(No Model.)

3 Sheets—Sheet 1.

F. M. ROOTS.

ROTARY PUMP.

No. 264,962. Patented Sept. 26, 1882.

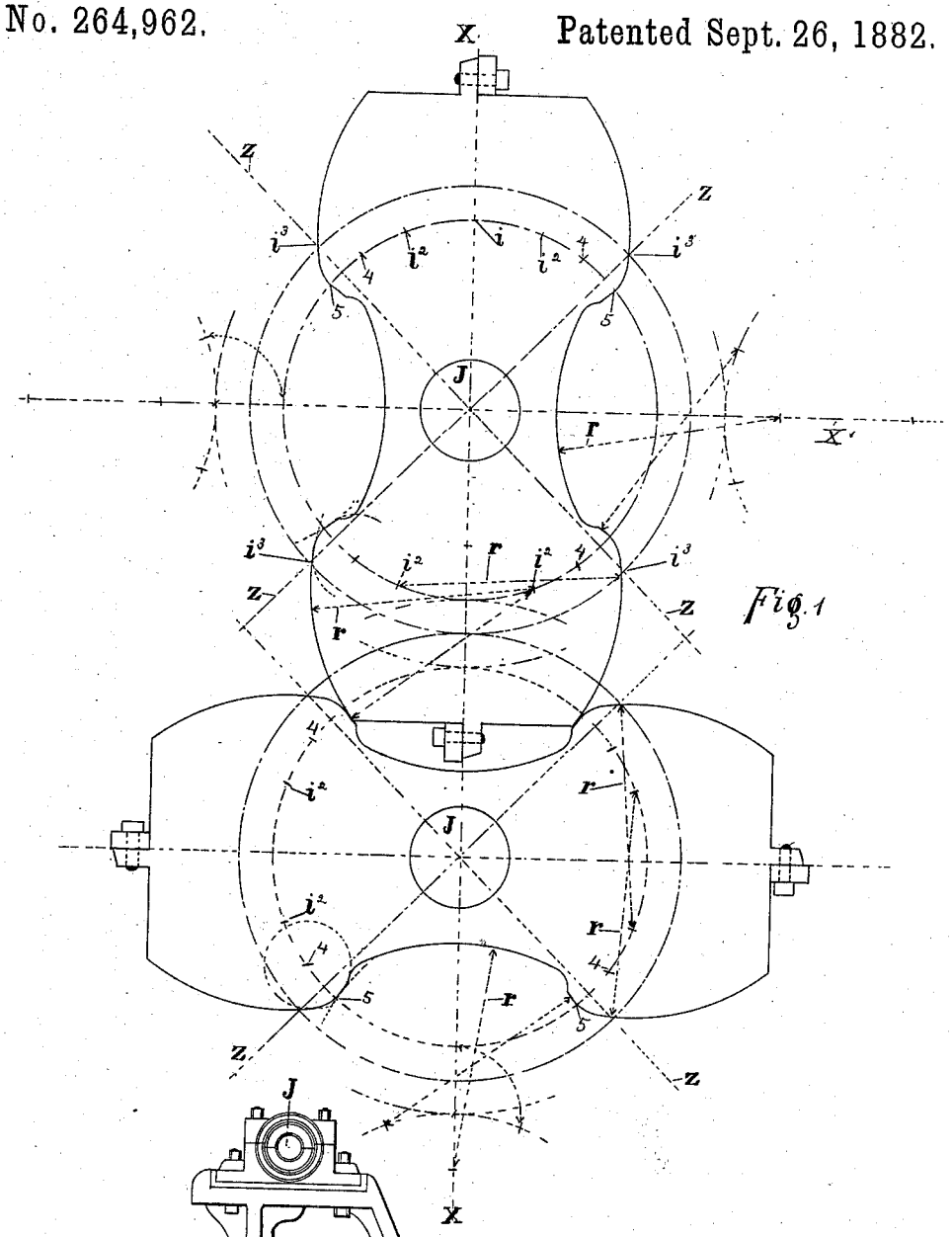

Fig. 1

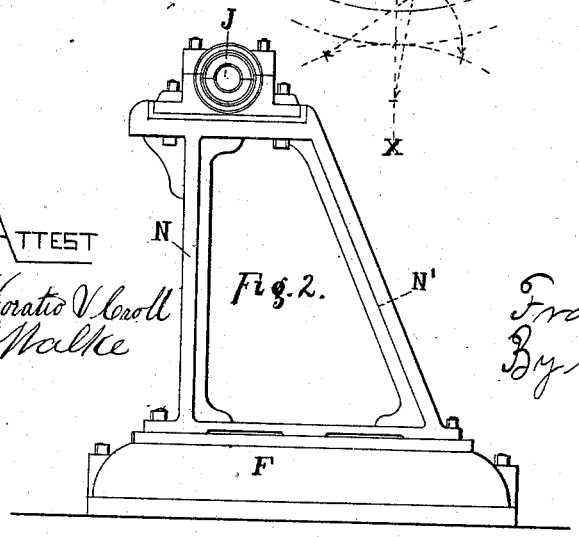

Fig. 2.

ATTEST

Horatio V. Croll

H. A. Walker

INVENTOR

Francis M. Roots

By Geo. J. Murray

his Atty

(No Model.) 3 Sheets—Sheet 2

F. M. ROOTS.

ROTARY PUMP.

No. 264,962. Patented Sept. 26, 1882.

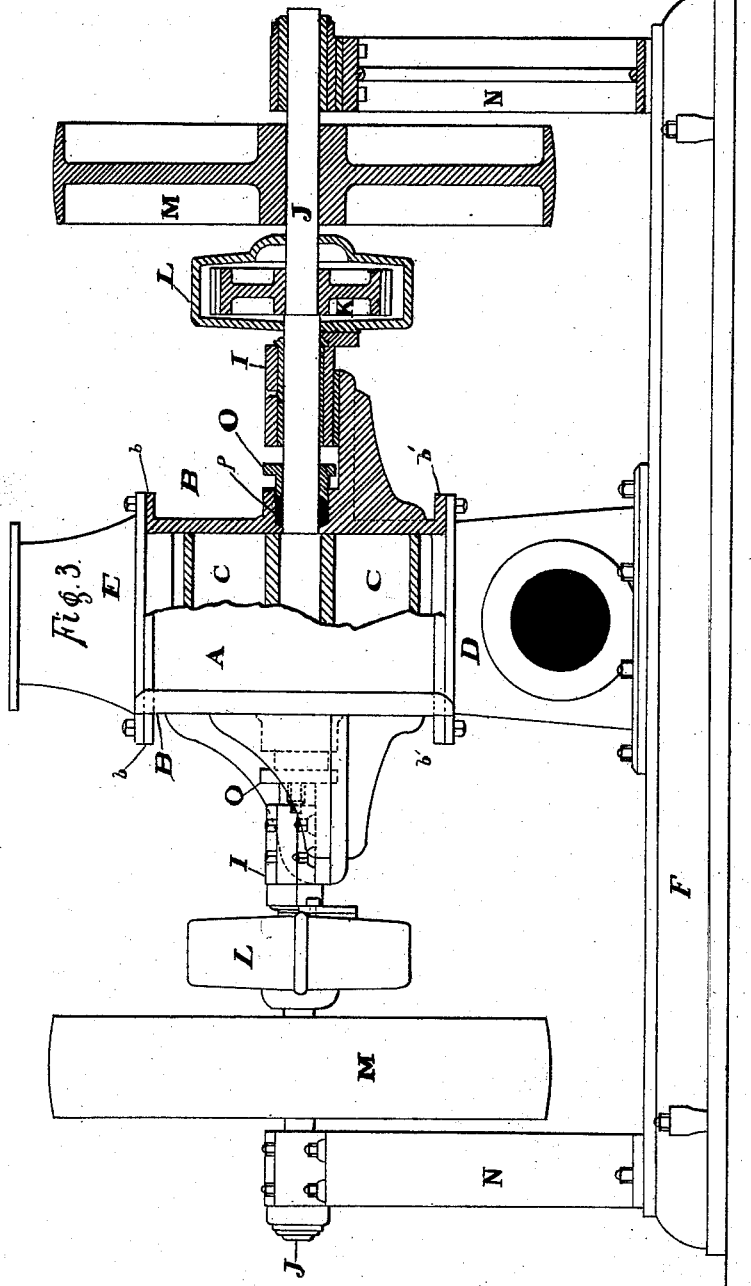

Fig. 3.

Attest
Horatio V. Croll
H. A. Walker

Inventor
Francis M. Roots
By Geo. J. Murray
his Atty

(No Model.) 3 Sheets—Sheet 3.

F. M. ROOTS.

ROTARY PUMP.

No. 264,962. Patented Sept. 26, 1882.

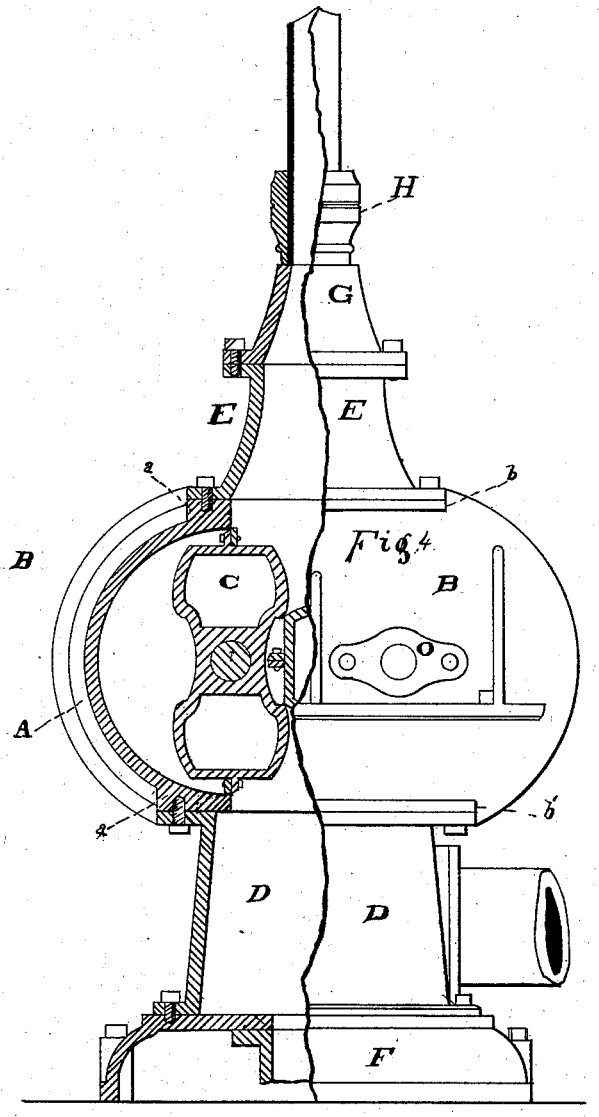

Fig. 4.

Attest
Horatio V. Croll
H. A. Walke

Inventor
Francis M. Roots
By Geo. F. Murray
his Atty.

UNITED STATES PATENT OFFICE.

FRANCIS M. ROOTS, OF CONNERSVILLE, INDIANA.

ROTARY PUMP.

SPECIFICATION forming part of Letters Patent No. 264,962, dated September 26, 1882.

Application filed March 6, 1882. (No model.)

To all whom it may concern:

Be it known that I, FRANCIS M. ROOTS, of Connersville, Fayette county, State of Indiana, have invented certain new and useful Improvements in Rotary Pumps, of which the following is a specification.

My invention relates to that class of rotary pumps in which two or more rotating abutments coact, together with their incasing shell, to force a current of water or other fluid, while keeping up contact with each other to prevent backward escapement of the fluid under pressure.

Its object is to produce pistons capable of sustaining a heavy pressure with the least possible friction between the abutting parts and to insure perfect contact between the abutments during their entire revolution.

It consists in certain novel features of construction by which the effectiveness of the machine is increased and its interior working parts protected from sediment or heavy foreign substances.

In Letters Patent No. 247,691, granted to me September 27, 1881, for rotary blowers, I describe a method for producing pistons which insures perfect contact between them during their entire revolution. The centers from which the arcs and contact-points are described are in an inscribed circle of about one-twelfth less diameter than the pitch-circle. Pistons so constructed answer every purpose for a blowing or other engine in which the required pressure is usually about one to two pounds per square inch, and never exceeds five pounds; but in pumps to be used for fire purposes the pressure ranges from one hundred to one hundred and fifty pounds per square inch. It is therefore necessary in this class of machines that the size of the shafts be increased, and that the thickness of the metal around the shafts shall not be less in any part than one-half the diameter of the shafts. To obtain these results the abutments must necessarily be contracted in the direction of their major axes and correspondingly widened in the direction of their minor axes. The method described in said Patent No. 247,691 will not produce such pistons, because the describing-centers are too far from the axis of rotation. When the centers from which the abutting surfaces are described are brought near to the axes—as they must be to produce these heavier pistons—I have found that the abutments will not clear each other when the convex and concave arcs meet in curves which are arcs of equal circles, but that in order to keep up perfect contact with the least possible friction the convex arcs must be compound curves and must meet the concave contact-surface by an arc of a smaller circle. I have also discovered a system for obtaining the centers and the radii by which the smaller arcs are described, so that by my present invention I am enabled to construct pistons of any required strength, as will be fully understood from the following description of the accompanying drawings, in which—

Figure 1 is a diagram illustrating my method or system for obtaining the points from and the radii by which all the contact-surfaces of my abutments are described. Fig. 2 is an elevation of the base-plate of my machine and one of the supporting-standards of the driving-shafts. Fig. 3 is a view of my machine partly in front elevation and partly in central vertical section. Fig. 4 is a view of the same in a plane at right angles to the view shown in Fig. 3. This view is partly an end elevation and partly a transverse vertical section.

The case of the pump is composed of two semi-cylindrical shells, A A, and two end plates, B B, which are secured to the shells by bolts.

C C are the two coacting rotary abutments. As shown, they are placed side by side, but they may be mounted one above the other.

The end plates have laterally-projecting flanges *b b'* at top and bottom, and the shells have projections *a a* at each edge. The faces of the flanges and projections are planed off to joint with the flanged edges of the pedestal D and discharge-pipe E.

The pedestal which supports the machine is bolted in the center of an iron base-plate, F, which has perforated bosses, through which it is bolted to the floor or supporting-timbers. The bed-plate is perforated underneath the pedestal, and the pedestal is similarly perforated upon one side, so that the influx-pipe may be placed either at the side or bottom, as desired. When the pipe is attached at one opening the other is closed by a cap. The large chamber formed by the pedestal insures an even steady supply of fluid to the pistons and forms a reservoir in which gravel or other

hard heavy substances will settle down to the bottom and not be drawn into the machine, as would be likely to happen were the flow from the supply-pipe to the pistons direct.

The discharge-pipe E is contracted to a cylindrical form at the top, and has a laterally-projecting flange for the attachment of a suitable discharge-pipe.

In Fig. 4 I have shown another tapering section of pipe, G, which is provided with a hose-coupling. This I attach when the machine is to be used for fire purposes; but when the machine is to be used as a ship's pump, and in other situations where it is merely the purpose to discharge a large amount of water, I attach a large pipe directly to pipe E.

The journal-boxes I of the shafts J rest upon supports cast with the end plates, B B. The shafts are geared together by cogs K, incased in housings L, which are supported by flanges depending from the ends of boxes I. Each shaft has a driving-pulley, M, secured upon its extended end. The shaft of the opposite abutments extends from opposite ends of the case, and outside of the driving-pulleys each is supported in the opposite standards, N N′, which are securely bolted to the bed-plate F. The packings *p* around the shafts within the end plates are compressed and held by glands O.

I will now refer to diagram, Fig. 1, and describe the method of constructing my improved abutments.

The abutment-shafts J J are located the requisite distance apart, depending upon the size of the machine to be constructed. Two equal circles are described around the shaft-centers by a radius equal to one-half the distance between said centers. These pitch-circles are divided into eight equal sectors. One of the dividing-lines passes, when extended, through both shaft-centers. This line I have marked X, and the lines diagonal to it Z Z. Within the pitch circle, and from its center, I describe a smaller circle, which I term the "inscribed" circle. The difference between the diameter of this circle and the pitch-circle (within limits hereinafter mentioned) determines the strength of the pistons. The smaller the inscribed circle the heavier or wider will be the pistons through the waist, and vice versa. The points from which the outer convex curves and inner concave contact-surfaces are described I obtain by taking the difference between the diameters of the inscribed and pitch circles, and then, with one point of a dividers in the point *i*, where the line X cuts the inscribed circle, I step off this distance in the inscribed circle upon each side of line *x* and obtain the points i^2. From these points as centers the opposite convex arcs of the abutments are described by a radius, *r*, extending from said points i^2 across line X to the point i^3, where the diagonal line Z cuts the pitch-circle. From these points i^2 as centers the convex arcs of one abutment and the concave contact-surfaces of the other abutment are described by the same radius, as clearly appears from an examination of the diagram, Fig. 1. It must be understood that the inscribed circle must not be so small as to throw the points i^2 across the lines Z Z. As before stated, the convex curves must meet the concave contact-surfaces in arcs of smaller circles; or, in other words, the points formed by the meeting of the convex and concave curves of equal circles must be dressed off to arcs of smaller circles.

The center and radius of the smaller circle I obtain by taking two-thirds of the difference between the diameters of the pitch and inscribed circles as the radius, and, with one point of the dividers on point 5, where the concave curve cuts the inscribed circle, I step off in the inscribed circle the point 4. With this point as a center I connect point 5 with the outer convex surface of the piston, thus forming the inner convex surface thereof. This gives the exact shape the curved surfaces of the pistons must have to move without friction and yet keep up perfect contact.

The curve in the waist of the piston is described by radius *r* from a point in the line X′. No arbitrary rule for describing this curve is necessary. It is only essential that it be cut back far enough for the free passage of piston ends.

The ends of the pistons are the same as I have shown and claimed in my former patent, No. 247,691, and the method of dressing the pistons is substantially the same as described in said patent, with this addition: the arc of the smaller circle herein shown I find is more conveniently dsessed off to the templets by a tool of suitable shape in the mode I have described in my former patent for dressing the concave surfaces than by centering the pistons in points 4.

Pistons constructed with their convex arcs composed of a compound curve described from points i^2 and 4 make a perfect machine, as the pressure forward is constant without any escapement of the fluid; but I do not limit myself to the exact curve described for the smaller arcs, as these are in contact with the opposite abutments but a very short time during each revolution. Should perfect contact not be kept up during this short time, it is evident that the backward escape would be so small as not to materially affect the usefulness of the machine; nor do I limit myself to the exact location of the points i^2, as these may be slightly varied and still produce a much more effective machine than any now known to me.

It is evident that my machine can be also used as a hydraulic engine. In such case the pistons, instead of forcing a current of water, would be driven by the pressure of the fluid and the power would be taken from pulleys M; and if the requisite registering mechanism is attached to the extended piston-shaft the machine will serve as a water-meter.

I claim as my invention—

1. The method of proportioning the outer convex curves of rotary pistons with relation to the size of said pistons, which consists in

constructing said curves in arcs of circles described from points i^2 in an inscribed circle by a radius extending from said points i^2 across line X to a point, i^3, where the diagonal line Z cuts the pitch-circle, said points i^2 being located the distance from the line X equal to the difference between the diameters of the pitch and inscribed circles.

2. The method of proportioning the inner convex curves of rotary pistons with relation to the size of said pistons, which consists in forming said curves upon arcs of circles the radii of which are equal to two-thirds the difference between the diameters of the pitch and inscribed circles, the centers of said circles being the points 4 in the inscribed circle, which centers are the length of the radius distant from the point 5, where the concave abutting arc cuts the inscribed circle.

3. Pistons for rotary pumps, constructed substantially as hereinbefore set forth—that is, having each convex abutting surface composed of arcs of circles of different radii, the respective concave abutting surfaces being composed of single arcs, the centers from which said several arcs are described being the points i^2 and 4.

4. The combination, substantially as hereinbefore set forth, of the pump-case, the inclosed rotary abutments and their actuating mechanism, with the pedestal D, forming the pump-support, and an enlarged chamber or reservoir between the supply-pipe and the pistons.

5. The combination, substantially as specified, of the pump-case, the rotary pistons and their actuating mechanism, with pedestal D, bed-plate F, and shaft-supporting standards N N′.

FRANCIS M. ROOTS.

Witnesses:
GEO. J. MURRAY,
D. S. OLIVER.