No. 789,681. PATENTED MAY 9, 1905.

A. BENEDETTO.

VIBRATORY STEAM ENGINE.

APPLICATION FILED DEC. 10, 1904.

2 SHEETS—SHEET 1.

Fig. 2.

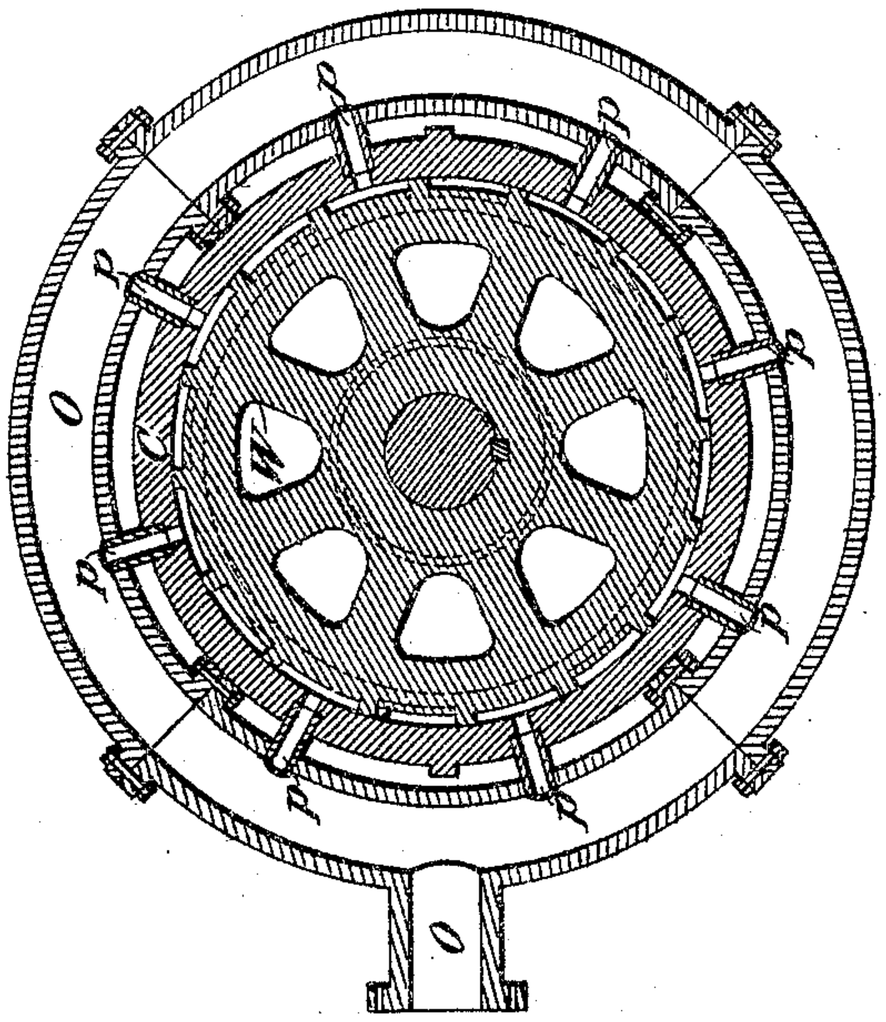
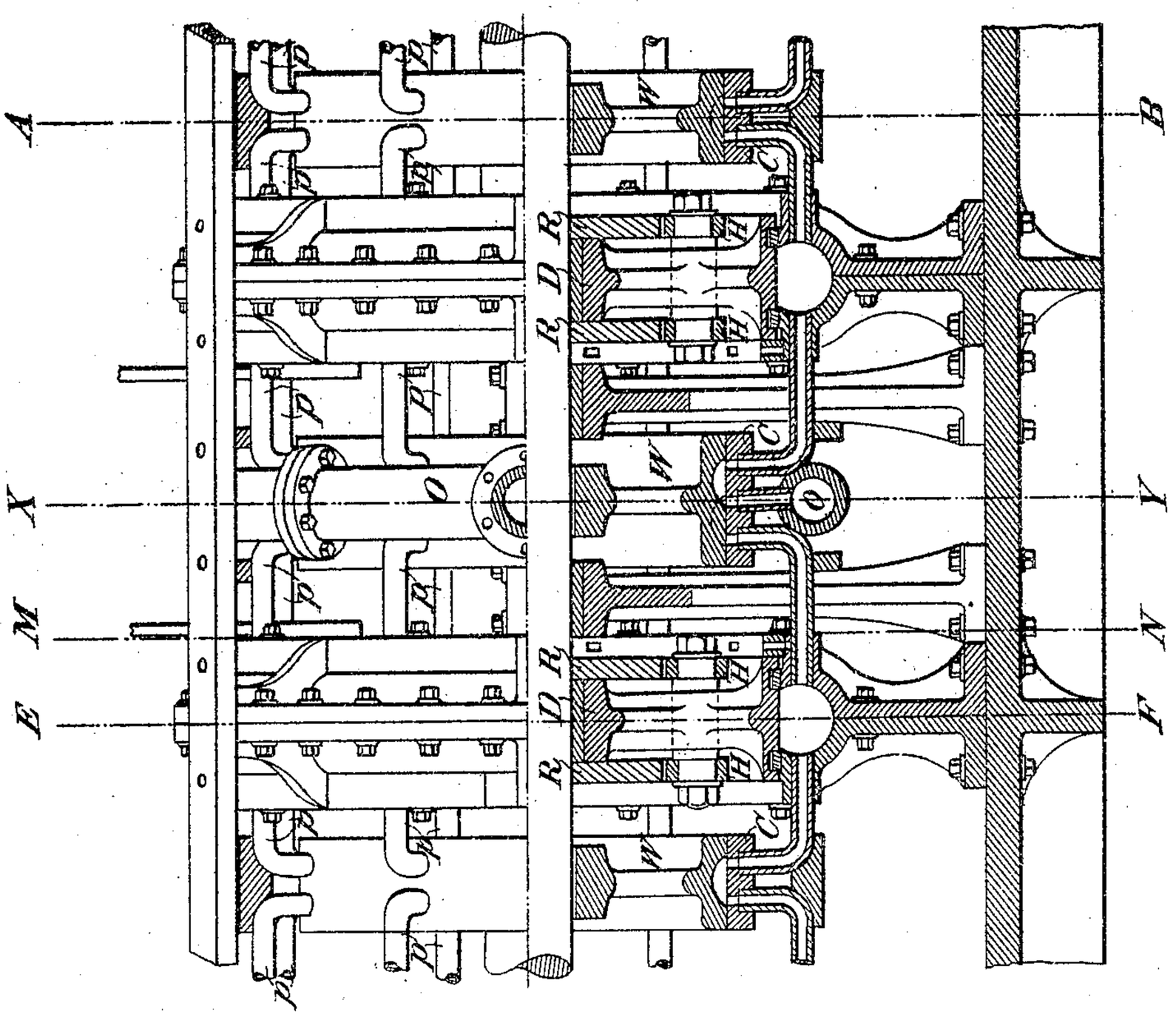


Fig. 1.



Witnesses:
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John Callahan

Inventor:
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Fig. 4.

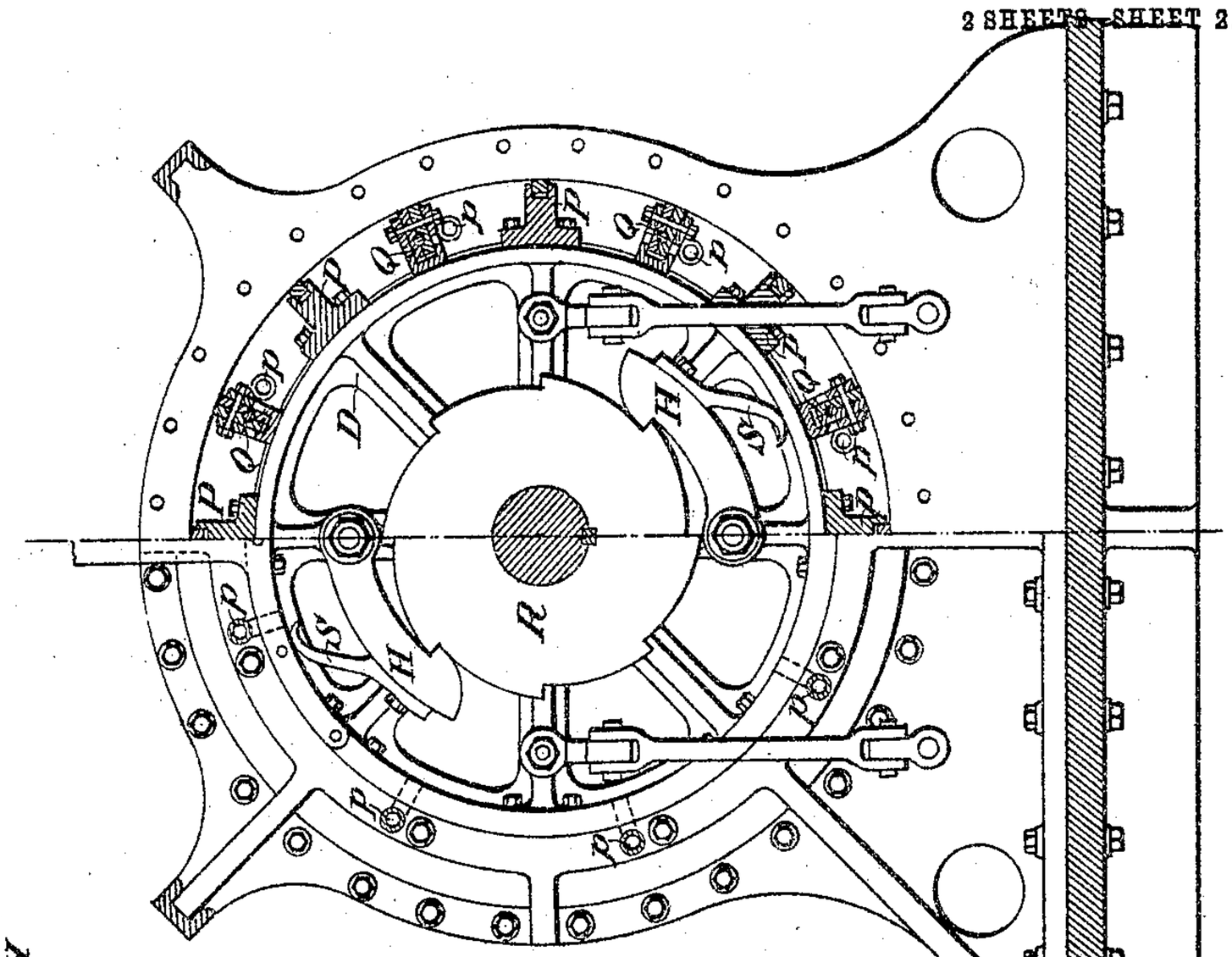


Fig. 5.

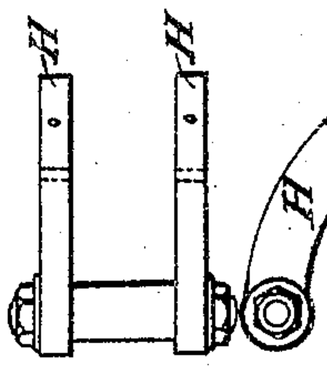
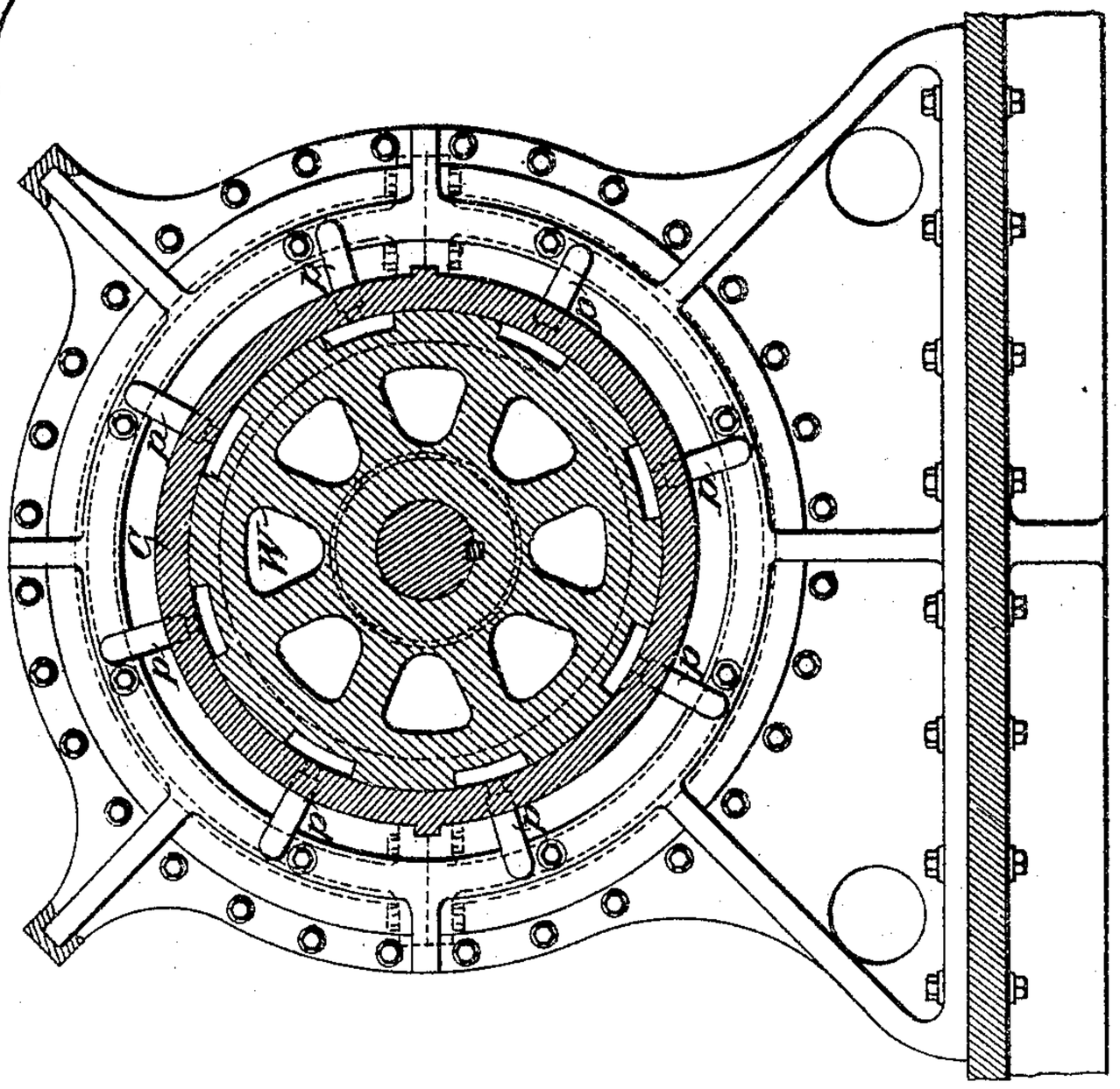


Fig. 3.



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No. 789,681. Patented May 9, 1905.

UNITED STATES PATFNT OFFICE.

ANTONIO BENEDETTO, OF WASHINGTON, DISTRICT OF COLUMBIA.

VIBRATORY STEAM-ENGINE.

SPECIFICATION forming part of Letters Patent No. 789,681, dated May 9, 1905.

Original application filed June 28, 1904, Serial No. 214,564. Divided and this application filed December 10, 1904. Serial No. 237,346.

To all whom it may concern:

Be it known that I, ANTONIO BENEDETTO, a citizen of the United States, residing at Washington, District of Columbia, have invented an Improvement in Multiple-Expansion Vibratory Steam-Engines of the type described in the application, Serial No. 214,564, filed June 28, 1904, of which improvement the following is a specification.

My invention relates to an arrangement for the non-reversibility of steam-engines of the type stated above; and the object of my invention is to simplify the construction and to reduce the cost of manufacture of steam-engines of the said type when the reversibility of the engine is not required. I attain this object by the mechanism illustrated in the accompanying drawings, in which—

Figure 1 shows the middle portion of the engine or the feed-pipe and the two high-pressure steam-chests. The upper part from the center of the shaft shows the elevation and the lower part shows the longitudinal section. Fig. 2 is a cross-section taken in the center of the engine according to the line X Y, Fig. 1. Fig. 3 shows a cross-section taken between a high and a low pressure steam-chest or according to the line A B, Fig. 1. The dotted lines show the fastening-ring around the steam-passages. Fig. 4 on the left-hand side shows a cross-section according to the line E F, Fig. 1, and on the right-hand side shows a cross-section according to M N. The driving and the ratchet wheel in the center, with the pawls, are shown in full elevation. Fig. 5 shows the plan and elevation of a couple of single pawls which are to be attached to the driving-wheels.

Similar letters refer to similar parts throughout the several views.

The engine consists of two series of annular steam-chests fastened at the base to a bedplate, each series starting from the center of the engine, where an annular feed-chamber is employed, and terminating at the extremities, where at each end an annular exhaust-chamber is employed. The two series of steam-chests are disposed symmetrically, each series having a steam-chest for each stage of expansion. The two high-pressure steam-chests are the nearest to the feed-chamber, so that the pressure decreases, proceeding toward the two extremities of the engine, where the exhaust-chambers are located. Fig. 1 shows the first steam-chest of each series or the two high-pressure steam-chests. A longitudinal shaft is passing through the center of the rings formed by the feed-chamber, steam-chests, and exhaust-chambers, and it is supported at the extremities by two engine-heads, which form a part of a covering surrounding the whole body of the engine. Said engine-heads and covering are not shown in the drawings. The steam-chests are formed by two pieces joined together, and the internal space of them has a form of a cylindrical ring open at the internal periphery and divided into a number of compartments by the fixed partition Q, Fig. 4. A driving-wheel D is provided in the center of each steam-chest, through the hub of which the shaft passes, said driving-wheel having a rim which surrounds the internal periphery of the steam-chest, closing its internal space. The driving-wheels carry around their periphery a number of paddles or piston-heads P, Fig. 4, inclosed in the internal space of the steam-chests, one to each compartment, so that each compartment is divided into two chambers. Each steam-chest is provided on one or on each side with an opening-ring, which surrounds part of the internal periphery of an annular rib, which is a part of the same steam-chest and which is extending beyond the side of the rim of the driving-wheel. Said opening-rings are provided with openings corresponding to every chamber of the steam-chests. The steam-passages being located through the annular ribs of the steam-chests are met internally and at right angles by openings directed toward the center, so as to meet the external surface of the opening-rings that are in contact with the said ribs. In the opposite side of each partition corresponding to each back chamber not provided with steam-passage and symmetrically to the opening of the opposite chamber and also directed toward the center, so as to meet the opening-ring, another opening is provided, which, running through the rib of the steam-chest and changing direction toward the

internal space, leads into the back chamber. In a certain position of the opening-rings all openings of them will correspond to the openings in the ribs of the steam-chests, so that every chamber will be opened to the atmosphere; but when the opening-rings take another position or they rotate around their center of a small amount the communication of every chamber with the atmosphere will be cut off. This is done by means of bars, one to each opening-ring, having one end fixed to it and the other end fastened to a longitudinal piece, by means of which all the bars are connected in series, and the said longitudinal piece may be shifted transversely by means of a screw and gear, thus changing the position of the opening-rings. The said screw is operated by means of a hand-wheel and the operation of shifting the said longitudinal piece is performed every time, either before starting the engine or after the engine is stopped. The object of this is to open momentaneously every chamber of the steam-chest to the atmosphere in order to allow every driving-wheel to take its normal position, as above specified, so that all the chambers will be equally filled with air. Then the longitudinal piece will be shifted back again in the previous position in order to close the communication between all the chambers and the atmosphere before starting the engine. When the steam is admitted in the engine through the feed-pipe in the center, which will deliver equally the steam to every other chamber of one high-pressure steam-chest, either to the right or to the left, the piston-heads attached to the driving-wheel of the said steam-chest will be driven from the middle to the end of the stroke, compelling the piston-heads attached to every other driving-wheel to move in the same manner and compelling also the other driving-wheels to carry their piston-heads in the opposite direction and for the same amount. Thus the air confined in the back chambers of the former steam-chests becomes compressed and the air contained in the back chambers of the latter steam-chests becomes rarefied. The steam at the end of this first stroke, that is only one-half of the full length of the regular stroke, will be cut off from the chambers of the said high-pressure steam-chest by the multivalve-wheel in the center, that is fixed to the shaft which receives the motion from the driving-wheels, and it will be admitted from the feed-pipe to the high-pressure steam-chest in the opposite side. Therefore the action of all the piston-heads will be reversed. The air that was compressed in the back chambers before becomes rarefied at the end of this stroke, and vice versa. This time the piston-heads, according to the previous half-stroke, are moving backward and they will travel for the full length of the stroke. During the latter action the steam contained in the first high-pressure steam-chest will be admitted into the low-pressure steam-chest next to it, where the steam will expand during the stroke, after which it will be admitted into the next steam-chest of a greater capacity or into the exhaust-pipe at the end of the stroke. In the same time in the first high-pressure steam-chest live steam will be admitted, which will perform the same operation as before. The air contained in the back chambers being alternatively rarefied and compressed will balance the vibratory motion of the piston-heads and driving-wheels.

All the driving-wheels are connected in series on each side of the center, so that under the action of the steam they will have an alternate reciprocating motion. This connection is not shown in the drawings.

Between every two consecutive steam-chests and between steam-chests and exhaust-chambers is a multivalve-wheel W, fixed to the shaft, provided with cavities around the periphery, which cavities act as valves, which are regulated by the revolving of the shaft. Each multivalve-wheel is surrounded by a connecting-ring C, which connects the steam-passages to the steam-chests, feed-chamber, or to the exhaust-chambers.

The driving-wheels receive the motive force from the steam, and they will transmit the said motive force to the shaft by means of pawls attached to the driving-wheels and of ratchet-wheels fixed to the shaft.

The improvement of the engine which forms the subject of this specification is the following: In a non-reversible engine of the type above specified the steam-chests are provided with a steam-passage *p*, inlet and outlet, to every other chamber, so that the steam-pressure will be exerted on one side of the piston-heads only. Before starting the engine all the driving-wheels will be found in a normal position, where the piston-heads are in the middle of each compartment, dividing it into two equal chambers. This is done by means of a series of springs attached to the connection of the several driving-wheels. The atmospheric pressure will also be established into every chamber by means of the opening-rings, which will close all the chambers when the engine is starting. The feed-chamber O in the center, the section of which is given in Fig. 3, is provided with the feed-ports *p*, which are distributed in correspondence of the steam-passages, inlets and outlets, of the steam-chests. The feed-ports, steam-passages, and exhaust-ports are leading the steam to or from the valves or cavities of the multivalve-wheels passing through connecting-rings C, as above specified.

For transmitting to the shaft the motive force that the driving-wheels receive from the steam a single ratchet-wheel R is employed on each side of each driving-wheel and fixed to the shaft, and two opposite single pawls H

H are attached on each side of each driving-wheel, each pawl corresponding to its ratchet-wheel, the ratchet-wheels and the pawls having the same disposition as to the direction of the teeth, which will face in the same direction as the side of the piston-heads on which is exerted the steam-pressure. A spring S is attached to each pawl, pressing against the internal surface of the rim of the driving-wheel to which the pawl is attached, so as to tend to hold the pawl always against the periphery of the ratchet-wheels. The single pawls on each side of the driving-wheels are connected to a pin passing through the arm of the driving-wheel and forming a couple, as shown in Fig. 5.

Having described the general features of the engine, what I claim as my invention is—

1. A multiple-expansion vibratory steam-engine of the type stated in the specification, having, an annular feed-chamber in the center provided at the internal periphery with feed-ports directed toward the center of the ring formed by the said chamber, two series of steam-chests, one on each side of the said feed-chamber, the annular internal space of each steam-chest being open at the internal periphery is closed by the rim of a driving-wheel, one of which is provided in the center of each steam-chest, all the said driving-wheels connected in series; said internal space of the steam-chests divided into a number of compartments by fixed partitions, each compartment divided into two chambers by a piston-head or paddle carried by the driving-wheel, every other chamber provided with a steam-passage, inlet and outlet; all the chambers of the steam-chests provided with openings leading to the atmosphere and checked by means of opening-rings, the feed-ports of the feed-chamber corresponding to the steam-passages of the steam-chests; two annular exhaust-chambers, one at each extremity of the engine provided at the internal periphery with exhaust-ports corresponding to the said steam-passages; a longitudinal shaft passing through the center of the driving-wheels, carrying a series of multivalve-wheels, each one located between two consecutive steam-chests and between the steam-chest and the exhaust-chamber at the two extremities of the engine, and surrounded by a connecting-ring to which are connected the steam-passages with the feed or exhaust ports; two couples of single pawls attached to each driving-wheel engaging to ratchet-wheels fixed to the shaft, substantially as specified.

2. In a multiple-expansion vibratory steam-engine of the type stated above, the combination of two diametrically opposite couples of single pawls attached to the arms of each driving-wheel, each couple consisting of a single pawl on each side of the driving-wheel; of a single ratchet-wheel on each side of each driving-wheel, fixed to the shaft, with which ratchet-wheels the pawls engage on two diametrically opposite points, the ratchet-wheels and pawls having the same disposition as to the direction of the teeth, which are facing in the same direction as the side of the piston-heads on which the steam-pressure is exerted; of a spring attached to each pawl, pressing against the internal surface of the rim of the driving-wheel, and tending to hold the pawl always against the periphery of the ratchet-wheel, substantially as specified.

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

ANTONIO BENEDETTO.

Witnesses:
JOHN CALLAHAN,
ANDREW WARGANIN.