No. 741,786. PATENTED OCT. 20, 1903.

J. J. GOODRICH & J. H. McPHERSON.

# TROLLEY STAND.

APPLICATION FILED NOV. 20, 1902.

NO MODEL. 2 SHEETS—SHEET 1.

Fig. 1.

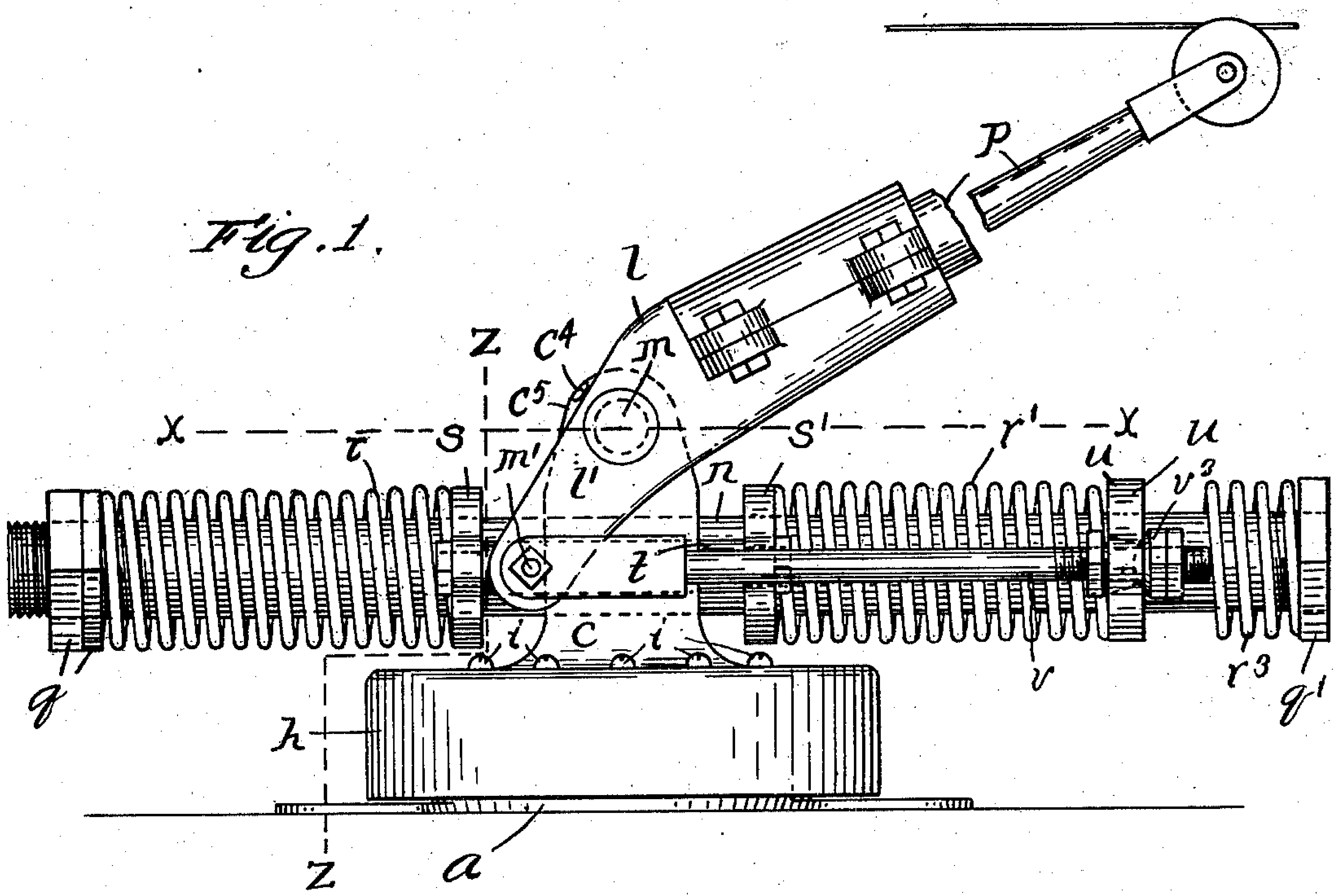


Fig. 2.

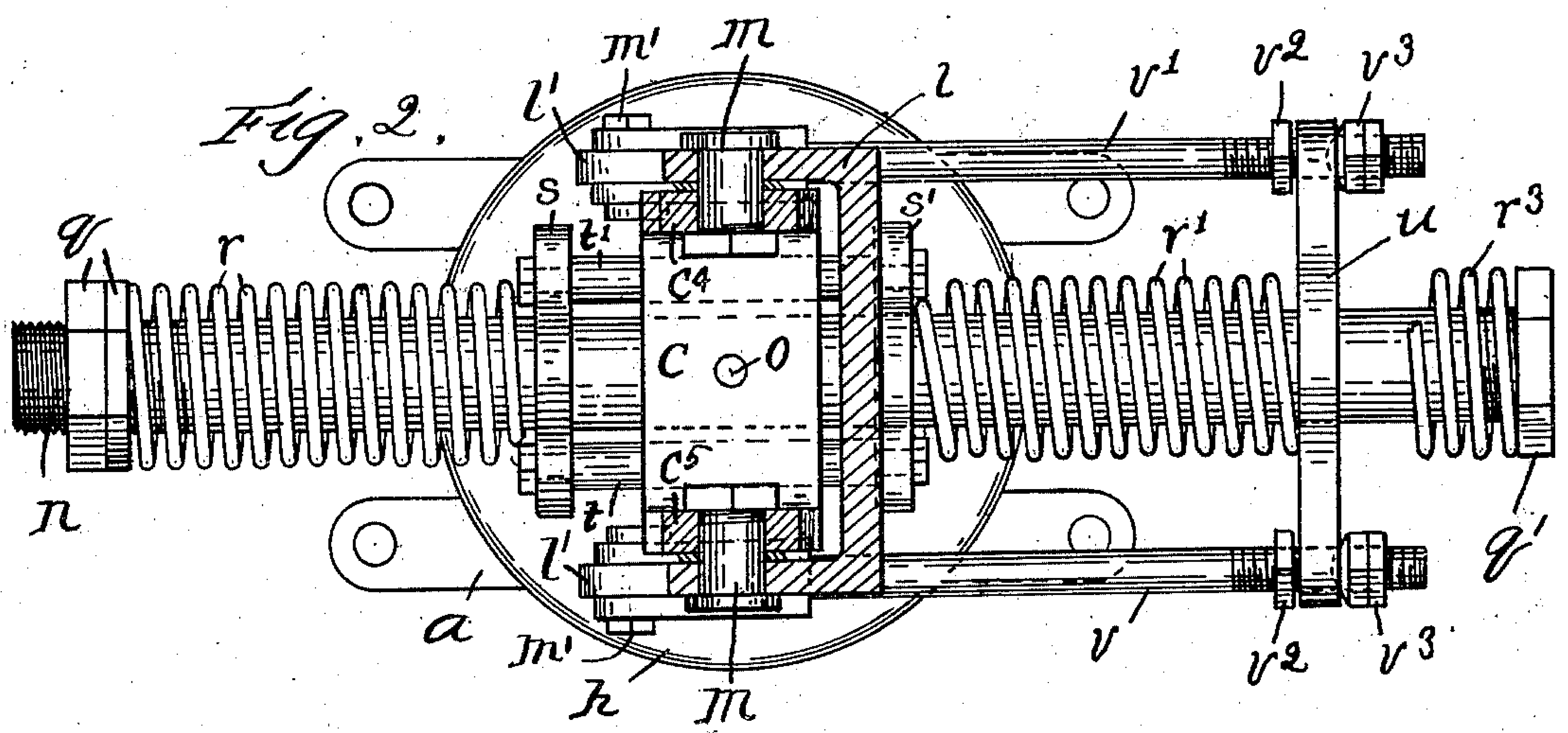


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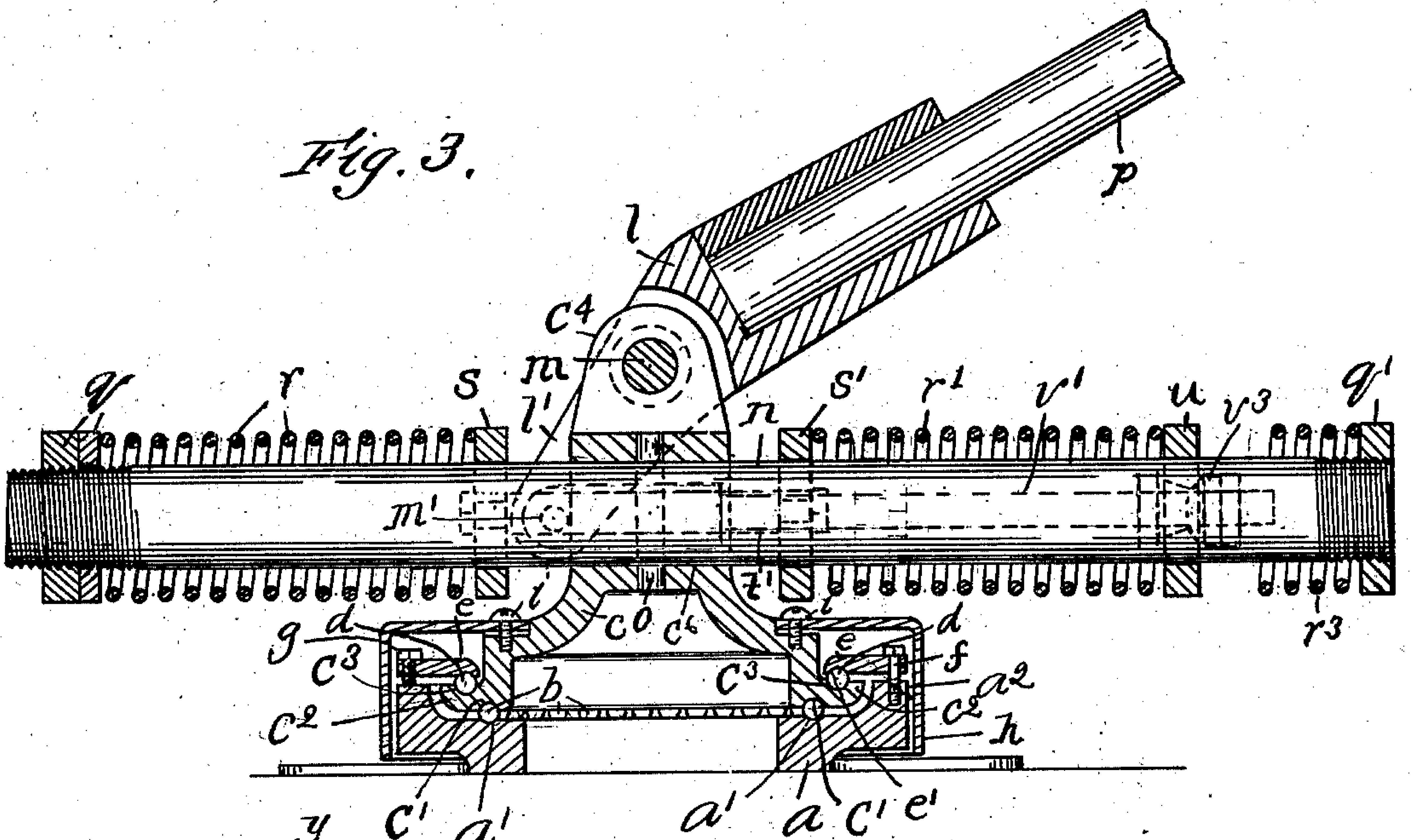
Fig. 3.



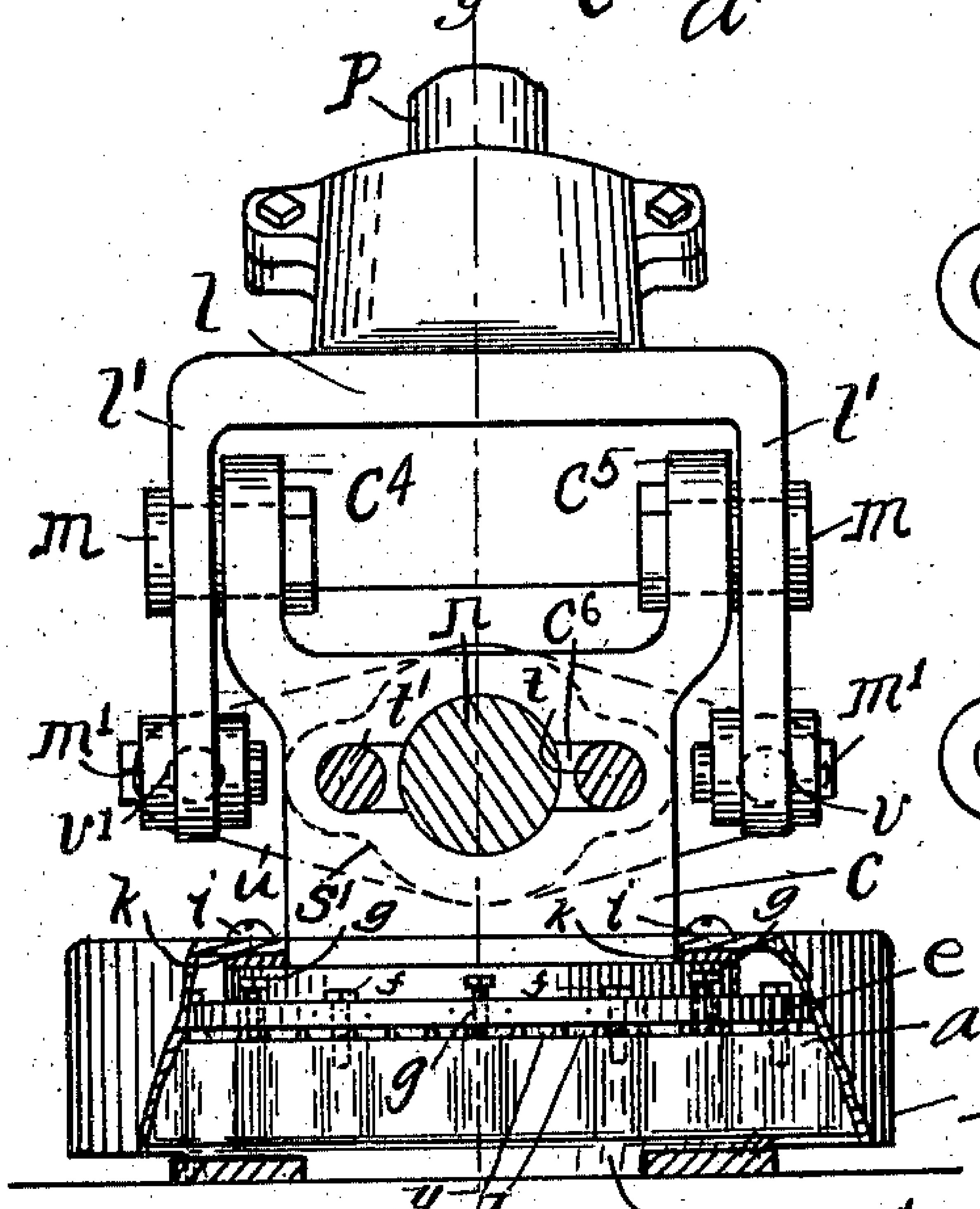


Fig. 4.

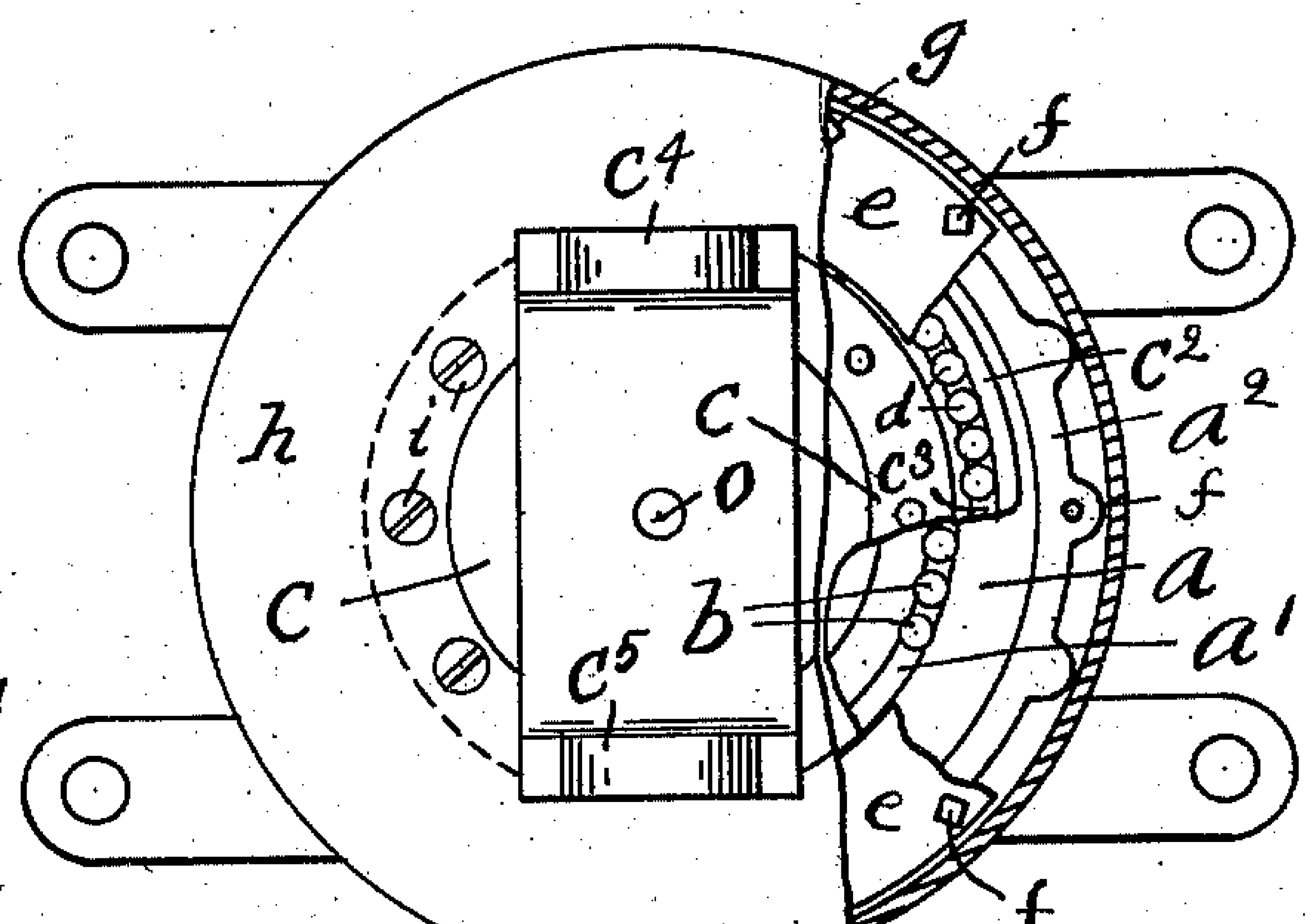


Fig. 5

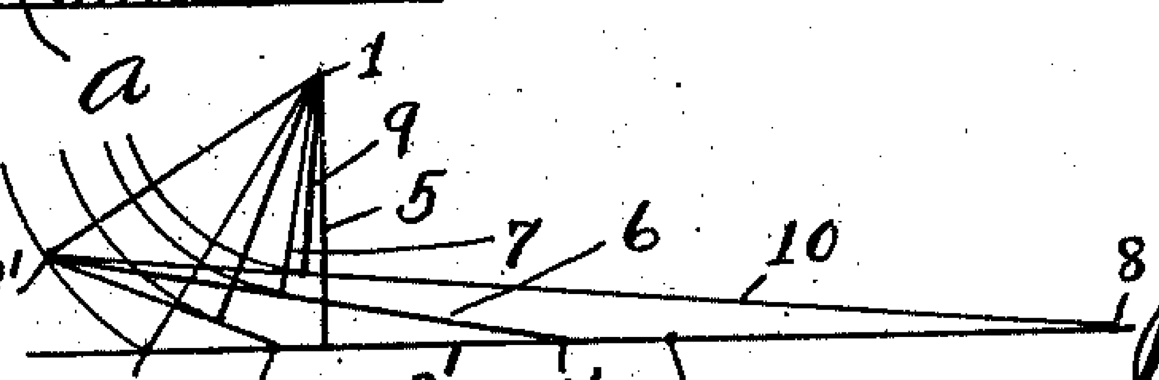


Fig. 6.

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# UNITED STATES PATENT OFFICE.

JOHN J. GOODRICH, OF METHUEN, AND JAMES H. McPHERSON, OF HAVERHILL, MASSACHUSETTS, ASSIGNORS OF ONE-THIRD TO WILLIAM R. PEDRICK, OF LAWRENCE, MASSACHUSETTS.

## TROLLEY-STAND.

SPECIFICATION forming part of Letters Patent No. 741,786, dated October 20, 1903.

Application filed November 20, 1902. Serial No. 132,110. (No model.)

*To all whom it may concern:*

Be it known that we, JOHN J. GOODRICH, of Methuen, and JAMES H. MCPHERSON, of Haverhill, county of Essex, State of Massachusetts, have invented an Improvement in Trolley-Stands, of which the following description, in connection with the accompanying drawings, is a specification, like characters on the drawings representing like parts.

This invention relates to certain improvements in that class of trolley-pole stands in which the pole is mounted so that it may swing horizontally and vertically and in which springs are provided for forcing the wheel borne thereby against the wire.

So far as we are aware in trolley-pole stands now in general use the tension on the spring which acts to force the trolley-wheel against the wire is increased as the pole is drawn down, and thus increased force is transmitted to the trolley-wheel, which is consequently pressed against the wire with much greater force when the wire is hung low or close to the car than it is when the wire is at the normal distance above the car. The increased force with which the trolley-wheel is pressed against the wire when the wire is hung close to the top of the car, as in passing under bridges or in subways, greatly increases the normal wear upon the wire, wheel, and wheel-bearing.

Trolley-stands in general use are so constructed also that the means for lifting the pole extend for a considerable distance in front of the axis of the support upon which the pole is pivoted, so that their inertia is so great, particularly by reason of the distance to which they extend from the center about which they swing, that the ready swinging of the trolley-pole as it follows the wire is at first retarded thereby, and then the acquired momentum tends to throw the trolley-wheel from the wire as its movement is arrested.

The principal objects of our invention are to provide a form of trolley-pole stand in which a constant tension is placed upon the pole whatever its vertical position and in which the parts which act to lift the pole are arranged closely adjacent the axis about which the pole-support swings. We accomplish these objects in the manner hereinafter described and as illustrated in the accompanying drawings, in which—

Figure 1 is a side elevation of a trolley-pole stand made according to our invention. Fig. 2 is a plan view, partly in section, on the line $x$ $x$, Fig. 1. Fig. 3 is a longitudinal cross-section on the line $y$ $y$ of Fig. 4. Fig. 4 is a cross-section on the line $z$ $z$, Fig. 1, with the water-shield partly broken away. Fig. 5 is a plan view with certain other parts also broken away. Fig. 6 is a diagrammatical view.

The base $a$ of the stand, which is secured to the top of the car, is provided with an annular ball-race $a'$ in the upper side thereof, in which a series of balls $b$ are arranged. Said base is also provided with an outwardly-projecting portion $a^2$, having a horizontal upper surface. The pole-support $c$ is preferably of inverted-cup-shaped form, as shown in Fig. 3, and has an annular ball-race $c'$ in its lower side, which is the complement of the ball-race $a'$, in which balls $b$ are also located. Said support is also provided with a circumferential flange $c^2$, having an annular ball-race $c^3$ on its upper side of greater diameter than the ball-races $a'$ $c'$ and in which the balls $d$ are also located. An annular plate $e$ is arranged above flange $c^2$ and is provided with an annular ball-race $e'$ in its lower side, which is the complement of the ball-race $c^3$ of the support $c$.

A series of cap-screws $f$ pass freely through the plate $e$ and are threaded into the upper side of the projecting portion $a^2$ of the base $a$, and a series of set-screws $g$ are threaded in the plate $e$, and their lower ends bear against the upper horizontal surface of the projecting portion $a^2$, as indicated in Fig. 3. By this means the plate $e$ may be rigidly held in any position within certain limits and may be so adjusted as to prevent all looseness of the bearing between the plate and support, thereby holding the support rigidly in its vertical position, yet permitting its free rotation. It will be apparent that to tighten this bearing it is simply necessary to unscrew the set-screws $g$ and take up on the cap-screws $f$, and to loosen it the cap-screws must be loosened and the set-screws screwed down.

A water-shield $h$ is secured by screws $i$ to an annular seat formed on the upper side of the support $c$, a packing-washer $k$ preferably being interposed between the shield and the support, so that access of water to the bearing is effectively prevented.

The support $c$ is provided with two upwardly-projecting ears $c^4$ $c^5$, to which the trolley-pole lever $l$ is pivoted by means of bolts $m$, which are secured in said ears and pass through the arms $l'$ at one end of the lever. The opposite end of said lever is provided with a socket in which the trolley-pole $p$ is secured by suitable means, said pole bearing the usual trolley-wheel at its end.

A horizontal rod or spring-holder $n$ passes through a central aperture $c^6$, formed in the body of the support $c$ midway between the ears $c^4$ $c^5$, said rod $n$ being rigidly secured to the support in the normal plane of movement of the pole by a pin $o$, which passes through the support and rod.

An adjustable stop-nut $q$ is threaded on the front end of the rod $n$, and a spring $r$ is interposed between said nut and a sliding collar or yoke $s$, located on the rod $n$ between the support $c$ and said nut. A second sliding yoke $s'$ is arranged on the rod $n$ at the opposite side of the support $c$ and is free to slide thereon, said yokes $s$ $s'$ being rigidly connected by a pair of rods $t$ $t'$, which pass through aperture $c^6$ in the support, said rods having shoulders against which the adjacent sides of said yokes bear and clamping-nuts at their opposite sides. A second spring $r'$ is arranged on the rod $n$ between the yoke $s'$ and a yoke $u$, also slidably mounted on said rod, and the arms $l'$ of the lever $l$ are connected to said yoke by a pair of rigid rods or links $v$ $v'$, which are pivoted at one end to the arms $l'$ by means of pivot-bolts $m'$, the opposite ends of said links being screw-threaded and passing through apertures in the yoke $u$. Nuts $v^2$ $v^3$ are screwed on said threaded ends and arranged in front and in the rear of the yoke $u$, respectively. The apertures in the yoke $u$ are made large enough to permit a certain swinging movement of the links therein, each nut $v^3$ on the rear side of the yoke being provided with a spherical or rounded face, and the bearing-surfaces therefor on the yoke are correspondingly shaped, providing, in effect, a pivotal connection between the yoke and each link, the centers of which are in the center of the apertures in the yoke and in the center of the spherical or rounded seats of the nuts on the yoke. As the springs $r$ $r'$ are confined between nut $q$ and yoke $u$ and the rigidly-connected yokes $s$ $s'$ are interposed between said springs and are free to slide on rod $n$, the result is that said springs act as a single spring in forcing the trolley-wheel upward.

A buffer-spring $r^3$ is interposed between the yoke $u$ and a stop-nut $q'$ at the rear end of the rod $n$.

In Fig. 1 the parts are illustrated in their normal position with the trolley-wheel running in contact with a trolley-wire hung at the usual height. The usual distance between the trolley-wire and the top of the car is about seven feet; but in subways and under bridges the wire is often hung within nearly a foot of the car. In some places the wire must be hung more than seven feet above the top of the car, so that the trolley-wheel may have to be pressed against the wire within a vertical distance of six or seven feet. In this normal position the center of the pivots $m'$, which connect the links with the lever, are preferably on a level with the horizontal center line of rod $n$. As the force which acts to draw the pole down acts vertically and the force of the springs $r$ $r'$ acts on the lever-arms $l'$ in a direction parallel or coincident with a straight line between the pivotal points at each end of links $v$ $v'$, it follows that the effective length of the short arm $l'$ of lever $l$ is equal to the length of a perpendicular line from the fulcrum of the lever $l$ or the center of pivots $m$ to the longitudinal center line of links $v$ $v'$, whatever the position of the latter, while the effective length of the long arm of the lever or pole end is equal to the length of a perpendicular line from said fulcrum to the vertical line through the axis of the trolley-wheel whatever the position of the wheel. As the trolley-wheel is forced down the effective length of the short arm of the lever is decreased, while that of the long arm is increased, with the result that the mechanical advantage of the trolley-wheel over the springs $r$ $r'$ is rapidly increased as it is lowered. The springs are compressed, and therefore their tension is also rapidly increased, as the wheel is moved down; but by correct adjustment of the parts, as now to be explained, we succeed in causing the increased tension of the springs to be exactly overcome by the increased mechanical advantage of the trolley-wheel as it is drawn down, with the result that the wheel is always pressed against the wire with the same force whatever its position within the ordinary limits of movement of the pole above referred to.

In designing and constructing a device with which the above results may be secured the arms of the lever are first made of such relative lengths that when a spring of desired strength is employed the wheel will be forced against the wire with substantially the force required. In practice the distance which the horizontally-running trolley-wire is hung above the pivot of the lever varies within approximately certain normal limits, and these limits are ordinarily such that the pole is required to swing through an arc the approximate limits of which are from about five degrees to sixty-five degrees above the horizontal. The pivotal point between the links and yoke moves in a path which is substantially horizontal. In order that the effective length of the short arm of the lever may grow shorter in direct proportion to the increased tension on the spring as it compresses it, it is essential that the pivotal points between the links and short arm and that between the link and yoke shall always be located on opposite sides of the line which indicates the position of the short arm when it is perpendicular to the link—that is, the limits of the path of movement of the pivotal point between the link and short arm in which the short arm will have an equalizing effect on the varying tension of the spring as it is compressed are the positions where the short arm and link are perpendicular and where they are coincident or "dead." The arc between these limits we may term for convenience the "arc of equalization." It follows, therefore, that in order to secure the desired results the angular relation of the short and long arm and the relative length of the short arm and location of the path of movement of the pivotal point between the link and yoke must be such that the line of the short arm is always within this arc of equalization, while the long arm or pole is between its normal vertical limits.

Owing to the variation in tension of different springs, we have found it to be impractical to make the arrangement above described perform its intended function without adjustment.

Having designed the above-described device with all possible accuracy, the manner in which we adjust it so that we may accomplish the above-described result and the reasons why such adjustments will accomplish this result may be best understood by reference to the diagrammatical view shown in Fig. 6. In this figure, 1 indicates the fulcrum of lever $l$, and 2 the horizontal line or plane in which the pivotal points between the links $v$ $v'$ and the yoke $u$ move as the lever swings on its fulcrum. 3 and 4 respectively indicate the position of the pivotal points between the links $v$ $v'$ and the lever-arm $l'$ and the yoke $u$ when these parts are in the normal position, (shown in Figs. 1 and 3,) with these points both in the same horizontal plane. In this position it will be apparent that the effective length of the lever-arm $l'$ will be equal to the length of the perpendicular line 5 from the fulcrum to the horizontal line 2 whatever the length of the links $v$ $v'$.

Assuming for an illustration that the lever $l$ is swung so that the pivotal point between the links and the lever is moved to the position at 3', moving the point 4 to the point 4', so that the center line of the links will assume the position of line 6, connecting the points 3' and 4', then the effective length of the lever-arm $l'$ in this position will be equal to the length of the perpendicular line 7 from fulcrum 1 to line 6. If in moving the lever to the second position just described, thereby lowering the trolley-wheel, it is found that the upward pressure at the wheel or the force with which it is pressed against the wire is increased, it becomes necessary to adjust the parts so that this upward pressure is the same as it was when the parts were in the initial position.

Assuming, for example, that the stop-nuts $q$ are screwed back on the rod $n$ or toward the support $c$ for a certain distance and the nuts $v^3$ are screwed back on the links $v$ $v'$ an equal distance away from the support, so that the length of links $v$ $v'$ is increased to such an extent that the pivotal point between the links $v$ $v'$ and the yoke $u$ is moved from the point 4' to the point 8 on the horizontal line 2 without varying the tension on the springs $r$ $r'$, then the effective length of the short arm of the lever will be measured by the length of the perpendicular line 9 from the fulcrum 1 to the line 10, connecting the point 8 and the point 3'. By swinging the points of intersection of the perpendicular line 7 with the line 6 and line 9 with line 10 through arcs having the fulcrum 1 as the center, so that said arcs intersect the same radius, it will be seen that the effective length of the short arm of the lever has been decreased for this position at 3', so that the mechanical advantage of the trolley-wheel over the springs is, in effect, increased, with the result that the wheel is forced against the wire with less force than when the pivotal point of the links and yoke was at 4'. By readjusting the parts so that the pivotal point between the links and yoke is moved to the point 11 at the other side of point 4', for example, the effective length of the short arm of the lever will be increased instead of diminished. By this means it will be seen that we are enabled to vary the effective length of the short arm of the same lever within necessary limits by a simple adjustment without varying the tension of the springs, so that when the trolley-wheel is moved either up or down to its normal limits from an intermediate position the upward pressure on the trolley-wheel will not be varied to an appreciable extent, and the wear on the wire, trolley-wheel, and wheel-bearing will be uniform whatever the height of the wire.

The force with which the wheel is pressed against the wire may be increased without varying the relative adjustment above described by screwing the nut $q$ rearwardly on the rod and nuts $v^3$ forwardly on the links for an equal distance and may be diminished by moving them likewise in the opposite directions; but the relative position of these nuts with respect to the lever cannot be materially varied without disturbing the balance between what is practically the constant weight on the trolley and the effective action of the spring within substantially the limits specified.

When the trolley-wheel leaves the wire, so that the pole is thrown upward by springs $r$ $r'$, the nuts $v^2$ on the links will engage the front side of the yoke $u$ and force the same rearwardly against the buffer-spring $r^3$, so that the upward movement of the pole may be arrested before it strikes forcibly against the guy-wires of the trolley-wire.

By arranging the springs $r$ $r'$ on opposite sides of the swiveled support $c$ we avoid having the spring-holder extend so far from the axis of the support as would be necessary if a single spring were located at one side thereof, as has been customary, so that the inertia of these parts in our device is less effective in retarding the free swinging movement of the pole on the car than it is in the prior construction.

Having thus described our invention, what we claim as new, and desire to secure by Letters Patent, is—

1. A trolley-pole stand having a support, a lever pivoted on said support, a trolley-wheel on the long arm of said lever, means comprising a spring for pressing said wheel upward against a horizontally-running wire hung at varying distances above the stand, and for equalizing the varying tension of said spring to produce a substantially uniform upward pressure of the wheel against the wire as it is moved between its normal vertical limits, comprising a yoke actuated by said spring, means for guiding said yoke horizontally, a link pivotally connected to said yoke, and to the short arm of said lever, the angular relation of the arms of the lever and the relative position of the path of the pivotal connection between the link and yoke being such that the pivotal point between said link and short arm is constantly within its arc of equalization while the trolley-wheel is within its normal vertical limits, and means for varying the length of said link without varying the tension on said spring, substantially as described.

2. A trolley-pole stand having a support, a lever pivoted on said support, a trolley-wheel on the long arm of said lever, means comprising a spring for pressing said wheel upward against a horizontally-running wire hung at varying distances above the stand, and for equalizing the varying tension of said spring to produce a substantially uniform upward pressure of the wheel against the wire as it is moved between its normal vertical limits, comprising a horizontally-disposed spring-holder encircled by said spring and mounted on said support, an adjustable stop on said holder for one end of said spring, a yoke slidably mounted on said holder and engaged by the opposite end of said spring, a link pivotally connected to the short arm of said lever and to said yoke, means for varying the length of said link, said parts being so arranged that the pivotal point between said link and short arm is constantly located at opposite sides of the right-angular position of the short arm with relation to the link in all positions of the wheel within said normal vertical limits, substantially as described.

3. A trolley-pole stand comprising a support, a pole-carrying lever fulcrumed therein, spring-holders arranged in alinement on opposite sides of said support, springs mounted thereon, a sliding connection between the adjacent ends of said springs, a stop for the opposite end of one of said springs, and a connection between said lever and the opposite end of the other spring permitting said springs to act to lift the pole, substantially as described.

4. A trolley-pole stand comprising a support, a pole-carrying lever fulcrumed therein, spring-holders arranged in alinement on opposite sides of said support, springs mounted thereon, a yoke slidably mounted on each holder between the adjacent ends of said springs, a rigid connection between said yokes, a stop for the opposite end of one spring, a connection between the opposite end of the other spring and the pole permitting the springs to act to lift the pole, substantially as described.

5. A trolley-pole stand comprising a support, a pole-carrying lever fulcrumed therein, spring-holders arranged in alinement on opposite sides of said support, springs mounted thereon, a yoke slidably mounted on each holder between the adjacent ends of said springs, a pair of rigid rods firmly secured to each of said yokes, a stop for the opposite end of one spring, a connection between the opposite end of the other spring and the pole permitting the springs to act to lift the pole, substantially as described.

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

JOHN J. GOODRICH.
JAMES H. McPHERSON.

Witnesses:
LOUIS H. HARRIMAN,
H. B. DAVIS.