(No Model.) 4 Sheets—Sheet 1.

L. H. MAYER.

PNEUMATIC MOTIVE POWER.

No. 590,686. Patented Sept. 28, 1897.

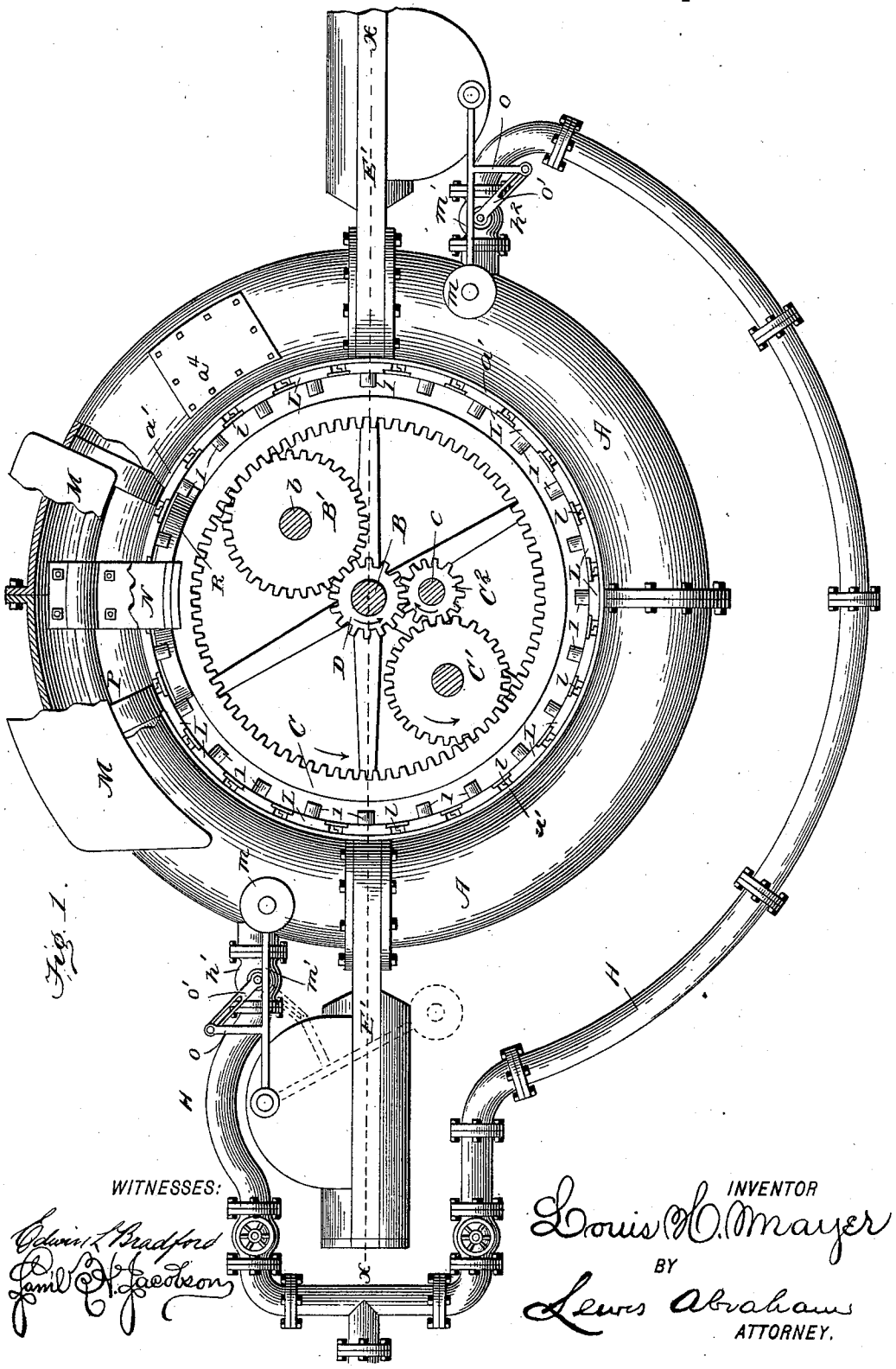


Fig. 1.

WITNESSES:

Edwin L. Bradford

Jam[illegible] H. Jacobson

INVENTOR

Louis H. Mayer

BY

Lewis Abrahams

ATTORNEY.

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(No Model.) 4 Sheets—Sheet 2.

L. H. MAYER.

PNEUMATIC MOTIVE POWER.

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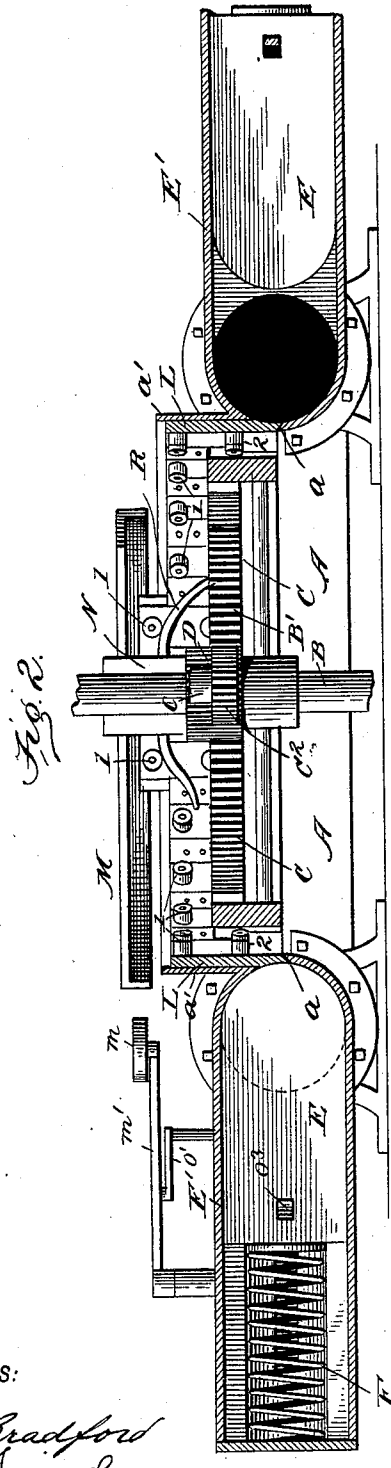


Fig. 2.

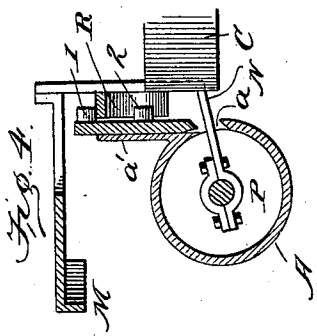


Fig. 4.

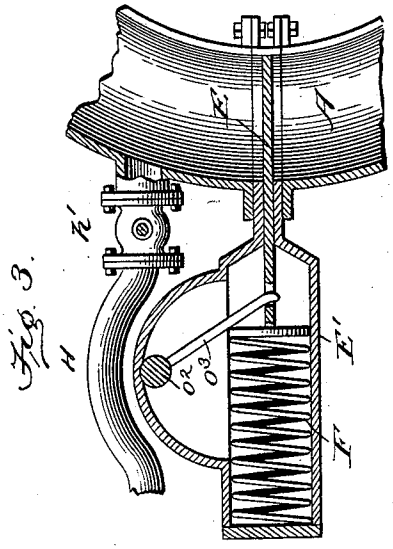


Fig. 3.

WITNESSES:

Edwin L. Bradford

Saml. E. Jacobson

INVENTOR

Louis H. Mayer

BY

Lewis Abraham

ATTORNEY.

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

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L. H. MAYER.

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Fig. 5.

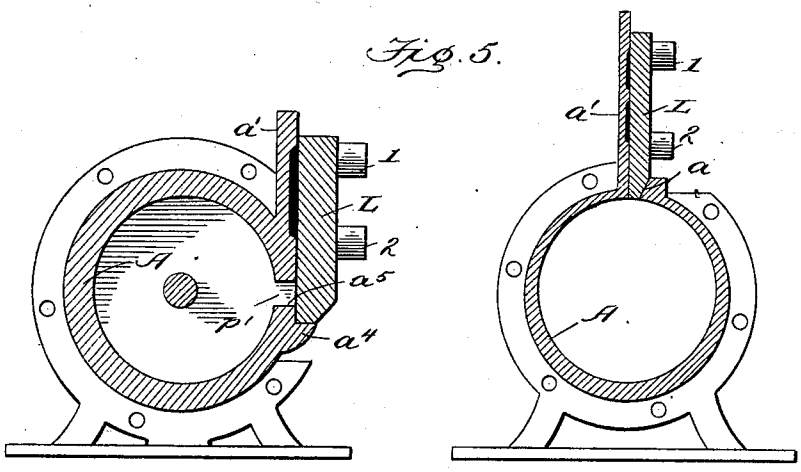


Fig. 6.

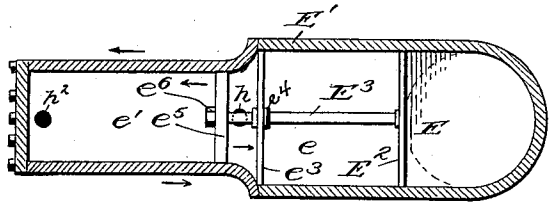


Fig. 7.

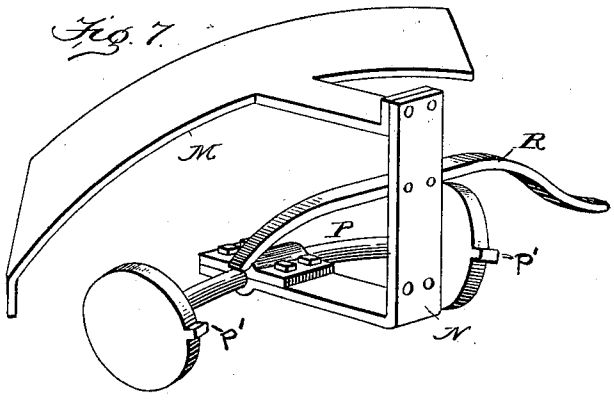
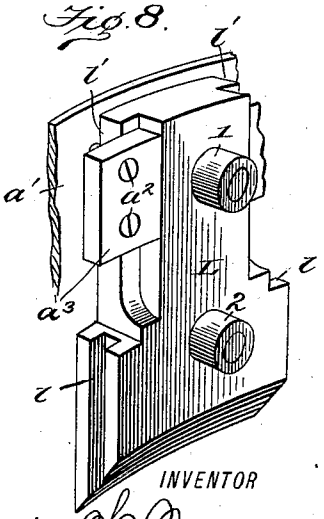


Fig. 8.



WITNESSES:

Edwin L. Bradford

Saml. H. Jacobson

INVENTOR

Louis H. Mayer

BY

Lewis Abraham

ATTORNEY.

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

(No Model.)

4 Sheets—Sheet 4.

L. H. MAYER.

PNEUMATIC MOTIVE POWER.

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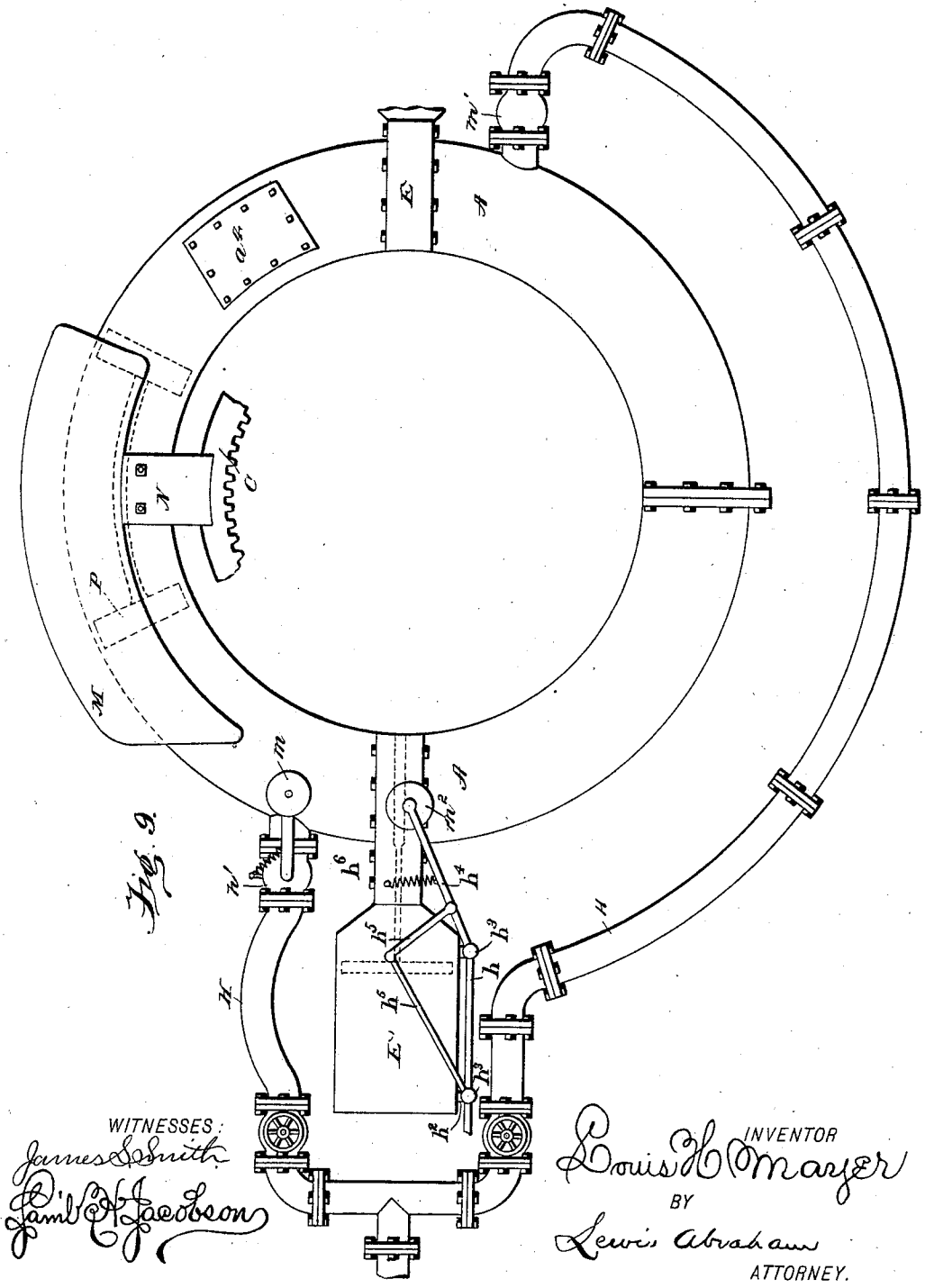


Fig. 9.

WITNESSES:
James L. Smith
Jamb. H. Jacobson

INVENTOR
Louis H. Mayer
BY
Lewis Abraham
ATTORNEY.

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

LOUIS H. MAYER, OF PHILADELPHIA, PENNSYLVANIA.

PNEUMATIC MOTIVE POWER.

SPECIFICATION forming part of Letters Patent No. 590,686, dated September 28, 1897.

Application filed October 4, 1895. Serial No. 564,606. (No model.)

To all whom it may concern:

Be it known that I, LOUIS H. MAYER, a citizen of the United States, residing at Philadelphia, in the county of Philadelphia and State of Pennsylvania, have invented certain new and useful Improvements in Pneumatic Motive Power; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

My invention relates to pneumatic power; and it consists of means for application thereof to actuate any description of machinery to which it is connected by suitable gearing.

In carrying out my invention I provide an endless tube within which is a piston having disk-heads the periphery of which conform to the inner surface of the tube, which piston is caused to travel continuously within the tube by action of exhaust of air from said tube, the movement of the disk-headed piston imparting action to gearing outside of the tube, all in manner and form as hereinafter fully described, and illustrated in the accompanying drawings.

Referring to the accompanying drawings, wherein like letters and numerals of reference point out similar parts on each view, Figure 1 is a top plan view of an annular tube, parts being broken away, showing the piston connected to movable gearing and air-ducts opening into the tube. Fig. 2 is a cross-sectional view on the line *x x* of Fig. 1. Fig. 3 is a detail sectional view of a portion of the tube, showing a section-gate closed therein and mechanism for reciprocating said gate transversely within and without the tube, also portion of exhaust-pipe with an inlet-opening into the main tube. Fig. 4 is a sectional view of the tube and piston and its connection with gear, also colter and bar for operating the slot-valve gates and valves of exhaust-tube. Fig. 5 represents sectional views of the main tube and slot-closing gates. Fig. 6 is a sectional view of gates for closing the tube in sections actuated by pneumatic power. Fig. 7 is a detail view of the piston, showing extension for connection to gear-wheel, the colter for actuating the slot-valves, and a device for opening and closing the air-duct pipes. Fig. 8 is a detail view of a slot-closing gate. Fig. 9 is a top plan view of the annular tube provided with closing-gate shown in Fig. 6, actuated by pneumatic power.

In the drawings I have illustrated a continuous annular tube on a horizontal plane and a vertical main shaft, but do not confine my invention thereto, as the tube may be oblong or adjusted vertically or at any desired angle, having interior traveling disk-headed piston actuated by motive power, presently set forth, to impart motion to the shaft of mechanism extending in any desired direction.

In the drawings, A is a tube to which are connected exhaust-pipes H H, each having inlets opening into the main conduit-tube a slight distance forward of a section-closing gate E, which is operated in a manner presently set forth. The tube A has a continuous slot *a*, which is opened and closed by valve-gates L, operated by a curved colter R, extending from a grip-arm N, which is permanently connected to the piston P, as plainly illustrated in the drawings.

The valve-gates L each have outwardly-extending friction-wheels 1 2, one above the other. As the bent colter is moved and strikes the upper wheel 1 it lifts a valve-gate and opens the slot *a*. As said colter progresses onward its invertedly-curved end by bearing upon the lower wheel 2 forces the valve-gate downward and closes the tube-slot, this actuation of the slot-closing valve-gates progressing continuously as the piston is caused to move within the main tube.

I deem the described means of opening and closing the tube-slot as exceedingly novel and useful, obviating employment of spring-pressure and gravitation, my improvement being adapted for moving the slot-valve gate outwardly at any desired angle and forcing it within the tube-slot whether said slot is at top, side, or any point of the tube.

Besides the described device for moving the valve-gates they are so constructed that they will always move reciprocatingly at right angles of the slot *a* without any risk of displacement or movement except in a direct line. To carry out this purpose, the valve-gates at their opposite sides for a given distance of their length are tongued and grooved,

as shown at i, while above said tongues and grooves each valve-gate is cut away, thus reducing its width at the upper section thereof, thus forming an intermediate open space i' between each two juxtaposing valve-gates. In connection therewith a back plate a' uprises from the main tube, to which plate is fastened by short screw-rods a^2 a clamp guide-plate a^3, each side of which overlies the edges of the respective adjacent slot-valves, at upper section thereof, the purpose being to maintain said valve-gates in perfect alinement when projected within and without the slot a and to limit their outward passage therefrom.

As I do not limit practical operation of my invention to placing the tube-slot at any point of its circumference, various modified forms of valve-gates may be employed without departing from the scope and purview of my invention.

In Fig. 5 I have illustrated the preferred form, whereby perfect movement and closure is secured as the lower end of the valve-gate engages a flange a^4, extending outwardly from the main tube, which limits the inward movement of each valve-gate, its outward movement being arrested by clamp guide-plate a^3, as previously set forth. In this form the interior of the tube has a continuous lengthwise groove a^5, into which passes a rider p', extending outwardly from periphery of the disk-head of the piston, as illustrated in Fig. 7.

In the other sectional view Fig. 5 is illustrated a form of valve-closing gate wherein its lower end when falling within the tube-slot closes the tube and its interior is maintained in a perfect spherical form, the lengthwise groove a^5 and flange a^4, as shown in other sectional view of Fig. 5, being omitted. Either construction illustrated may be employed in practice of my invention, but, as before set forth, the flange a^4 for limiting movement of the valve-gate L is preferable.

The grip-arm N, connected to the piston, extends outwardly through the slot of the tube and at its outer end is fastened to periphery of a main gear-wheel C, which transmits action to wheel C' and turns smaller wheel C^2, which by engagement with teeth of wheel D on shaft B will turn said shaft and actuate suitable mechanism connected therewith, said gearing being shown on a uniform plane, and by action thereof will turn the shaft B in direction illustrated by arrows on Fig. 1.

B' is another gear-wheel, which in practice is elevated above the plane of the connected gear, hereinbefore described, but by suitable means may be lowered down on its axle b and brought into engagement with teeth of shaft-wheel D and by the same action lower the small gear-wheel C^2 on its axle c, whereby, as will be readily understood, reverse rotation will be imparted to the shaft B, no special mechanism being shown or claimed for vertical movement of said wheels B' and C^2 for connection and disengagement with shaft-wheel D, the teeth of which are of sufficient breadth and thickness to be brought into engagement with either of the described gears.

The tube A has closing-gates E, which are provided with means, when actuated, to slide them transversely within and without the tube and as required to prevent a continuous passage of exhaust of air the full length of the tube.

I show only two closing-gates in the drawings, but more may be used to increase force, especially on pneumatic tubes extending along a route, for, as before set forth, although confining description of my invention to an annular tube I do not limit practical application thereto, for it is equally adaptable for employment on pneumatic tubes of any length which by use of the gates E can be opened and closed into sections of required length at predetermined times by action of a moving piston P.

The gates E are shown in Fig. 2, the one to the left being projected within the tube, and the opposite one forced outwardly therefrom, whereby the exhaust of air will be arrested by the closed gate, but will freely pass the point where the gate is withdrawn from the tube.

Extending outwardly from the tube are gate-boxes E', within which the gates will reciprocate when actuated.

In the drawings each gate on Figs. 1 and 2 is illustrated as provided with rearward compressible and resilient springs F, which act in conjunction with other power applied to move the gates E to and fro within and without their boxes E' and the tube. Said springs are not, however, indispensable, as various means may be employed to operate said gates.

The gates E, of the form illustrated in Figs. 1, 2, and 3, that, as hereinbefore set forth, open and close the tube into sections, are forced into the tube A by pressure of the spring F at rear end of the box E'. Sectional views of said gates are shown in Figs. 2 and 3. They are moved outwardly from the tube A into box E' as the piston traverses within the tube, when the lower turned end of the arm M strikes the disk m at outer end of arm m', (see Figs. 1 and 2,) and as said arm, which is connected to the piston as hereinbefore described and illustrated, passes beyond the location of the gate E said gate is immediately projected by pressure of spring F into the tube A.

In Fig. 6 I illustrate the preferred form of operating the gates by pneumatic force introduced within the gate-box by opening a valve, in connection with which motive-power springs F may be employed, if desired. In said figure the gate-box E' has connected thereto branch pipes h h, extending from pipes H H, provided with independent closing-valves h^3, by which admission and exclusion of pneumatic force is controlled. In this form the gate-box E' has a rearward chamber e' of smaller dimension than the for-

ward chamber *e*. The section-gate E is shown as projected within the tube A. At rear end of said gate is an imperforate plate E^2, from which extends a piston-rod E^3. The gate-box is separated by partition e^3, dividing it into two chambers *e e'*, in the forward one of which the gate E can move forwardly to and within the tube and rearwardly up to the partition e^3, against which the plate E^2 will rest when brought into contact therewith. The piston-rod E^3 extends in a right line from plate E^2, to which it is permanently attached, and passes through apertured stuffing-box e^4 at center of partition e^3, from which it extends to a head-plate e^5, to which it is permanently connected by a nut-bolt e^6. Said head-plate fits into the rear chamber *e'* of the gate-box, its periphery being supplied with a suitable yielding cover that will enable it to pass to and fro within said chamber and maintain it hermetically closed around said periphery during movement of the head-plate therein. When the valves h^3 are opened, exhaust of air will ensue within the chamber *e'* and draw the head-plate rearwardly, as indicated by arrow at upper side of the incasement, and through piston connected to said plate and to plate E^2 withdraw the gate from the tube. Reverse action is accomplished by closure of valve h^3, and whereby the exhaust operates on the forward surface of head-plate e^5 to draw it forwardly in direction of the arrow at the lower part of the incasement-chamber, the opening and closing of said valve being effected by arm M, extending from gripper N, as said arm progresses onward in connection with bars extending outside of the tube of the same character, as hereinafter described, for operating valves of the pipes H.

In Fig. 9 I have fully illustrated means for opening and closing the air-ducts. The arm M, carried onward by the piston, to which it is connected, will strike valve-disk *m* of pipe H and close valve *h'*, thereby closing the exhaust of air from the tube A. As the arm progresses and disk *m* is released from pressure of said arm the disk *m* will spring back into position shown in Fig. 9 and the pipe H will be reopened, so that there will be exhaust of air from section of the tube A rearwardly of next adjacent closing-gate E. This action of opening and closing the exhaust-ducts connected to the main tube A can be employed whatever form of section-closing gate is employed.

As projection of the section-gates E within the tube A and withdrawal therefrom rearwardly into gate-box E', of the construction shown in Fig. 6, is preferably done by pneumatic power, the method and means of actuation of said gates are shown in Fig. 9. A pipe *h* is connected to the pipe H and has branches h^2 opening into gate-box E', one forward of head-plate e^5 and one rearwardly thereof. Said branch pipe *h* is provided with valves h^3. Extending toward the main tube A from the forward valve h^3 is a rod h^4, having at its terminal end a disk m^2, which is maintained in the position shown in Fig. 9 by coiled spring h^6. The rod h^4 has branches h^5 pivotally extending therefrom and rearwardly connected to the rearward valve h^3 of pipe *h*. As the arm M progresses in the manner and by the means hereinbefore described it will strike the disk *m'*, carrying the rod h^4 with it, closing the forward valve h^3 and opening the rearward one, whereby air-exhaust will progress rearwardly and draw out the gate E from the main tube A. After the arm and the piston have passed beyond the line on which the gate E is moved to and fro the disk *m'* will spring back into position shown in Fig. 9, closing the rear valve h^3 and opening the forward one, whereby the gate will return into the main tube and close the respective section, so that exhaust of air will be in front of the forward head of the piston P.

The gates E, of the form illustrated in Figs. 1 and 2, are operated by arm M, which is connected to grip-bar N, and said arm also as the piston passes onward is brought in contact with plate *m* at end of bar *m'* and moves said bar forwardly, thereby closing valve *h'* of pipe H. (See dotted lines, Fig. 1.) The bar *m'*, provided at its end with plate *m*, has a branch arm *o* extending outwardly at right angles therefrom, to which is pivotally connected another short arm *o'*, connected to valve *h'*, and as the plate *m* at end of bar *m'* is moved onwardly by pressure of the arm M, extending outwardly from the gripper N, the valve *h'* will be closed, and when the plate *m* is released from pressure the valve will be reopened. The bar *m'* is fastened to the upper end o^2 of a bar o^3, connected inside of gate-box E' to gate E, and when the disk *m* is moved onwardly by pressure of the arm M, as hereinbefore set forth, said bar o^3 will withdraw gate E from the tube, and when released from pressure the spring F will force the gate back into the tube, the opening and closing of the valves *h'* and actuation of the gates E being concurrently effected by pressure on the plate *m* at outer end of bar *m'*, as described.

The adjacent section-gate E is by same action forced backward into its incasement, but the preferable means for operating the section-gates is pneumatic force, in manner and form illustrated on Fig. 6 and hereinbefore described.

The piston P, having terminal disk-heads outwardly shaped to fit within the inner conformation of the tube A, is caused to travel therethrough by exhaust of air from the tube through pipes H, which at their terminal station are connected to an exhaust air-pump of well-known character. (Not shown in the drawings; as no special description of pump is relied on.)

As soon as the arm M passes onward beyond the section-gate line the plate *m* is released from pressure and the valve *h* becomes

opened, giving free conduit for exhaust of air through pipe H and tube A up to the next closed section-gate.

The main tube A is supplied with one or more manholes a^4 of suitable construction for having access to interior of the tube for a purpose that will be readily understood.

Although the annular tube herein described and illustrated is shown provided with two sectional gates E, more may be employed in accordance with my invention on such tube when increased force is to be applied.

In the operation of the device with an annular tube divided into two sections both gates E are projected therein, as illustrated on the left-hand side of Fig. 2, and exhaust of said sections is applied through the air-duct pipes H. Within one of the sections is the disk-headed piston, normally next adjacent to one of the section-gates E, which by force of exhaust of air is carried away therefrom onwardly toward the other closed section-gate. As it progresses it will consecutively lift each slot-valve gate and close them by contact of the colter-arm with the friction-wheels 1 2, and the grip-arm extending through the slot a, being permanently connected to the main gear-wheel C, will turn it and transmit motion to the shaft B. When the piston approaches the next section-gate E, it will close the valve of pipe H, as previously described. As soon as the piston passes through the opening of the tube made free by retraction of the respective gate E within its incasement outward pressure is withdrawn from the gate, and it immediately returns within the tube, and the inlet of pipe H being free by opening of its valve the exhaust will progress forward of the section-gate, closed in manner set forth. The piston is drawn onward by exhaust through the next inlet, and as it reaches the next section-gate E the same action will be imparted thereto and to the valve of the exhaust-pipe adjacent to said gate, and thus by alternate opening and closing of the tube A the piston will travel continuously and transmit motive power to the gear with which it is connected and thereby rotate the shaft or actuate any movable elements of machinery.

Having thus fully described my invention and practical operation thereof, what I claim, and desire to secure by Letters Patent of the United States of America, is—

1. In a device of the character described, gates for dividing the main tube into sections, consisting of an incasement divided into chambers the forward one being of larger dimensions than the rear one, said chambers being separated by an air-tight partition, the forward chamber provided with a reciprocating movable gate having a rearward plate from the center of which extends a piston-rod extending through stuffing-box of the partition that divides the chambers of the incasement and thence passes rearwardly and is connected by a nut-bolt to a disk-head the periphery of which conforms to the inner surface of the smaller chamber, in combination with branch pipes, having inlets within said chamber, at opposite sides of the disk-head of the piston, the branch pipes being connected to a main exhaust-tube, and means for opening and closing said branch pipes, whereby as air is exhausted from either surface of the piston-head disk, the gate connected to the piston will reciprocate within the incasement, as and for the purpose intended, substantially as described.

2. In a pneumatic motive device of the character described, a main slotted tube, a piston adjusted to travel within said main tube, and having a grip-arm extending outwardly through the slot of the tube connected to gear-wheel of mechanism outside of the tube, said grip-arm having an upturned branch, to the outer end of which is connected a bar for opening and closing valves of pipes connected to the main tube, said upturned branch of the grip-arm supplied with bent colter, all in combination with slot-valve gates having outwardly-extending friction-rollers, one above the other, which the colter, as the piston traverses the main tube, will cause to consecutively open and close said slot, substantially as described.

3. In a pneumatic motive device of the character described, a tube with a slot extending lengthwise thereof, the tube at one side of said slot having an outwardly-extending flange, the tube at the opposite side of the slot provided with an uprising back plate, in combination with slot-valves adapted to slide in alinement with said back plate and when actuated to close the slot, and rest upon the tube-flange at side of the slot, said slot-valves being each provided with two friction-rollers, one above the other in vertical alinement, and bent colter extending from grip-arm of a piston moved within the tube by exhaust of air therefrom, the upturned bent portion of the colter as it progresses, by engagement with the upper friction-roller extending from the valve-gate lifts said valve-gate outwardly from the tube-slot and the downwardly-bent portion of the colter when brought into engagement with lower friction-roller extending from the valve-gate forces it within the tube-slot and closes it, substantially as described.

LOUIS H. MAYER.

Witnesses:
SAML. H. JACOBSON,
FRANK B. MARLOW.