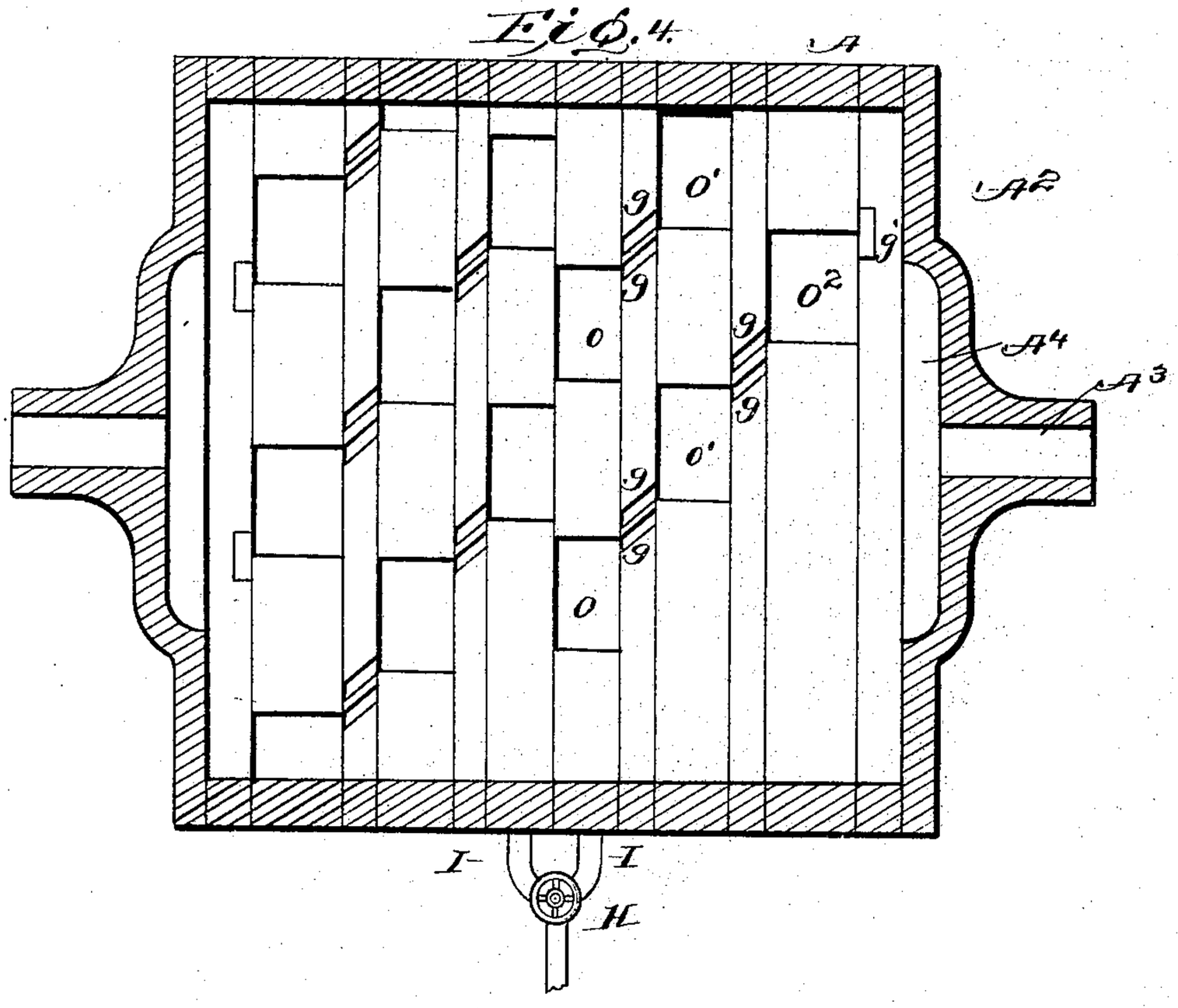
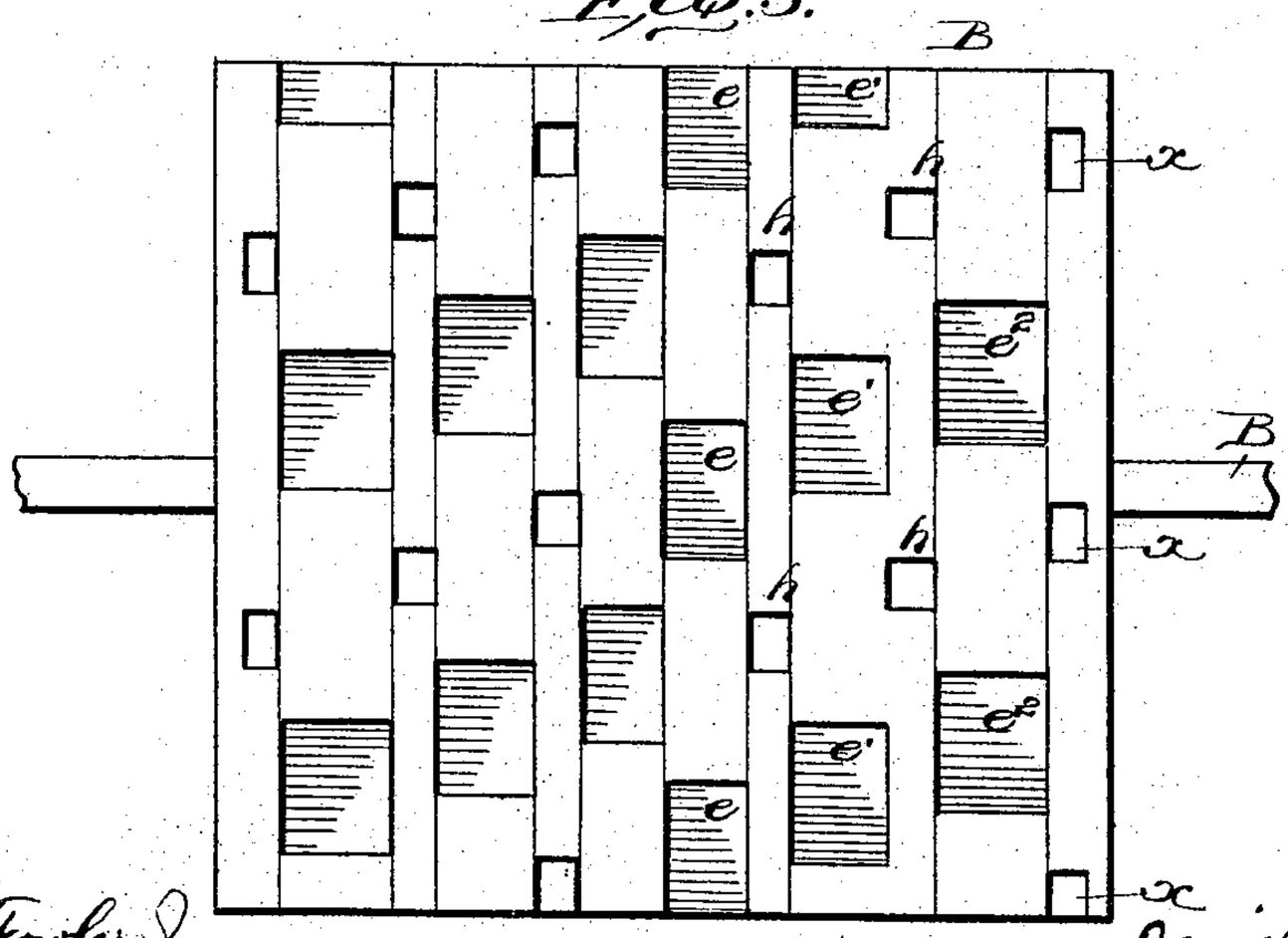


Fig. 5.



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NO MODEL. 4 SHEETS—SHEET 4.

Fig. 6

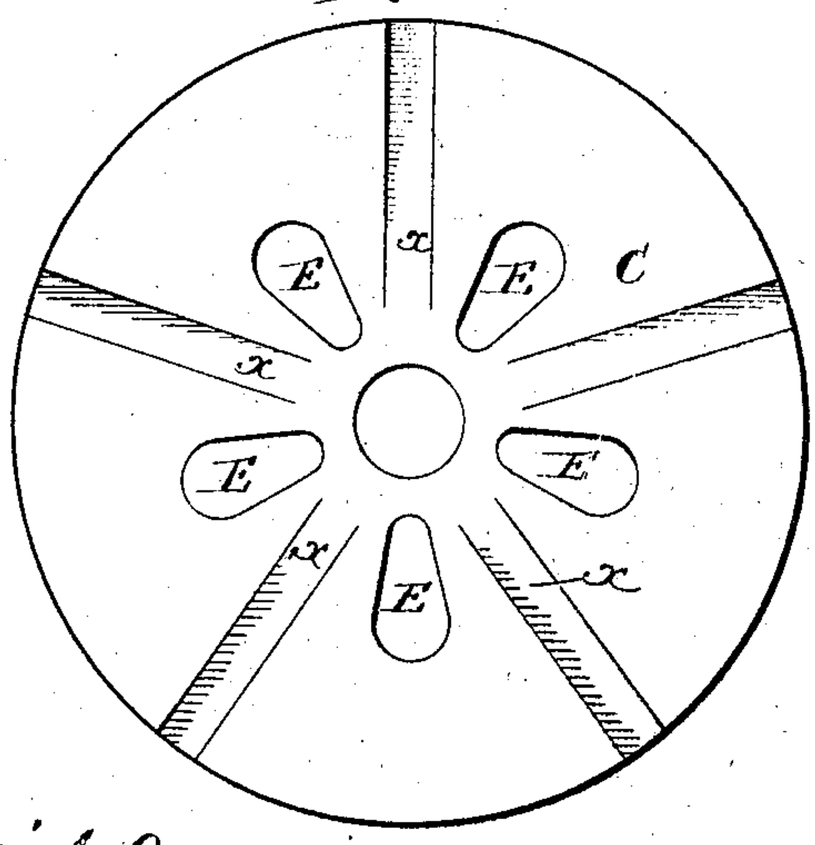


Fig. 9.

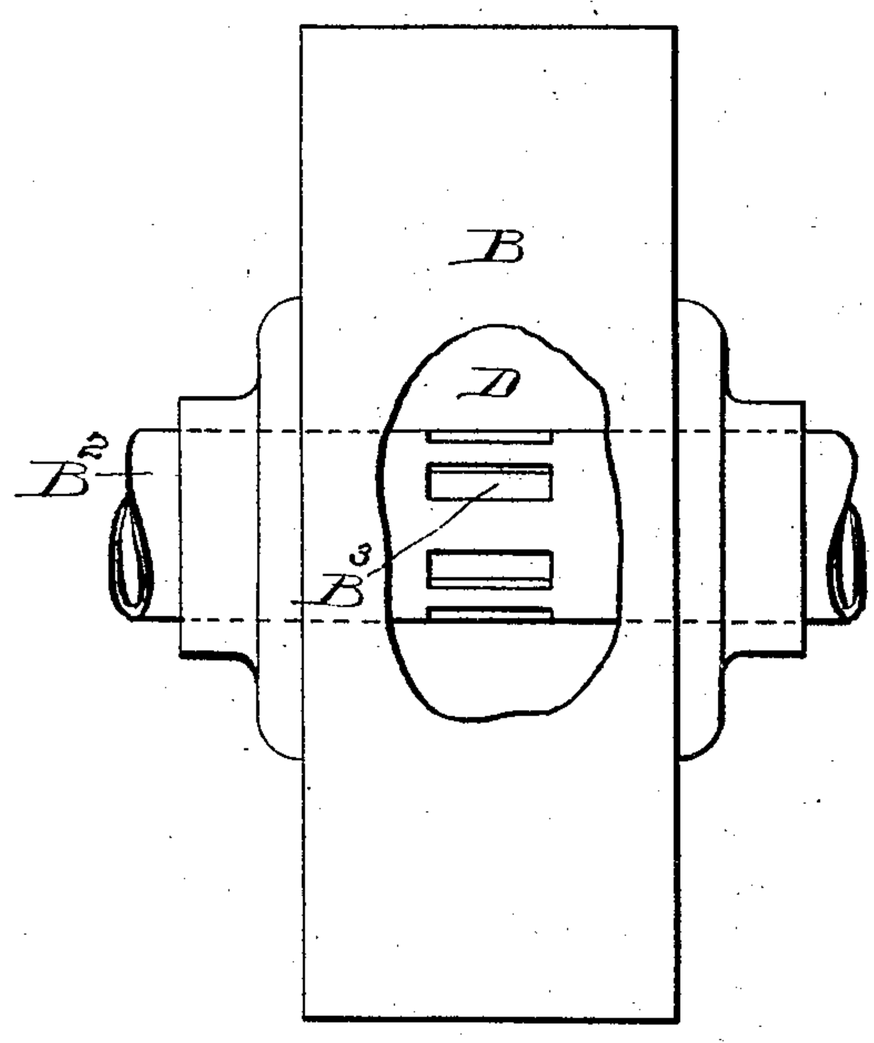
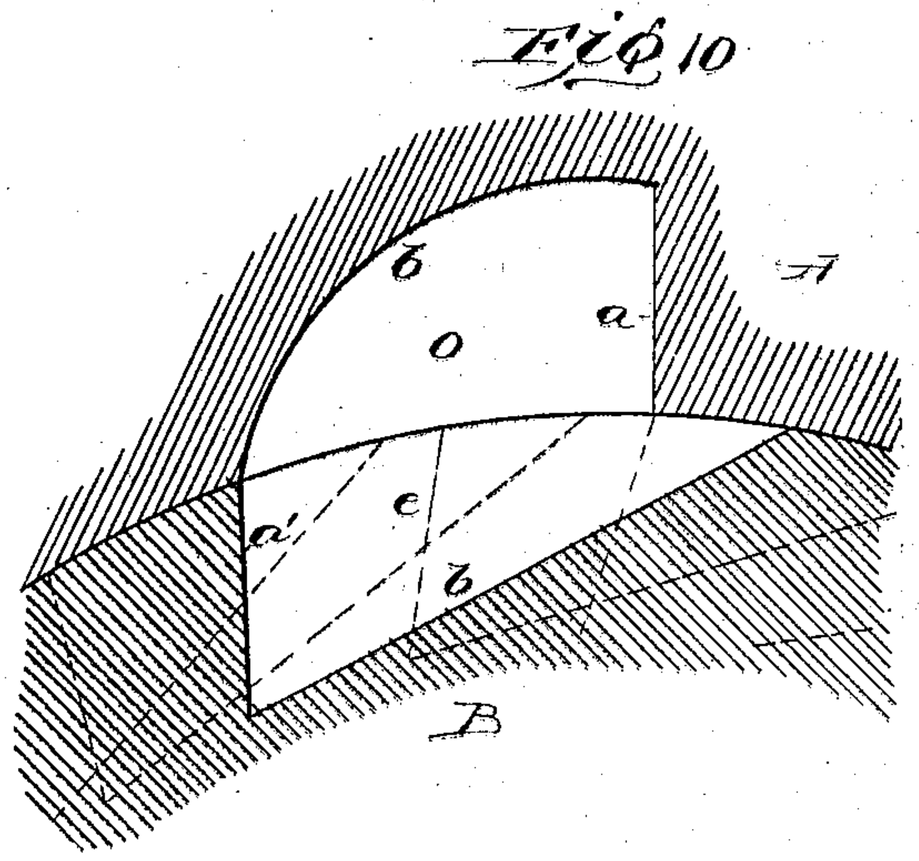


Fig. 10



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No. 764,817. Patented July 12, 1904.

UNITED STATES PATENT OFFICE.

DANIEL McARTHUR, OF JERSEY CITY, NEW JERSEY.

TURBINE.

SPECIFICATION forming part of Letters Patent No. 764,817, dated July 12, 1904.

Application filed September 15, 1903. Serial No. 173,270. (No model.)

To all whom it may concern:

Be it known that I, DANIEL McARTHUR, a citizen of the United States, residing at Jersey City, in the county of Hudson, State of New Jersey, have invented certain new and useful Improvements in Turbine-Motors; and I hereby declare the following to be a full, clear, and exact description of the same, reference being had to the accompanying drawings, in which—

Figure 1 is an end elevation of a turbine-motor embodying my invention. Fig. 2 is a vertical longitudinal sectional view of the same. Fig. 3 is a vertical transverse section of the motor. Fig. 4 is an inside view of the upper half of the shell or casing. Fig. 5 is a view in elevation of the inner cylinder or rotary member of the motor. Fig. 6 is an inner view of the head of the inner cylinder or rotary member of the motor, showing the exhaust passages and outlets. Fig. 7 is a diagram of the expansion-pockets on the interior of the shell or casing. Fig. 8 is a diagram of the expansion and bleeding pockets in the periphery of the inner cylinder or rotary member of the motor and the exhaust-passages leading to the center of the rotary member. Fig. 9 is a view of a modification of the rotary member, parts broken away, showing the central exhaust-passages communicating with the hollow shaft of the rotary member. Fig. 10 is an enlarged sectional view of portions of the casing or shell and the rotary member, showing the expansion-pockets thereof in apposition, the leading-face or abutment of the pocket of the rotary member being at an acute angle to the radius of the rotary member.

Like symbols refer to like parts wherever they occur.

My invention relates to the construction of turbine-motors or rotary engines of the compound type adapted for locomotive, marine, or stationary service and for the utilization of motive fluid derived from steam, gas, compressed air, gasolene, or equivalent source.

The several objects I have in view in my present invention include, first, simplicity and cheapness of construction; second, such an admission of the motive fluid as will avoid side thrust and secure the maximum leverage; third, such a construction of the expansion-pockets of the rotary member as will utilize the maximum working force of the motive fluid; fourth, such a relative arrangement of the expansion-pockets of the casing and rotary member and the bleeding-pockets that a full expansion of the motive fluid in any given pocket takes place before bleeding occurs; fifth, such a relative arrangement of the expansion-pockets of the successive series as will in compounding utilize substantially the full equivalent of the force units of the motive, fluid, and, sixth, such a relative arrangement of the expansion-pockets in the rotary member of a reversing-motor as will effectively balance said member.

In carrying out my invention I form the expansion-pockets of the rotary member with abutments or leading-faces at an acute angle to the radius of said member, whereby the pockets are prevented from spilling when opening upon a casing-pocket and the liability of separation of the casing and periphery of the rotary member is minimized, and such a construction embodies one feature of my invention.

I arrange the expansion-pockets and bleeding-pockets of the rotary member and the expansion-pockets of the casing or shell at such intervals that the bleeding-pockets of the rotary member will not register with the expansion-pockets of the casing or shell until full expansion has taken place and the shell or casing pockets are bled in advance of the charge of higher pressure approaching in the expansion-pockets of the rotary member, and such a construction embodies a second feature of my invention.

In conjunction with the relative arrangement of the expansion-pockets and bleeding-pockets of the rotary member and the expansion-pockets of the casing or shell last noted I introduce the motive fluid at the center of the motor and prolong the motive-fluid inlet, so as to insure that a second or following pocket of the rotary member shall open on the motive-fluid inlet before the first or leading

pocket has passed said inlet, whereby dead-centers are avoided, and such a construction embodies a third feature of my invention.

In order to prolong the expansion and tranfer periods of the motive fluid and increase the efficiency of the motor, I incline the tranfer-ears of the casing-pockets of the successive series, whereby the expansion takes place around as well as across the motor, and such a construction embodies a fourth feature of my invention.

The pockets of the successive series in a compounding motor being arranged staggering or the pockets of the succeeding series in advance of those of the preceding series in order to obtain a reversing-motor which shall be perfectly balanced, I arrange the pockets of the rotary member on one side of said motor alternating with those of the other side, or, in other words, the expansion-pockets of one side opposite the space occupied by the bleeding-pockets of the other side, and such a construction embodies a fifth feature of my invention.

In order to secure a free exhaust with compactness and simplicity of construction, I employ an exhaust-passage which extends tthrough and delivers centrally of the motor, and such a construction embodies a sixth feature of my invention.

There are other minor features of invention, all as will hereinafter more fully appear.

The motor shown in the drawings and chosen for purposes of illustration only is a reversible triple-expansion motor embodying my invention, the series of pockets on each side of the transverse center being three in number, the abutments of the pockets being reversely arranged on the opposite sides of the transverse center of the motor, or, in other words, the drawings illustrate two like motors with reverse abutments coupled side by side on a single shaft. While in the drawings the number of pockets in a series has been limited to five (in the casing and on the rotary member) and the number of the series to three, it is to be understood that any feasible number of pockets may be included in one series and any feasible number of series may be embodied in the motor without departing from the spirit and scope of my invention. Further, for purposes of illustration the casing or shell and the rotary member (or wheel) have been shown as constructed of transverse sections or rings and disks, which will probably be the most desirable construction for small motors; but no limitation thereto is intended, as the shell or casing and the rotary member (or wheel) may be integral or single castings, where such a construction is deemed more desirable, and, further, while in the illustration the outer member or casing is fixed and the inner member is the rotary member, yet the reverse construction may be adopted by simply transposing the transfer-ears and bleeding-pockets, as will be apparent to one skilled in the art.

With the foregoing explanation it will be unnecessary hereinafter to describe more than one half of the reversible motor of the illustration, it being understood that the description applies equally to the other half, excepting that the abutments of the pockets are reversed, and the pockets of one side staggered with the pockets of the other side for purposes which will hereinafter appear.

I will now proceed to describe my invention more fully, so that others skilled in the art to which it appertains may apply the same.

In the drawings, A indicates the outer member, casing, or shell, which may be composed of a series of transverse sections or rings or may be cast integral, if preferred, said casing having a base A′, by which it may be secured to a suitable bed, and heads A^2, bolted or otherwise secured to the shell A and provided with bearings A^3 for the shaft B′ of the rotary member B of the motor.

B indicates the inner member or rotary member of the motor, preferably in the form of a hollow cylinder supported from and connected to the shaft B′ by spiders or perforated heads C (see Figs. 3 and 6) in order to secure an ample central exhaust-chamber D and exhaust-ports E, which latter open into the head-chambers A^4, whence lateral exhaust-pipes F F lead to the final exhaust-pipe G. In lieu of the perforated heads C of the rotary member *b* the rotary member may have a hollow shaft B^2 (see Fig. 9) with exhaust-ports B^3 leading thereinto from the hollow center D of the rotary member. The rotary member B may be made up of sections or disks, as indicated in the drawings, or may be cast in a single piece, as preferred.

At suitable intervals in the periphery of rotary member B are expansion-pockets *e e′* e^2, and in corresponding planes in the interior of the casing A are coacting expansion-pockets *o o′* o^2 for the reception of the motive fluid, (see Figs. 4 and 5,) said motive fluid being admitted centrally of the motor through the inlet-port I of the shell or casing A, which inlet-port is controlled by a suitable throttle-valve H for cutting off the motive fluid or for directing the motive fluid to one or the other division of the reversible motor in reversing. These pockets have the same general form in both the casing and the rotary member, (see Figs. 3 and 10,) inasmuch as both sets of pockets are of taper form and have an abutment (*a* or *a′*) and curved or inclined bottoms *b*, whereby clogging or back pressure is avoided, but differ in that while the abutment *a* (or rear wall) of the casing-pocket *o* or fixed member may be on substantially a radial line the abutment *a′* (or leading wall) of the pocket *e* of the rotary member B should form an acute angle with a radius of said rotating member,

and this prevents the pocket of the rotary member (or wheel) from spilling out the pressure immediately it opens on a casing or shell pocket. This inclination or pitch of the leading-face or abutment of the pocket in the rotary member also insures a nearer approach to parallism of the abutments a a' of the casing-pocket o and the rotary-member pocket e throughout the entire time said pockets are in apposition and insure greater efficiency in the motor. The casing or shell pockets also differ from those of the rotary member or wheel in being provided with laterally-projecting offsets or ears g, the ears of adjacent pockets of the different series being parallel and overlapping, so that when coupled or connected by the passage of a bleeding-pocket h there occurs a transfer of the motive fluid from a casing-pocket o of one series to the leading adjacent casing-pocket o' of the next series. These offsets g, which I term "transfer-ears," may extend at a right angle to the pockets, if desired; but in order to prolong the period of the travel of the "bleeding-pockets" h across the ears g g I prefer to incline the ears to the pocket, as shown in the drawings. The final series of the exhaust-pockets of the shell or casing A have transfer-ears g', which from time to time register with the exhaust-passages x of the rotary member B, leading to the central exhaust D E, &c.

In the periphery of the rotary member of the motor interposed between the planes of the expansion-pockets thereof and being in the plane of the transfer-ears g g of the casing-pockets o are shallow pockets h, which I term "bleeding-pockets," the number of the bleeding-pockets in a series or row being equal to the number of expansion-pockets in each series of the casing and rotary member, the number of the series being one less than the number of series in the rotary member, the finals x being exhaust-passages which extend centrally through the rotary member B and which from time to time register with the ears g' g' of the final series of pockets in the casing or shell A to conduct the exhaust-vapor to the central chamber D of the rotary member, thence by ports E and exhaust-pipes F G away from the motor.

The pockets of the motor having the several characteristics hereinbefore pointed out, their relative arrangement may be such as indicated on the drawings, (see Figs. 5 and 8)—that is to say, in series or rows from the transverse center of the rotary member toward the ends thereof—the symbol e being used to indicate all the expansion-pockets of the first series of the rotary member or wheel, e' all the pockets of the second series, e^2 all the pockets of the third series thereof, and so on, according to the number of series possessed by the motor, the size of the pockets, the number of pockets in a series, and the number of the series being determined by the size of the motor and the desire of the constructor. The expansion-pockets of the series e e', &c. are staggered, so that the pockets of series e' lead the pockets of series e and those of e^2 lead the pockets of series e', and intermediate of the series of pockets e e' e^2 are a series of bleeding-pockets h, corresponding in number with the expansion-pockets of the rotary member less one series, (the final series,) parallel with which are the openings of the exhaust-passages x. The bleeding-pockets are staggered with relation to each other and also with relation to the expansion-pockets e e', &c.

In case of a reversing-motor (see Fig. 5) the same relative arrangement of expansion-pockets and bleeding-pockets is preserved; but the expansion-pockets on the opposite side of the transverse center (or those of the reverse motor) are opposite the space occupied by the bleeding-pockets of the first-named side, so that the rotary member B will be perfectly balanced.

The expansion-pockets o o' o^2 of the casing or shell A, which correspond in number with the expansion-pockets e e' e^2 of the rotary member or wheel, are likewise arranged in series and in planes corresponding with the pockets in the rotary member, the first row of the series being indicated by the symbol o, the second by the symbol o', the third by the symbol o^2, and so on, according to the number of rows or series, and the pockets o o' o^2 of the successive rows are also staggered or arranged to successively lead from within outward toward the ends of the motor, as in the case of the corresponding pockets e e' e^2 of the rotary member.

The pockets o o, o' o', o^2 o^2 in the several series o o' o^2 of the casing or shell A are arranged somewhat closer together than are those e e, e' e', e^2 e^2 in the rotary member B, (see diagram Figs. 7 and 8,) so that about one-third more or less of the distance around the interior of the casing A is left for an extended motive-fluid inlet I, which will insure the opening of a second pocket e of the rotary member B to the motive fluid before the preceding pocket e has closed, and, further, the increased distance between the pockets e e, e' e', and e^2 e^2 of the rotary member B prevents the expanding-pockets from bleeding each other at any point of the revolution of the rotary member B.

The construction of the motor and the relative arrangement of the expansion-pockets, bleeding-pockets, center inlet, and central exhaust being substantially such as hereinbefore pointed out, the operation of the motor will be as follows: The motive fluid upon entering the inlet I of the casing A at the center thereof passes forward to the first expansion-pocket e of the rotary member B, which is

open on the inlet-channel I. By impact the rotary member B is caused to revolve until this first expansion-pocket *e* covers the first expansion-pocket *o* of the first series in the casing A where expansion takes place, the kinetic energy forcing the rotary member around until the *e* pocket has passed the deep end or abutment *a* of the *o* pocket, serving as a stationary fulcrum from which the expansive force acts on the leading wall or abutment *a'* of the receding pocket *e*. After the *e* pocket of the rotary member has passed the first *o* pocket it carries its reduced pressure forward to the remaining *o* pockets of the first series of the casing A and successively utilizes the remaining pressure in the succeeding pockets of the series. Each *e* pocket of the rotary member B will in succession receive its charge from the motive-fluid-inlet channel I and in its turn traverse the several *o* pockets of the casing, expanding thereinto successively, as before noted. Coincident with the above-noted expansion taking place around the periphery of the rotary member B the bleeding-pockets *h* of the rotary member, at regular intervals and subsequent to the expansion in the *e* and *o* pockets, cross the ears *g* of the casing-pockets *o o'*, transferring the motive fluid from the *o* pockets of the first series of the casing into the *o'* pockets of the second series of the casing, where in connection with the *e'* pockets of the rotary member B expansion takes place in a similar manner as hereinbefore recited as occurring in pockets *e o* of the first series. Similarly the remaining motive fluid is transferred from casing-pockets *o'* to casing-pockets o^2 and expands in casing-pockets o^2 and rotary-member pockets e^2 of the third series of expansion-pockets, the transfer being made, as before, by the conjunction of the second series of bleeding-pockets *h* with the lapping ears *g g* of the pockets *o' o²* of the second and third series of the casing or shell A. This transfer of the motive fluid in the direction of rotation around and across the rotary member B of the motor proceeds continuously and in proportion to the number of pockets in a series and the number of series in the motor, the final series of casing-pockets o^2 exhausting through the ears *g'* into the central exhaust-passages *x*, thence through central exhaust-chamber D, ports E, and exhaust-pipes F and G. The exhaust from casing-pockets o^2 through ears *g* occurs from time to time and as frequently as the exhaust-passages *x* of the rotary member B pass said ears *g'*, which periods may be lengthened or shortened by regulating the number and arrangement of said exhaust-passages *x*.

During the continual expansion and transfer of the motive fluid both forwardly around and transversely across the face of the rotary member B each pocket, whether expansion *e* or bleeding *h*, can only perform its part of the work at precisely the time required. It is impossible to bleed any *o* pocket until after expansion, nor does the rotary member B empty the high pressure it is constantly bringing forward until the casing-pocket has been bled by either a bleeding-pocket *h* or a final exhaust-passage *x*.

In the foregoing description it has been assumed that the motive fluid is to be admitted only to the first series of *e* pockets of the rotary member B. If, however, it is deemed desirable to increase the power with a greater consumption of motive fluid, it can readily be done by admission of the same into the first pocket of every series of the casing-pockets *o o' o²* by an arrangement of motive-fluid inlets, which will at once suggest itself to those skilled in the art, and, further, where the power is to be derived from gasolene by explosion, as is commonly done in automobiles, the same may be effected by attaching sparking means to each pocket of the casing in manner also well understood by those skilled in the art.

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

1. In a rotary engine or turbine-motor of the class specified, the combination of coacting members, one of which is a rotary member, each of said members having two or more series of expansion-pockets, the abutments of the pockets of the rotary member making an oblique angle with a radius of said rotary member, and means whereby the motive fluid is transferred throughout the different series in the direction of rotation, substantially as and for the purposes specified.

2. In a rotary engine or turbine-motor of the class specified, the combination of coacting members, one of which is a rotary member, each of said members provided with a series of pockets arranged on a line oblique to the axis of the rotary member, the abutments of the pockets of the rotary member making an oblique angle with a radius of said rotary member, substantially as and for the purposes specified.

3. In a rotary engine or turbine-motor of the class specified, the combination of coacting members, one of which is a rotary member, one of said members having a series of pockets, said pockets arranged in succession on a line oblique to the axis of the rotary member, and means for transferring the motive fluid from pocket to pocket in the direction of rotation throughout the series, substantially as and for the purposes specified.

4. In a rotary engine or turbine-motor of the class specified, the combination of coacting members, one of which is a rotary member, each of said members provided with a series of pockets arranged on a line oblique

to the axis of the rotary member, and means for transferring the motive fluid in the direction of rotation from one pocket to another of said series of pockets, substantially as and for the purposes specified.

5. In a rotary engine or turbine-motor of the class specified, the combination of a casing and a rotary member, each having pockets, those of the casing arranged in two or more series, the pockets of one series leading the pockets of another series, and means for transferring the motive fluid in the direction of rotation from the pockets of one series to those of another series, substantially as and for the purposes specified.

6. In a rotary engine or turbine-motor of the class specified, the combination of a casing and a rotary member, each provided with two or more series of pockets, the pockets of one series arranged to lead the pockets of another series, and means for transferring the motive fluid in the direction of rotation from one series of casing-pockets to another series of said casing-pockets, substantially as and for the purposes specified.

7. In a rotary engine or turbine-motor of the class specified, the combination of a casing and a rotary member, each provided with expansion-pockets, those of the casing arranged in series and having offsets or transfer-ears, and the rotary member having bleeding-pockets in the plane of the transfer-ears of the casing-pockets, substantially as and for the purposes specified.

8. In a rotary engine or turbine-motor of the class specified, the combination of a casing and a rotary member, each provided with two or more series of pockets, the pockets of the casing having offsets or transfer-ears, and the rotary member having "bleeding-pockets" in the plane of the transfer-ears of the casing-pockets, substantially as and for the purposes specified.

9. In a rotary engine or turbine-motor of the class specified, the combination of coacting members one of which is a rotary member, both of said members provided with expansion-pockets, the expansion-pockets of one of said members arranged in parallel series, and one of said members provided with bleeding-pockets for transferring the motive fluid from the pockets of one series to those of another, substantially as and for the purposes specified.

10. In a rotary engine or turbine-motor of the class specified, the combination of coacting members one of which is a rotary member, both of said members provided with two or more series of expansion-pockets, the pockets of one series arranged to lead those of another series, the pockets of one member having offsets or transfer-ears, and one member having bleeding-pockets in the plane of the offsets or transfer-ears of the pockets on the other member, substantially as and for the purposes specified.

11. In a rotary engine or turbine-motor of the class specified, the combination of coacting members, one of which is a rotary member, both of said members provided with expansion-pockets, the pockets of one member arranged in series and provided with offsets or transfer-ears, and the other member provided with bleeding-pockets in the plane of the transfer-ears of the first-named member, substantially as and for the purpose specified.

12. In a rotary engine or turbine-motor of the class specified, the combination of coacting members, one of which is a rotary member, both of which are provided with expansion-pockets, the pockets of one member having inclined transfer-ears, and the other of said members having bleeding-pockets arranged in the plane of the transfer-ears of the pockets of the first-named member, substantially as and for the purposes specified.

13. In a rotary engine or turbine-motor of the class specified, the combination of coacting members, one of which is a rotary member, each of said members having a plurality of expansion-pockets, the pockets of each member arranged in a different plane, one pocket in advance of or leading another, and means on one of the members for transferring the motive fluid in the direction of rotation from one pocket to another across and around the motor, substantially as and for the purposes specified.

14. In a rotary engine or turbine-motor of the class specified, the combination of coacting members, one of said members provided with pockets having transfer-ears, and means for connecting pockets through the transfer-ears, substantially as and for the purposes specified.

15. In a rotary engine or turbine-motor of the class specified, the combination of coacting members, one of which is a rotary member, said members having expansion-pockets, and the rotary member having an exhaust-passage which discharges centrally of said member, substantially as and for the purposes specified.

16. In a rotary engine or turbine-motor of the class specified, the combination of coacting members one of which is a rotary member, each of said members having expansion-pockets, the pockets of one of said members having transfer-ears, and the other member having bleeding-pockets and an exhaust in the planes of the transfer-ears of the pockets of the first-named member, substantially as and for the purposes specified.

17. In a rotary engine or turbine-motor of the class specified, the combination of coacting members, one of which is a rotary member, each member having two or more series of expansion-pockets, and one of said mem-

bers having means of transferring the motive fluid in the direction of rotation from the pockets of one series to those of another, and a centrally-disposed pressure-inlet, substantially as and for the purposes specified.

18. In a rotary engine or turbine-motor, the combination of coacting members, one of which is a rotary member, said members having each a series of expansion-pockets, and a motive-fluid-pressure inlet therefor adapted to charge the next succeeding expansion-pocket before the prior leading-pocket has closed, substantially as and for the purposes specified.

19. In a reversible rotary engine or turbine-motor of the class specified, the combination of coacting members, one of which is a rotary member, one of said members being provided with series of corresponding pockets, the pockets of one series being in staggered relation with the pockets of the corresponding series on the opposite side of the median line of the motor, substantially as and for the purposes specified.

20. In a reversible rotary engine or turbine-motor of the class specified, the combination of coacting members, one of which is a rotary member, one of said members being provided with series of corresponding pockets, the pockets of one series being in staggered relation with the pockets of the corresponding series on the other side of the median line of the motor, and a centrally-disposed pressure-inlet, substantially as and for the purposes specified.

21. In a rotary engine or turbine-motor of the class specified, the combination of coacting members, one of which is a rotary member, each member provided with two or more series of pockets, and means whereby the motive fluid is transferred throughout the different series in the direction of rotation, substantially as and for the purposes specified.

22. In a rotary engine or turbine-motor of the class specified, the combination of coacting members, one of which is a rotary member, said rotary member provided with series of expansion-pockets and with series of bleeding-pockets, the number of expansion-pockets and bleeding-pockets in a respective series being equal, and the number of series of said bleeding-pockets being less than the number of series of said expansion-pockets, substantially as and for the purposes specified.

23. In a rotary engine or turbine-motor of the class specified, the combination of coacting members, one of which is a rotary member, said members each having expansion-pockets, and means whereby the motive fluid is transferred from a pocket of the rotary member through a plurality of pockets in the other member before being returned to a pocket of the rotary member, substantially as and for the purposes specified.

24. In a rotary engine or turbine-motor of the class specified, the combination of coacting members, one of which is a rotary member, each of said members provided with two or more series of pockets, and means for dividing and transferring the motive fluid axially of the rotary member and in the direction of rotation thereof, substantially as and for the purposes specified.

25. In a rotary engine or turbine-motor of the class specified, the combination of a fixed and a rotary member, each of said members having two or more series of pockets, and means for dividing and transferring the motive fluid in the direction of rotation into pockets of different series of the fixed member, substantially as and for the purposes specified.

In testimony whereof I affix my signature, in presence of two witnesses, this 12th day of September, 1903.

DANIEL McARTHUR.

Witnesses:
JAMES MACINTOSH,
B. F. DECKER.