

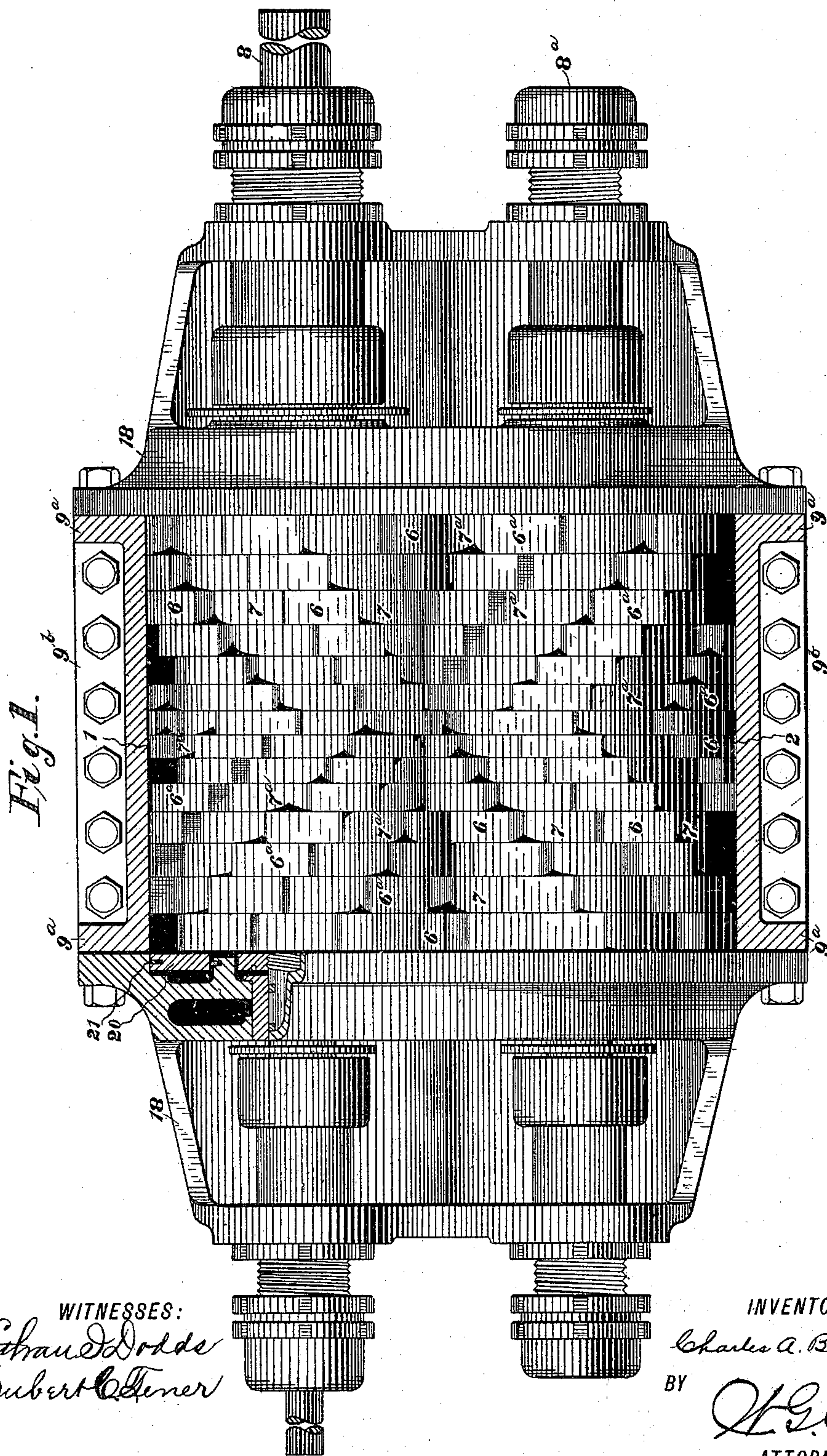
(No Model.)

3 Sheets—Sheet 1.

C. A. BACKSTROM.
STEAM ENGINE.

No. 572,946.

Patented Dec. 15, 1896.



WITNESSES:

Edward Dodds
Hubert C. Finer

INVENTOR

Charles A. Backstrom

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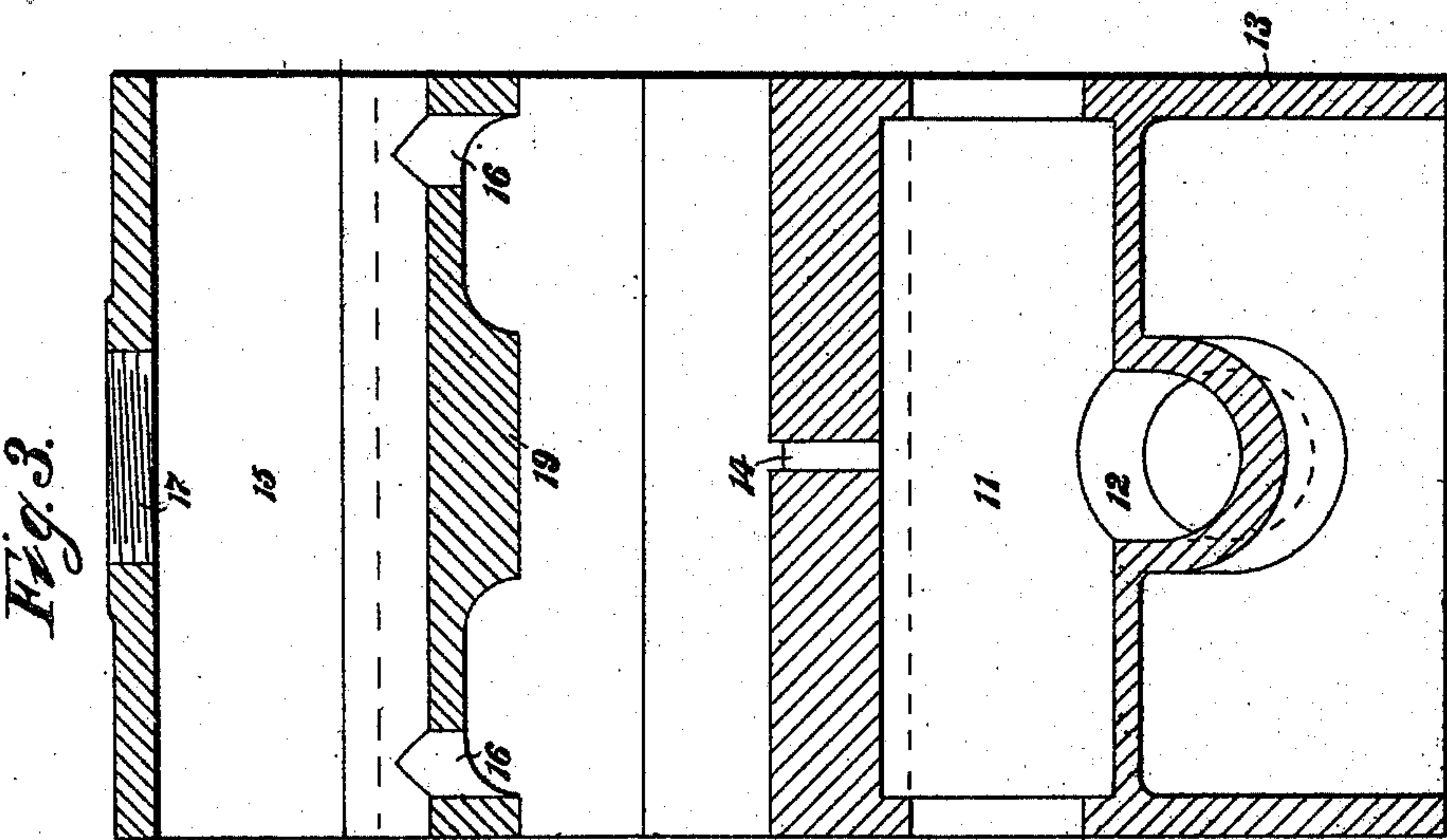
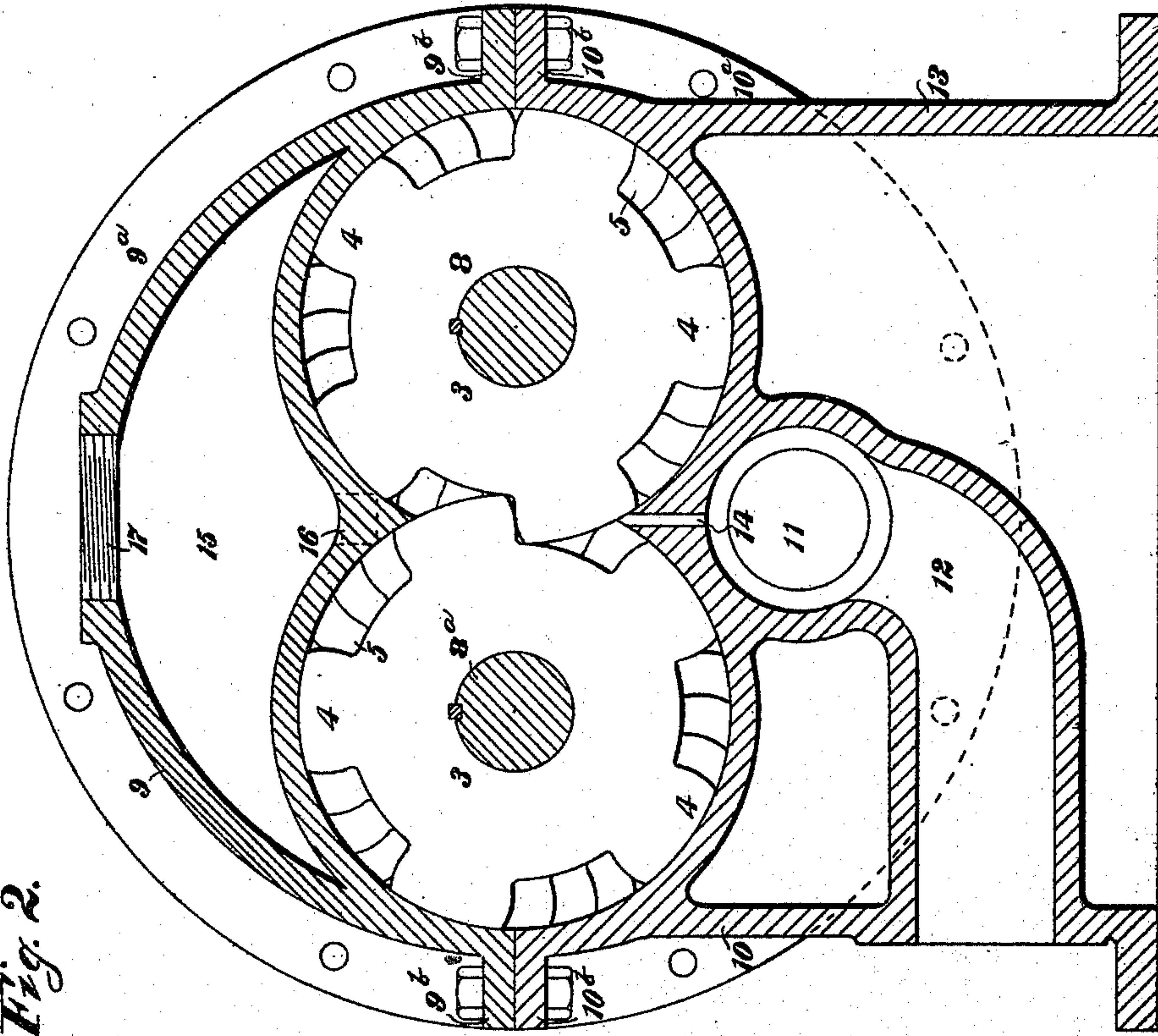
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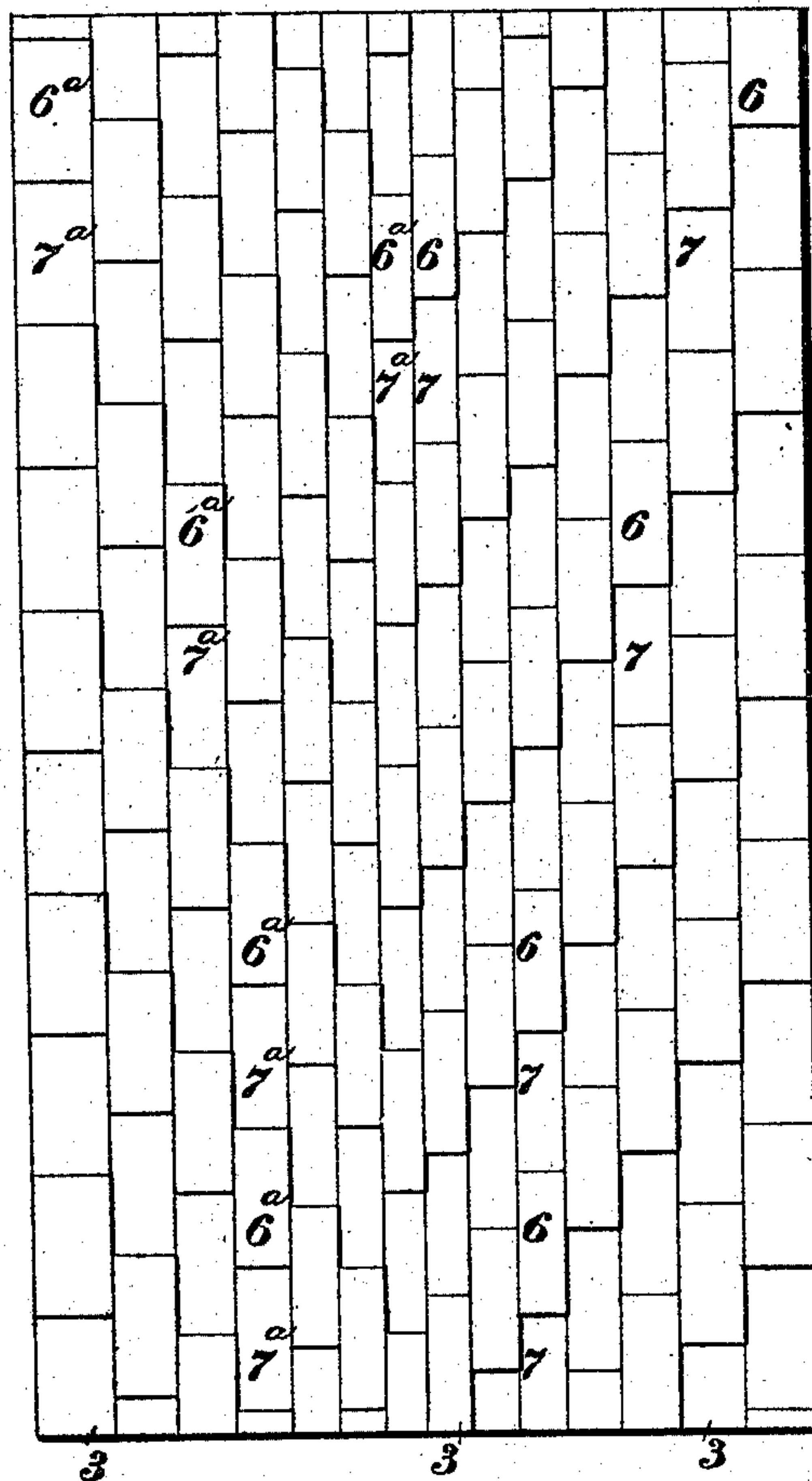
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Fig. 4.



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UNITED STATES PATENT OFFICE.

CHARLES A. BACKSTROM, OF NEW YORK, N. Y., ASSIGNOR TO GEORGE WESTINGHOUSE, OF PITTSBURG, PENNSYLVANIA.

STEAM-ENGINE.

SPECIFICATION forming part of Letters Patent No. 572,946, dated December 15, 1896.

Application filed January 13, 1896. Serial No. 575,269. (No model.)

To all whom it may concern:

Be it known that I, CHARLES A. BACKSTROM, a citizen of the United States, residing in New York, in the county and State of New York, have invented a new and useful Improvement in Steam-Engines, of which the following is a specification.

My invention relates to steam-engines, and more particularly to that general class of engines in which steam is utilized to directly produce rotary motion, as distinguished from that general class in which steam effects a longitudinal reciprocating motion of a piston, and in which rotary motion is derived from such reciprocating piston by means of additional mechanism.

The object of my invention is to provide an engine which shall be simple and compact in its construction, which shall have great piston speed and consequent economy in its consumption of steam, and which may be easily operated and governed.

With these ends in view I have devised an engine in which a plurality of cylinders or drums provided with zigzag gear-teeth and corresponding grooves are arranged in a closely-fitting casing, so that the teeth and grooves of the adjacent drums or cylinders shall intermesh, whereby a body of steam introduced under suitable pressure between such drums or cylinders into the grooves successively and then cut off shall act expansively upon the teeth and cause the drums to rotate in opposite directions, the steam being exhausted after it has become expanded to such a degree as to perform no effective work.

My invention is illustrated in the accompanying drawings, in which—

Figure 1 is a plan view of the engine, a portion of the casing being shown in section. Fig. 2 is a transverse vertical section through the drums and casing, and Fig. 3 is a longitudinally vertical section through the casing, the heads and the cylinders being omitted. Fig. 4 is a development of one of the cylinders.

Referring to the drawings in detail, 1 and 2 are the cylinders or drums, which are exact duplicates of each other and which are preferably built up of plates or disks 3, as indicated most clearly in Fig. 2. As shown in

Figs. 1 and 4, these plates or disks 3 vary in thickness, the thickest plates being at the ends of the drums and the thinnest ones at the middle, the decrease in thickness from the ends to the middle being a gradual one. By reason of this construction the expansion of the steam, and consequently the work done by it, is effected in the shortest possible time, and, furthermore, the smallest possible portion of the cylinders or drums is unbalanced at any time by unequal pressures. This construction of the drums is not essential to the operation of my invention, however, and in practice it may sometimes be found desirable to make all of the plates or disks of the same thickness as well as of the same contour. I have also shown each plate as provided with five gear-teeth 4 and five spaces 5 alternating therewith, but this number may be more or less than five, if desired.

The drums or cylinders are built up to form a perfect gear of a certain number of teeth, depending upon the number of plates and the number of teeth in each plate, each successive plate being placed in advance of the preceding plate, so as to form an element of the completed gear. In the example shown in the drawings fourteen plates are employed in building up each drum, each of said plates having five teeth. It will thus be seen that each drum is provided with two complete gears, each of which has thirty-five elements or teeth, those of one set or gear being substantially a half-tooth in advance of the other and the two gears being pitched in opposite directions from the central plane of the drum. These plates thus assembled upon a suitable shaft are rigidly clamped together.

6 and 6^a are the rows of zigzag gear-teeth, which constitute pistons and which will be hereinafter designated as "gear-tooth" pistons, and 7 and 7^a the corresponding rows of zigzag grooves, which, in conjunction with the contiguous portions of the casing, constitute expansion-chambers. The gear-tooth pistons 6 and grooves 7 extend in helical lines from the central plane of the drum to one end, and the gear-tooth pistons 6^a and grooves 7^a in the same manner from the central plane to the other end of the drum. The two drums are constructed exactly alike, and when

placed side by side in contact the gear-tooth pistons 6 6^a of one drum will engage with the grooves 7 7^a of the other drum, as will be readily understood.

5 While I prefer to place the drums side by side, so that their axes shall lie in the same horizontal plane, it will be understood that they may be otherwise arranged, if desired.

In the construction shown each of the sets
10 of pistons and grooves extends over a little more than one-third of the circumference of the drum, and this has been found a desirable and satisfactory arrangement in practice, but it is obvious that this length may be
15 varied within considerable limits, if desired. I have also shown each of the drums as made up of fourteen toothed plates, but it is obvious that a greater or less number may be employed without departing from the inven-
20 tion.

The drum 1 is mounted upon and keyed to a shaft 8, and the drum 2 is similarly mounted upon and keyed to a shaft 8^a. The longitudinal portion of the casing for the drums 1 and
25 2 is made in two parts 9 and 10, provided, respectively, with a semicircular flange 9^a and 10^a at each end and with side flanges 9^b and 10^b, the latter being fastened together by bolts, as shown. The inner contour of the
30 casing is such as to exactly fit the drums, the two portions communicating at their adjacent sides. The width of this communicating opening will obviously be dependent upon the depth of the teeth upon the drums.

35 Extending longitudinally of the casing and centrally below the two drums is a chamber 11, into which steam is admitted through a conduit 12, extending through the base 13. An inlet-port 14 is located at the middle of
40 the chamber 11, this location being such as to admit the steam into the space formed between the teeth on the two cylinders located midway between their ends. Located in the opposite side of the casing is an ex-
45 haust-chamber 15, with which communicate two exhaust-ports 16, located, respectively, near the ends of the drums. The exhaust from the chamber 15 is through a centrally-located outlet 17. The arrangement of these
50 ports and chambers may be considerably varied in practice and the chambers 11 and 15 may be omitted altogether, if desired. The shafts 8 and 8^a are journaled in heads 18, bolted to the flanges 9^a and 10^a, these heads
55 being provided with the usual boxes and oiling devices, which, as they form no part of my invention, need not be further described.

In the present invention I have shown the shaft 8 as longer than the shaft 8^a, this longer
60 shaft being intended for the application of a pulley or other suitable power-transmitting device. It will be readily understood, however, that power might be transmitted from either or both of the shafts, if desired. It
65 should be stated that the central portion 19 of the part 9 of the casing is or may be extended downward between the two drums in order to

insure a slight compression of steam sufficient to properly balance the drums. If this or
70 some other provision were not made, the upward pressure of the steam entering through the port 14 might cause binding and frictional wear between the drums and the contiguous upper side of the casing.

While I have shown the inlet-port located
75 at the bottom of the casing and the exhaust-ports at the top, it will be understood that this arrangement may be reversed, if desired, in practice, the operation being the same in both cases, except that in the form shown the
80 upward pressure of the steam will serve to counterbalance the weight of the drums.

At each end of each cylinder or drum a ring or plate 20 is located, as shown in Fig. 1. This plate may be provided with suitable
85 packing 21, as indicated, or the packing may be dispensed with. These rings or plates 20 serve as a means for retaining the steam until a complete turn of the drums takes place.

The operation of the engine may be briefly
90 stated as follows: When the steam is introduced through the inlet-port 14, it enters the expansion-chamber formed by the teeth adjacent to the port and the contiguous portion of the casing, and as the teeth constitute pis-
95 tons against which the steam acts the drums are caused to rotate in opposite directions. As the rotation continues the steam is cut off and a progressively-increasing space is afforded for the expansion of the body of steam
100 admitted and a constantly-increasing effective piston area is provided until the steam reaches the ends of the drums, when, on account of the end plates, it will be carried as
105 dead steam until the exhaust-ports are reached, when it will be exhausted into the chamber 15. This operation is continuous, for as soon as one of the drums has rotated a very short distance after the first introduction
110 of the steam the other drum will receive steam, which in turn will be cut off. The central space between the next adjacent pistons of the first drum will then come beneath the inlet-port and a supply of steam will be
115 admitted to that space and then cut off and expanded to the ends of the drum as the rotation continues. This introduction and expansion of steam successively into one space or groove after another will be repeated and the rotation of the drums be thus rendered
120 continuous. With this arrangement of zig-zag gear-tooth pistons and grooves the rotation of the two drums exactly in unison and without any slip is insured, said pistons and grooves constituting a perfect gear. It thus
125 appears that the entire expansive force of the steam is utilized without waste and in such a manner as to produce the most desirable results.

While I have shown an engine comprising
130 two drums provided with a specific number of pistons and expansion-chambers and a casing provided with two exhaust-ports located opposite the inlet-port, I desire it to be

understood that my invention is not limited as regards the number, dimensions, or arrangement of the said parts.

I claim as my invention—

5 1. A steam-engine consisting of a casing and a pair of drums provided with a plurality of intermeshing zigzag gear-tooth pistons and corresponding grooves diverging in helical lines from the central plane of the drums and
10 each extending over a portion of the circumference to the ends thereof, said grooves, in conjunction with the contiguous portions of the casing, constituting sets of expansion-chambers, said casing being provided with a
15 port for admitting steam at the meeting-points of the successive grooves and gear-tooth pistons during the rotation of the drums, and with means for exhausting the steam after it has become expanded to the effective
20 limit, and said casing and pistons serving to cut off the steam from the sets of expansion-chambers successively when the initial chambers become filled.

2. In a steam-engine, the combination with
25 a casing, of a plurality of rotary drums provided with helically-arranged, intermeshing, zigzag gear-tooth pistons and with corresponding grooves which, in conjunction with contiguous portions of the casing, constitute
30 expansion-chambers, said casing being provided with means for admitting steam to the initial chambers successively, and with one or more exhaust-ports for permitting the escape of the steam from the inclosing casing
35 after it has become expanded to its effective limit, and said pistons, in conjunction with said casing, serving to cut off the steam from the initial chambers successively after the same become filled.

40 3. A multiple-piston steam-engine consisting of a plurality of rotatable drums each of which is provided with a plurality of sets of zigzag gear-tooth pistons, and a casing provided with inlet and exhaust ports, the spaces
45 between said gear-tooth pistons and casing constituting a plurality of sets of expansion-chambers helically disposed and pitched in opposite directions from the middle of the drums, those of each set being successively
50 opened for the admission of steam as the drums rotate, the steam being successively introduced into the initial chambers, cut off therefrom, and then progressively expanded into the succeeding chambers, whereby it is

caused to act upon a constantly-increasing 55 piston area.

4. A multiple-piston steam-engine consisting of a casing provided with inlet and exhaust ports and a plurality of rotatable drums each of which is provided with a number of 60 helically-disposed, zigzag gear-tooth pistons of progressively-increasing thickness from the middle to the ends of the drums, the spaces between said pistons and casing constituting sets of expansion-chambers, those of each set 65 being of progressively-increasing capacity from the middle to the ends of the drums, the steam being successively introduced into the middle chamber, cut off therefrom, and then progressively expanded in the succeeding 70 chambers, whereby it is caused to act upon a constantly-increasing piston area.

5. The combination with a casing, of a pair of cylindrical, rotatable drums for the reception and direct utilization of steam expan- 75 sively, each composed of a series of disks or plates respectively provided with a plurality of peripheral teeth each of which has a perfect gear-tooth contour, said disks or plates being assembled so that the teeth of adjacent 80 plates break joints, whereby helical, zigzag or stepped gear-tooth pistons and corresponding grooves are formed, said grooves and the adjacent portions of the casing constituting expansion-chambers, and cut-off points. 85

6. In a steam-engine, the combination with a casing, of a pair of rotatable drums for the reception and direct utilization of steam ex- 90 pansively, each composed of a series of disks or plates each of which has a plurality of peripheral gear-teeth, the teeth of each successive plate, beginning at each end of the drum, being set in advance of those of the preceding plate, thereby forming a series of zigzag 95 or stepped gear-tooth pistons and corresponding grooves which diverge from the central plane of the drum and extend to its ends, said grooves and the adjacent portion of the casing constituting expansion-chambers, and cut-off points. 100

In testimony whereof I have hereunto subscribed my name this 10th day of January, A. D. 1896.

CHAS. A. BACKSTROM.

Witnesses:

JAMES B. YOUNG,
HUBERT C. TENER.