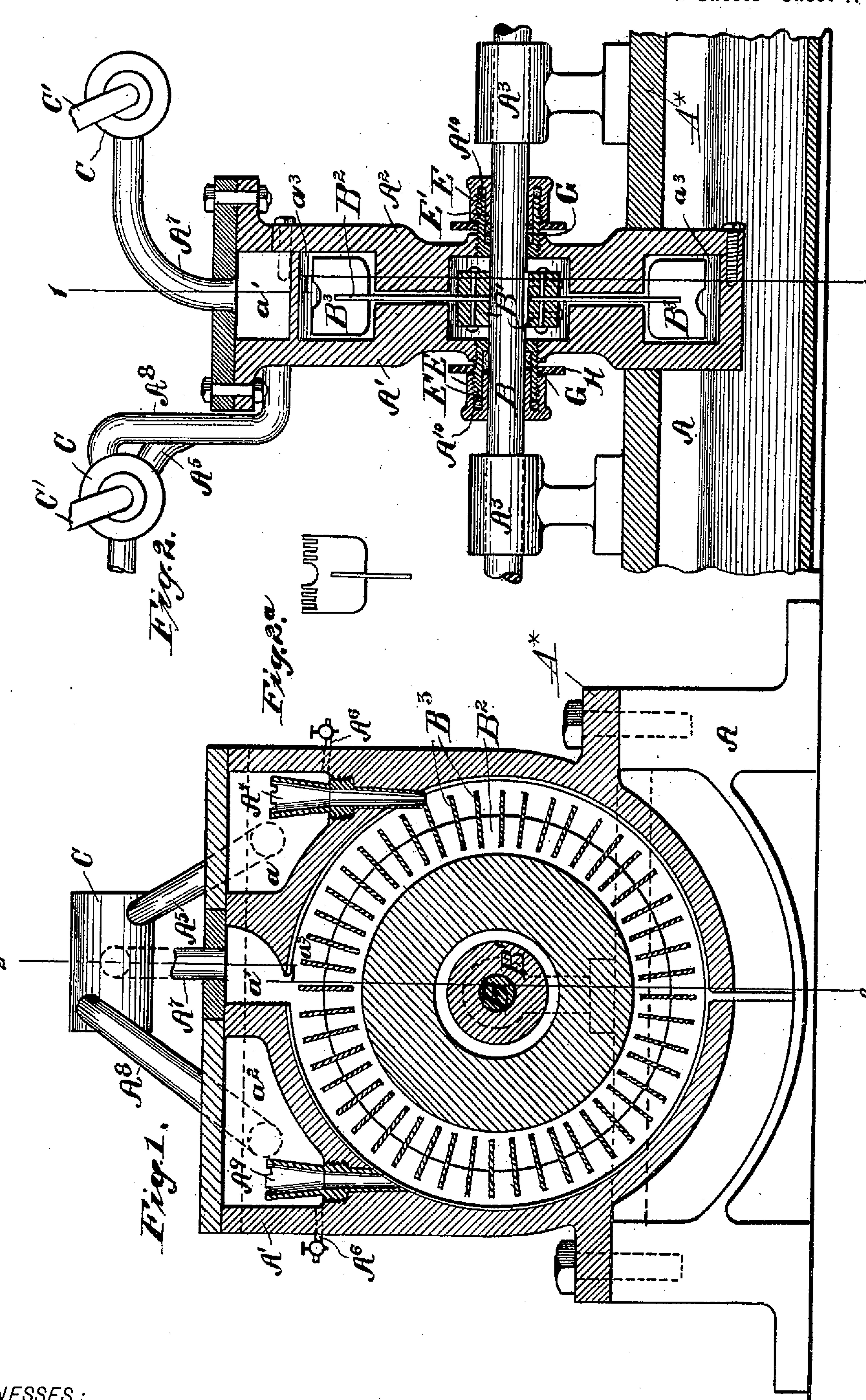
No. 621,586. Patented Mar. 21, 1899.

J. M. SEYMOUR, Jr.

ROTARY IMPACT OR TURBINE STEAM ENGINE.

(Application filed Mar. 28, 1898.)

(No Model.) 2 Sheets—Sheet 1.

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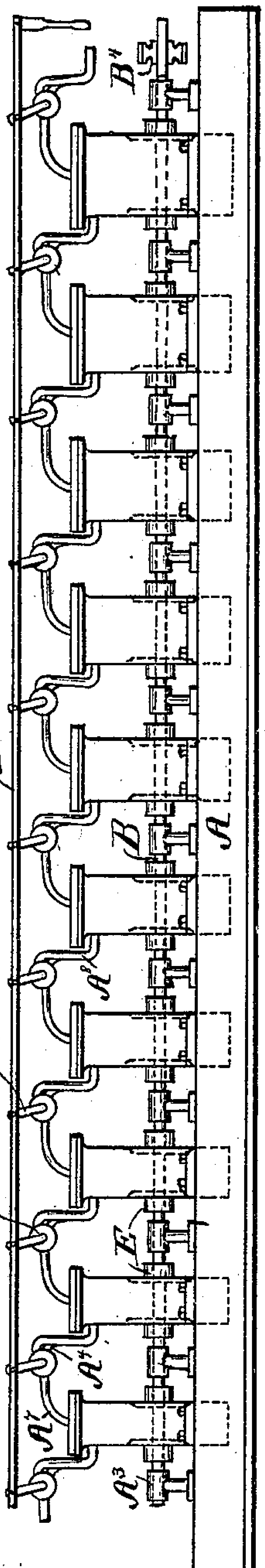

Fig. 3.

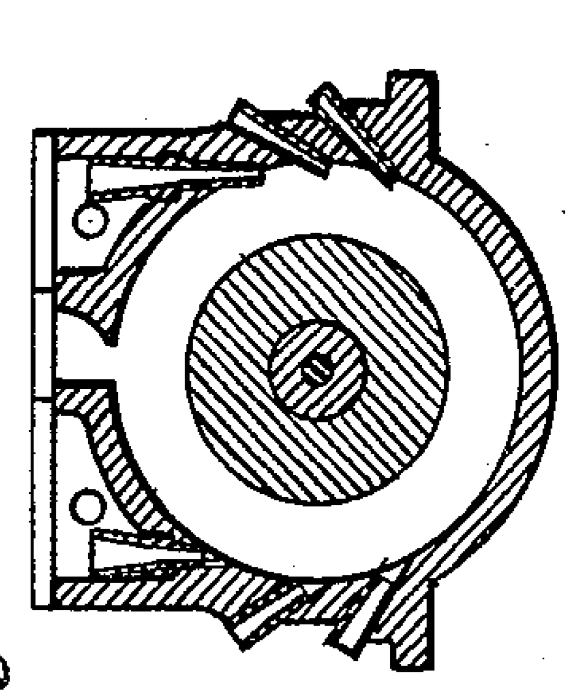

Fig. 7.

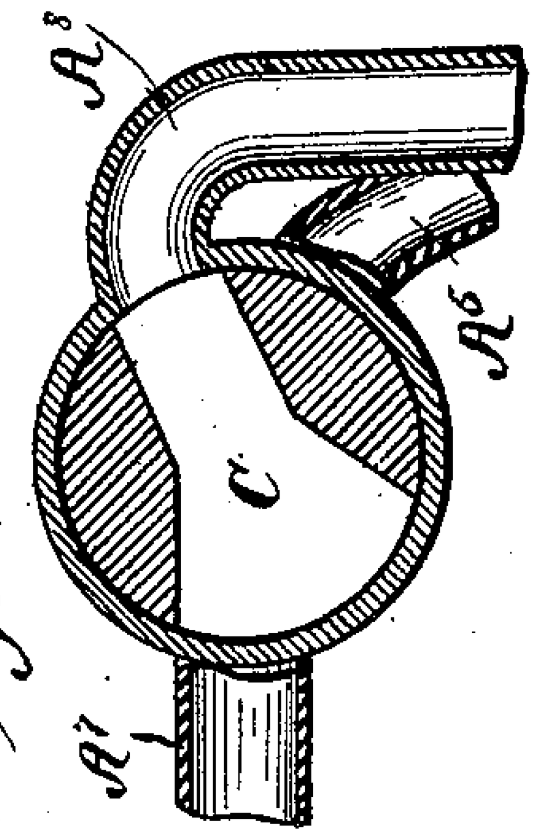

Fig. 6.

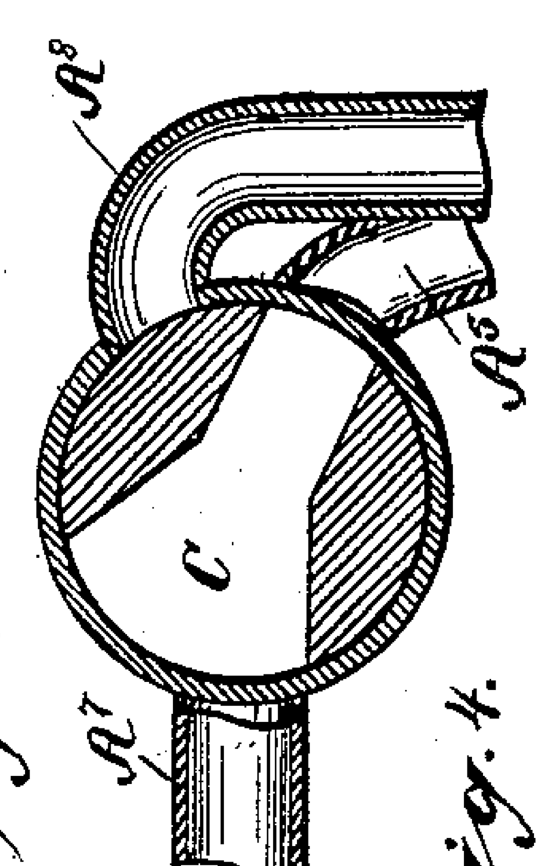

Fig. 5.

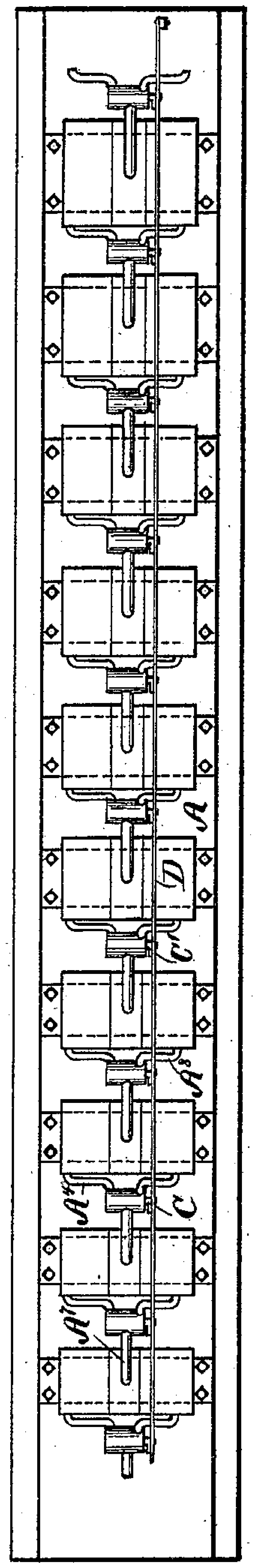

Fig. 4.

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JAMES M. SEYMOUR, JR., OF NEWARK, NEW JERSEY.

## ROTARY IMPACT OR TURBINE STEAM-ENGINE.

SPECIFICATION forming part of Letters Patent No. 621,586, dated March 21, 1899.

Application filed March 28, 1898. Serial No. 675,365. (No model.)

*To all whom it may concern:*

Be it known that I, JAMES M. SEYMOUR, Jr., a citizen of the United States, residing at Newark, in the county of Hudson, in the State of New Jersey, have invented a certain new and useful Improvement in Rotary Impact or Turbine Steam-Engines; and I do hereby declare that the following is a full and exact description thereof.

My improved engine is of that class in which the steam acts in the form of a rapidly-issuing jet arranged to strike against floats in the periphery of a wheel and the whole suitably incased, so that after the steam has partially expended its force in impelling the first wheel it is educted and led to a second wheel, which is preferably of the same diameter as the first, but having its float wider and the space provided therefor in the fixed casing correspondingly wider. The operation of transferring the steam from one casing to another continues, each casing or unit being more capacious than the previous one, and finally the steam is discharged at a merely nominal pressure.

My floats are set squarely across their respective wheels and are capable of favorably receiving steam to turn the wheel in one direction or the other. I provide two nozzles in the casing for each wheel and have devised an arrangement of valves by which the direction of the steam is simultaneously changed in all the units when required. In ordinary uses of an engine the going ahead occupies a much larger proportion of the time and of the power than the motion in the opposite direction. I favor the action in that direction by extending the forward nozzle inward into the path of the floats and correspondingly recess the peripheries of the floats or blades to allow them to pass, while the nozzle for the reverse motion is not so extended, a portion of its efficiency when in reverse motion being sacrificed to avoid its interference with the motion of the steam, and consequently of the wheel in the go-ahead motion.

My invention allows the engine to be compounded to a high degree with an extremely simple form.

The accompanying drawings form a part of this specification and represent what I consider the best means of carrying out the invention.

Figure 1 is a section on the line 1 1 in Fig. 2. Fig. 2 is a corresponding section on the line 2 2 in Fig. 1. Fig. 3 is a side elevation showing the entire series, and Fig. 4 is a corresponding plan view. The remaining figures show details on a larger scale. Figs. 5 and 6 are cross-sections on the three-way cock which serves as a valve. Fig. 5 shows it in the position for going ahead, and Fig. 6 in the position for reverse motion. Fig. 7 is a side elevation showing a modification. Fig. $2^a$ shows a modification in the form of one of the details—the floats.

Similar letters of reference indicate corresponding parts in all the figures where they appear.

A is the fixed support, of cast-iron, certain portions being designated when necessary by supernumerals. I employ a series of wheels and inclosing casings, constituting, with their accompanying parts, the several separate units, which are combined in a series, working the steam in succession through each to the next.

B is a shaft, slender and highly finished to adapt it to run lightly and easily in suitable bearings and stuffing-boxes. It extends through in the axial line of the several casings and carries a series of hubs B′, so spaced as to lie within the several casings. Each hub B′ constitutes the center and firmly connects with the shaft a disk $B^2$. Except in certain dimensions a description of the first unit will suffice for all.

At the periphery of the disk is fixed a series of plane floats, each radial to the shaft. The hub B′, disk $B^2$, and series of floats $B^3$ are stiffly united and constitute the revolving portion of the first unit.

The revolving parts of the several units increase in width from the first to the last. I have shown ten with only a moderate increase in the width; but the number of the units may be varied and the difference in width greatly increased or diminished.

I have the casings for the narrow units at the beginning of the series thick, so as to give more stiffness to resist the tendency to spring apart. The thickness may be reduced for the lower pressures. The several units are so shown in Figs. 3 and 4. The difference in the thickness makes the difference in the breadth of the working portion of each less apparent.

Each unit comprises two principal castings, the first, A′, having lugs which are bolted firmly to the bed or base A, and the second and more readily-removable part, $A^2$, attached to A′ by a series of bolts near the periphery. Each carries a stuffing-box, which will be again referred to farther on. Between the several units are well-lubricated bearings $A^3$, held firmly on the base A and accurately in line.

It will be noted that the elevated top or platform A of the base has an opening for each engine, so that the casing of the same will occupy and depend below said platform, the lateral ears $A^{12}$ integral with the peripheral portion of the casting $A^2$, resting on and bolted to the platform. By this arrangement the engine can be firmly mounted on a substantial base and yet set comparatively low. Figs. 3 and 4 indicate how the base correspondingly receives and supports a plurality of these engines. The intermediate bearings $A^3$ are also bolted on the base.

One overhung end of the shaft B carries a small and accurately-cut gear-wheel $B^4$, from which the power due to the intensely rapid revolution of the shaft is transmitted by ordinary reducing-gear (not shown) to drive any machinery to which this efficient and compact form of engine is adapted.

Returning to the description of the first unit, the steam is introduced to the wheel through a tangential nozzle $A^4$, which is provided with screw-threads near its mid-length, by which it is set upright in the part A′, with its upper end enlarged and adapted to be turned by a suitable wrench in inserting and removing it from time to time. The upper end is inclosed in a considerable chamber *a*, which receives the steam through a pipe $A^5$, which will be again referred to farther on. The lower portion of the chamber *a*, around the tapering nozzle $A^4$, is drained by a pipe $A^6$, with ordinary provisions, as a cock, for opening it at intervals or setting it a little open during the entire working, with the effect to insure that the steam allowed to blow down in a strong jet through the nozzle $A^4$ is practically freed from water. The floats $B^3$ travel around in a capacious annular chamber $a^3$. The discharge end of the nozzle $A^4$ extends into this channel. (See Fig. 1.) The outer edge of each float is recessed and the whole so proportioned that they avoid contact with this nozzle, and also leave a considerable passage in which the steam received through the nozzle at an intensely high velocity and directed very effectively against those floats $B^3$ which are immediately adjacent to the nozzle is allowed to travel nearly around, acting on the several floats more or less efficiently all the way. A passage $a'$ at the highest point in the channel $a^3$ provides for the eduction. Through this passage the steam rises into a pipe $A^7$, still retaining a considerable portion of its original boiler-pressure, and is ready to be similarly inducted into the next unit, and so on.

C is a three-way cock of sufficient capacity to allow the steam to move through with little resistance. It is operated by a lever C′, connected to a longitudinal rod D, which may be operated either directly or by a suitable lever or wheel. (Not shown.) When the plug of this cock is in one position, (that shown in Fig. 5,) it directs the steam received through the eduction-pipe $A^7$ from the last preceding unit, so that it is delivered through the induction-pipe $A^5$ of the next succeeding unit, and so on. Thus conditioned the shaft is revolved in the opposite (the reverse) direction.

When the rod D is moved endwise, it operates all the stop-cocks C, turning each plug into the position shown in Fig. 6, and thus performs the important operation of reversing the motion of the engine. In this reversed condition the steam is received from the boiler or from the preceding unit through the pipe $A^7$, as before; but instead of being delivered to the next unit through the ordinary induction-pipe $A^5$ it is delivered through a supplementary induction-pipe $A^8$. This leads to a chamber $a^2$, having a form and arrangement the reverse of the chamber *a*. In this chamber $a^2$ I mount a nozzle $A^9$, which may be similar to the nozzle $A^4$, except that it is shorter. The portion of the time in which an engine under any ordinary conditions is required to run backward is so small relatively to that in which it runs in the forward direction that we can afford to use the steam less efficiently and less economically in the backward motion. The nozzle $A^4$ for the going-ahead motion extends well into the annular chamber $a^3$ and somewhat into the path of the floats $B^3$ and by that arrangement increases the efficiency of the jet in the go-ahead motion; but if there were a corresponding extension of the other nozzle $A^9$ such extension would do harm by interfering with the flow of the steam as it accompanies and exceeds the rapid revolving motion of the floats. The nozzle $A^9$ is therefore extended only so far as allows it to terminate completely outside of the chamber $a^3$.

There is one stop-cock C between each unit and the next and also one between the first unit and the boiler. When the engine is conditioned for going ahead, the steam received from the boiler (not shown) through the pipe $A^7$ is directed at full pressure into the chamber *a* of the first unit, it parts with its water, if it has any, in that chamber, and the dry steam is discharged therefrom, through the nozzle $A^4$, upon the favorably-presented floats $B^3$. Thence it flows around faster than the rapid revolutions of the floats, and consequently of the shaft B, and escapes through the passage $a'$ up through the eduction-pipe $A^7$ and through the similarly-set stop-cock C of the second unit, from whence it flows through the induction-pipe of the second unit in the same manner as it was received from the boiler into the first unit and with the same effect, except that it is at a lower pressure. The increased width of the second unit allows this lower pressure to be efficient, and the steam after flowing through this unit moves to the third at a still lower pressure, and so on through the series.

The ratio of breadth of the several units, several times before referred to, is important. The rate of rotation of the floats within all are necessarily uniform, because all are rigidly fixed on the same shaft; but the widths of the units and the capacity of the chambers $a^3$ can be so graduated that the pressure of steam received at a hundred pounds in the first unit may be reduced by uniform steps—ninety, eighty, seventy, &c.—or it may be reduced by other steps, as eighty, sixty-five, fifty-two and one-half, forty-two, &c., or according to any other ratio. An approximation to the latter rate of reduction may be preferable, so as by giving less difference in pressure in the induction and eduction in the wide terminal units to compensate for the greater area of the floats therein, and thus to attain an approximately uniform strain on the several disks $B^2$ and hubs B′.

It is not important to the success of my engine to maintain close fits between relatively-moving surfaces except the stuffing-boxes around the shaft. These (shown in Fig. 2) are capable of easy adjustment, so as to arrest the passage of the steam and make but little friction.

The tubes $A^{10}$ on the stationary parts A′ and $A^2$, respectively, are externally threaded, and each receives an internally-threaded cap E, which latter carries an inner tube E′, lying against the shaft, effecting the compression on the packing G. An internally-threaded washer H of larger diameter may be applied in the position represented to serve as a jam-nut to avoid any possible turning of the nicely-adjusted cap by the friction of the shaft. These portions of the casting A′ $A^2$ which are adjacent to the plane faces of the disk $B^2$ need not fit tightly. Obviously those surfaces will be more nearly in contact with the rapidly-revolving disk within when the steam is shut off and the pressure is down than when they are sprung apart by the full force of high-pressure steam between them. In any given unit after the central space around the hub has been filled with steam at the mean pressure which obtains in that unit there is but little tendency for steam to flow in any direction through that space. The reduction of pressure which occurs in each unit takes place mainly close to the discharge end of the nozzle $A^4$, and the steam discharged from that nozzle strikes the floats immediately presented and acts strongly thereon. After being thereby partially arrested it mainly flows around in the annular channel $a^3$, acting slightly on each, but in the aggregate with considerable force on the series of floats until it has traveled some three-fourths of the circuit and then escapes.

Each annular chamber $a^3$ is lined on its exterior side with a different metal, as copper or brass, smoothly finished and burnished. The considerable space allowed between such surface and the path of the floats is traversed by the rapidly-moving steam with but very little resistance, except as it acts on the outer edges of the floats, to usefully impel the wheel.

It is easy to vary the proportion of the expansion occurring in any given unit by simply enlarging the nozzles by which the steam after passing through this unit is discharged into the next. Thus if the first unit receiving the steam from the boiler at a hundred is by the aid of a gage on the connection or by other means found to discharge it at, say, ninety it can be easily made to discharge at a lower pressure and thus utilize more of the force of the steam in this first unit by simply boring out the interior of the induction-nozzle $A^4$ of the second unit.

My engine utilizes the steam at a lower velocity than ordinary steam-engines of its class. If steam at high pressure is allowed to flow directly into the atmosphere, its velocity is some two or three thousand feet per second—too high to be utilized by its impact without great loss in the gearing, which reduces the velocity. In my engine it has in entering each unit only a moderate velocity due to the difference of pressure between the induction and the discharge in that unit. Thus if in the first unit it is reduced from one hundred pounds to ninety it will have a velocity of something like six hundred and sixty feet per second and about the same velocity in each of the several units. The lower velocity imparted to my shaft is reduced to practicable speeds with less loss in the gearing by reason of the initial velocity being so much lower.

I attach importance to the fact that by lining the iron with a non-oxidizable metal and burnishing the surface exposed to the violent friction of the steam I reduce the loss from friction and may allow the engine to remain unused a long period without serious deterioration of the burnished surface; also to the fact that the notch in the outer edge of each blade allows the nozzle for the forward motion to extend well into the path of the blades, making its action peculiarly efficient; also that my rolling valves are connected independently to a single operating-rod, because it affords facility for control with easy independent adjustment or repairs; also to the fact that my series of units or separate engines are of uniform diameter, but of successively-increasing width, because this arrangement provides for an even disposition of the ends, bearings, valve-rod connections, &c.

Modifications may be made without departing from the principle or sacrificing the advantages of the invention. The number of the floats $B^3$ in some or all of the units may be greater or less than shown. I have described the floats as plane and attach importance to that condition; but it may be expedient in some cases to give a slight degree of curvature, making each float a portion of a cylinder or a portion of a sphere; but it is essential to success that the floats shall be so nearly plane that they will work efficiently in obedience to the action of jets of steam in either direction. Parts of the invention may be used without the whole. I can dispense with the provisions by the cavities $a$ and $a^2$ for drying the steam. There may be two or more jets inducting steam into each unit. Fig. 7 shows such arrangement. They may be distributed uniformly or otherwise. I have shown them aggregated near the main induction-points first shown. I have shown the outer edge of the floats as provided with a nearly semicircular notch in its mid-width. The form of this notch may be varied. It may be found preferable to form the whole outer edge of the float with notches, as indicated in Fig. $2^a$. It will be understood that there are ordinary provisions for lubricating and for regulating, &c. The regulation may be effected by an ordinary throttle-valve controlling the flow from the boiler.

I claim as my invention—

1. A rotary impact steam-engine comprising a wheel with plane floats free to revolve loosely in a suitably-formed space in an inclosing casing, the floats having each a deep notch in its outer edge and provisions as the gear-wheel $B^4$ and connected parts for communicating power, two jet-nozzles $A^4$ and $A^9$, arranged to drive the wheel in opposite directions, the jet-nozzle $A^4$ which drives it in the forward direction being extended into the notches, and the jet-nozzle $A^9$ terminating at a point outside of the path of the rotating steam, all substantially as herein specified.

2. The combination with a base having the platform provided with a series of transverse openings adapted to snugly receive a corresponding series of engine-casings, of a rotary steam-engine for each opening, the casing of which comprises the castings $A'$, $A^2$, depending below the platform-opening and having lateral integral ears bolted to the platform, and a suitable float-wheel, impelling jet-nozzle and exhaust, substantially as herein specified.

3. A rotary impact steam-engine comprising a wheel with plane floats free to revolve loosely in a suitably-formed space in an inclosing casing, the floats having each a deep notch in its outer edge and having provisions as the gear-wheel $B^4$ and connected parts for communicating power, two jet-nozzles $A^4$ and $A^9$ arranged approximately tangential, adapted to serve alternately to drive the wheel in opposite directions, the jet-nozzle $A^4$ being extended into the float-notches, in combination with other wheels set on the same shaft and corresponding casings each receiving the steam from the preceding and forming a series in which the steam impels the wheels with successively-diminished pressure, and with corresponding three-way cocks C, with provisions for operating the series from a single operating part as the rod D, controlled by the attendant, all substantially as herein specified.

4. A rotary impact steam-engine comprising a casing, the sides of which are thick to prevent springing apart and provide the inner enlargements forming a central hub-chamber, liberal float-chamber $a^3$, and narrow connecting annular passage, a lining material for said float-chamber adapted to maintain a burnished condition, a shaft bearing in the casing sides and carrying a wheel the web of which moves in the narrow passage and carries at its periphery within the chamber $a^3$ a series of notched floats, in combination with a steam-supply jet-nozzle extending in the path of the notches, arranged approximately tangentially for driving the wheel, and suitable steam-exhaust, substantially as set forth.

5. A rotary impact steam-engine comprising a casing the sides of which are thick to prevent springing apart and provide the inner enlargements forming a central hub-chamber, liberal float-chamber $a^3$, and narrow connecting annular passage, a shaft bearing in the casing sides and carrying a wheel the web of which moves in the narrow passage and carries at its periphery within the chamber $a^3$ a series of notched floats, a steam-supply jet-nozzle arranged approximately tangentially and extending in the path of the notches, in combination with other wheels set on the same shaft and corresponding casings of diminished thickness, each receiving the steam from the preceding and forming a series in which the steam impels the wheels with successively-diminished pressure, and with corresponding three-way cocks C, with provisions for operating the series from a single operating part as the rod D controlled by the attendant, all substantially as herein specified.

6. A rotary impact steam-engine comprising a series of wheels mounted to rotate with a single shaft and each having a series of plane floats deeply notched at their edges, said floats being operated by the impact of the steam applied tangentially on each by jet-nozzles $A^4$, $A^9$, the former extending into the float-notches, the several units maintaining uniform diameters but successively increasing in breadth and being so connected that the steam shall pass through all in succession, substantially as herein specified.

In testimony that I claim the invention above set forth I affix my signature in presence of two witnesses.

J. M. SEYMOUR, Jr.

Witnesses:
J. B. CLAUTICE,
M. F. BOYLE.