(No Model.) 3 Sheets—Sheet 1.

H. M. FELLOWS & A. R. WHITHAM.

APPARATUS FOR OBTAINING MOTIVE POWER.

No. 551,669. Patented Dec. 17, 1895.

Fig. 3.

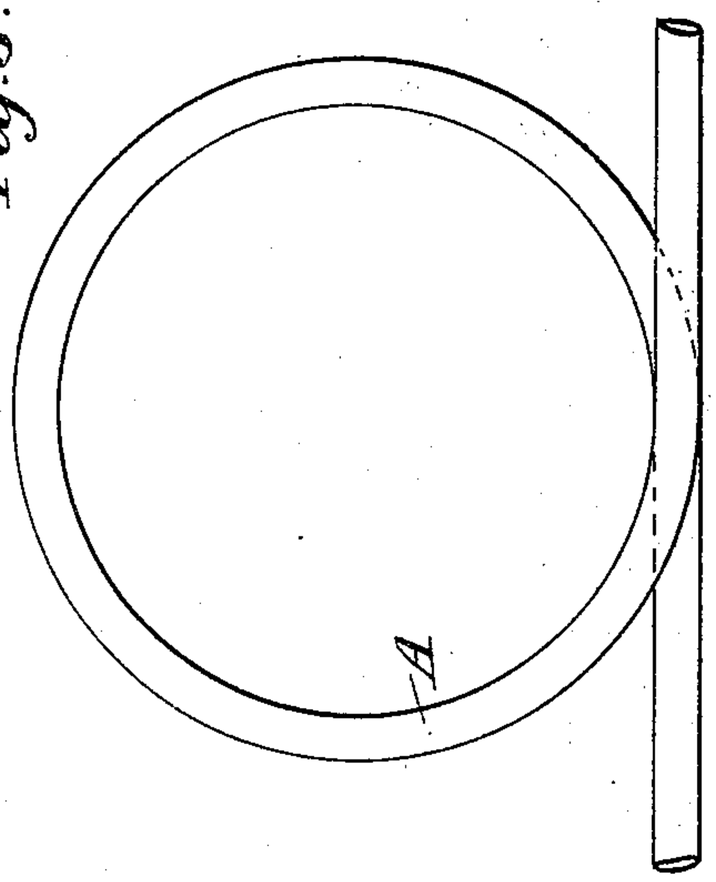


Fig. 3A.

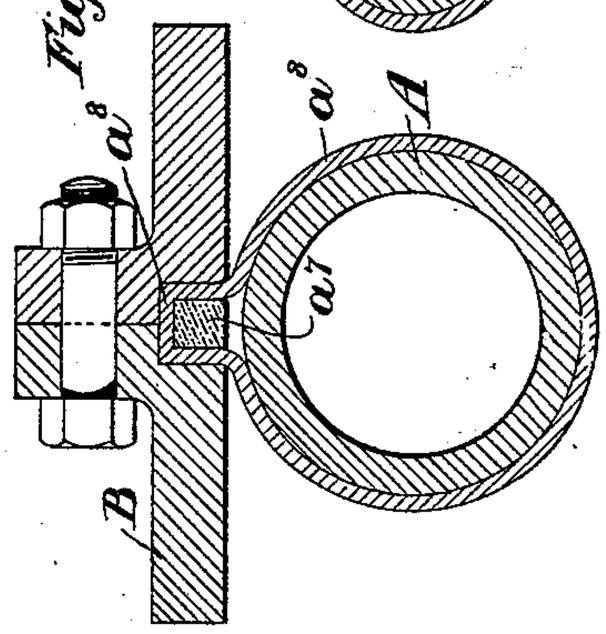


Fig. 3B.

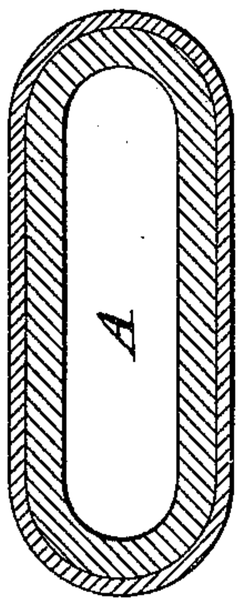


Fig. 1.

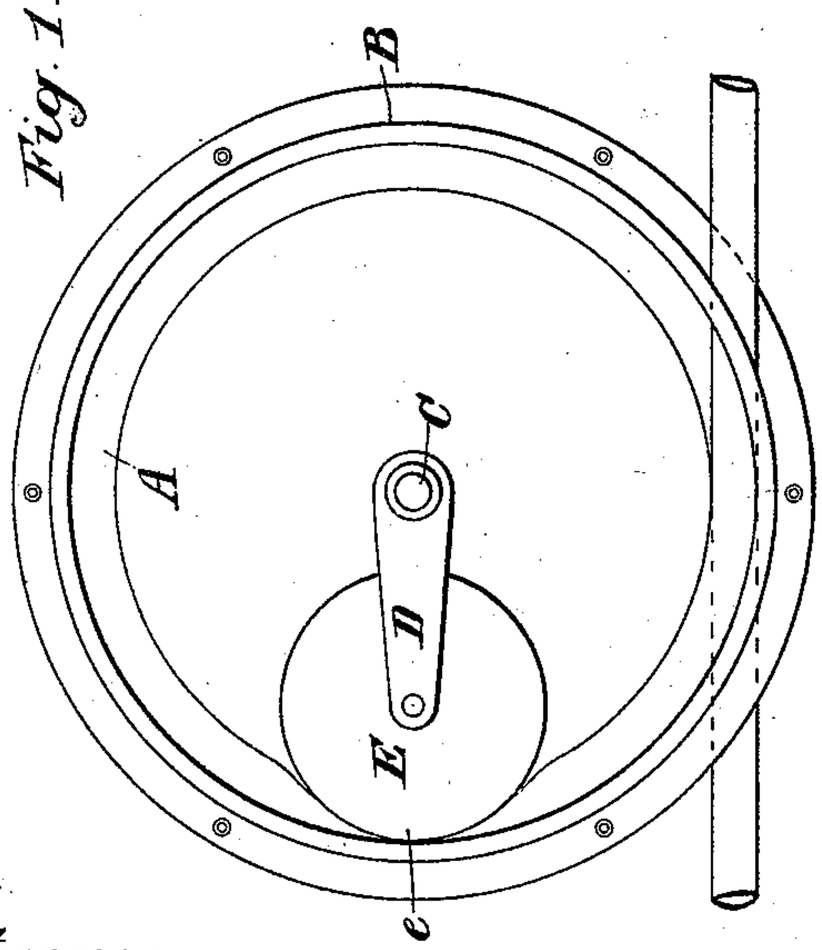
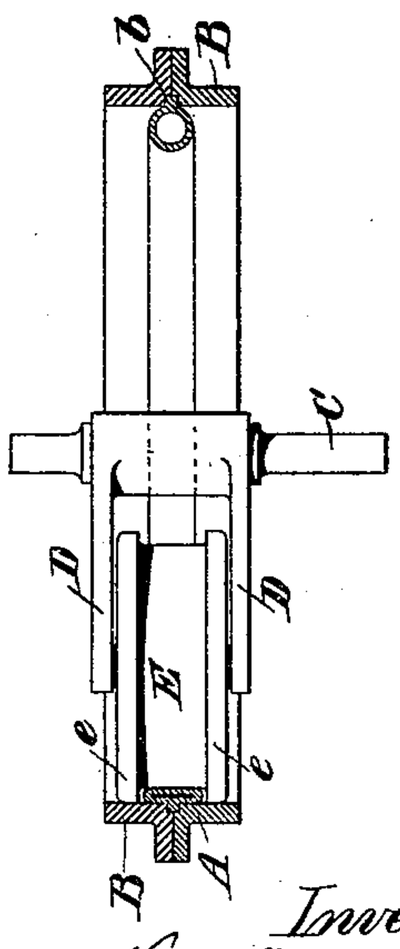


Fig. 2.



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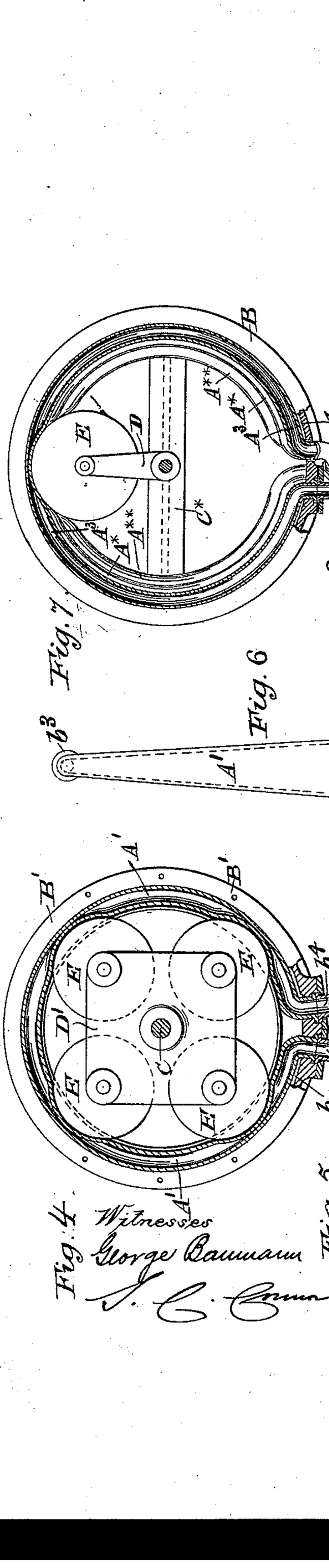

Fig. 1.

Fig. 6.

Fig. 8.

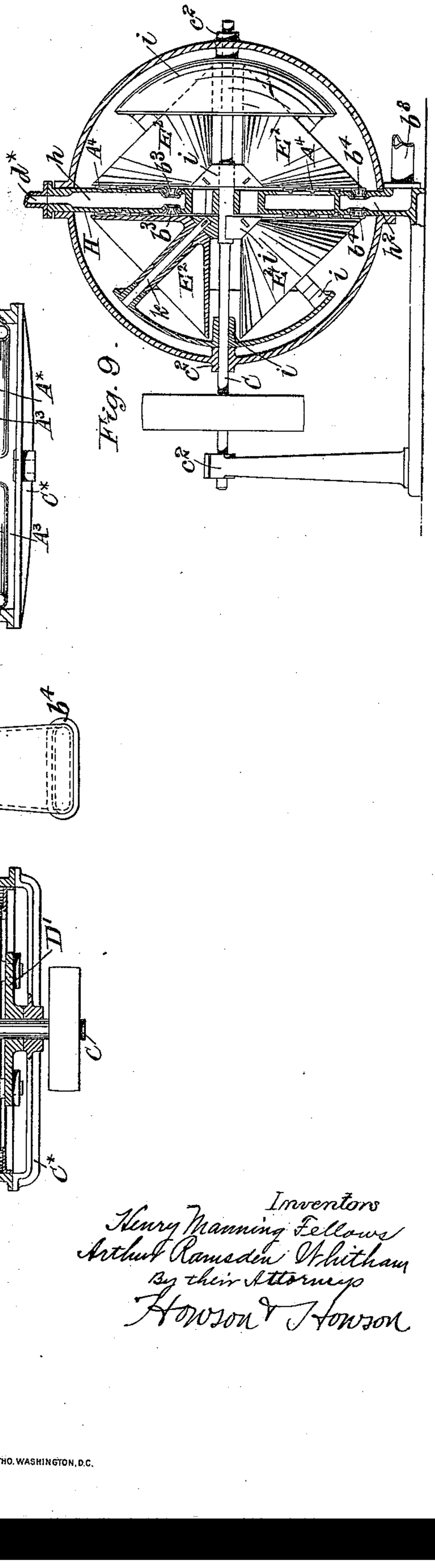

Fig. 9.

Fig. 4.

Fig. 5.

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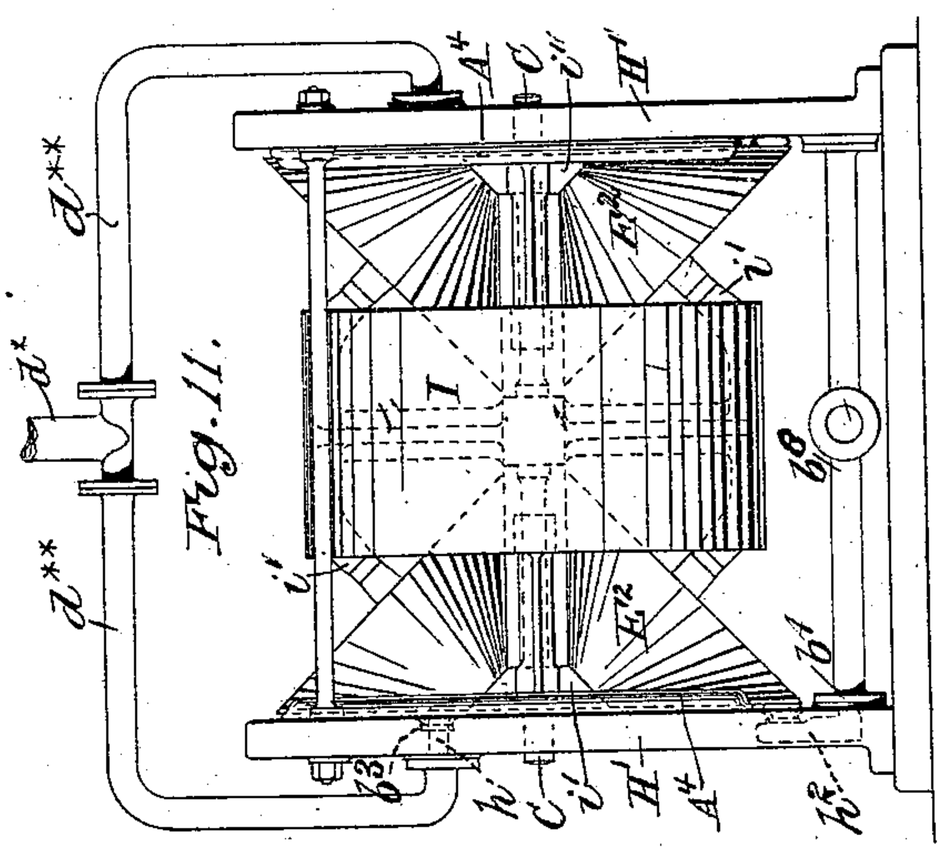

Fig. 11.

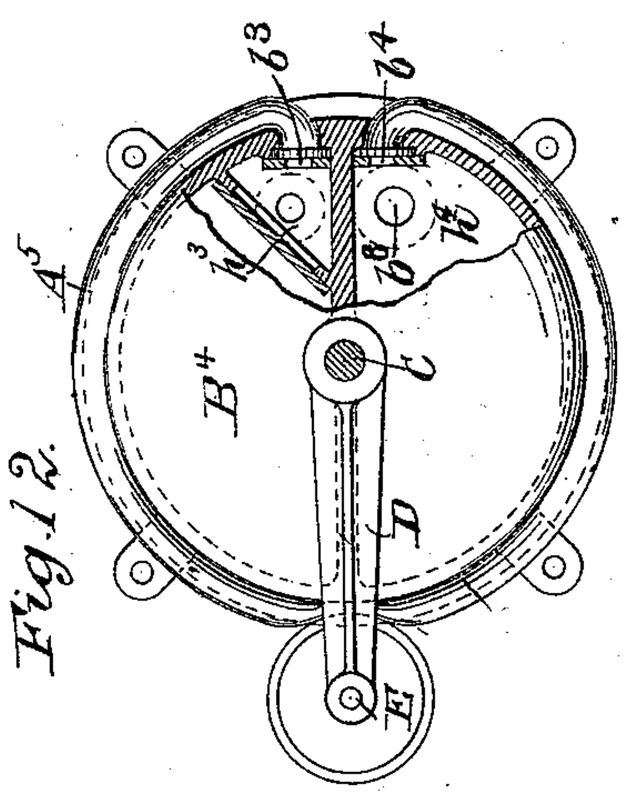

Fig. 12.

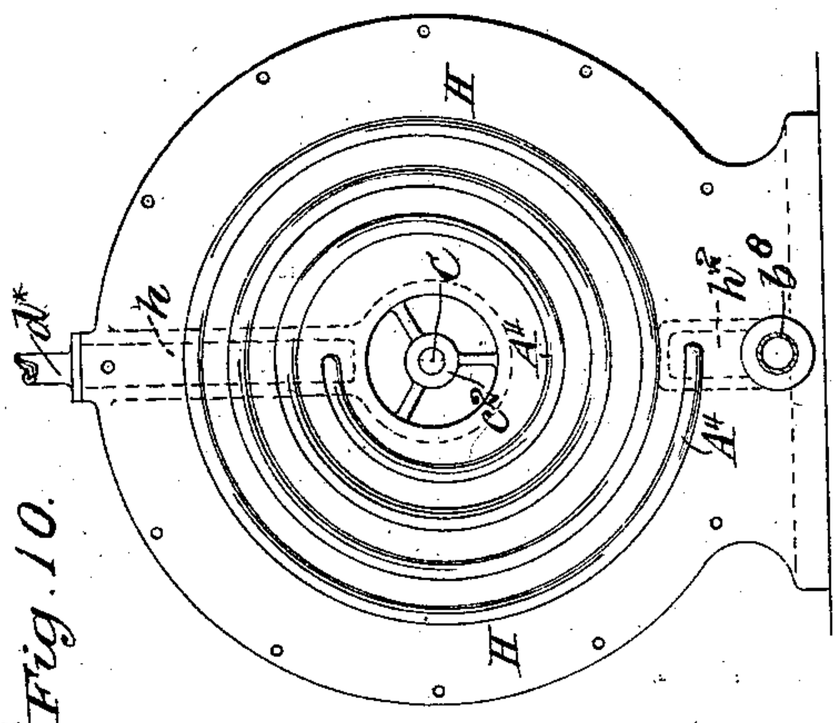

Fig. 10.

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UNITED STATES PATENT OFFICE.

HENRY MANNING FELLOWS, OF GREAT YARMOUTH, AND ARTHUR RAMSDEN WHITHAM, OF BRAMHOPE, ENGLAND.

APPARATUS FOR OBTAINING MOTIVE POWER.

SPECIFICATION forming part of Letters Patent No. 551,669, dated December 17, 1895.

Application filed May 26, 1893. Serial No. 475,575. (No model.)

To all whom it may concern:

Be it known that we, HENRY MANNING FELLOWS, ship-builder, residing at 76 Southtown Road, Great Yarmouth, in the county of Norfolk, and ARTHUR RAMSDEN WHITHAM, residing at Bramhope, near Leeds, in the county of York, England, subjects of the Queen of Great Britain and Ireland, have invented certain Improvements in Apparatus for Obtaining Motive Power, of which the following is a specification.

This invention has for its object to employ a flexible or compressible tube or passage or flexible or compressible tubes or passages and a compressing device or compressing devices to operate in combination with steam or other motive fluid to obtain motive power, as hereinafter described.

The invention may be carried out in various ways, which we will describe with reference to the accompanying drawings, from which the nature of the invention and the manner in which it may be carried out in practice will be readily understood.

Figure 1 shows, in elevation, and Fig. 2, in sectional plan, an arrangement showing the principle of this invention, in which the flexible or compressible tube is arranged inside an annulus. Fig. 3 shows such flexible or compressible tube or passage separately. Figs. 3^A and 3^B are detail views. Fig. 4 is a sectional elevation, and Fig. 5 is a horizontal section, of an arrangement according to this invention for using steam expansively in a tapered flexible tube or passage, and Fig. 6 is a plane projection of the flexible tube. Figs. 7 and 8 are respectively a sectional elevation and a plan of an arrangement of several tubes of different diameters in which steam is used expansively. Fig. 9 is a sectional elevation, and Fig. 10 a face view, of a disk provided with flexible tubes arranged spirally in its faces and compressed by conical rollers. Fig. 11 shows a modified arrangement in which two disks facing each other are employed, each having a flexible tube arranged spirally on its face. Fig. 12 shows an arrangement in which the flexible tube is arranged on the periphery of a disk or cylinder.

Referring to Figs. 1, 2, and 3, the flexible or compressible tube or passage A is arranged as a coil secured throughout its length to the frame or annulus B by any suitable means—such as by making the annulus B in parts, Fig. 2, and pinching between them the web *b*, formed on or attached to the tube A. The tube A may be made of any suitable material—such as woven asbestos for high temperatures or rubber for low temperatures and armored by plaiting or coiling around it hemp, silk, fine metal wire or the like. Another way of connecting the tube to the annulus B, as shown in Fig. 3^A, is by means of a metal ring a^7 attached to the tube A by means of the armoring or covering a^8 and clamped between the parts of the annulus B.

One end of the tube A is in connection with the source of supply of the motive fluid and the other end of the said tube is in connection with the exhaust. A shaft C is mounted in bearings (not shown, but they may be secured to the annulus B or the part to which it is fixed) so as to rotate within the said annulus B, the said shaft carrying an arm or arms D secured thereto and each provided with a roller E which bears against the tube or passage A so as to compress it against the inner side of the annulus B. The roller E may be mounted so as to be capable of radial movement on the arms D and pressed against the tube A by a spring or by centrifugal force.

Motive fluid under pressure is admitted to the compressible tube or chamber A at the inlet and in endeavoring to pass through the said tube at the part thereof which is compressed by the roller E imparts to the arms D and to the shaft C a motion of rotation in its bearings, which motion may be utilized for driving machinery of various kinds to which it may be connected by any suitable gearing. The motive fluid finds it exit by the exhaust as the roller E passes the exhaust-passage. If instead of a complete circle the flexible or compressible tube A be only part of a circle the shaft C should be provided with two or more compressing arms or disks set in such relative positions to each other that they come successively into operation to compress the tube. It is obvious that the flexible tube or

passage A need not be of cylindrical form, as shown in Figs. 1, 2, 3, and 3^a, as it may be of elliptical form, as shown in Fig. 3^b.

The flexible tube or passage A, Figs. 1, 2, and 3, as before described, may be made of any suitable material—such, for example, as rubber or woven asbestos.

When steam is employed as the motive agent it may be caused to work expansively by making the compressible tube of gradually-increasing diameter or capacity from the inlet end toward the outlet end for the steam, as shown, for example, in Figs. 4, 5, and 6. In Fig. 5 the tube A′ is shown as being fixed to the interior of the annulus B′ by means of a web b on the tube inserted and secured by any suitable cement in an annular groove formed in the inner surface of the said annulus. Any desired number of compressing-rollers E may be provided. In the drawings four are shown, which are carried in bearings in plate D′ secured to the shaft C, which is mounted in bearings in bars $C^\times$ fixed to the annulus B′. Steam admitted to the tube A′ at b^3 after acting on one of the compressing-rollers E is confined in the portion of the said tube between the said rollers and the next roller which comes into position to be acted on by the live steam, the steam thus confined between the two rollers then acting by expansion on the first mentioned roller until it passes the outlet b^4 through which the exhausted steam escapes. The steam may be caused to act expansively on two or more rollers at the same time, according to the number of rollers employed, whereby the full effective power of the steam may be utilized for driving the shaft C. Instead of employing a tube of gradually-increased diameter, as last described, several tubes of different diameters may be arranged side by side in the annulus B^3, as shown in Figs. 7 and 8, the smallest tube A^3 being connected to the next larger tube $A^\times$, preferably outside the annulus, as shown at $a^\times$, the tube $A^\times$ being similarly connected to the next larger tube $A^{\times\times}$ and so on according to the number of tubes employed.

Only one pressing-roller E is employed, which is carried on an arm D secured to the shaft C, this roller being of sufficient length to bear simultaneously on all the tubes. Live steam, which is admitted to the small tube A^3 at b^3, acts on the roller E to give rotation to the shaft C; but when the said shaft has completed a revolution the steam which had acted on the roller passes into the larger tube $A^\times$ and the roller being then in position to again receive the pressure of the live steam entering the tube A^3 at b^3 the said roller is acted on thereby and also by the expansive action of the steam in the larger tube $A^\times$. When the shaft C is about to complete another revolution the steam from the tube $A^\times$ enters the tube $A^{\times\times}$ and the steam from the tube A^3 passes into the tube $A^\times$. as before. The roller being now again in position to be operated upon by the live steam entering the tube A^3 at b^3 will also receive the pressure of the expansive action of the steam in the tubes $A^\times$ and $A^{\times\times}$. When the engine is in full work, the exhaust-steam escapes from the large tube $A^{\times\times}$ by the outlet b^4 at each revolution of the shaft. The full power of the steam may be thus utilized in the same manner as in an ordinary triple-expansion steam-engine.

Instead of arranging the flexible tube in an annulus, as hereinbefore described, a tube or more than one tube may be arranged in a spiral direction or otherwise on the face or on the faces of a stationary disk and compressed by one or more rollers so as to cause the steam to act expansively.

Fig. 9 is a vertical section of an arrangement in which flexible tubes are arranged spirally on the two faces of a hollow disk, and Fig. 10 is a face view of the disk. The tubes A^4 may be fixed to the faces of the disk H by any convenient means and each tube A^4 communicates at one end b^3 with a chamber h in the interior of the said disk, the opposite end of each tube communicating at b^4 with another chamber h^2 in the said disk in connection with the exhaust passage or pipe b^8. Through the center of the disk H passes a shaft C carried in bearings c^2, on which shaft are fixed supports i for spindles k on which conical rollers E^2 revolve, which rollers bear on and compress the tubes A^4 on both faces of the disk.

Live steam is admitted at $d^\times$ to the chamber h in the disk H and passes thence into the tubes A^4 at b^3 and acting on the rollers E^2 cause them to travel around the faces of the disk and give rotation to the shaft C.

In the drawings we have shown two compressing-rollers E^2 on each side of the disk; but if desired only one or more than two rollers may be employed. At each revolution of the shaft C the steam admitted at b^3 to each tube is confined by the roller or rollers E^2 in the convolutions of the tube and as each convolution is of gradually-increasing capacity the steam therein acts expansively upon the rollers and assists the live steam in giving rotation to the shaft C. The pairs of rollers E^2 are shown in the drawings as being arranged in the same plane on the opposite sides of the disk H; but if desired they may be arranged so that the rollers on one side of the disk are situated in a plane at right angles to the plane of the axes of the rollers on the opposite side of the disk. The inlets b^3 to the tube A^4 on opposite sides of the disk may be arranged in different position instead of being opposite each other, as shown, so as to obtain a uniform torque on the shaft C.

Instead of employing a hollow disk and arranging flexible tubes on opposite sides thereof, as last described, two disks H′, as shown in Fig. 11, may be employed, arranged to face each other, the contiguous faces of these disks being each provided with a spirally-arranged compressible tube A^4, as hereinbefore de-

scribed. Each disk H′ has a passage *h* formed therein with which the inner end b^3 of the compressible tube A^4 communicates and a chamber h^2 with which the outer end b^4 of the said tube is connected, as in the arrangement last described. The passages *h* in the two disks are connected together by branches $d^{\times\times}$ $d^{\times\times}$ from a steam-inlet pipe $d^{\times}$, and the chambers h^2 are connected together by branches from an exhaust-pipe b^8. On a shaft C which passes through the centers of the disks H′ are fixed supports *i*′ for the spindles of four conical compressing-rollers E^2 arranged in pairs between the disks H′, one pair of rollers bearing upon and compressing the tube A^4 on each disk. Steam admitted to the tubes A^4 through the pipe $d^{\times}$ and its branches $d^{\times\times}$ $d^{\times\times}$ and passages *h* in the disks act on the rollers of each pair, so as to give rotation to the shaft C, the steam being caused to act expansively in the convolutions of the tubes A^4 in the manner hereinbefore described with reference to Figs. 9 and 10, so as to assist the live steam in driving the shaft C after the manner of a multiple-expansion steam-engine. I is a driving-pulley fast on the shaft C for transmitting motion to machinery.

Instead of arranging the compressible tube shown in Fig. 6 in the interior of an annulus, as hereinbefore described, the said tube may be arranged on the periphery of a disk or on the exterior of a cylinder or circular chamber B^4, as shown in Fig. 12, a compressing-roller E carried on an arm D fixed on the shaft C being caused by motive fluid admitted to the tube A^5 to travel around the periphery of the chamber and impart rotation to the shaft C.

The interior of the chamber B^4 is divided by partitions into compartments h^3 and h^4, with which the opposite ends of the tube A^5 are respectively connected. The tube A may extend only once around the periphery of the disk or cylinder, or it may pass several times around it if desired. Motive fluid is admitted to the compartment h^3 and passes thence into the tube A^5 at b^3 and after acting upon the roller E so as to rotate the shaft C it passes from the end b^4 of the tube into the compartment h^4 and exhausts through the pipe b^8.

We claim as our invention—

1. A motive power engine comprising a compressible passage provided with a motive fluid inlet and exhaust, the said passage being of increasing capacity from the said inlet to the said exhaust, in combination with a rotatable shaft provided with a device adapted to compress the said passage, and to be acted upon by the motive fluid passing through the said passage, all substantially as and for the purposes set forth.

2. An apparatus for obtaining motive power comprising a frame provided with a compressible passage having an inlet and an exhaust for a motive fluid, in combination with a rotatable shaft provided with one or more arms carrying rollers adapted to compress the said passage and adapted to be acted upon by the motive fluid passing through the said passage, the said passage being of increasing capacity from one roller to the next, from the inlet end to the exhaust end, substantially as and for purpose set forth.

3. An apparatus for obtaining motive power, comprising a compressible passage of tapering form, a rotatable shaft provided with a compressing device adapted to compress the said passage, and means for supplying the said passage at its smaller end with steam to act upon the said compressing device, and an exhaust for the fluid at the larger end, all substantially as and for the purposes set forth.

In testimony whereof we have signed our names to this specification in the presence of two subscribing witnesses.

HENRY MANNING FELLOWS.
ARTHUR RAMSDEN WHITHAM.

Witnesses to the signature of the said Henry Manning Fellows:

JOHN HENRY ENGLISH,
FREDERICK THOMAS CALVER.

Witnesses to the signature of the said Arthur Ramsden Whitham:

GEORGE DYALL,
WILLIAM HENRY GORDON.