No. 843,073. PATENTED FEB. 5, 1907.

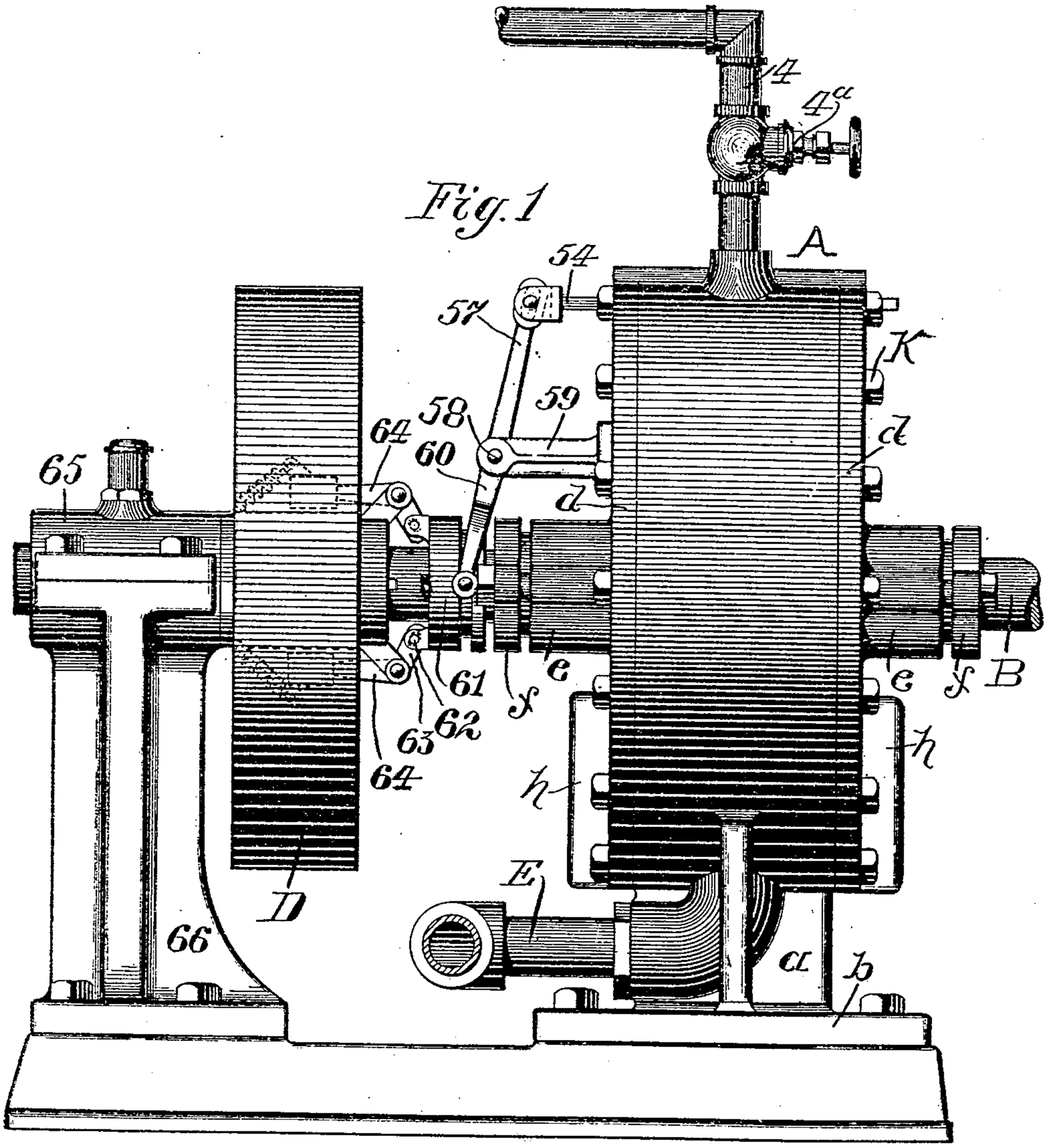
C. COMSTOCK.

IMPACT AND REACTION MOTOR.

APPLICATION FILED NOV. 24, 1902. RENEWED APR. 19, 1905.

5 SHEETS—SHEET 1.

Fig. 1



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Examiner.

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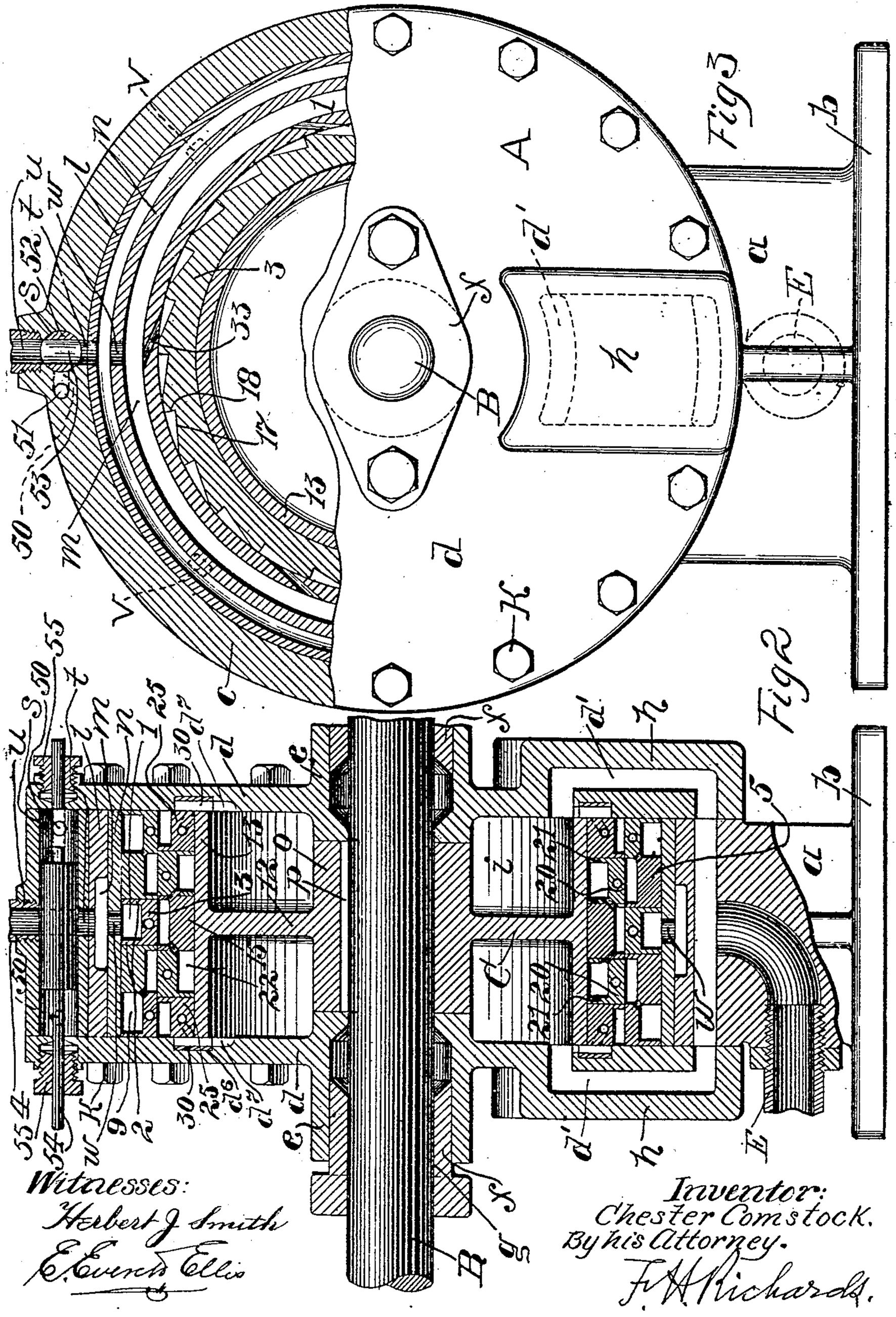
5 SHEETS—SHEET 2.



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5 SHEETS—SHEET 3.

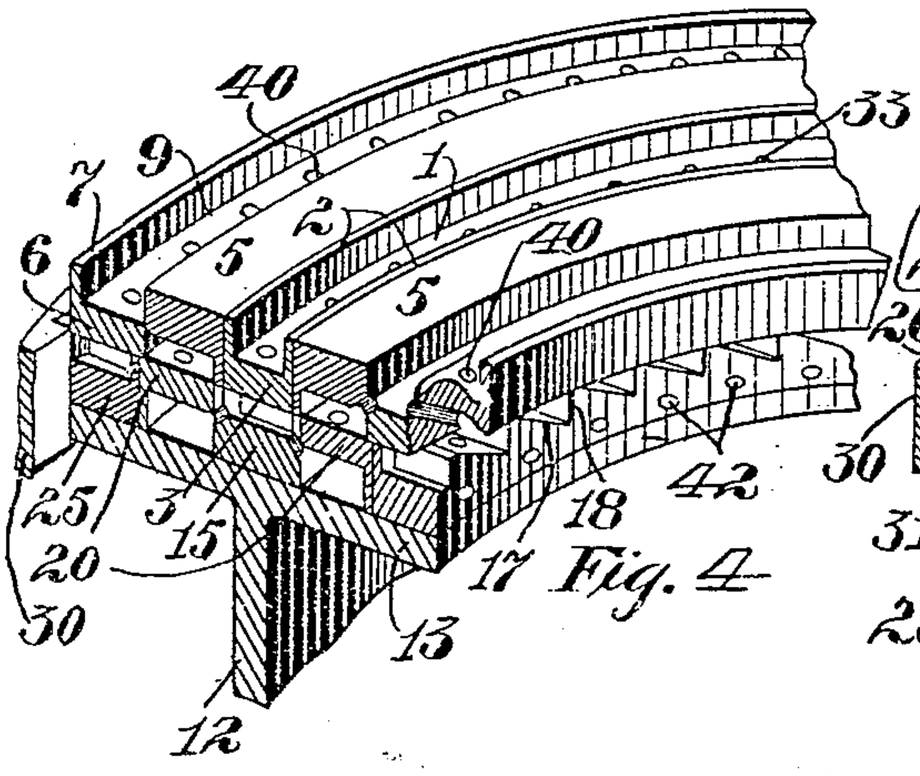

Fig. 4

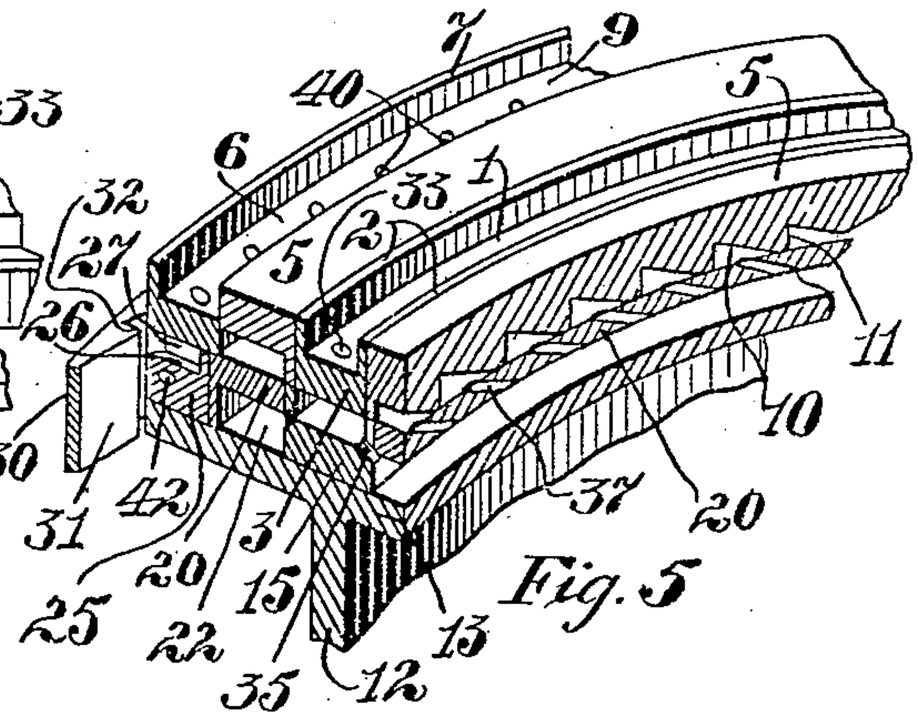

Fig. 5

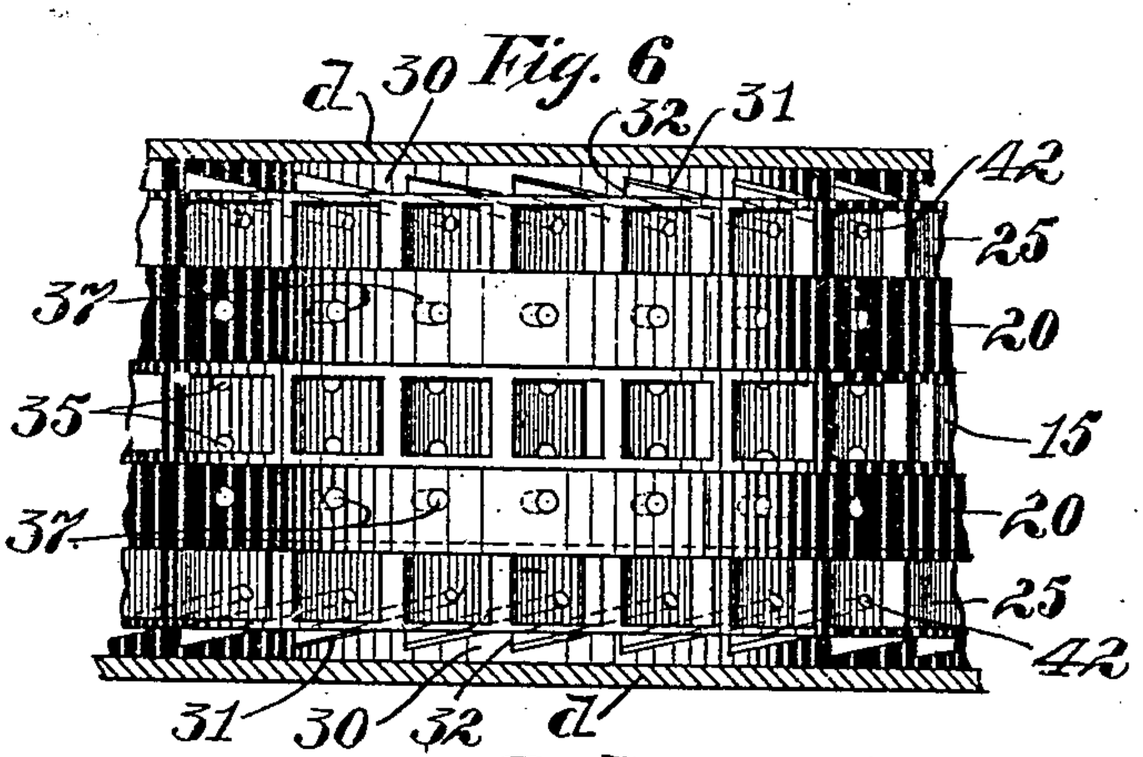

Fig. 6

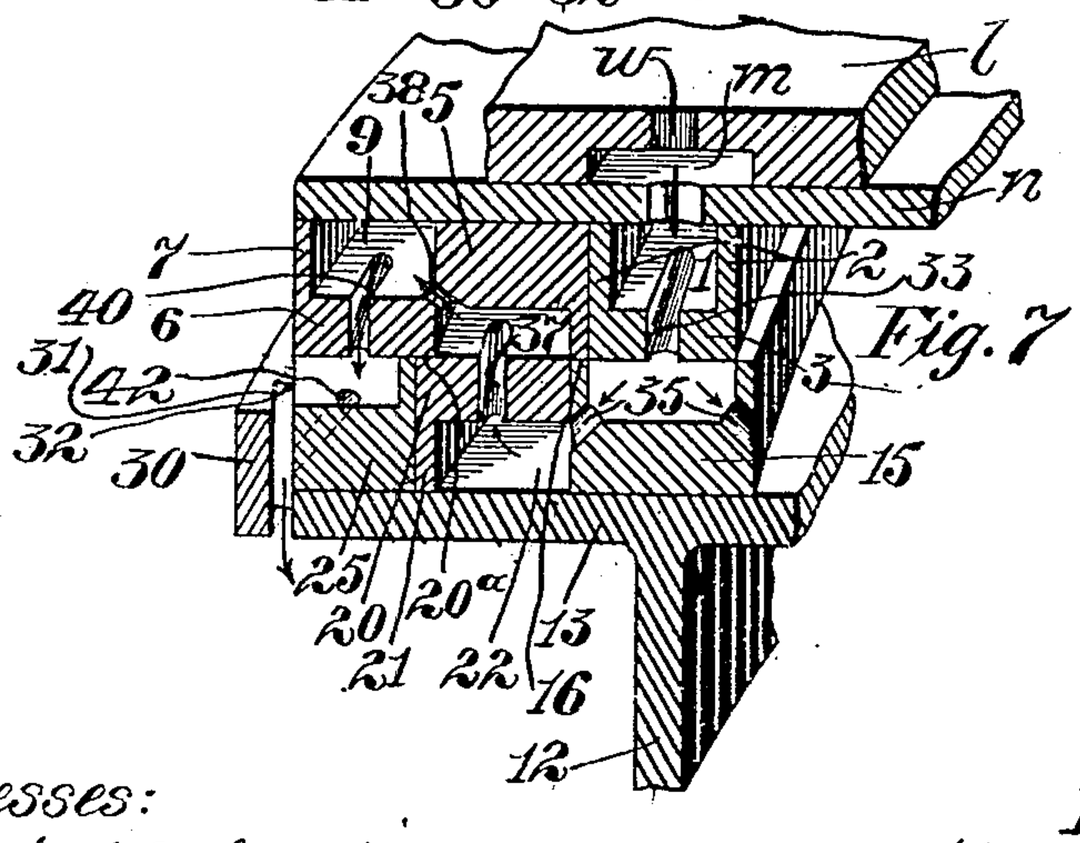

Fig. 7

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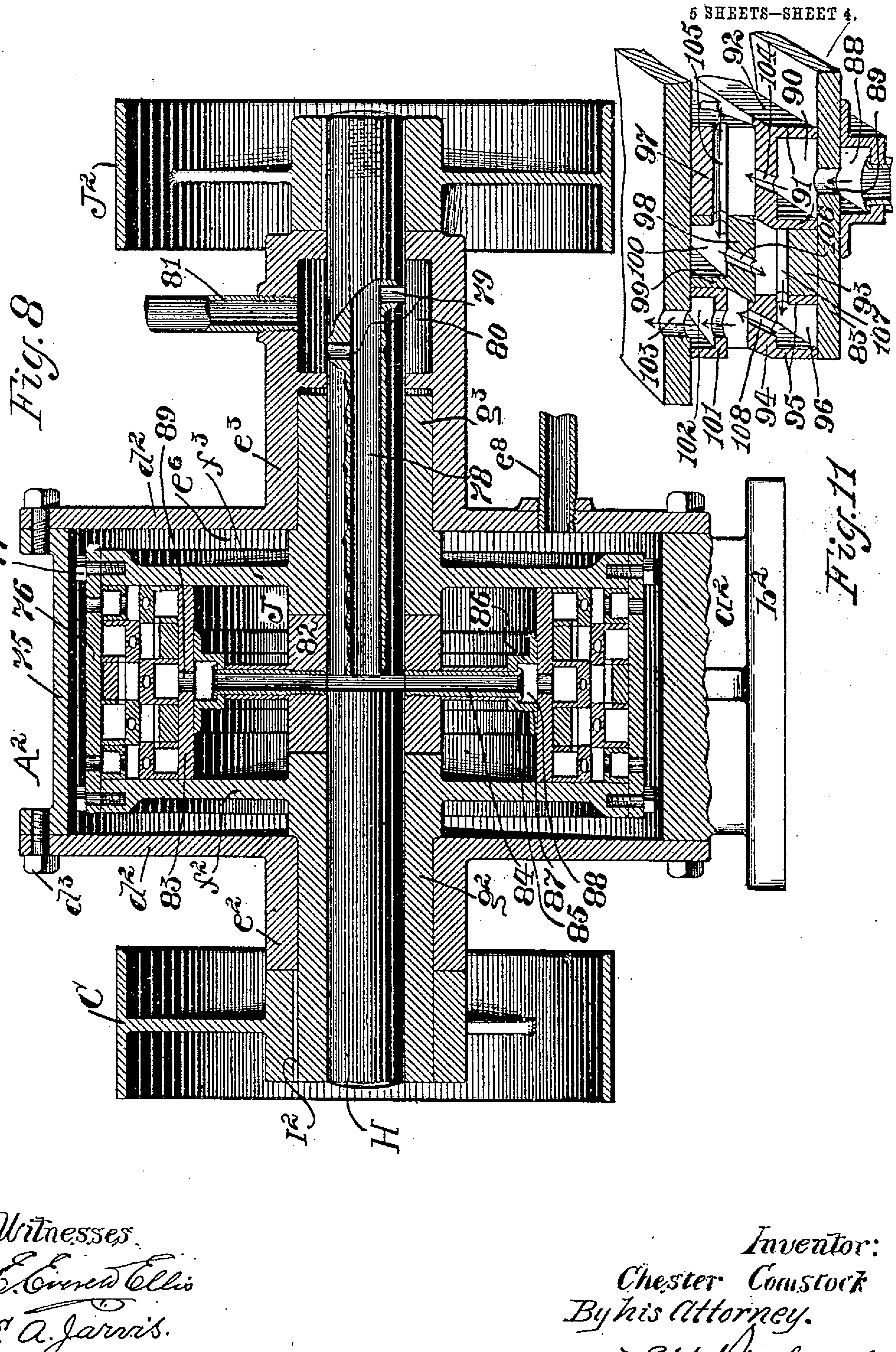
5 SHEETS—SHEET 4.



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No. 843,073. PATENTED FEB. 5, 1907.

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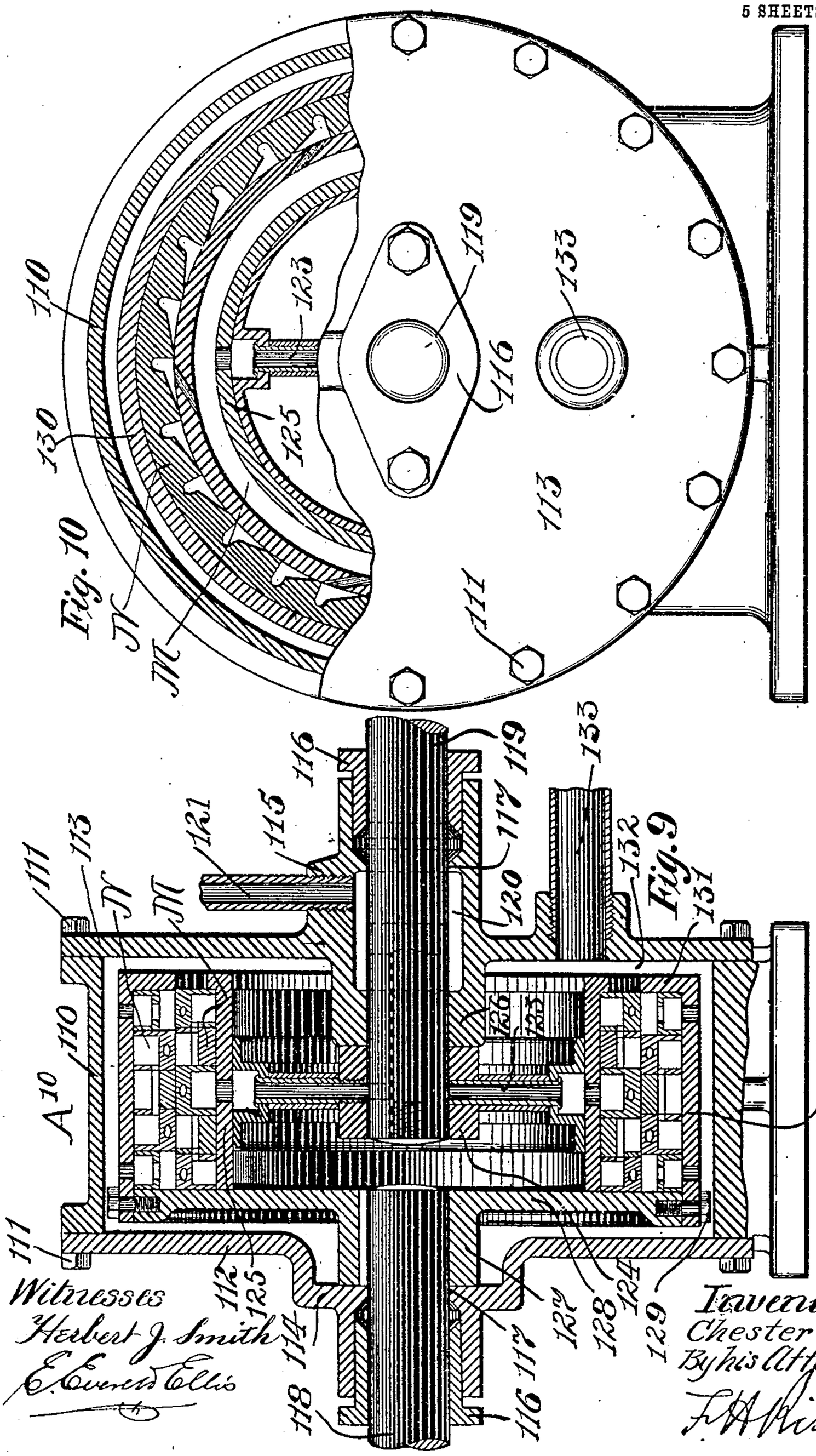
IMPACT AND REACTION MOTOR.

APPLICATION FILED NOV. 24, 1902. RENEWED APR. 19, 1905.

5 SHEETS—SHEET 5.



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UNITED STATES PATENT OFFICE.

CHESTER COMSTOCK, OF BROOKLYN, NEW YORK.

IMPACT AND REACTION MOTOR.

No. 843,073. Specification of Letters Patent. Patented Feb. 5, 1907

Application filed November 24, 1902. Renewed April 19, 1905. Serial No. 256,412.

To all whom it may concern:

Be it known that I, CHESTER COMSTOCK, a citizen of the United States, residing in Brooklyn, in the county of Kings and State of New York, have invented certain new and useful Improvements in Impact and Reaction Motors, of which the following is a specification.

This invention relates to motors or rotary engines; and it consists, substantially, in the improvements hereinafter particularly described.

The invention has reference more especially to motors or rotary engines of that class in which steam or other expansible fluid is employed as the propulsive agent, and while my improvements are applicable alike to motors of either single or compound type I have preferably elected the latter type herein for the purposes of illustration.

One of the principal objects of the invention is to provide an impact-motor capable of deriving a maximum amount of kinetic energy from the force of expansion of the propulsive agent employed, and one also in which there is perfect balance of parts, as well as harmony of action thereof, tending to the production of regular or uniform motion.

A further object is to provide a motor of this character wherein the force of expansion of the propulsive agent employed is equally distributed and practically continuous in effect, and one also in which vibration is reduced to the minimum and in which the evils resulting from undue friction are largely overcome.

A still further object of the invention is to provide an impact-motor which is comparatively simple in the construction and organization of the parts or elements thereof, besides being most economical both in the production and expenditure of energy, while still furnishing maximum driving power.

The above and additional objects are attained by means substantially such as are illustrated in the accompanying drawings, in which—

Figure 1 is a vertical side elevation of one form or embodiment of my improved impact-motor as it appears when constructed for operation. Fig. 2 is a vertical longitudinal sectional view taken through the casing and the rotatable impact-wheel therein, some of the parts being shown in elevation. Fig. 3 is a part vertical transverse sectional view of Fig. 2, taken just to one side of the central plane of rotation of the impact-wheel and showing more clearly the construction by which the full force of direct impingement of the expansible propulsive agent upon such wheel is derived. Fig. 4 is a sectional detail view in perspective to more clearly indicate the construction of the peripheral portion of the impact-wheel, together with the stationary interior structure coöperating with the wheel in producing the desired motion of the latter. Fig. 5 is a similar view to Fig. 4, the section in one direction being taken in a different plane to show one of the means forming abutments or resistances whereby the impact-wheel is assisted to be driven by the reactive effect of the successive charges of the expansible propulsive agent employed. Fig. 6 is a sectional plan view of part of the casing and interior construction, taken about on the line $x\,x$ of Fig. 2. Fig. 7 is a view somewhat similar to Fig. 4, showing more clearly the course of lateral flow taken by each charge of the expansible propulsive agent on either side of the central plane of rotation of the impact-wheel. Fig. 8 is a vertical longitudinal sectional view of another form or embodiment of my improved impact-motor, and Fig. 9 is a vertical longitudinal sectional view representing a modification of this latter form or embodiment. Fig. 10 is a part vertical transverse sectional elevation of the form of motor shown in Fig. 9 and is substantially a similar view to Fig. 3. Fig. 11 is a view substantially similar to Fig. 7 and representing more clearly the mode of operation of my improved impact-motor shown at Figs. 8, 9, and 10.

Before proceeding with a more detailed description it may be stated that my improved impact-motor may be constructed of either single or compound type and also that the same may be either single or double acting in character, accordingly as may be desired in practice, and in either case the same is both effective and reliable in operation, being capable of easy and ready control by the attendant or operator in charge, as well as comparatively noiseless and without loss by leakage or otherwise of any of the force or power of the propulsive agent employed, these features being of considerable importance in an engine or motor of this class. The embodiments herein shown are such as to readily overcome any tendency to interruption of the speed of the motor from counteracting forces, and likewise no difficulty is

experienced in starting and stopping the motor. The prime mover or impact-wheel of the motor is actuated both by direct impingement and reaction of the expansible propulsive agent thereupon, and means are employed whereby the successive charges of such agent are caused to flow laterally in streams which are numerously distributed about said impact-wheel on either side of the central plane of rotation thereof. The effect of the operation of my improved motor is such as to greatly facilitate the exhaust of the expansible propulsive agent after expenditure of its force, and due to the special construction and organization which I preferably employ the casing of the motor constitutes an important factor in the maintenance of equilibrium and stability of structure. I may employ means for governing the supply of expansible propulsive agent to the motor in accordance with the speed of the latter, and it will be apparent that various changes may be made in the several embodiments herein shown without departure from the spirit or scope of my invention.

Specific reference being had to the embodiment shown in Figs. 1 to 7, inclusive, of the drawings, A represents the casing of my improved compound impact-motor, the same being mounted upon a suitable pillar or standard *a*, having a base *b*, the said casing being constituted of a cylinder *c*, having end disks or heads *d d*, each formed centrally thereof with a sleeve or stuffing-box *e*, having a gland *f* and provided with a suitable bearing *g* for the support of the shaft B, which is driven by the motor, as will hereinafter be explained. The disks or cylinder-heads *d* are each set outwardly at the part *h* thereof beneath the shaft, by which to provide conduits *d'*, leading from an inner exhaust-chamber *i*, for the spent propulsive agent, and said disks or heads are secured to the ends of the said cylinder *c* in a fluid-tight manner by means of bolts *k*, as shown. These disks or cylinder-heads are also of special construction on their inner faces, whereby the impact-wheel C is materially assisted to be driven or propelled in the operation of the motor, as will hereinafter be more fully described. In the present instance of my invention the cylinder *c* is stationary, and rigid therewith is preferably an inner cylinder *l*, formed with a continuous circumferential channel *m*, and closely fitting within said latter cylinder is still another stationary cylinder *n*, the central outer surface of which serves to close the said channel *m*, and thereby form a supply-chamber for steam or other expansible propulsive agent employed for driving or propelling the said impact-wheel C, and through the latter the shaft B, it being here remarked that the hub *o* of said impact-wheel is keyed or otherwise secured to the shaft B at *p*, the ends of said hub being movably adapted to the inner ends of the said sleeves or stuffing-boxes *e*. (See Fig. 2.) The sides of said channel or supply-chamber *m* are located a suitable distance beyond and on either side of the central plane of rotation of said impact-wheel C, and formed in the upper part of cylinder *c*, preferably in vertical alinement with the axis of shaft B, is an inlet-chamber *s* for the steam or other expansible propulsive agent, said inlet-chamber being in communication with the channel or supply-chamber *m* through an opening *t*, and also formed in the cylinder *c* is an opening *u* for receiving the end of a steam or other pipe 4, Fig. 1, leading from the source from which the expansible propulsive agent is derived, said pipe having a suitable cut-off or controlling valve 4ª. The innermost cylinder *n* is held in stationary position by means of keys or other means *v*, (see dotted lines, Fig. 3,) and at as many points thereof as may be desired, but preferably at diametrically opposite points, (see Figs. 2 and 3,) the said innermost cylinder *n* is formed with openings *w*, leading from said channel or supply-chamber *m* to an inner annular pressure-chamber 1, formed between the continuous flanges or side portions 2 2 of a stationary ring 3, centrally disposed both with reference to the heads of the casing and the sides of the impact-wheel, the said flanges or side portions 2 2 extending outwardly with reference to the axis of rotation of said wheel and having the edges thereof in contact with adjacent portions of the inner surface of said innermost stationary cylinder *n*. Also rigidly secured within the casing in any suitable way and on either side of the stationary ring 3 is another ring 5, having the outer surface thereof in contact with adjacent portions of the inner surface of the innermost cylinder *n*, and adjoining the lower outer edges of said latter rings are the upper inner edges of smaller rigid or stationary rings 6, having the outer continuous sides thereof also flanged or extended outwardly at 7 with reference to the axis of the impact-wheel, said extended portions being also in contact with adjacent portions of the inner surface of said innermost cylinder *n*; it being noted that the body of each of said rings 6 is of substantially equal depth or thickness with the body of said ring 3 and that the depth or thickness of each of said rings 5 is substantially equal to the full depth or thickness of each of the said rings 3 and 6. In this way an outer annular chamber, channel, or course 9 is formed at each end of the casing A and on either side of the channel or supply-chamber *m*, it being observed that said courses 9 are each of somewhat greater dimensions transversely than the said channel or supply-chamber *m*, and on reference to Fig. 5 it will be seen that the inner surface of each of the said rings 5 is recessed at regular intervals all around to form pockets each constituted of

an inclined wall 10, disposed tangentially to said ring-surface, and a straight wall 11, the face of which is radial to the axis of the impact-wheel. The said impact-wheel C is constructed of a central web 12, connecting the hub *o* with the outer rim 13 thereof, the annular spaces between said hub and rim constituting the exhaust-chambers *i*, hereinbefore referred to, and secured to the outer face of said rim in any suitable way is a ring 15, which is of width preferably to extend beyond and to either side of the said web 13, the said ring 15 being herein shown of width in excess of the width of ring 3 beyond it, the outer faces of the projecting side portions of this ring 15 being in working contact at 16 (see Fig. 7) with adjacent portions of the inner surface of the said rings 5. The outer surface of the main body or central portion of the ring 15 is formed at intervals all around with pockets each constituted of an inwardly-inclined wall 17, which is substantially tangential to the said surface of the ring, and a straight wall 18, the face of which is radial to the axis of the impact-wheel, said walls being reversely disposed to the corresponding walls constituting the pockets of each of the stationary rings 5, (see Figs. 4 and 5,) and the pockets of each of said latter rings and the ring 15 are preferably equal in number. Also secured to the outer surface of the wheel-rim 13 in any suitable way and on either side of the centrally-disposed ring 15 is a ring 20, the depth or thickness of the main body of which is substantially equal to the depth or height of the straight walls 18 of the pockets in said ring 15, the outer side of each of these rings 20 being flanged or extended inwardly all around at 21 to rest on the rim, as shown, the said rings being also each of sufficient width to project beyond the inner side of the adjacent stationary ring 6 and form a working contact at 20^a with a portion of the inner surface of said latter ring. (See more particularly Fig. 7.) The full depth or thickness of each of the rings 20 (including the said flanged or extended portion 21 thereof) is substantially equal to the depth or thickness of the central ring 15, and in virtue of the construction and organization described and shown an annular course 22 is formed between the inner surface of the body of each of said rings 20 and the adjacent portions of the outer surface of the rim 13. Located upon the said rim at the outer side of each of the rings 20 is still another or outer ring 25, the depth or thickness of which is practically equal to the full depth or thickness of each of said rings 20, and the outer surface of each of said outer rings 25 is recessed at intervals all around, similarly as the outer surface of ring 15, to form pockets each constituted of an inclined wall 26, disposed tangentially to the surface of the ring, and a straight wall 27, the face of which is radial to the axis of impact-wheel C, (see Fig. 4,) said walls 26 and 27 being equal in number and corresponding in position with the walls of the pockets of said ring 15, as shown. It may be stated at this point that in the operation of the motor the straight walls of the pockets of each of the rings 15 and 25 constitute the means by which direct impingement is had of the charges of expansible propulsive agent upon the impact-wheel, while the corresponding walls of the pockets of ring 5 constitute abutments or resistances for assisting in the propulsion of said wheel by the reactionary effect of such charges.

Fitted in a circular recess d^6 therefor on the inner surface of each of the disks or cylinder-heads *d* is a ring-plate 30, located directly alongside the outer edge of the adjacent ring 25, and said ring-plates are each formed or provided on its inner surface with pockets each constituted of an outwardly-inclined wall 31 and a straight substantially radially disposed wall 32, the said walls being preferably equal in number to and ccoupying practically the same relative positions as the corresponding walls of the pockets on the inner surface of each of the before-mentioned stationary rings 5. It will be observed that the height of each of the recesses d^6 is greater than the width of said ring-plates, thus leaving an open space d^7 at the inner edge of each ring-plate, the purpose of which will be explained hereinafter. Referring back to the stationary ring structure within the casing and the coöperating movable-ring structure carried by the impact-wheel, it will be seen that the body of the stationary ring 3 is formed at predetermined equidistant points thereof with injector-ports 33, the sides of each of which are inclined or tangential to the surface of said ring and substantially parallel with the inclined walls of the pockets formed on the outer surface of each of the movable rings 15 and 25. In other words, the positions of the sides of said injector-ports are such that successive charges of steam or other expansible propulsive agent which may be forced through the ports will impinge upon the straight or radially-disposed walls of the pockets of the ring 15, thereby turning the wheel C by the direct force of impact. As shown in Fig. 3, the number of said injector-ports is comparatively limited, whereas in Fig. 4 one is shown for each of the pockets of the said ring 15, either of these constructions answering the purposes of my invention. Formed in the sides of each of the said pockets of the ring 15 are conduits or ports 35, the sides of which are inclined outwardly in opposite directions to each other, the said conduits or ports leading from the said pockets to the courses 22 on either side of the said ring 15, and each of the movable rings 20 is formed at points cor-

responding to the pockets in the stationary ring 5 beyond it with conduits or ports 37, the sides of each of which are inclined or tangential with respect to the surface of said ring, the position of said sides being practically the reverse of the position of the sides of the said injector-ports 33 in the ring 3. Formed in the outer side of each of the pockets of each of the said rings 5 is also a conduit or port 38, the sides of which are inclined outwardly, but reversely to the sides of the conduits or ports 35, the said first-named conduits or ports 38 leading from the said pockets of the rings 5 to the chambers 9 at the outer sides of said latter rings. Each of the stationary rings 6 is formed at points corresponding to the position of the pockets of the corresponding movable ring 25 with conduits or ports 40, the sides of each of which are in substantial parallelism with the sides of each of the injector-ports 33, the said conduits or ports 40 leading from the said courses 22 to the said pockets. (See Fig. 7.) Each of the said pockets of each of the said rings 25 is formed with a conduit or port 42, the sides of which are inclined outwardly, as shown, the said conduits or ports leading from the said pockets to the pockets formed or provided on the ring-plates 30, secured to the inner sides of the cylinder-heads.

Referring to Figs. 1, 2, and 3, it will be seen that the inlet-chamber *s* for the expansible propulsive agent is in communication at the points 50 with a relief-chamber 51, formed in the cylinder *c*, and located in the said inlet-chamber is a balance-valve 52, which works across the openings *t* and *u* and itself is provided with an opening 53 (see Fig. 3) for establishing communication between said first-named openings. Said balance-valve is practically a piston with the two ends of its rod 54 working in stuffing-boxes 55, properly fitted in openings in the cylinder-heads. (See Fig. 2.) As shown in Fig. 1, one end of said piston-rod is in movable connection with one arm 57 of a lever which is movably supported at 58 by a bracket 59 from the casing, the other arm 60 of said lever being in movable connection with a collar 61, which is slidable on the shaft B and which is in movable connection at 62 with the arms 63 of an ordinary centrifugal governor 64, suitably supported and relatively disposed both with reference to said shaft and a drive-pulley D, carried thereby, it being noted that this portion of the shaft is supported in suitable bearings 65 therefor at the upper end of a standard or upright 66. It is apparent from the construction and organization just described that the balance-valve is operated from the governor in a manner to entirely control the supply of expansible propulsive agent to the motor proportionately as the speed of the latter increases or diminishes.

It will be understood, of course, that in the operation of the particular embodiment of my improved motor described the channel or pressure-chamber 1 is kept constantly filled with steam or other expansible propulsive agent under pressure, such agent being supplied to said pressure-chamber either continuously or under successive impulses received in the supply-chamber, and consequently charges of this agent will be expelled under pressure through the injector-ports 33 and act by direct impingement upon the straight or radially-disposed walls of the pockets of the ring 15 to turn the wheel C by the force of impact. While thus partially expending its force the charge received in each of said pockets spreads outwardly of its own pressure and flows through the conduits or ports 35, into the chambers 22 on either side of said ring 15, and thence the separate portions of the charge flow through the conduits or ports 37 of the rings 20, and the reactionary effect produced by the impingement thereof upon the straight or radially-disposed walls or abutments of the pockets of the rings 5 assists in driving or propelling the said impact-wheel, as is apparent. Simultaneously with the reactive effect thus produced the separate portions of each charge of the said expansible propulsive agent next passes through the conduits or ports 38 into the outer courses 9 and thence through the ports 40 of the rings 6 and against the straight or radially-disposed walls of the pockets of rings 25 by direct impingement, similarly as in the first instance referred to, and finally the said separate portions of the charge pass out through the conduits or ports 42 of rings 25, and a second reactionary effect is next produced by impingement of the charge portions upon the straight or radially-disposed walls 32 of the ring-plates 30 on the inner sides of the heads of the casing, this second reactionary effect also materially assisting in the driving or propulsion of the wheel. The abutments or final resistances afforded by these latter walls also tend by the reactive force of the charge portions of propulsive agent thereagainst to steady the entire structure, and it is apparent that the spent charges pass from the pockets in the ring-plates through the spaces *d'* at the inner edges of said plates, then into the exhaust-chambers *i*, and finally to the exhaust-pipe E through the conduits *d'*. It will be understood, of course, that the number of stationary and movable rings herein described may be increased or diminished, as may be desired, and it is evident that by employing a set of each of such rings at one side only of the web of the wheel the motor may be altered from the compound type to a motor of the single type. The construction and organization of parts herein shown, however, is preferred in practice.

It may be stated that in the lateral flow of

the separate portions of each charge of expansible propulsive agent employed there is a gradual increase of volume of such portions in their outward progression, accompanied by a corresponding decrease of pressure thereof, and in order to compensate for this and still gain the maximum effect from the charges I preferably form each of the conduits or ports 38 of a greater transverse area than that possessed by each of the conduits or ports 35, while the transverse area of each of the conduits or ports 42 is still greater than that of the said conduits or ports 38. The transverse area of each of the conduits or ports 37 and 40 may be substantially equal to each other, and the corresponding area of each of said conduits or ports 35 is preferably less than the transverse area of each of the injector-ports 33, the combined transverse area of opposite ones of said conduits or ports 35, however, being greater than the similar area of one of said injector-ports. For like reasons the several chambers herein referred to may also be made of varying dimensions, as already described. It will be understood that pending the passing of the several pockets of the impact-wheel before the injector-ports the successive charges exert both the direct and reactionary effects desired for driving or propelling the wheel. The construction and organization described and shown may be altered, however, without departure from my invention.

Referring to the form or embodiment of my improved impact-motor shown in Fig. 8 of the drawings, it may be stated that the construction and organization of parts therein shown are substantially the same as in the form or embodiment already described, with the difference that in the first instance the motor is single-acting, while in the present instance the same is double-acting, which is to say that according to this second form or embodiment two shafts are driven by the motor in opposite directions to each other and that the construction and organization of corresponding parts are somewhat reversed in order. Thus in said Fig. 8, A^2 represents the outer casing of the motor as a whole, the same comprising a stationary cylinder 75, mounted upon a pillar or standard a^2, having a base b^2, said cylinder being closed fluid-tight by means of a head d^2, secured to each end thereof through the medium of fastening-bolts d^3. The said heads are formed centrally thereof with hollow sleeves e^2 and e^3, communicating with the interior of the outer casing, it being here stated that the said interior of the casing constitutes an exhaust-chamber e^6 for the propulsive agent after expenditure of its force and that one of said heads d^2 is provided with an outlet-pipe e^8 for escape of the exhaust. In this instance of my invention two oppositely-rotating wheels are employed, one being practically an inner casing consisting of a cylinder or rim 76, to which are secured, by means of bolts or screws 77, the heads or end plates f^2 and f^3, the latter being formed or provided with hub-sections g^2 g^3, which are rotatably fitted within the sleeves e^2 and e^3 and constitute a hollow shaft, the inner ends of said hub-sections being separated, as shown, and the outer end of one, g, of them having keyed or otherwise secured thereto at i^2 the hub of a driven pulley G. Passing through the said hub-sections or hollow shaft g^2 g^3 is a shaft H, which is also hollow at 78 for a part of its length and is formed in opposite sides thereof with inlet-ports 79, which are in communication with the interior of an inlet-chamber 80, formed at the outer extremity of sleeve e^3, said inlet-chamber having an inlet-pipe 81 leading into the side thereof from any suitable source (not shown) from which the expansive propulsive agent is derived, and the outer end of the hollow portion of said shaft has also keyed or otherwise secured thereto a driven pulley J^2. Keyed or otherwise secured to this shaft H centrally of the casing A^2 is the hub 82 of another wheel J, which is constituted of a rim 83 and a series of hollow spokes 84, the inner ends of which are fitted to said hub 82 and are in communication with the hollow portion 78 of said shaft H, as shown, the outer ends of said spokes being fitted in openings therefor in a ring 85, which is provided all around at the sides with outward extensions 86, which in turn are flanged at 87 and secured to the inner surface of the said rim 83 on opposite sides of the central plane of rotation of said wheel J. The said ring and adjacent portion of the inner surface of the wheel-rim 83 thus constitute a continuous annular supply-chamber 88, having openings 89, which are in communication with a pressure-chamber 90, formed between the flanges or extended side portions 91 of a ring 92, (similarly constructed as the ring 3 already described,) suitably secured in position upon the outer surface of said rim 83, so as to revolve with wheel J. Also secured to the rim 83 in like manner on either side of said ring 92 is a ring 93, which is formed on its outer surface with pockets each constituted of an inclined wall and a straight or radially-disposed wall similarly as on the inner surface of each of the rings 5 already mentioned. Secured to the outer surface of the said rim 83 also in like manner and on the outer side of each of said rings 93 is a ring 94, (similar to each of the rings 6,) the sides of which are flanged or extended at 95 to rest upon the rim, and thereby form a continuous course 96, as shown. Secured to the inner surface of the cylinder or rim 76 of the rotatable casing or wheel, so as to inclose the said ring 92, is a ring 97, the inner surface of which is formed all around with pockets each constituted of an inclined wall and a straight or

radially-disposed wall, the same as the ring 15, hereinbefore mentioned, said walls being reversely disposed to the corresponding walls of the pockets of each of the said rings 93. Also secured to the inner surface of said cylinder 76 on either side of the ring 97 is a ring 98, the main body of which is of depth or thickness less than that of said ring 97 and the outer side of which is flanged or extended at 99, so as to form, with the adjacent side of ring 97, a course 100. Still further secured to the inner surface of thes aid cylinder or rim 76 on the outer side of each of the said rings 98 is an outer ring 101, the inner surface of which is also formed with pockets each constituted of an inclined wall and a straight or radially-disposed wall located in the same direction or position as the corresponding walls of the pockets of ring 97, the said rings 101 also each being formed in its outer surface with a continuous outlet-chamber 102, which is in communication with the exhaust-chamber e^6 through openings 103, formed in the rim 76 at predetermined intervals thereof. The body of the ring 92 is formed at suitable intervals thereof with suitable injector-ports 104, (similar to those in ring 3 of the first embodiment described,) whereby the charges of expansible propulsive agent may act by direct impingement upon the radially-disposed walls of ring 97, and this latter ring is formed at either side of each pocket thereof with a conduit or port 105 for the lateral flow or passage of the divided portions of each charge to the adjacent courses 100, from each of which the charge portion flows through a conduit or opening 106 in the ring 98, whence it further expends some of its remaining expansive force against the reversely-disposed radial walls of the pockets of the adjacent ring 93, and thus it will be seen that the wheel J and inner ring, together with their shafts and pulleys, are caused to revolve in opposite directions. As each of the charge portions is acting upon the said radially-disposed walls of the pockets of the ring 93 it escapes through a conduit or port 107 to the adjacent outer course 96 of the ring 94, whence it passes through an opening 108 in the body of the latter and impinges in like manner against the straight or radially-disposed walls of the pockets of the adjacent ring 101 and finally passes through opening 103 to the exhaust-chamber and through the outlet-pipe e^8. It is thought the construction and operation of this embodiment of my improved motor will be fully understood without further explanation; but it may be stated that I am not strictly limited to the details thereof herein preferably shown and described, since deviations therefrom may be made without departure from my invention. The steam or other expansible propulsive agent is fed to the supply-chamber of the wheel J from the hollow portion of shaft H through the hollow spokes of said wheel, as is apparent.

Referring to the modification shown in Figs. 9 and 10, it may be stated that the construction and organization of the inner wheel M and outer wheel N are substantially the same in all essential particulars as in the form or embodiment shown at Figs. 8 and 11, the only difference residing in the mounting of said wheels and their shafts. Thus in said Figs. 9 and 10 the outer casing A^{10} is constructed of a cylinder 110, having secured to the ends thereof by bolts 111 the heads 112 and 113, the latter being formed centrally thereof with hollow sleeves 114 and 115, respectively, each having a stuffing-box and gland 116 and suitable bearings 117, a shaft 118 working in one of said stuffing-boxes and bearings and a shaft 119 working in the other, the said sleeve 115 being formed with an interior inlet-chamber 120, having in communication therewith a pipe 121, leading from a source (not shown) of supply of expansible propulsive agent. The said shaft 119 is hollow, (see dotted lines,) similar to the hollow portion 78 of shaft H of Fig. 8, and is in communication with said inlet-chamber by means of lateral openings in the shaft. In this instance also the inner wheel M is in communication with the interior of said hollow shaft 119 through hollow spokes 123, the inner and outer ends of which are secured to the hub 124 and rim 125, respectively, of said inner wheel M, said hub being keyed or otherwise secured to the inner end of said hollow shaft 119, as shown, it being observed that the sleeve 115 is extended inwardly of the casing at 126 to form an additional bearing for this shaft. Also in the present instance the outer wheel N is constructed of a hub 127, keyed or otherwise secured to the inner end of shaft 118 and carrying at its inner end a disk 128, to the periphery of which is secured, by means of bolts or screws 129, one end of a cylinder 130, the other end of which is flanged at 131, leaving an open space at this side of the structure which is in communication with the interior of the casing A^{10}, which interior constitutes an exhaust-chamber 132 for the spent propulsive agent, said exhaust-chamber having an outlet-pipe 133, leading from the head 113 of said casing.

Having thus described my invention, I claim—

1. In an impact-motor, the combination with a circular set of pockets and a member opposed thereto having a set of jets, said opposed member completely closing the mouths of all of said pockets, of a member having a second set of jets, a second set of pockets, the mouths of all of which are completely closed by the last-mentioned member, and means for conducting the steam from said first set of pockets to said second set of jets; said conducting means including outlets formed

interiorly in said pockets, and the aggregate capacity of said outlets being materially greater than the aggregate capacity of said second set of jets.

2. In an impact-motor, the combination with a member having a jet, of a circular set of pockets opposite thereto, the mouths of all of said pockets being completely closed by said jet member, two circular course members into both of which said pockets discharge laterally, jets in each of said course members, a circular set of pockets opposite the jets in one of said course members, and a circular set of pockets opposite the jets in the other of said course members, all of said pockets being completely closed by the opposed course members.

3. In an impact-motor, the combination with a jet, of a circular set of pockets opposite thereto; two circular courses into both of which said pockets discharge; jets for each of said courses, a circular set of pockets opposite the jets in one of said courses, and a circular set of pockets opposite the jets in the other of said courses; two courses in communication with said second and third sets of pockets respectively; fourth and fifth sets of pockets, and jets provided in the last-mentioned two coures in position to play upon said fourth and fifth sets of pockets.

4. In an impact-motor, the combination with two cylindrical members, whereof one fits steam-tight within and is revoluble relatively to the other, of the following devices formed in said members, namely, a central circular set of pockets, sets of pockets arranged in two series which ramify upon said central set, and sets of jets for discharging into all of said pockets; said sets of jets alternating with said sets of pockets and being in series therewith, the mouths of each pocket being closed by the surface of the opposing cylindriform member.

5. In an impact-motor, the combination of a cylindriform wheel member and a cylindriform casing member closely fitted thereto so as to prevent escape of steam longitudinally between said members, one of said members having circular sets of peripheral pockets and also having an annular course between said sets; said course being in communication with the first set of pockets, and being also provided with a series of jets, and the other of said members having annular courses opposite said sets of pockets and also having a set of pockets opposite the jets in the wheel; said casing courses being also provided with jets, and all the courses alternating in series with the sets of pockets, so that the steam may jet from the first course through the first set of pockets to the second course and may then jet through the second set of pockets to the third course, and may then jet into the third set of pockets.

6. In an impact-motor, the combination with a wheel and a casing of a plurality of circular sets of peripheral pockets, said sets being of equal diameter, and a plurality of annular case members of equal diameter, provided with jets opposed to said pockets, said members being disposed alternately in series with said sets of pockets, so that the steam may jet from the first course into the first set of pockets and pass thence into the second course, thence jet into the second set of pockets, and so on throughout the series, each course member completely closing the mouths of all of the opposed pockets, and each of the latter having an escape into the succeeding course member.

7. In an impact-motor, the combination with a wheel and a casing, of a plurality of circular sets of peripheral pockets and a plurality of opposed annular course members provided with jets; said course members being disposed alternately in ramifying series with said sets, so that the steam may jet from the first course member into the first set of pockets, and pass thence partly into one course member and partly into another course member, and may jet from the last-mentioned course members into succeeding sets of pockets, each course member completely closing the mouths of all of the opposed pockets, and each of the latter having a lateral escape for the steam into the succeeding course member.

8. In an impact-motor, the combination of two cylindrical sets of rings, one set surrounding and fitting close to the other throughout for preventing escape of steam, and means for enabling relative rotation of said sets; some of said rings being formed with pockets and others of said rings being formed with annular courses provided with jets, said rings forming a series in which the pocket-rings alternate with the course-rings, and the pockets in each ring having outlet-openings into the succeeding course.

9. In an impact-motor, the combination of two cylindriform sets of rings, one set surrounding the other and fitting closely thereto, and means for enabling relative rotation of said sets, some of said rings being formed with pockets and others of said rings being formed with annular courses provided with jets, said rings forming a ramified series in which the pocket-rings alternate with the course-rings, and the pockets in each having outlet-openings into the succeeding course, the first pocket-ring in the series having connection with two course-rings, and the latter having jets playing into two succeeding pocket-rings.

10. In an impact-motor, the combination with a wheel and a casing, of two sets of rings, one set being upon the inner side of the casing and surrounding the other set, which is upon the outer side of the wheel, and means for enabling relative rotation of said

wheel and casing; some of said rings being formed with pockets and others of said rings being formed with annular courses provided with jets; said rings forming a ramified series in which the pocket-rings alternate with the course-rings, and the pockets in each having outlet-openings into the succeeding course, the first pocket-ring in the series having connection with two course-rings, and the latter having jets playing into two succeeding pocket-rings, which in turn are in connection with two succeeding course-rings, the latter having jets for playing into two succeeding pocket-rings.

11. In an impact-motor, the combination of two cylindrical sets of rings, one set surrounding and fitting closely to the other for preventing escape of steam, and means for enabling relative rotation of said sets; some of said rings being formed with pockets and others of said rings being formed with annular courses provided with jets, said rings forming an operant series in which the pocket-rings alternate with the course-rings, and the pockets in each ring having outlet-openings into the succeeding course, the rings in each set being contiguous, and each set being capable of withdrawal as a whole from the other set.

12. In an impact-motor, the combination of two sets of rings, the rings in each set being contiguous, and the rings in one set fitting steam-tight within the other set throughout, and being so mounted that one set may be separated from the other set as an entirety, each of said sets comprising pocket-rings and course-rings, and the course-rings in each set being opposite the pocket-rings in the other set, and having jets for playing into the latter, and being also in connection with the preceding pocket-ring in its own set to receive and discharge therefrom.

13. In an impact-motor, the combination with a wheel and a casing, of a set of rings upon the wheel and a set of rings upon the casing; some of said rings having courses and jets, and others of said rings having pockets each formed with an abrupt impact-face which extends the entire width of the ring; the pocket-rings being narrower than the course-rings, and being placed opposite thereto so as to be overlapped at each edge thereby; said pocket-rings and course-rings forming an operant series in which the pocket-rings and course-rings alternate.

14. In an impact-motor, the combination with a wheel and a casing, of a set of rings upon the wheel and a set of rings upon the casing, some of said rings having courses and jets and others of said rings having pockets each formed with an abrupt impact-face which extends the entire width of the ring; the pocket-rings being narrower than the course-rings and being placed opposite thereto so as to be overlapped at each edge thereby; said pocket-rings and course-rings forming an operant series, in which the pocket-rings and course-rings alternate, and the course-rings having inlets in their side walls opposite the pockets, so as to admit steam therefrom.

15. In an impact-motor, the combination of a casing, a shaft, a wheel rigidly affixed to the shaft, and means by which the wheel may be revolved both by direct impingement and by the reaction of an expansible propulsive agent thereupon; said means consisting of an outer set of rings and an inner set of rings; each ring in each set being in contact with the next ring of the same set, and some of said rings being provided with pockets and others with jets opposite thereto; said rings taken together forming an operant series or train.

16. In an impact-motor, a casing, a shaft, a wheel rigidly affixed to the shaft, and means by which the wheel may be revolved both by direct impingement and by reaction of an expansible propulsive agent thereupon; said means consisting of an outer set of rings and an inner set of rings, each ring in each set being in contact with the next ring of the same set and diametrically opposite to the ring with which it coöperates in the other set, and some of said rings being provided with pockets and others with jets opposite thereto, said rings taken together forming an operant series or train.

17. In an impact-motor, the combination of a casing, a shaft, a wheel rigidly affixed to the shaft, and means by which the wheel may be revolved both by direct impingement and by the reaction of an expansible propulsive agent thereupon; said means consisting of an outer built-up cylindriform set of rings and an inner built-up cylindriform set of rings, the set on the wheel fitting steam-tight within the set on the casing, some of said rings having jets for the discharge of the propulsive agent, and others of said rings having pockets for the reception of the impact propulsive agent.

18. In an impact-motor, the combination of a casing, a shaft, a wheel rigidly affixed to the shaft, and means by which the wheel may be revolved both by direct impingement and by the reaction of an expansible propulsive agent thereupon; said means consisting of an outer built-up cylindriform set of rings and an inner built-up cylindriform set of rings, the set on the wheel fitting steam-tight within the set on the casing; some of said rings having jets for the discharge of the propulsive agent, and others of said rings having pockets for the reception of the impact of the propulsive agent, and the rings having discharge-ports alternating in operant series with the rings having pockets.

19. In an impact-motor, the combination of a casing, a shaft, a wheel rigidly affixed to

the shaft and means by which the wheel may be revolved both by direct impingement and by the reaction of an expansible propulsive agent thereupon, said means consisting of an outer built-up set of rings, and an inner built-up set of rings; some of said rings having jets for the discharge of the propulsive agent, and others of said rings having pockets for the reception of the impact of the propulsive agent, the rings having discharge-ports alternating in operant series with the rings having pockets, and each ring in each set being in contact with the next ring in the same set.

20. In an impact-motor, the combination of a casing, a shaft, a wheel rigidly affixed to the shaft, and means by which the wheel may be revolved both by direct impingement and by the reaction of an expansible propulsive agent thereupon; said means consisting of an outer built-up set of rings and an inner built-up set of rings; some of said rings having jets for the discharge of the propulsive agent and others of said rings having pockets for the reception of the impact of the propulsive agent, the rings having discharge-ports alternating in operant series with the rings having pockets, and each ring in each set being in contact with the next ring in the same set, and diametrically opposite to the ring with which it coacts in the other set.

21. In an impact-motor, the combination of a casing, a shaft, a wheel rigidly affixed to the shaft, and means by which the wheel may be rotated both by direct impingement and reaction of an expansible propulsive agent thereupon; said means consisting of an outer and inner set of rings, some of which have full-width pockets and others of which have jets, each ring in each set being in contact with the next ring of the same set, and diametrically opposite to the ring with which it coacts in the other set, the rings which have jets being of greater width than rings which have pockets.

22. In an impact-motor, the combination of a casing, a shaft, a wheel rigidly affixed to the shaft, and means by which the wheel may be rotated both by direct impingement and reaction of an expansible propulsive agent thereupon; said means consisting of an outer and inner set of rings, some of which have full-width pockets and others of which have jets; each ring in each set being in contact with the next ring of the same set and diametrically opposite to the ring with which it coacts in the other set, the rings which have jets being of greater width than the rings which have pockets, and the rings which have pockets being contiguous to the rings which have jets, so that the latter rings close the pockets.

23. In an impact-motor, the combination of a casing, a shaft, a wheel rigidly affixed to the shaft, and means by which the wheel may be rotated both by direct impingement and reaction of an expansible propulsive agent thereupon; said means consisting of an outer and an inner set of rings, each ring being in contact with the next ring of the same set, some of said rings having jets and others having full-width pockets which are closed by the sides of the adjacent rings, said adjacent rings having jets, and courses between the pockets and the jets.

24. In an impact-motor, a steam-supply chamber connected with a built-up rigid cylindriform set of rings of equal diameter, each of which is in close contact with the next, some of said rings having pockets, and others thereof having jets, and all of said rings being mounted for rotation.

25. In an impact-motor, the combination with a set of pockets and a member opposed thereto having a set of jets, said opposed member completely closing the mouths of said pockets, of a member having a second set of jets, a second set of pockets, the mouths of all of which are closed by one of the members, and means for conducting the steam from said first set of pockets to said second set of jets; said conducting means including outlets located in said pockets and the aggregate capacity of said outlets being materially greater than the aggregate capacity of said second set of jets.

26. In an impact-motor, the combination of two members, whereof one fits steam-tight within the other, the outer member being so formed upon one of its faces, and the inner member being so formed upon one of its faces as to permit the member to have relative rotation with the other member said members having in their faces the following coöperative elements, namely, a central set of pockets, jets for discharging into said pockets, a course upon each side of said set of pockets, the latter being in communication with both courses, jets in said courses, pockets arranged in two circular sets in position to coact with the last-mentioned jets, courses also in communication with the last-mentioned two sets of pockets, jets in the last-mentioned courses, and pockets arranged in two more circular sets in position to be played upon by the last-mentioned jets.

27. In an impact-motor, the combination of two sets of rings, one set so coöperating with the other as to prevent the escape of steam, and means for enabling relative rotation of said sets, some of said rings being formed with pockets and others of said rings being formed with courses provided with jets, said rings forming a series in which the pocket-rings alternate with the rings, and the pockets in each ring having outlet-openings into the succeeding course.

28. In an impact-motor, the combination of a plurality of sets of rings, one set so cooperating with the other as to fit closely

thereto, and means for enabling relative rotation of said sets, some of said rings being formed with pockets and others of said rings being formed with annular courses provided with jets, said rings forming a ramified series in which the pocket-rings alternate with the course-rings, and the pockets in each having outlet-openings into the succeeding course, the first pocket-ring in the series having connection with two course-rings and the latter having jets playing into two succeeding pocket-rings.

29. In an impact-motor, the combination of two sets of rings, one set so related to the other as to prevent escape of steam, and means for enabling relative rotation of said sets, some of said rings being formed with pockets and others of said rings being formed with annular courses provided with jets, said rings forming an operant series in which the pocket-rings alternate with the course-rings, and the pockets in each ring having outlet-openings into the succeeding course, the rings in each set being contiguous and each set being capable of withdrawal as a whole from the other set.

30. In an impact-motor, a ring having a series of pockets formed thereon, in combination with an attached adjoining ring closing said pockets but having outlets therefor, and also having jets in communication with said outlets, and a ring having pockets opposite said jets.

31. In an impact-motor, a ring having a series of pockets formed thereon, each pocket being formed with a face which extends across the width of the ring, in combination with an attached adjoining ring closing said pockets but having outlets therefor, and also having jets in communication with said outlets, and a ring having pockets opposite said jets.

32. In an impact-motor, the combination with a ring, being formed with a series of pockets, each pocket comprising an impact-face, of a ring secured at each side of said pocket-ring, to close the sides of the pockets, said side rings being formed with courses which are in communication with said pockets, jets for said course-rings, and pocket-rings opposite said jets.

33. In an impact-motor, the combination with a ring, being formed with a series of pockets, each pocket comprising an impact-face, of rings secured at each side of said pocket-ring to close the sides of the pocket, at least one of said side rings having an annular course, and its walls being perforated opposite said pockets to receive the discharge therefrom, jets also formed in said course-ring, and a pocket-ring opposite said jets.

34. In an impact-motor, a steam-supply member connected with a built-up rigid set of rings, each of which is in close contact with the next, some of said rings having pockets and others thereof having jets, and all of said rings being mounted for rotation.

35. In an impact-motor, the combination with a jet, of a circular set of pockets opposite thereto, two circular courses into both of which said pockets discharge, jets for each of said courses, a circular set of pockets opposite the jets in one of said courses, and a circular set of pockets opposite the jets in the other of said courses, two courses in communication with said second and third sets of pockets respectively, fourth and fifth sets of pockets, and jets provided in the last-mentioned two courses in position to play upon the said fourth and fifth sets of pockets, said courses, jets and pockets being formed in two cylindriform members fitting steam-tight one within the other, and one thereof being mounted for rotation.

36. In an impact-motor, the combination with a jet of a circular set of pockets opposite thereto, an annular course at each side of said set of pockets and in communication therewith, a set of jets in each of said compartments and a set of pockets opposite each of said sets of jets, said courses, jets and pockets being formed in two cylindriform members fitting steam-tight one within the other, and one thereof being mounted for rotation.

37. In an impact-motor, the combination with a jet, of a circular set of pockets opposite thereto, an annular course at each side of said set of pockets and in communication therewith, a set of jets in each of said compartments, a set of pockets opposite each of said sets of jets, annular courses at the outer sides of said second and third sets of pockets and each provided with a set of jets, and a set of pockets opposite each of the last-mentioned sets of jets, said courses, jets and pockets being formed in two cylindriform members fitting steam-tight one within the other, and one thereof being mounted for rotation.

38. In an impact-motor, the combination of two coöperating members, whereof one consists of a set of pockets and the other consists of a set of jets, and the following parts at each side of said members, namely, a circular course in communication with said pockets, jets in said circular course, and a circular set of pockets opposite the last-mentioned jets, said courses, jets and pockets being formed in two cylindriform members fitting steam-tight one within the other, and one thereof being mounted for rotation.

39. In an impact-motor, the combination of two coöperating members, whereof one consists of a set of pockets and the other consists of a set of jets, and the following parts at each side of said members, namely, a circular course in communication with said pockets, jets in said circular course, a

circular set of pockets opposite said jets, a circular course in communication with the last-mentioned pockets, jets in the last-mentioned course, and a circular set of pockets opposite the last-mentioned jets, said courses, jets and pockets being formed in two cylindriform members fitting steam-tight one within the other, and one thereof being mounted for rotation.

40. In an impact-motor, the combination of two members, whereof one fits steam-tight within the other, the outer member being so cylindrical upon its inner face and the inner member being so cylindrical upon its outer face as to permit one member to be slipped endwise over the other and to enable relative rotation of the members; said members having in their cylindrical faces the following coöperative elements, namely, a central set of pockets, jets for discharging into said pockets, a course upon each side of said set of pockets, the latter being in communication with both courses, jets in said courses and pockets arranged in two circular sets in position to be played upon by the last-mentioned jets.

41. In an impact-motor, the combination of two members, whereof one fits steam-tight within the other, the outer member being so cylindrical upon its inner face and the inner member being so cylindrical upon its outer face as to permit one member to be slipped endwise over the other and to enable relative rotation of the members, said members having in their cylindrical faces the following coöperative elements, namely, a central set of pockets, jets for discharging into said pockets, a course upon each side of said set of pockets, the latter being in communication with both courses, jets in said courses, pockets arranged in two circular sets in position to coact with the last-mentioned jets, courses also in communication with the last-mentioned two sets of pockets, jets in the last-mentioned courses, and pockets arranged in two more circular sets in position to be played upon by the last-mentioned jets.

42. In an impact-motor, the combination with a plurality of pocket-rings, of a plurality of course-rings opposite thereto and having jets, said pocket-rings and course-rings taken together forming an operant series in which the pocket-rings alternate with the course-rings, and connections being provided between the pockets in each ring and the course in the succeeding ring in the series, said pocket and course rings forming two cylindriform sets, whereof one fits steam-tight within the other.

43. In an impact-motor, the combination with a plurality of pocket-rings, of a plurality of course-rings opposite thereto and having jets; said pocket-rings and course-rings taken together forming an operant series in which the pocket-rings alternate with the course-rings, and connections being provided between the pockets in each ring and the course in the succeeding ring in the series, said rings being mounted in two sets, whereof one surrounds the other, and fits steam-tight thereto throughout.

44. In an impact-motor, the combination with a plurality of pocket-rings, of a plurality of course-rings opposite thereto, and having jets; said pocket-rings and course-rings taken together forming an operant series in which the pocket-rings alternate with the course-rings, and connections being provided between the pockets in each ring and the course in the succeeding ring in the series, said rings being mounted in two sets, whereof one surrounds the other, the rings in each set being flush one with another, and each set forming a cylinder which may be withdrawn bodily from the other set, and said sets fitting steam-tight throughout.

45. In an impact-motor, the combination with a plurality of pocket-rings, of a plurality of course-rings opposite thereto, and having jets, said pocket-rings and course-rings taken together forming an operant series in which the pocket-rings alternate with the course-rings, and connections being provided between the pockets in each ring and the course in the succeeding ring in the series, said rings being mounted in two sets, whereof one surrounds and fits steam-tight throughout to the other, a wheel upon the outer periphery whereof one of said sets is secured, and a casing upon the inner periphery whereof the other of said sets is secured.

46. In an impact-motor, a ring having a series of pockets formed therein, each pocket occupying the entire width of the ring, in combination with an attached adjoining ring closing said pockets but having outlets therefor, and also having jets in communication with said outlets, and a ring having pockets opposite said jets.

47. In an impact-motor, a ring having a series of pockets formed therein, each pocket being formed with an abrupt impact-face which extends across the entire width of the ring, in combination with an attached adjoining ring closing said pockets but having outlets therefor, and also having jets in communication with said outlets, and a ring having pockets opposite said jets.

48. In an impact-motor, the combination of a jet, a ring, a set of pockets in said ring opposite said jet, a second ring, a set of jets in said second ring, communications in said second ring between said set of pockets and said set of jets, a third ring, and pockets in said third ring opposite said set of jets, all of said rings being in steam-tight contact throughout.

49. An impact-motor comprising a casing, a shaft, a wheel rigid with the shaft, and means for rotating said wheel both by direct

impingement and reaction of charges of an expansible propulsive agent thereupon, said means being constituted of two sets of rings, the rings in one set being in close contact each to the next, and all rigidly attached to the casing, and the other rings being in close contact each to the next, and all attached to the wheel, and the rings of each set alternating in their adaptability to discharge and to receive the impingement of the propulsive agent.

50. An impact-motor comprising a casing, a shaft, a wheel rigid with the shaft, and means for rotating said wheel both by direct impingement and reaction of charges of an expansible propulsive agent thereupon; said means being constituted of two sets of rings, one of which is attached to the casing and the other of which is attached to the wheel, some of said rings having full-width pockets, which are closed by the adjacent rings, the latter having jets for the discharge of the propulsive agent.

51. An impact-motor comprising a casing, a shaft, a wheel rigid with the shaft, and means for rotating said wheel both by direct impingement and reaction of charges of an expansible propulsive agent thereupon; said means being constituted of two sets of rings, one of which is attached to the casing and the other of which is attached to the wheel, some of said rings having full-width pockets, which are closed by the adjacent rings, the latter having jets for the discharge of the propulsive agent, and having in their side walls adjacent to the pockets, ports through which the propulsive agent is received from the pockets.

52. An impact-motor comprising a casing, a shaft, a wheel rigid with the shaft, and means for rotating said wheel both by direct impingement and reaction of charges of an expansible propulsive agent thereupon; said means being constituted of two sets of rings, one of which is attached to the casing and the other of which is attached to the wheel, some of said rings having full-width pockets, which are closed by the adjacent rings, the latter having jets for the discharge of the propulsive agent, and having in their side walls adjacent to the pockets, ports through which the propulsive agent is received from the pockets, the rings having jets being of greater width than the rings having pockets, and so arranged that these jet-rings of one set overlap the pocket-rings of the other set to such an extent and so closely that they constitute barriers to the leakage of the propulsive agent.

53. In an impact-motor the combination with a circular set of pockets, and a member opposed thereto having jets, said opposed member closing the mouths of said pockets, of a member having a second jet, and a second set of pockets, the mouths of all of which are closed by the last-mentioned member, and means for conducting the fluid from the first set of pockets to the second set of jets, said means including outlets formed in said pockets.

54. In an impact-motor the combination with a set of pockets, and a member opposed thereto having jets, said opposed member closing the mouths of said pockets, of a member having a second jet and second set of pockets, the mouths of all of which are closed by the last-mentioned member and means for conducting a fluid from the first set of pockets to the second set of jets.

55. In an impact-motor, the combination with a ring having a series of pockets therein, each pocket comprising an abrupt impact-face which extends entirely across the ring, of a ring secured at each side of said pocket-ring to close the sides of the pockets, said side rings being formed with courses which are in communication with said pockets, jets for said course-rings, and pocket-rings opposite said jets.

56. In an impact-motor, the combination with a ring, having a series of pockets formed therein, each pocket comprising an abrupt impact-face which extends entirely across the ring, of rings secured at each side of said pocket-ring to close the sides of the pockets; at least one of the said rings having an annular course, and its walls being perforated opposite said pockets to receive the discharge therefrom; jets also formed in said course-ring, and a pocket-ring opposite said jets.

57. In an impact-motor a combination of two sets of members each set being contiguous and the members in one set fitting steam-tight in the other set and being so mounted that one set may be separated from the other set each of said sets comprising pocket members and course members and the course members in each set being opposite to the pocket members in the other set and having jets for playing into the latter and being also in connection with the preceding pocket member in its own set to receive the discharge therefrom.

58. In an impact-motor, the combination of a wheel and a casing fitted thereto so as to prevent escape of steam longitudinally between said members, one of said members having sets of peripheral pockets and also having a course between said sets, said course being in communication with the first set of pockets, and being also provided with a series of jets, and the other of said members having courses opposite said sets of pockets and also having a set of pockets opposite the jets in the wheel, said casing-courses being also provided with jets, and all the courses alternating in series with the sets of pockets, so that the steam may jet from the first

course, and may then jet through the second set of pockets to the third course, and may then jet into the third set of pockets.

59. In an impact-motor, the combination with a wheel and a casing, of a plurality of peripheral pockets and a plurality of case members provided with jets opposed to said pockets, said members being disposed alternately in series with said sets of pockets, so that the steam may jet from the first course into the first set of pockets, and pass thence into the second course, thence jet into the second set of pockets, and so on through the series, each course member completely closing the mouths of all of the opposed pockets, and each of the latter having an escape for the steam into the succeeding course member.

60. In an impact-motor, the combination of two members one surrounding and fitting closely to the other for preventing the escape of a fluid and means for enabling relative rotation of said sets, some of said members being formed with pockets and others of said members being formed with annular courses provided with jets, said members forming an operant series in which the pocket members alternate with the course members and pockets in each member having outlet-openings in the succeeding course, the members in each set being contiguous and each set being capable of withdrawal as a whole from the other set.

Signed at Nos. 9–15 Murray street, New York, N. Y., this 20th day of November, 1902.

CHESTER COMSTOCK.

Witnesses:

FRED. J. DOLE,

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