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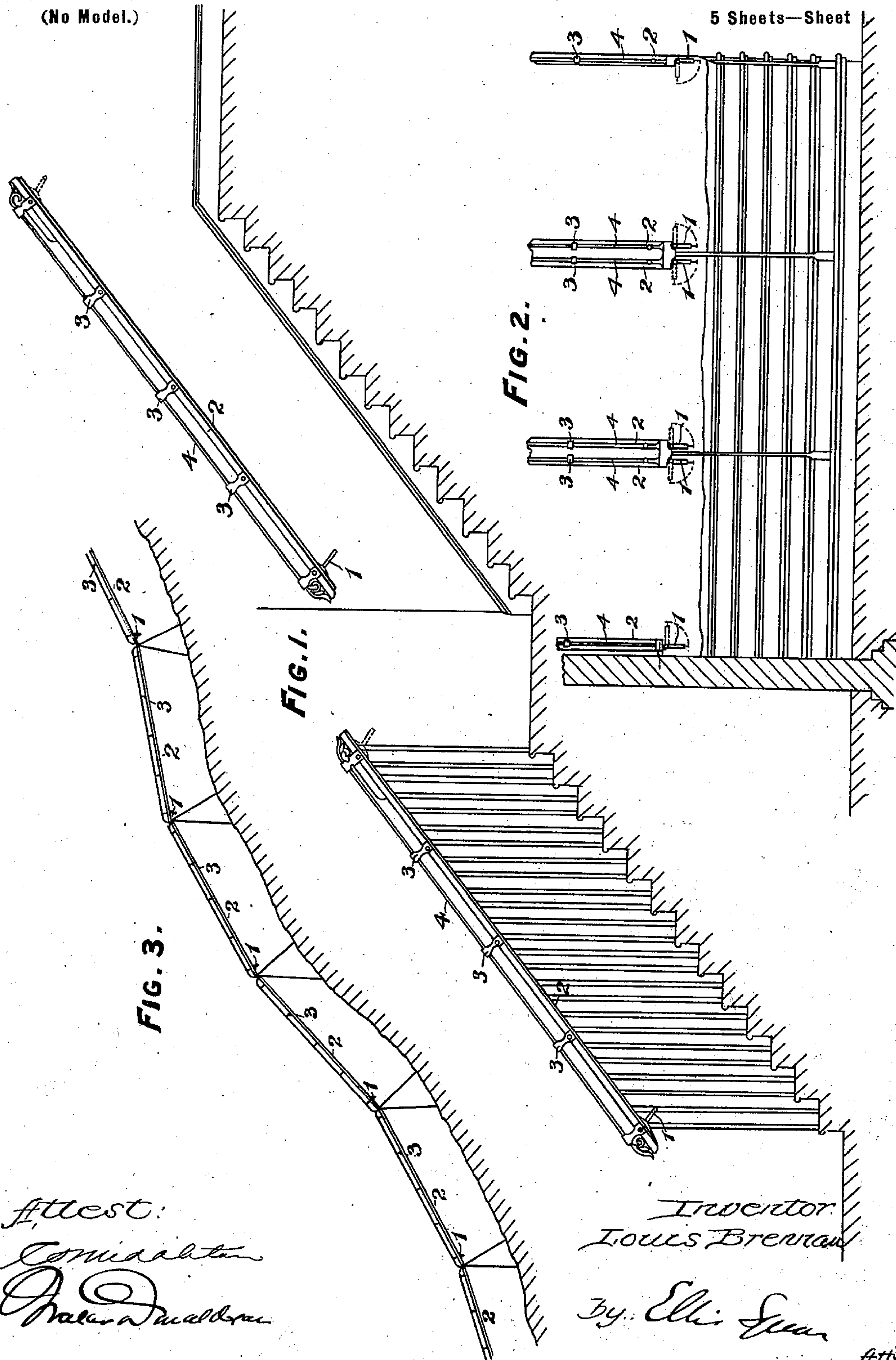
Patented June 17, 1902.

L. BRENNAN.

SYSTEM AND APPARATUS FOR FACILITATING THE ASCENT OF STAIRS OR INCLINED
WAYS.

(Application filed Sept. 9, 1901.)

(No Model.)



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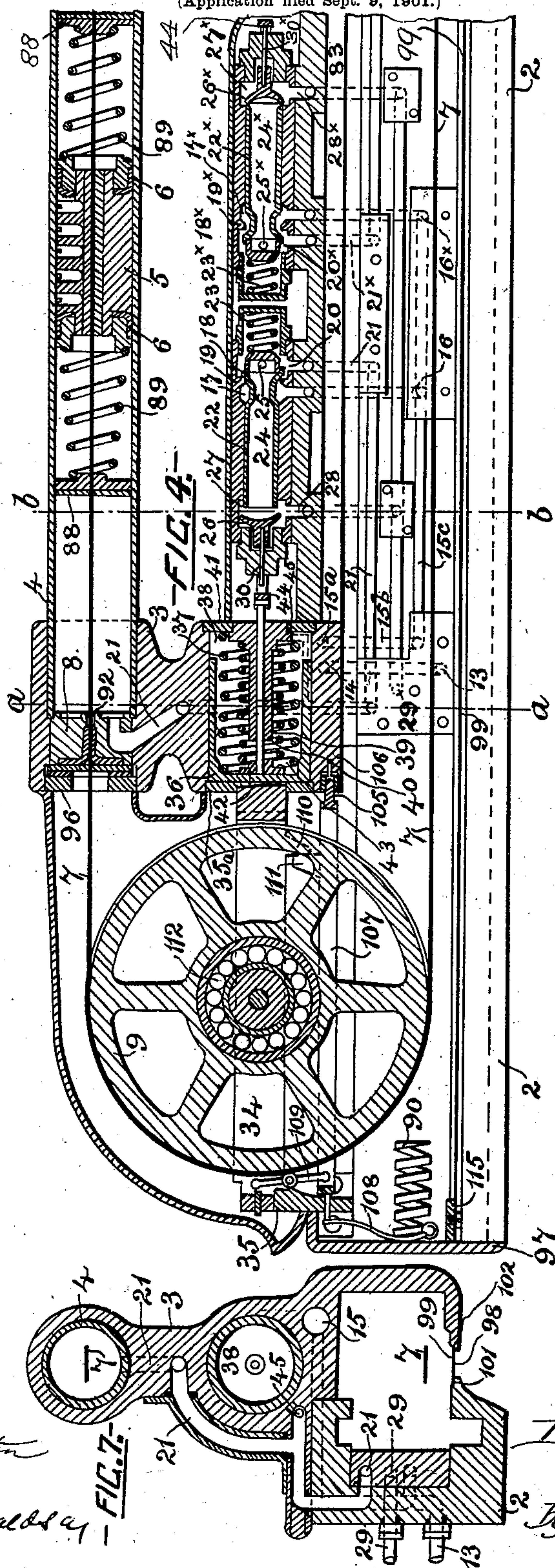
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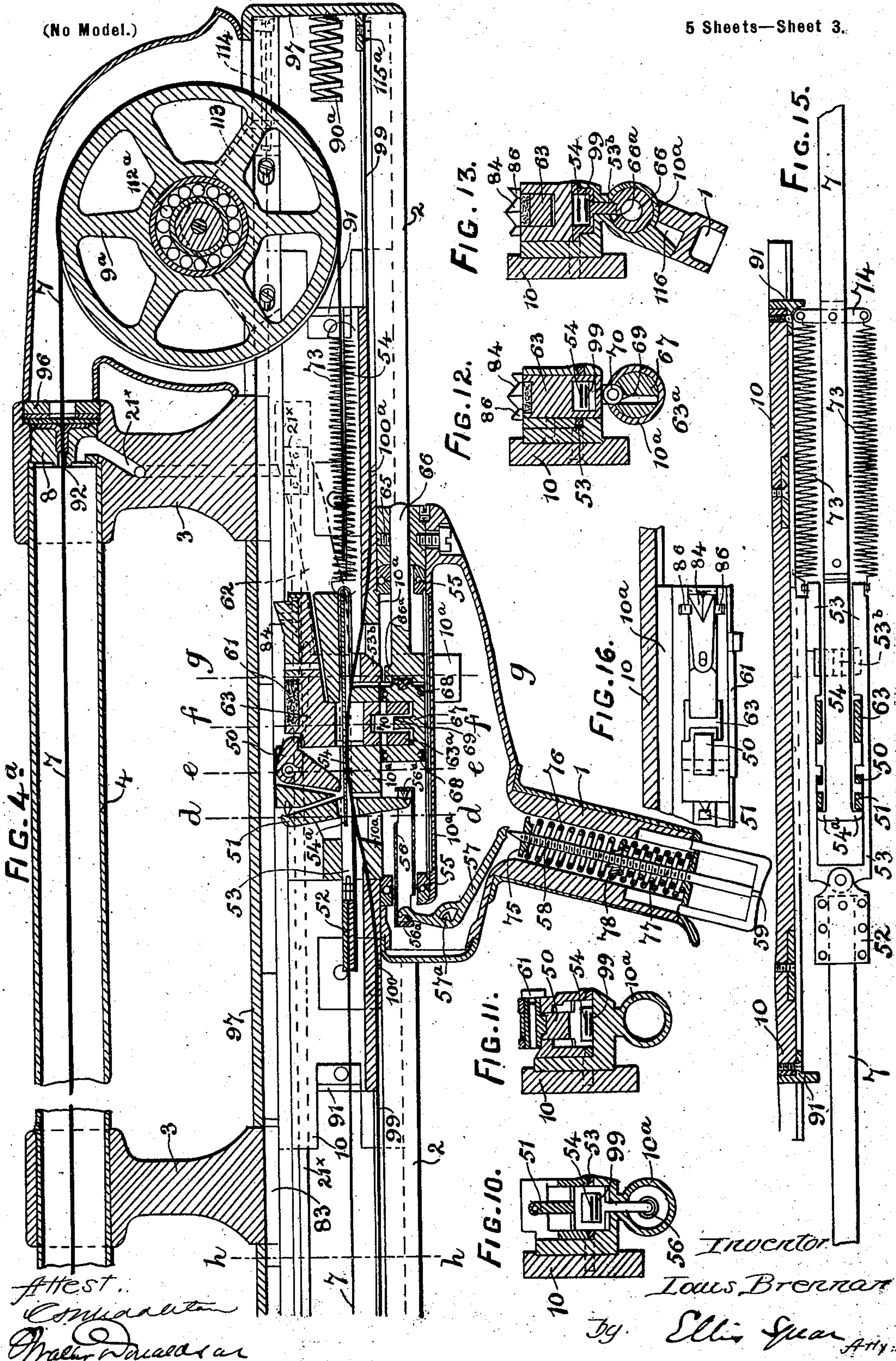
By Ellis Spear

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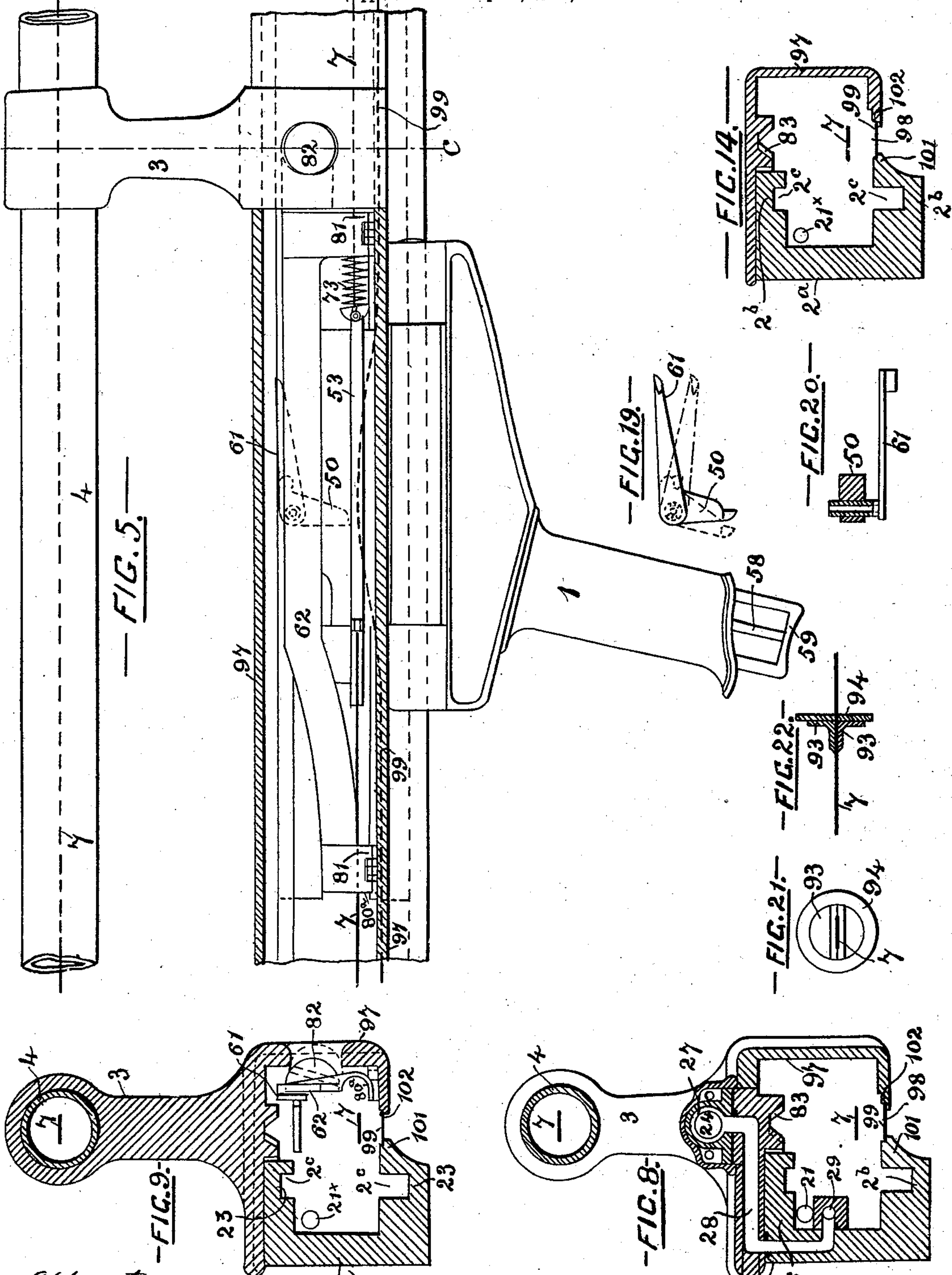
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5 Sheets—Sheet 4.



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No. 702,534.

Patented June 17, 1902.

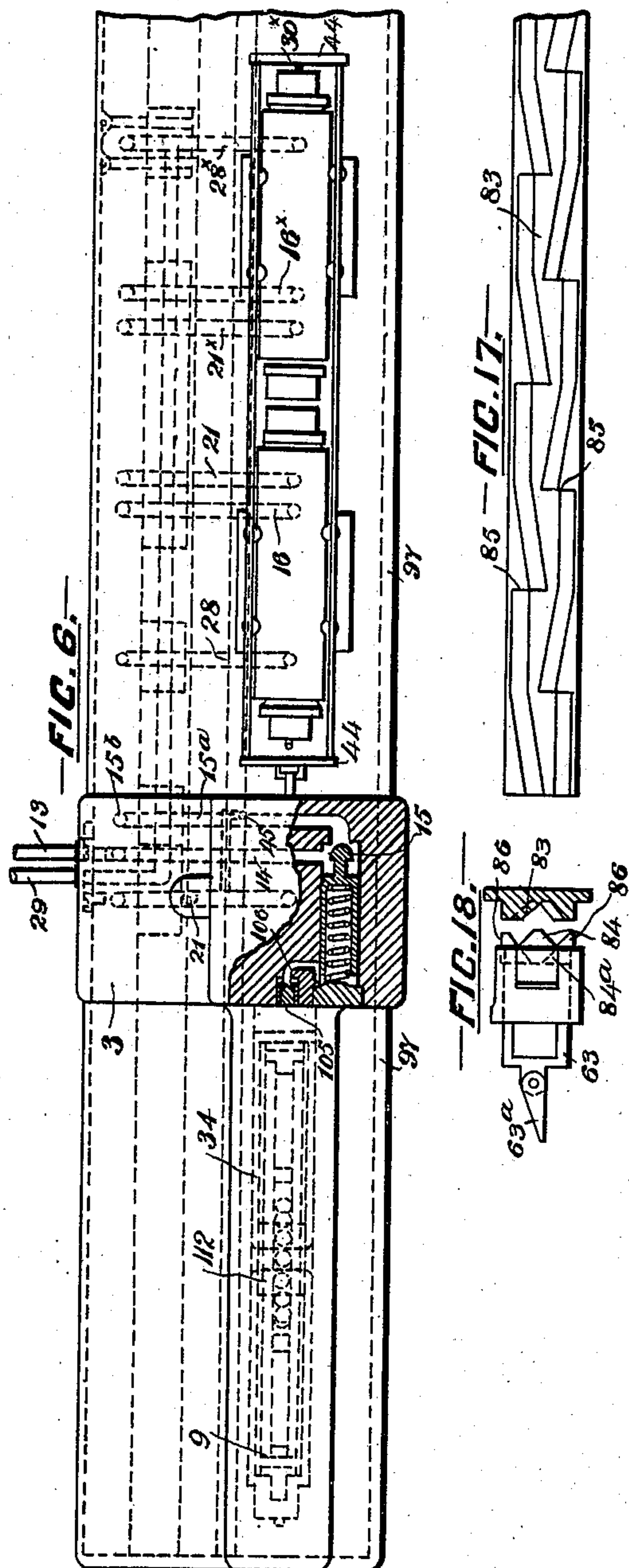
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(Application filed Sept. 9, 1901.)

(No Model.)

5 Sheets—Sheet 5.



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UNITED STATES PATENT OFFICE.

LOUIS BRENNAN, OF GILLINGHAM, ENGLAND.

SYSTEM AND APPARATUS FOR FACILITATING THE ASCENT OF STAIRS OR INCLINED WAYS.

SPECIFICATION forming part of Letters Patent No. 702,534, dated June 17, 1902.

Application filed September 9, 1901. Serial No. 74,854. (No model.)

To all whom it may concern.

Be it known that I, LOUIS BRENNAN, civil and mechanical engineer, a subject of the King of Great Britain and Ireland, residing at Woodlands, Gillingham, in the county of Kent, England, have invented a certain new and useful System and Apparatus for Facilitating the Ascent of Stairs or Inclined Ways, (for which I have made application for Letters Patent in Great Britain, No. 3,415, bearing date February 16, 1901; in Belgium, No. 125,658, dated August 16, 1901, and in France, No. 302,116, dated August 16, 1901,) of which the following is a specification.

According to this invention, in connection with stairs or inclines, handles (or equivalent tractors hereinafter included in the expression "handles") are provided, which are caused to travel upward by motive power when required, so as to serve as tractors, whereby users are assisted in walking up the stairs or inclines. Each tractor-handle may be caused to travel along a suitable guiding-support secured to a hand-rail, such as used at the side of a staircase, or to some support parallel or nearly parallel to a hand-rail or to a wall bordering the staircase or the like. Provision is made whereby the user is enabled to adjust the magnitude of the upward force as desired, and also whereby the tractor-handle on being released will be automatically and rapidly returned to its initial or lowest position on the guiding-support, so as to be ready for the use of another person desirous of obtaining assistance. Means may also be provided for stopping the descent of the handle at other points, so as to obviate waiting at the foot of the stairs until it has completed its descent. To guard against accident, when the handle is being used it is prevented from returning down the guiding-support by the engagement of a non-return pawl or pawls with a fixed rack.

My invention may be carried out in various ways.

Referring to the accompanying drawings, which illustrate, by way of example, one arrangement of apparatus according to this invention, Figure 1 is a sectional side view of two flights of stairs each provided with apparatus for facilitating their ascent. In the case of the lower flight the apparatus is shown

attached to an ordinary hand-rail supported by the balusters, while in the case of the upper flight the apparatus is attached to a wall bordering the stairs. Fig. 2 is a sectional front view of a portion of a broad flight of stairs provided with several sets of my apparatus, the set on the left being attached to the wall and that on the right to the ordinary balusters. At suitable intervals in the breadth of the stairway additional baluster or other supports are provided, each having fitted to it two sets of apparatus adapted for use by persons on opposite sides of the support. Fig. 3 illustrates the application of the invention to assist persons in walking up or climbing an irregular incline, such as a cliff or hillside. Several sets of apparatus are in this case supported one beyond another on trestles, standards, or the like. Figs. 4 and 4^a show to a larger scale longitudinal vertical sections of the upper and lower portions, respectively, of the apparatus, the middle portion thereof being omitted from these figures. Fig. 5 is a sectional elevation showing the handle and other parts of the apparatus. Fig. 6 is a sectional plan of that part of the apparatus shown in Fig. 4. Figs. 7 and 8 are respectively transverse sections on the lines *a a* and *b b*, Fig. 4. Fig. 9 is a transverse section on the line *c c*, Fig. 5. Figs. 10, 11, 12, 13, and 14 are respectively transverse sections on the lines *d d*, *e e*, *f f*, *g g*, and *h h*, Fig. 4^a. Figs. 15 to 22 are detail views hereinafter referred to.

1 is the tractor-handle, and 2 its guiding-support, which is secured to a wall or is otherwise supported parallel, or approximately so, with the general inclination of a flight of stairs or incline, as illustrated in Figs. 1 to 3. The guiding-support 2, when the apparatus is applied to a flight of stairs, may conveniently be of a length corresponding therewith.

Supported above and parallel to the guide 2, by means of standards or brackets 3 secured thereto, is a cylinder 4, fitted with a piston 5, Fig. 4, provided with cup-leathers 6 or other packing and adapted to be actuated by compressed air or other fluid admitted to the cylinder. To the piston 5 is securely attached a flexible connector, such as a steel or other suitable metallic tape or cord 7, that passes in an air-tight manner through the piston 5 and the ends 8 of the cylinder, and, extending around

guide-pulleys 9 and 9^a, respectively located at the upper and lower ends of the apparatus, has its ends connected to a slide or carriage 10, (hereinafter referred to as a "slide,") carrying the tractor-handle 1 and mounted upon the guide 2. Thus downward movement of the piston 5 in the cylinder 4 causes upward movement of the slide 10 and tractor-handle 1, and vice versa. The guide may consist of a bar 10 having a vertical web 2^a, with a pair of lateral flanges 2^b on one side thereof and formed with oppositely-arranged longitudinal grooves 2^c, adapted to receive and hold the slide in place between the flanges.

The compressed air or other fluid for actuating the piston and hereinafter referred to as "compressed air" may be forced into a reservoir by means of a pump driven by an electric, hydraulic, or other suitable motor. The motor may be arranged to automatically restore the maximum pressure to the reservoir each time the pressure therein falls below a predetermined limit. The air supply and exhaust passages or pipes may conveniently be arranged within the guide-bar 2, the web of which is suitably recessed on the inside for the purpose. The slide is formed or provided with a projecting part 10^a, Figs. 10 and 4^a, to which the handle 1 is so hinged that when required for use it can be turned upward and that when released it will turn down beneath the guide 2, in which position it will not be a source of danger during its return or downward movement.

13, Figs. 4, 6, and 7, is the pipe which leads the compressed air from the reservoir to the apparatus. The pipe 13 is connected by a passage 14, Fig. 6, which is controlled by an automatic stop-valve 15, the passage 15^a, the perpendicular passage 15^b, the longitudinal passage 15^c, and the two branch passages 16 16^x, with the inlet-chambers 17 17^x of the valves 18 18^x, which respectively regulate the admission of compressed air to the upper and lower ends of the cylinder 4. The valves 18 18^x, which are identical in construction, are adapted to close the respective apertures 19 19^x, formed in the partitions that separate the inlet-chambers 17 17^x from the chambers 20 20^x. These latter communicate by passages 21 21^x with the two ends of the cylinder. The valves 18 18^x are oppositely arranged end to end, as shown, and open or lift toward their respective chamber 20 20^x. They are formed with cylindrical bodies that extend through the apertures 19 19^x and chambers 17 17^x and fit accurately but freely in the cylindrical portions of the casings 22 22^x. The bodies of the valves are reduced in diameter between their heads which close the apertures 19 19^x and those portions which fit the casings 22 22^x, and the valve-seats and the said casings are of equal area, so that the valve is balanced when closed. Weak springs 23 23^x may be provided to insure that the valves shall close. The valves 18 18^x have passages 24 24^x formed through them which communicate

with the chambers 20 20^x through openings 25 25^x. 26 26^x are valves which control the exhaust of air from the respective ends of the cylinder 4 through the passages 24 24^x. The said valves 26 26^x are situated in exhaust-chambers 27 27^x, into which the outer ends of the respective valves 18 18^x project and which are connected by branches 28 28^x to a common exhaust-pipe 29. The valves 26 26^x are adapted to seat upon the outer edges of the ends of the bodies of the valves 18 18^x, so as to close the passages 24 24^x, and the valves 26 26^x and 18 and 18^x are therefore of the same effective area. The valves 26 26^x are provided with spindles 30 30^x, which extend in opposite directions through the ends of the valve-casings. Joints in the air-pipes or passages may be made air-tight by means of washers of packing material inserted in recesses formed in the faces of the parts to be joined together, the arrangement being such that the securing together of the parts compresses the packing material. Suitable packing material for making these air-tight joints is the material known as "velvrl," but any other suitable material may be employed.

The guide-pulley 9 has its axle mounted in a movable frame 34, which is caused by the tightening of the tape 7 to move toward the guide-pulley 9^a in opposition to a spring or springs tending to keep the pulley in its outermost position. In the arrangement illustrated the pulley-frame 34 rests at each end upon supports 35 and 35^a and abuts against a piston 36, that works in a cylinder 38, and is pressed outwardly by a spring 37 with sufficient force to prevent undue sagging of the tape 7. The piston 36 has pressed against it a rod 39, that extends through a guide 40 in the cylinder-cover 41, said rod having attached to its inner end a plate 42, between which and the cover 41 is a spring 43, tending to keep the rod 39 in contact with the piston 36. To the outer end of the rod 39 is attached one end of a frame 44, which, as will be seen from Fig. 6, incloses both sets of valves and whose length is such that when in its mid-position its ends allow the release-valves 26 26^x to be open, while the admission-valves 18 18^x are closed. The frame 44 is moved in one direction by the pulley-frame 34 and piston 36 and in the opposite direction by the spring 43. This spring, acting on the valve 18^x, regulates the pressure of air beneath the piston 5, and thus controls the speed at which the slide 10 moves on the return stroke. The cylinder 38 (see Fig. 4) is in communication with the passage 21, which leads to the upper end of the cylinder 4 through a by-pass 45, Figs. 4 and 7, and thus the pressure in the cylinder 38 is always the same as that in the cylinder 4 above the piston 5 and acts, together with the springs and 43, in resisting inward movement of the pulley-frame 34. The valves 18 and 26 and 18^x and 26^x, controlling the distribution of compressed air to and from the upper and

lower ends of the cylinder 4, respectively, are regulated by inward or outward movements of the pulley-frame 34, which occur whenever a variation in the tension of the tape 7 takes place.

It is to be observed that the combination-valves 18 and 26 or 18^x and 26^x possess characteristic properties apart from acting as admission and discharge valves. They also act as reducing-valves of a new type, serving to supply air from a reservoir at a higher pressure to a cylinder at a lower pressure, the pressure to which the air is reduced depending on the load applied to either of the spindles 30. So far the action is that of an ordinary reducing-valve. The fact, however, that the valve 26 is held against the cylindrical end of the valve 18 by the same load which acts to open the valve determines that the valve 26 shall open to the exhaust-passage whenever the air-pressure under it shall exceed the force exerted upon the spindle 30. When this occurs, the valve 26 discharges from the chamber 27 till the pressure falls sufficiently. In this manner the pressure within the said chamber rises and falls with the rise and fall of the force applied to the said valve 26. This property enables me to maintain a chamber at a varying pressure, rising and falling as the force on the valve rises and falls. This valve combination forms a part of my invention which may be applied to other purposes than those hereinbefore described. The form shown in the drawings I find to be the best; but I may modify the form without departing from the invention.

The end of that part of the tape 7, Figs. 4^a and 15, which passes around the upper guide-pulley 9 is connected to one arm of a bell-crank lever 50, mounted in the slide 10 by the stirrup-frame 53, and the end of that part which passes around the lower guide-pulley 9^a is connected to a lever 51, also mounted in the slide 10, by the bar 54. As will be seen from Figs. 4^a and 15, the upper end of the tape 7 is secured between plates 52, that are pivoted to the stirrup-piece 53, which has inwardly-projecting lugs 53^a, that are engaged by the forked lower arm of the lever 50. The other end of the tape 7 is secured to the bar 54, which extends into the stirrup-piece 53 and through the fork of the lever 50 and an opening in the lever 51, as shown, and has at its end outwardly-projecting lugs 54^a, formed with knife-edges which work in V-grooves at the back of the lever 51. The lever 51 extends downwardly into that part 10^a of the slide 10 which forms the non-rotatable portion of the hinge of the handle. The part 10^a is hollow, and the handle is attached to it by means of ball-bearing connections 55 at each end. The lower end of the lever 51 is linked by a skeleton or loop 56, which is coaxial with the hinge of the handle and extends through the upper ball-bearing connection 55 to a bent lever 57, against which bears a push pin or bar 58, that carries a thumb-knob 59, pro-

jecting from the end of the handle. The lever 57 is pivoted on a knife-edge 57^a, secured to and within the handle, and the link 56 is provided with center-point bearings 56^a, so as to enable the handle to be turned about its hinge.

In order that when the slide approaches the lower end of the guide the supply of air may be cut off from the lower end of the cylinder by the closing of the valve 18^x and that the release-valve 26^x may open, there is attached to the lever 50 an additional arm 61, (see Figs. 4^a, 5, 9, 19, and 20,) which overhangs one side of the slide, and as the slide approaches the end of its downward stroke slides along and is raised by a bar 62, having a cam-surface 80^a, (indicated by dotted lines in Fig. 4^a;) thus causing the lever 50 to tighten the tape and move the pulley-frame 34 against the action of the springs 37 and 43, thereby causing the valve-frame 44 to move to its mid-position clear of the valves, leaving both the exhaust-valves open. To enable the descent of the slide to be stopped at intermediate points at intervals along the guide 2—for instance, at each standard 3, Figs. 5 and 9—additional bars 62, with cam-surfaces 80^a, are so mounted on longitudinally-arranged hinges 81 as to normally incline outwardly, as indicated by dotted lines, clear of the arm 61 of the bell-crank lever 50. Connected to each bar 62 is an externally-projecting button 82, by pushing which the bar can be turned into the path of the arm 61, so as to act in the same way as the fixed bar at the bottom of the guide. When the pressure is removed from the arm 61 by the raising of the handle, the bar 62 will fall outward into its normal position. The cam-surfaces 80^a are formed at the forward ends of the bars 62 and continued for a sufficient distance and are of a suitable shape to raise the arm 61 without shock to the height required for the purpose of actuating the valves, as described, and are then continued for some length in a straight line parallel to the direction of motion of the slide in order to hold the arm in the position indicated while the momentum of the slide is being overcome by the friction of the various parts of the apparatus. The bars 62 only partly tighten the tape, the raising of the handle into the position for use being adapted to further tighten it. For this purpose beneath the upper arm of the lever 50, Fig. 4^a, there is mounted in the slide 10 a vertically-movable bolt 63, which as it rises further actuates the lever 50. The arm 61 and the lever 50, which is shown detached in Figs. 19 and 20, may be connected by a narrow key-piece on the arm entering a wide key-way in the lever in such wise that when the bolt 63, Figs. 12 and 4^a, is raised and comes in contact with the upper arm of the lever 50 the latter will be partly turned and the tape further tightened, but the arm 61 will remain stationary. In order that the turning upward of the handle shall cause the bolt 63 to rise, the handle has secured to it by a set-screw,

Fig. 4^a, a coupling-bar 66, the inner end or head of which is formed with a clutch that engages with a corresponding part upon the end of a rotary block 67, that is mounted upon ball-bearings 68 in the tubular part 10^a of the slide 10. The block 67 is cut away so as to form a cam-surface 69 (see Figs. 4^a and 12) and to receive on each side thereof projections 63^a on the bolt 63, that hold the block 67 in place longitudinally. The cam 69 acts against an antifriction-roller 70, Fig. 12, carried by the bolt 63. The head of the clutch-bar 66 is formed with a peripheral recess 66^a, (see Figs. 4^a and 13,) into which a projection 53^b on the stirrup-piece 53, Figs. 13 and 15, enters when the handle is lowered and the said stirrup-piece has not been drawn to the right hand, Fig. 4^a, by the raising of the arm 61. On the raising of the arm 61 the projection 53^b moves out of the recess 66^a and releases the handle, and on the raising of the handle the clutch-head will pass behind the projection 53^b, thus preventing its return and taking the direct strain of the tape off the bell-crank lever, antifriction-roller, &c.

As will be seen from the drawings, the levers 50 and 51, the block 63, and other parts fixed to or carried by the slide 10 are so formed as to permit the passage through them of the bar 54 and the cover-tape 99, hereinafter described.

Springs 73, Figs. 4^a and 15, tend to draw the ends of the tape together in opposition to the springs 37 and 43, Fig. 4. The springs 73 are at one end connected to pins on the stirrup-piece 53 and at the other to a yoke 74, pivoted to the bar 54.

Between a nut 75, Fig. 4^a, on the push pin or bar 58 and the outer end of the handle is a spring 76, which acts in conjunction with the springs 73 and is so arranged as to maintain the knife-edge or center-point bearings of the mechanism actuated from the thumb-knob 59 in their proper positions. These three springs act in opposition to the springs 37 and 43 and serve to relieve or assist the pressure required on the thumb-knob.

77 is a strong short spring interposed between a nut or collar 78 on the push pin or bar and the inner end of the handle to which it is attached. It forms an elastic stop and resists outward movement of the thumb-knob 59.

In practice it is advisable to so adjust the tension on the tape 7 by means of a screw 114, Fig. 4^a, acting on a bracket 113, carrying the lower guide-pulley 9^a, that on the handle being raised into the horizontal position ready for use and before the thumb-knob is pressed the valve 26, Fig. 4, is closed and the valve 18 is so far opened as to allow the pressure in the cylinders 4 and 38 to rise slightly, but not sufficiently to move the piston 5. On this taking place the pressure acting upon the piston 36, Fig. 4, which, together with the valve 26, has a combined area equal to twice that of the cylinder 4, will force it outward against the resistance of the elastic stop 77,

Fig. 4^a, acting through the tape 7, until the valve 18 is closed, when no further rise in pressure will take place in the cylinders 4 and 38. Upon a backward pull being put on the handle without the thumb-knob being pressed the frame 34 will thereby be moved inward, the valve 18 will be reopened and admit more air to the cylinders until the pull is balanced, when the valve will again close, as before. On the pull being relaxed the pressure of air in the cylinder 38 will again force the piston 36 outward and allow the valve 26 to open and the air-pressure to be proportionately reduced. This counterbalancing action of the air in the cylinder 4 is so rapid both in rising and falling that even if the non-return pawl, to be hereinafter described, was entirely removed no appreciable motion of the handle would be felt to take place, and were it not for the introduction of another force tending to destroy the equilibrium no motion of the slide and handle could be obtained. This additional force is introduced by the pressure of the thumb upon the knob 59, which will cause the tape 7 to be tightened, the result being to again reopen the admission-valve 18, increase the pressure of air in the cylinder, and this extra pressure not being counterbalanced by an equivalent pull upon the handle will produce a movement of the piston 5 and the slide carrying the handle at a velocity depending on the amount of pressure placed upon the knob. On removing the thumb-pressure from the knob 59 the air-pressure in the cylinders will again fall to that corresponding to the pull upon the handle and the forward motion will cease. To complete the cycle of operations, on the handle being released the air-pressure in the cylinders will fall to the slight pressure before mentioned, and on the handle turning down by gravity beneath the guiding-support the tape will be relaxed, with the result that air will be admitted to the lower end of the cylinder, causing the slide and handle to return down the guide until arrested by one of the bars 62, as before described.

83, Figs. 17 and 18, is a rack secured to the guide-bar 2, and 84, Figs. 4^a, 16, and 18, is a pawl pivoted upon the upper surface of the bolt 63. In the event of the tape breaking or of pipes bursting, &c., this pawl prevents backward movement of the slide, and is thus a safeguard against danger. The rack and the pawl (see Figs. 17 and 18) are so formed that as the latter is moved upward with the bolt 63 by the raising of the handle 1 it is caused to assume the proper attitude for engagement with the rack, having been during its descent first caused to assume its central position. The rack is double, the teeth 85 being disposed alternately and face to face on opposite sides of a shallow channel of a shape in section somewhat resembling an inverted V. The pawl 84 (see Figs. 4^a, 16, and 18) decreases in height and width toward its pivot and is beveled at 84^a, Fig. 18, on its

under side. This formation causes the beveled under side of the pawl to bear during its downward movement against the beveled walls 86, Fig. 18, of the slot in which the bolt 5 63 works and to thus center itself, while the doubly-inclined upper portion of the pawl will during the time it is being lifted slide on the inclined portions of the rack-teeth until the pawl comes to rest in the deepest part of the channel, when ascent of the slide 10 along its guide 2 will cause the pawl to turn to and from about its pivot as it passes over the teeth of the rack.

At each side of the piston 5 is a leather-faced plate or disk 88, loosely fitting the cylinder 4 and having the tape 7 passing through a slot in it, as shown in Fig. 4. The plate or disk is held at a short distance from the piston by a light coiled spring 89 and is adapted to seat itself around the air communication 21 21^x in the end of the cylinder just before the piston completes its stroke, the air inclosed between the piston and the plate or disk then serving as a cushion. The area of the air communication is enlarged at its inner end, as shown, to prevent retardation of the return movement of the piston. Instead of or in addition to such an air-cushion strong buffer-springs 90, Figs. 4 and 4^a, may be arranged at the two ends of the guide 2 in such positions as to act as cushions for the slide as it nears the ends of its strokes. Preferably these springs are bare at the ends against which the ends 91 of slide abut, as shown, and are secured by their other ends to their supports.

Each end of the cylinder 4 is closed by means of a plug 8, Figs. 4 and 4^a, which is formed with a slot 92, through which the tape 40 7 passes. Into the slot 92 there extends a packing-leather, (see Figs. 21 and 22,) formed of two L-shaped pieces of leather 93, arranged back to back and cemented to a leather disk 94, which is formed with a slit to permit the passage through it of the tape 7. Each packing or lip leather is secured in position by means of a screwed ring 96, Figs. 4 and 4^a, between which and an internal shoulder on the standard the outer edge of the leather disk is clamped, thus making an air-tight joint, the air-pressure serving to keep the leather lips in close contact with the tape. Instead of lip-leathers metallic or other packing of any suitable kind may be employed.

97, Figs. 4, 4^a, 5, 6, 7, and 8, is a cover-plate which is secured to the bar 2 and extends in a downward direction over its front, as shown. Between the lower edge of the cover-plate 97 and the lower flange of the guide 2 there is left a slot 98, Figs. 8 and 9, through which the part 10^a of the slide to which the handle is hinged projects. The slot 98 is closed both in front and behind the slide 10 by means of a cover band or tape 99, which 65 is secured to the guide by plates 115 115^a, Figs. 4 and 4^a. For the purpose of enabling

that part of the slide which carries the handle to project through the slot 98 the tape 99 is bent upward and over said projecting part in the form of a wave, which travels with the 70 slide. The tape or band 99 thus closes the slot 98 except at the part occupied by the slide, with the movement of which it does not interfere. Toward each end of the slide 10 the band or tape 99 lies between suitably-curved upper and lower guide-surfaces 100 100^a, Fig. 4^a, respectively, which guide it in easy curves through the slots in the levers and bolt on the slide through which the tape 7 extends, and that part of the slide over which 80 the tape 99 passes is also suitably curved. Beyond the slide the edges of the cover-band 99 rest on lips or ledges 101 102, Figs. 8 and 9, formed, respectively, upon the cover-plate 97 and the lower flange of the guide 2, the 85 band or tape thus serving to inclose the working parts of the apparatus in such wise as to protect them from damp, dirt, and insects.

105, Figs. 4 and 6, is a small relief-valve which regulates the escape of air through a 90 passage 106, Fig. 6, from the back of the automatic stop-valve 15, which is interposed between the air-supply and the admission valves of the apparatus in order to reduce waste of compressed air by leakage past said admission-valves when the tractor is not in use. 95 The valve 105 is carried by a frame 107, which is pressed by a spring 108 toward the right, so as to keep the valve 105 closed.

109, Fig. 4, is a lever pivoted on the support 35, one end of said lever projecting into the frame 107 and the other into the pulley-frame 34. 100

110 111 are projections formed, respectively, on the frames 34 and 107 and adapted to engage with each other. With this arrangement when the tape is tightened so as to move the pulley-frame 34 from its mid-position toward the right the frame 107 will be moved in the opposite direction through the lever 110 109 and the relief-valve 106 opened, and the stop-valve, being thus relieved of pressure on the one side, will also quickly open. On the return to its mid-position of the frame 34 the spring 108 will again close the valve 105, and 115 the stop-valve 15 will be also closed by the spring shown as soon as the pressure on both sides becomes equal. If the frame 34 be moved beyond its mid-position in the other direction to the left, the frame 107 will be 120 moved with it by the engagement of the projections 110 and 111, and the relief-valve 105 will be again opened, so as to allow the stop-valve 15 to open. From this arrangement it follows that on the arm 61 being raised by one 125 of the bars 63 the stop-valve 15 will be closed and leakage prevented.

The guide-pulleys 9 9^a of the tractor-tape 7, which are protected by suitable covers, as shown, may be mounted on ball or other bearings 112 112^a, so arranged as to allow of the pulleys readily alining themselves to the tape. 130

116, Fig. 13, is a buffer of rubber or other suitable material for preventing noise being caused by the handle when it falls beneath the guiding-support.

5 A suitable reservoir-pressure of air for working an apparatus such as above described is approximately seven kilograms per square centimeter when the piston 5 has an area of one square inch; but this may be varied according to circumstances.

In some cases it may be desirable to remove dust and moisture from the compressed air and to reuse the air as far as may be possible. This may be done by leading the air ex-
15 hausted from the cylinders back to the pump, which recompresses it into the reservoir.

It is to be understood that I reserve to myself the right to vary the form, dimensions, proportions, materials, and other details as
20 may be found desirable in carrying out my invention, and although the combination and arrangement of parts constituting the complete apparatus which I have described and illustrated by way of example is one which
25 will be found to give very satisfactory results in actual practice yet it is to be distinctly understood that I desire to reserve to myself the exclusive right not only to the said apparatus in its entirety, but also to the various
30 novel features embodied in my invention, whether the same be used in combination or be employed separately.

It will be evident that in some cases it may be found advantageous to construct apparatus
35 for facilitating the ascent of stairs and inclines (which expression is intended to include the sides of hills and any other incline capable of being ascended) wherein features of my invention might be combined with de-
40 vices other than those herein specifically described for fulfilling like functions, and I desire to expressly point out that the so-called "tractor" may be any suitable device capable of being grasped or engaged by hand and
45 of being caused to travel in the manner and for the purpose set forth, the particular construction of handle I have described and illustrated being merely an example of what I have found suitable.

50 Having now described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. In an apparatus for facilitating the ascent of stairs and inclines, a suitable guiding-
55 support, a part to be grasped by the hand adapted to reciprocate back and forth on said guiding-support, a power propelling-band, means for operating it in either direction, a device for connecting and disconnecting the
60 movable part with the band, substantially as described.

2. An apparatus for facilitating the ascent of stairs and inclines comprising in combination: a movable part to be grasped by the
65 hand which is permanently connected to a motor; means for starting the motor, means for automatically reversing the motor to re-

turn the movable part to its original position, and means for automatically stopping the motor when the original position is reached. 70

3. An apparatus for facilitating the ascent of stairs and inclines comprising in combination: a movable part to be grasped by hand; a cylinder containing a piston operated and controlled by fluid-pressure, the piston being connected to said movable part; means for admitting discharging and controlling flow of fluid to and from the said cylinder; means for reversing the direction of the fluid-flow to return the piston and the
75 movable part to its original position, and means for automatically stopping the piston when the original position is reached. 80

4. An apparatus for facilitating the ascent of stairs and inclines comprising in combination a movable part to be grasped by hand; a cylinder containing a piston operated and controlled by fluid-pressure, the piston connected to the said movable part by a flexible band which passes over pulleys and is stretched by them; means for varying the tension of the band controlled from the movable part grasped by hand whereby the centers of the pulleys are caused to vary their distance from each other; means for operating the valves controlling the motive fluid by the change of position of the pulleys whereby the rate of motion of the piston is varied as desired; means for reversing the direction of the fluid-flow to return the piston and the
85 movable part to its original position, and means for automatically stopping the piston when the original position is reached. 90 95 100

5. An apparatus for facilitating the ascent of stairs and inclines comprising in combination: a movable part to be grasped by the hand, a cylinder containing a piston operated and controlled by fluid-pressure, the piston being connected to said movable part, means for admitting and discharging the flow of fluid to and from said cylinder, means whereby the amount of flow of motive fluid may be controlled by the person using the apparatus, and means for reversing the direction of the flow of fluid to return the movable part to initial position. 105 110 115

6. In an apparatus facilitating the ascent of stairs or inclines, (a) a tractor, (b) a motor-cylinder fitted with a piston, (c) a flexible band or cord, (d) a movable forward pulley and a stationary rearward pulley around which the flexible band or cord passes, (e) means for counterbalancing the pull upon the handle or tractor which means comprise a compound valve for controlling the distribution of motive fluid to and from the forward end of the motor-cylinder and a cylinder which communicates with the forward end of the motor-cylinder and contains a piston which serves as a support or abutment to the movable pulley, substantially as described. 120 125 130

7. An apparatus for facilitating the ascent of stairs and inclines comprising a motor cylinder and piston, a handle or tractor, a

flexible connector between the said piston and the said handle or tractor which flexible connector passes around movable and stationary pulleys, means for counterbalancing the pull upon the handle or tractor, and means whereby a force additional to and independent of the pull on the handle or tractor may be applied by the user through the connector to the movable pulley thereby admitting motive fluid to the upper end of the motor-cylinder so as to increase the pressure therein which pressure (being unbalanced by the pull on the handle or tractor) will cause movement of the motor-piston and upward movement of the handle or tractor according to the requirements of the user, substantially as described.

8. In apparatus of the kind hereinbefore referred to, the combination of a slotted guide, a slide mounted thereon, a handle hinged to a portion of the said slide which projects through the said slot, and a cover band or tape which extends in the form of a wave over the said projecting portion of the slide and through the slide in such wise as to protect the working parts of the apparatus from dirt, dust and insects, substantially as described.

9. In apparatus of the kind hereinbefore referred to, the combination of a guide, a slide mounted thereon, a handle hinged to the said slide, a fixed rack, and a non-return pawl which is brought into its operative position relatively to the said rack by the turning of the handle into the position for use, substantially as described.

10. For facilitating the ascent of stairs and inclines; apparatus comprising a handle or tractor which is arranged to slide on a guide more or less parallel to the stairs or incline, and is attached by a flexible connector to a piston working in a cylinder, characteristic features of the arrangement being that the said handle or tractor is hinged in such a manner that by raising it the device controlling the distribution of motive fluid to the two ends of the cylinder will be brought from its mid or central position to such a position as to just open the admission-valve to the upper end of the cylinder, whereas the fall of the handle or tractor will permit the movement of the said controlling device into such a position that motive fluid will be admitted to the lower end of the motor-cylinder and the handle or tractor will then be caused to travel downward along the guide until

stopped, and a further characteristic feature being that the said handle or tractor is provided with means whereby, at all parts of its travel, the distribution of motive fluid to and from the cylinder can be controlled by the user to suit his or her requirements.

11. In apparatus of the kind hereinbefore referred to, means for stopping the descent of the handle or tractor comprising a bar having a cam-surface adapted to so act on a lever as to increase the tension of the flexible connector and bring the device which controls the movement of the distribution-valves to its mid or central position substantially as described, whether such bars be fixed at the bottom of the guide, or be movable at intermediate points thereof.

12. In apparatus of the kind hereinbefore referred to, a compound fluid-pressure-regulating valve which comprises admission and release valves whereof the former can be opened and the latter closed by a load which is capable of variation at the will of the user, the arrangement being such that the loads on the admission and release valves of the compound valve are equal, substantially as described.

13. In apparatus of the kind hereinbefore referred to, an automatic stop-valve interposed between the motive-fluid supply and the admission valves of the apparatus, for the purpose of preventing leakage when the apparatus is not in use; the relief-valve which regulates the opening and closing of the said stop-valve being adapted to be opened to allow the stop-valve to also open only when one or other of the admission-valves is about to be opened, substantially as described.

14. In apparatus of the kind hereinbefore referred to, a slide having a handle or tractor hinged thereto and provided with connections to the ends of the flexible connector between it and the piston of the motor-cylinder and means for tightening the said connector, the construction, arrangement and operation being substantially such as described and illustrated.

In witness whereof I have hereunto set my hand in presence of two witnesses.

LOUIS BRENNAN.

Witnesses:

M. ATKIN LOU ADAMS,
ALBERT E. PARKER.