UNITED STATES PATENT OFFICE.

JOHN KILBURN, OF BELMONT, MASSACHUSETTS, ASSIGNOR TO THE SAWYER SPINDLE COMPANY, OF MAINE, A CORPORATION OF MAINE.

SPINDLE-BEARING.

SPECIFICATION forming part of Letters Patent No. 705,847, dated July 29, 1902.

Application filed February 27, 1897. Serial No. 625,286. (No model.)

To all whom it may concern:

Be it known that I, JOHN KILBURN, a citizen of the United States, residing at Belmont, in the county of Middlesex and State of Massachusetts, have invented certain new and useful Improvements in Spindle-Bearings; 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.

As spindles of the self-centering or top type are commonly constructed they are provided with a tapered pintle, and the spindle-bearing comprises a bolster or tubular bearing within which the spindle-pintle rotates and the bore of which is correspondingly tapered.

The object of the present invention is to provide an improved means for adjusting the spindle-pintle in the bolster to take up the wear of parts and prevent undue friction and the binding of the spindle-pintle in the bolster.

To the above end the present invention consists of the devices and combination of devices hereinafter more specifically set forth and claimed.

The present invention is illustrated in the accompanying drawings, in which—

Figure 1 is a longitudinal section through a spindle-bearing involving the present invention, the lower portion of the spindle, including the spindle-pintle, being shown in elevation. Fig. 2 is a sectional view of the lower portion of a spindle-bearing, showing the lower portion of the spindle-pintle in elevation and illustrating a modified form of my invention. Figs. 3 and 4 are transverse sections on lines $x\,x$ and $y\,y$, Fig. 2. Fig. 5 is a sectional view of the lower portion of a spindle-bearing, illustrating another modification of the present invention; and Figs. 6 and 7 are similar views illustrating still further modifications.

Similar letters of reference are applied to like parts in the several views.

In the drawings, A represents the lower portion of a spindle having the usual tapered pintle a and preferably the usual sleeve-whirl a'. B represents the bolster, the bore of which is tapered to fit the spindle-pintle a and which is provided with the usual wicking or other elastic packing b. C represents the spindle-rail, and D the bolster-case, all of which parts except as hereinafter specified may be and conveniently are of the usual construction and in themselves form no part of the present invention.

Referring more particularly to the form of my invention illustrated in Fig. 1 of the accompanying drawings, I have shown as formed in the base of the bolster B a polygonal aperture b', substantially in line with the bore of the bolster B. I have also provided a step-pintle, the lower end of which rests upon an adjustable support d in the base of the bolster-case D and the upper portion of which is projected into the aperture b' and forms the step upon which the spindle-pintle a rests. The adjustable support d, as shown, consists of a threaded bolt, which engages a correspondingly-threaded aperture d' in the base of the bolster-case D. The upper portion d^2 of the aperture d' is preferably contracted to a slightly-greater diameter in section than the pintle F. The lower portion f of the pintle F is polygonal in section and loosely engages a correspondingly-shaped aperture d^3 in the adjustable support d. The upper portion f' of the pintle F is also polygonal in section and loosely engages the aperture b'. The intermediate portion of pintle F is preferably cylindrical, so that it is free to rotate and also reciprocate in its bearings d^2 in the base of the bolster-case D. H represents a bolster-support, which in said Fig. 1 is shown as a sleeve or tube loosely surrounding the step-pintle F and resting upon the base of the bolster-case D, the bolster B resting upon the top thereof. As shown in Fig. 1, the pintle F is restrained from rotation by engagement with the aperture d^3 in its adjustable support d and by engagement with the aperture b' restrains the bolster B from rotation, and the arrangement is such that the bolster B is given free lateral play to allow the spindle A to center itself under an unbalanced load.

In the modification illustrated in Figs. 2, 3, 4, and 5 the step-pintle F′ is shown as polygonal throughout its length and the aperture

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C. J. KINTNER.

ELECTRIC RAILWAY.

(Application filed Oct. 29, 1900. Renewed Feb. 28, 1902.)

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Fig. 4.

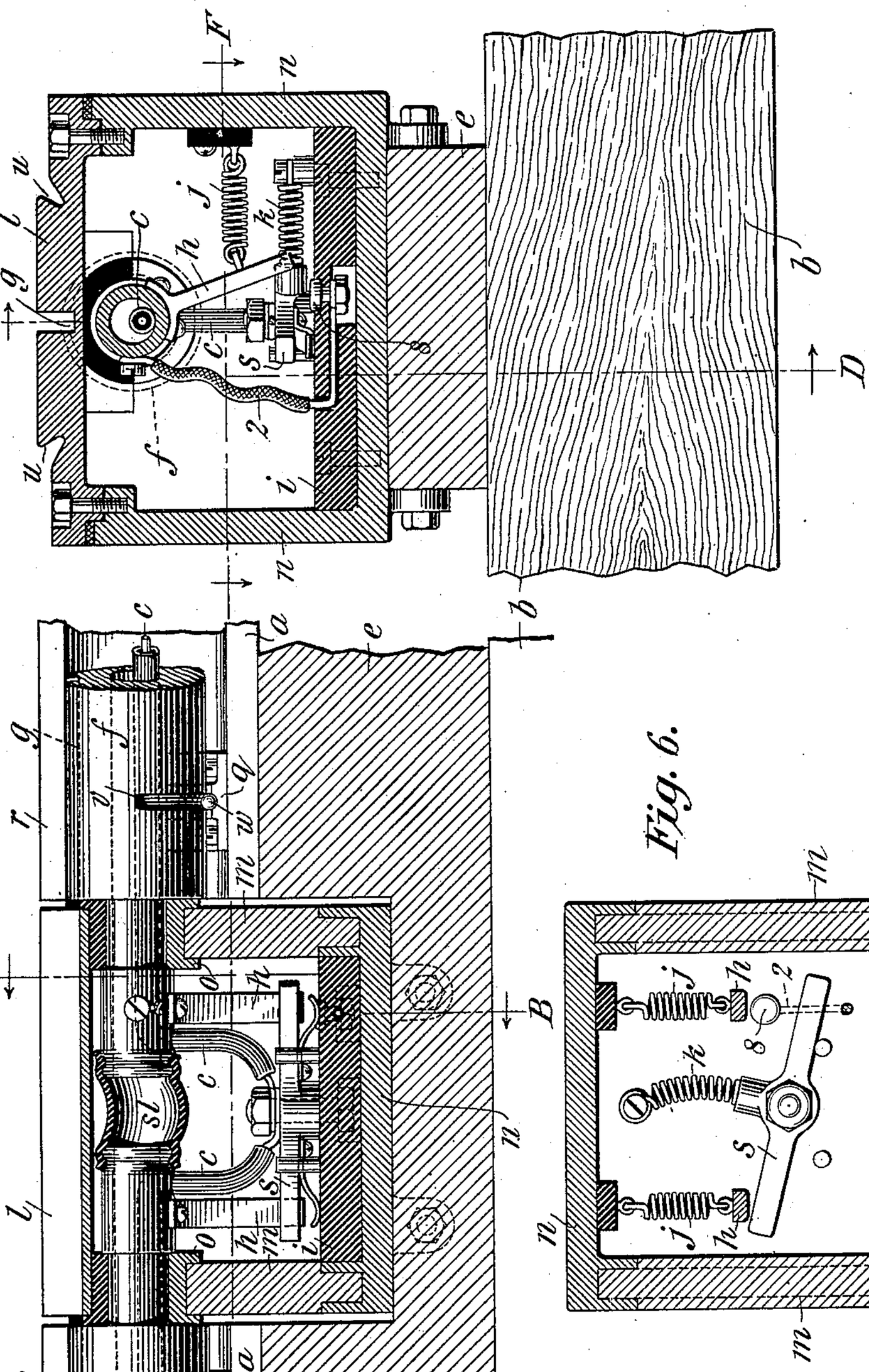

Fig. 6.

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Fig. 8.

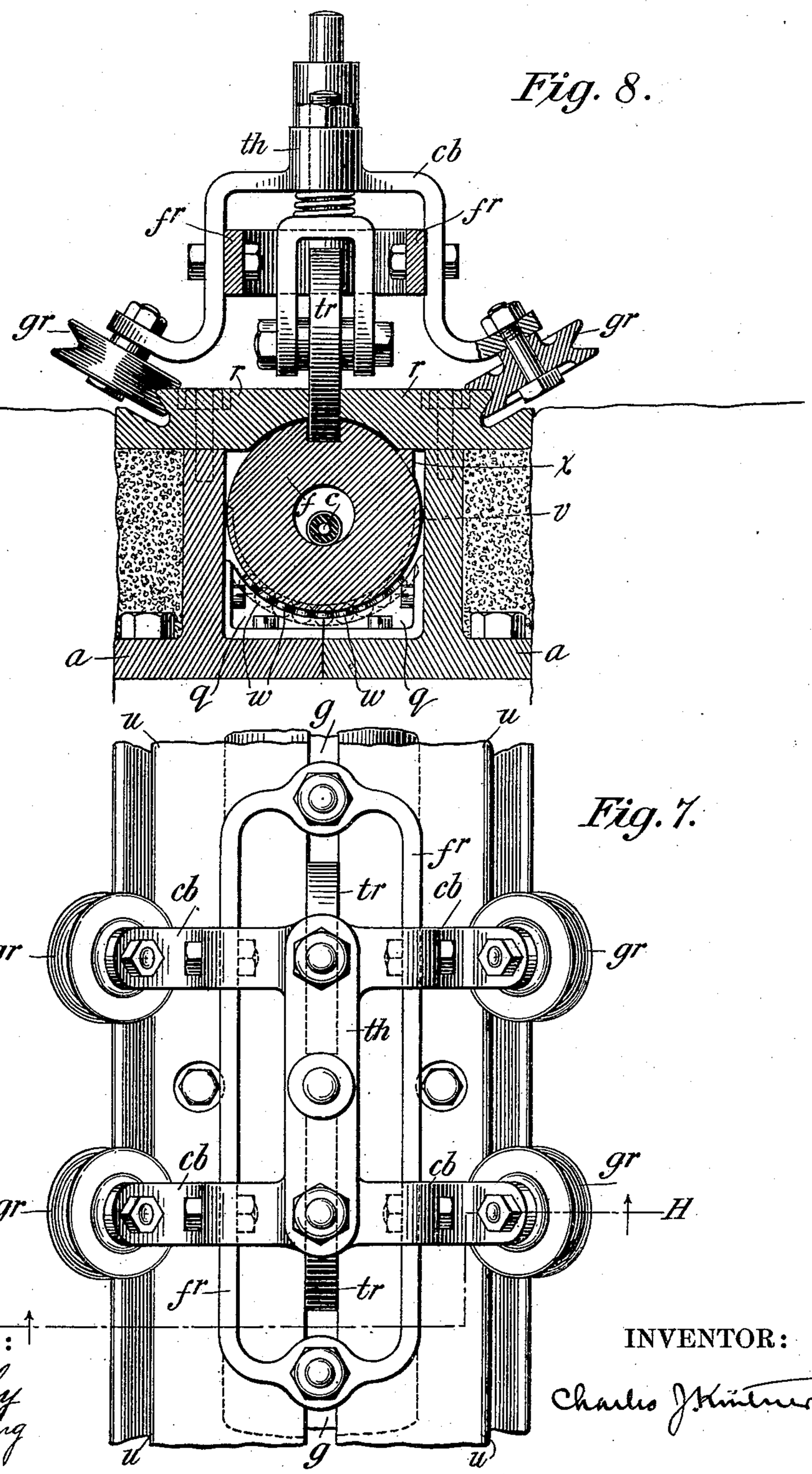

Fig. 7.

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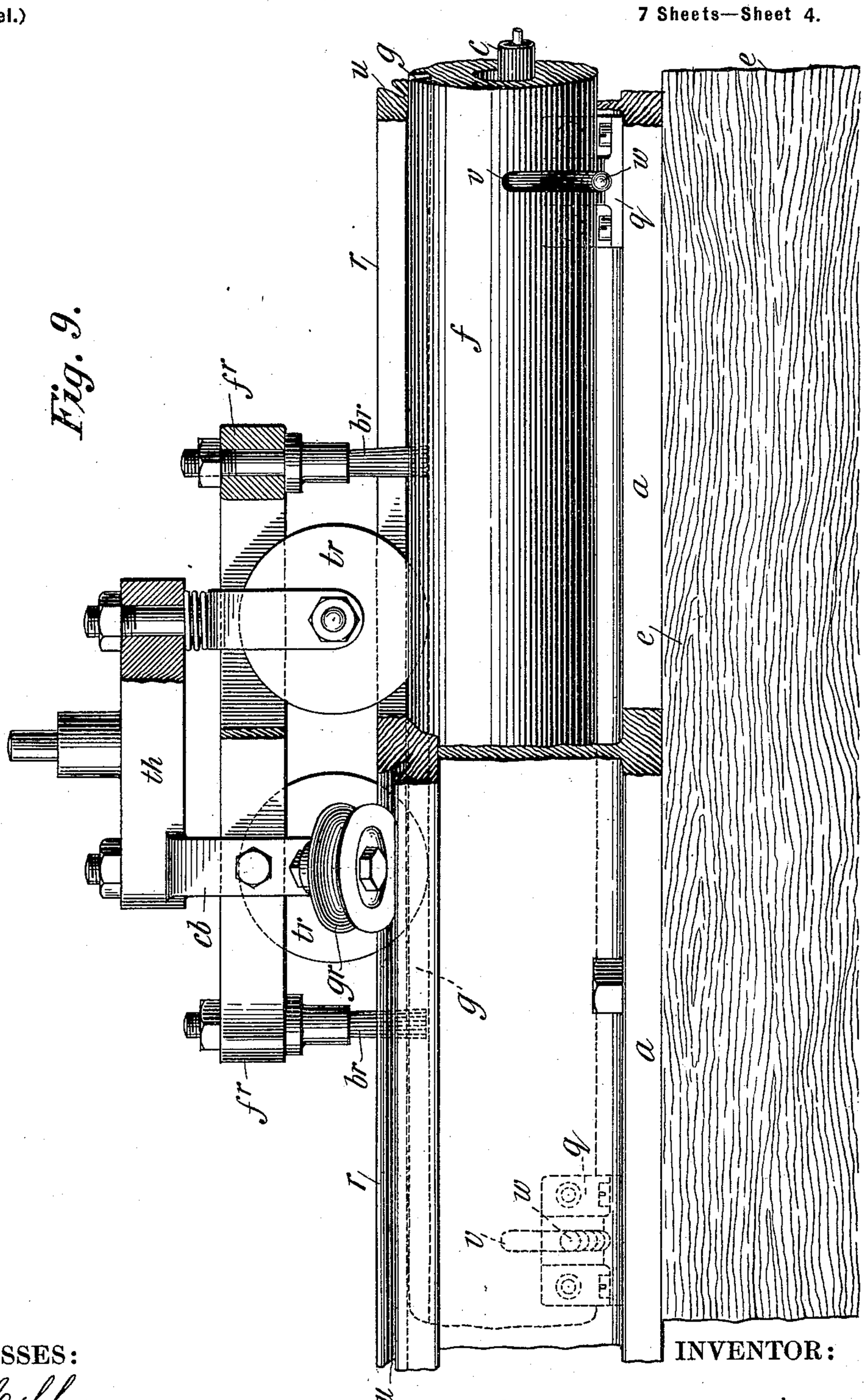
(No Model.) 7 Sheets—Sheet 4.

Fig. 9.



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(No Model.) 7 Sheets—Sheet 5.

Fig. 10.

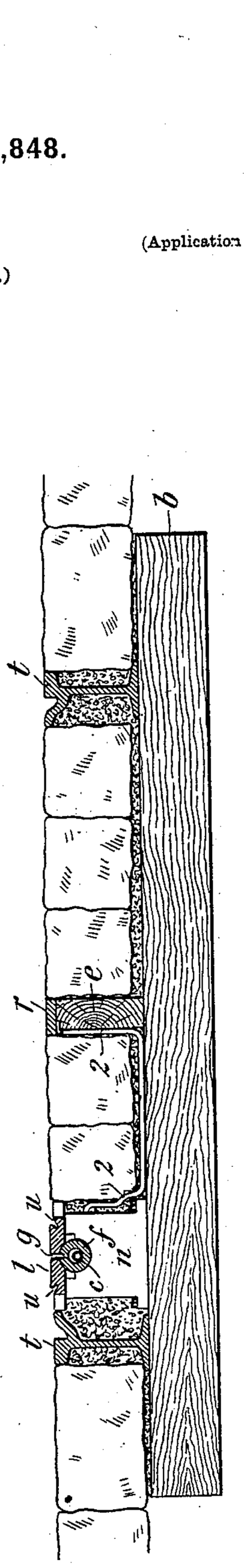


Fig. 11.

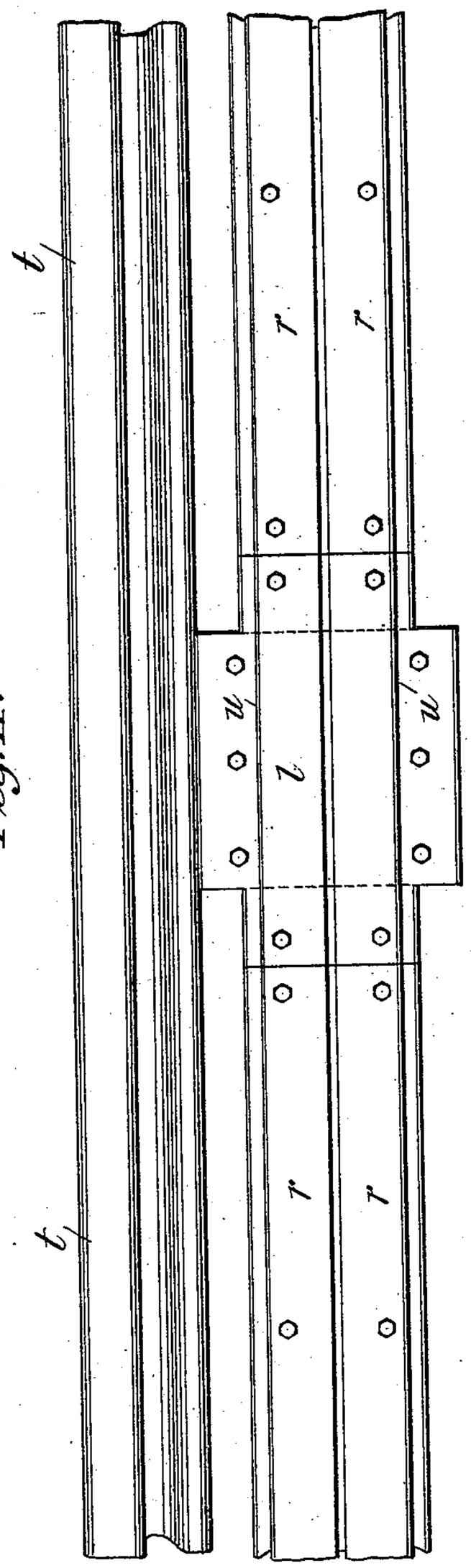
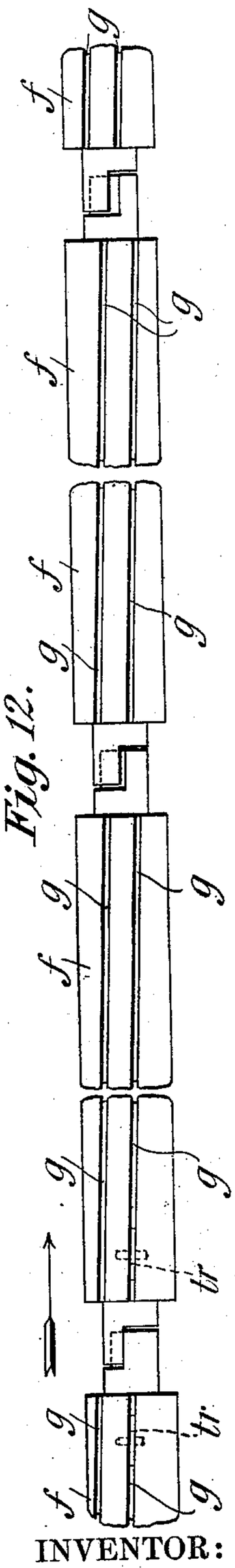


Fig. 12.



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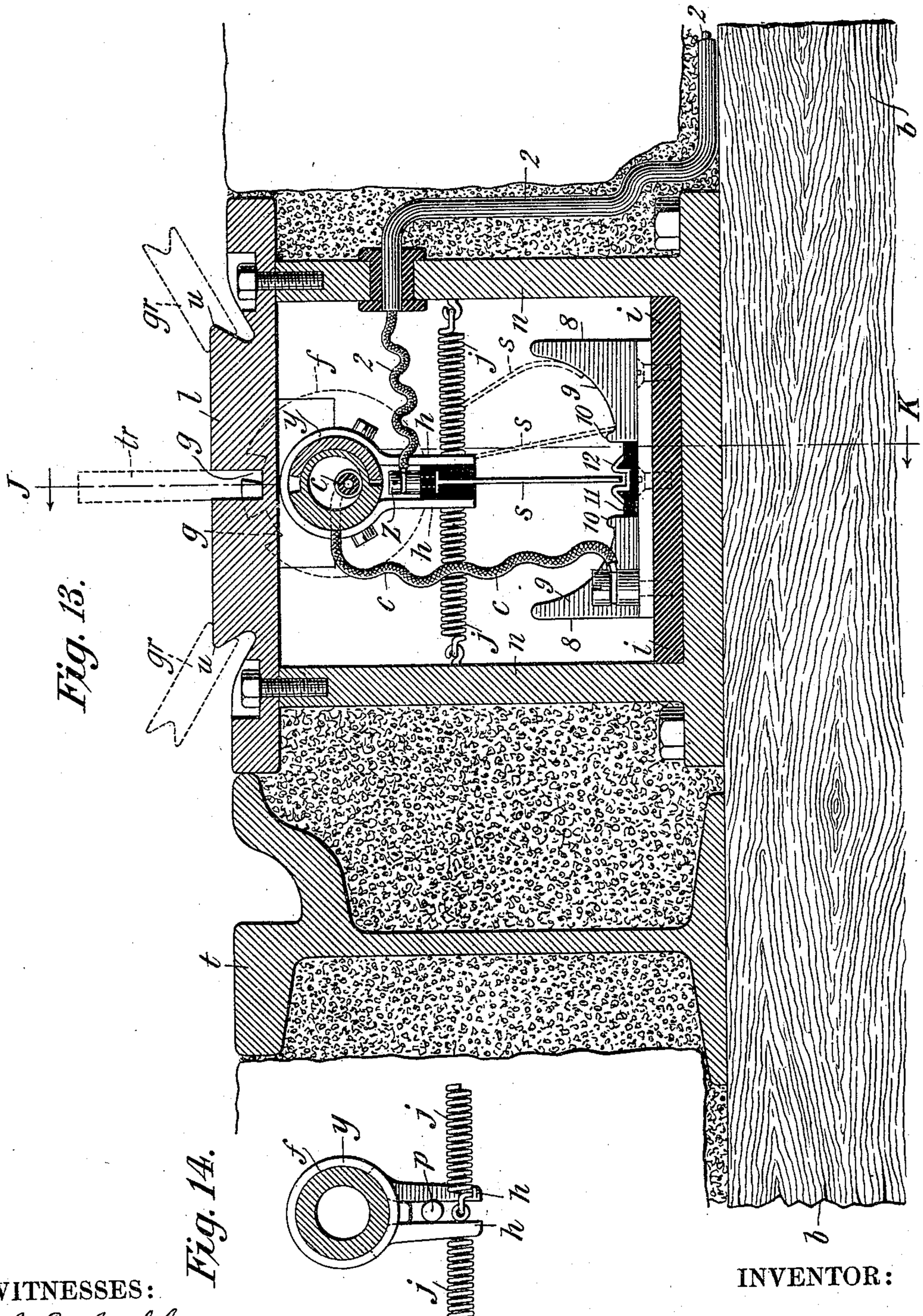

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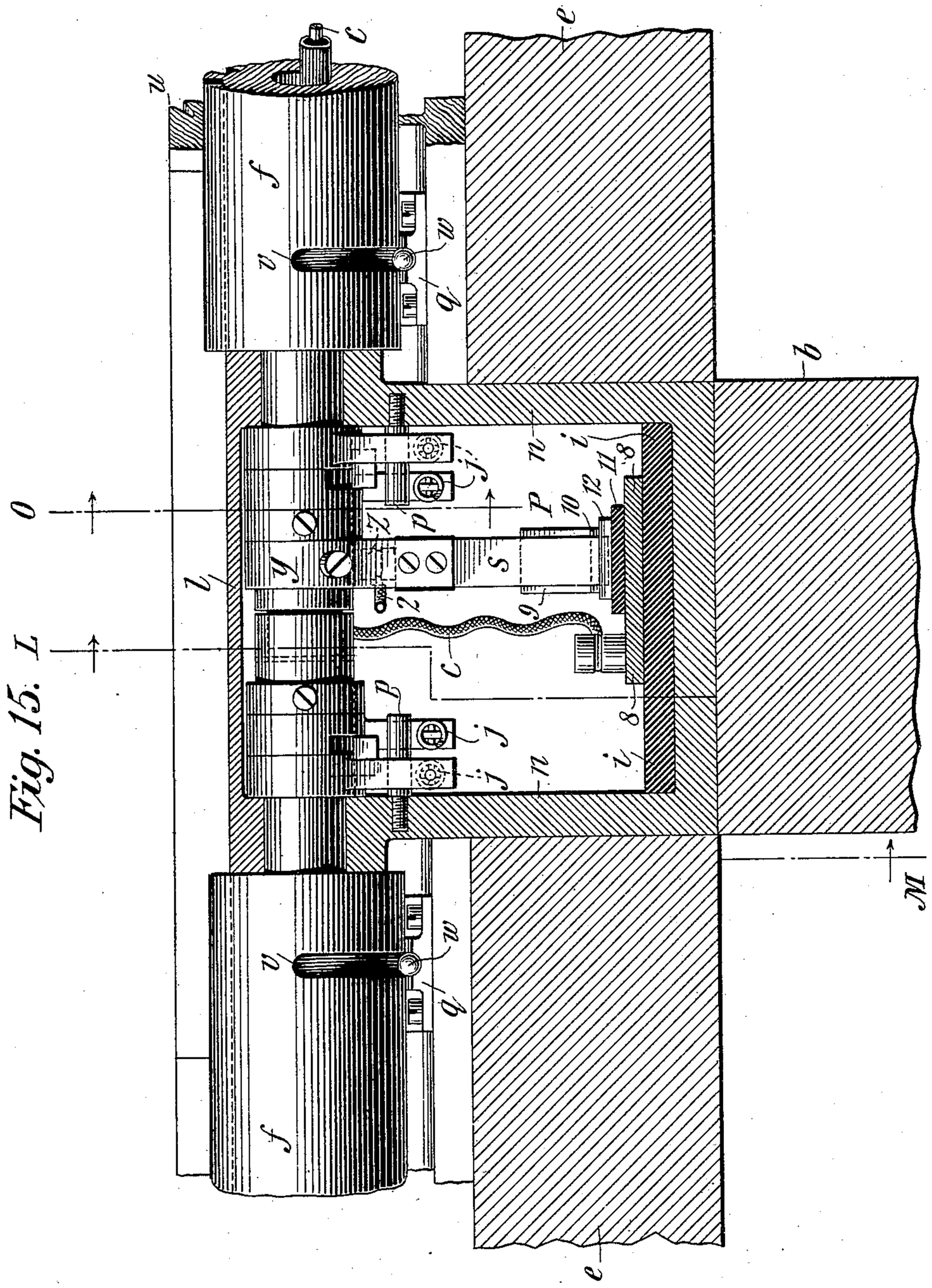

Fig. 15.

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ELECTRIC RAILWAY.

SPECIFICATION forming part of Letters Patent No. 705,848, dated July 29, 1902.

Application filed October 29, 1900. Renewed February 28, 1902. Serial No. 96,128. (No model.)

To all whom it may concern:

Be it known that I, CHARLES J. KINTNER, a citizen of the United States, residing at New York, in the borough of Manhattan, county and State of New York, have made a new and useful Invention in Electric Railways, of which the following is a specification.

My invention is directed particularly to improvements in that type of electric railways known in the art as "third-rail systems," in which a current feeder or main is connected with a source of electrical energy at a power-house and extends over the entire route, third-rail sectional conductors being located in close proximity to the road-bed and provided with means for automatically connecting the same to and disconnecting them from the current feeder or main as a car, vehicle, or train travels thereover; and it has for its objects, first, to provide mechanically-actuated switches for effecting the circuit connection between the third-rail or sectional conductors and the current feeder or main as the car, vehicle, or train passes over or by said switches and without wrecking or damaging mechanical action thereto; second, to provide a series of tubular rotary switches located in alinement with each other and parallel with the tram-rails, said tubular switches acting also as a conduit for the current feeder or main; third, to provide a series of tubular rotary switches located in alinement with each other and parallel with the tram-rails, said tubular switches acting also as a means for the conveyance of a heating medium for maintaining the insulation perfect and avoiding evil effects to the parts of the structure from frost or ice; fourth, to combine with the aforesaid tubular rotary switches a novel form of switch-actuating trolley of such a nature that it will always maintain a fixed relation to the switches under all conditions of usage no matter what may happen to the car, vehicle, or train which imparts movement thereto.

Prior to my invention attempts have been made to construct or devise mechanically-actuated switches whereby third-rail sectional conductors are automatically connected to and disconnected from a current feeder or main by a moving trolley or shoe carried by a car and adapted to act mechanically directly upon the switches as it passes thereover; but, so far as I am aware, such attempts have not met with success, for the reason that where a car travels at great speed there is such a wrecking or damaging influence upon the switches that they are soon destroyed.

My improvement contemplates the use of rotary switches, each of indefinite length, located in alinement or parallel with the tram-rails and adapted to be given a gradual continuous rotary movement throughout the entire time that the switch-actuating trolley carried by the car is passing by or over any switch. This gradual continuous movement I effect by a trolley or shoe carried by the car and acting mechanically upon one or more screw-threads or grooves extending in the direction of the length of the switch and having the desired pitch to give to the switch a continuous easy movement without shock, the circuit connections being effected by the agency of mechanical means, in switch-boxes, in the nature of movable terminals at either or both ends of the rotary switches.

Reference is now had to the drawings for a full and clear understanding of the invention, such as will enable others skilled in the art to construct and use the same.

Figure 1 is a transverse sectional view of the road-bed of on electric railway embodying one form of my improvement. Fig. 2 is a plan view of the third-rail sectional conductors located in alinement with each other and their intervening switch-boxes, one pair of such third rails being removed for the purpose of illustrating the structural nature of one of the tubular rotary switches and its relation to the adjacent switch-boxes. Fig. 3 is a diagrammatic view illustrating the power-house generator, current feeder or main, branch feeders, tubular rotary switches, switch-actuating trolley or means for controlling the movements of the same, and circuit connections to the motor on board the car. Fig. 4 is a transverse sectional view of one of the switch-boxes, the end of one of the tubular rotary switches, and the inclosed insulated current feeder or main, together with the supporting girder or stringer, the structure of the apparatus inside the switch-box and a part of one of the supporting cross-ties being shown in elevational view, said section being taken on the broken line A B, Fig. 5, and as seen

looking thereat from right to left in the dition of the arrows. Fig. 5 is a longitudinal sectional view of one of the switch-boxes, its cover, and the girder or stringer which supports or sustains the switch-box and the journal-bearings of the switches, the ends of two of the adjacent tubular rotary switches, the ball-bearings therefor, and the apparatus inside the box being all shown in side elevational view, said view being taken upon the broken line C D, Fig. 4, and as seen looking thereat from left to right in the direction of the arrows. Fig. 6 is a transverse sectional view of one of the switch-boxes and its inclosed switching mechanism, the movable and fixed terminals of the switch and the springs for maintaining the tubular rotary switches normally in a definite position being shown in plan view, said sectional view being taken on the line E F, Figs. 4 and 5, and as seen looking thereat from the top toward the bottom of the drawings in the direction of the arrows. Fig. 7 is a plan view of a short section of the two top sectional or third rails, which constitute also the slitted cover of the conduit that incloses the tubular rotary switches, together with the switch-actuating trolley for controlling the movements of said switches, a portion of the latter being shown at the top of this figure of the drawings in full lines and in dotted lines at the bottom thereof. Fig. 8 is a transverse sectional view taken through Fig. 7 on the broken line G H and as seen looking thereat from the bottom toward the top of the drawing in the direction of the arrows, one of the switch-actuating trolley-rollers, one of the guide-rollers therefor, a part of the supporting-frame and trolley-head therefor, one set of ball-bearings of the switch and their supporting-cradle being shown in elevational view, the other guide-roller being shown in sectional view. Fig. 9 is a side elevational view of the entire structure shown in Figs. 7 and 8, a part thereof being broken away to better illustrate the interior structure and the manner of supporting the tubular rotary switches upon ball-bearings. Fig. 10 is a transverse sectional view similar to Fig. 1 of a modified structure in which the switching apparatus is located adjacent to one of the tram-rails, and the sectional or third rails are entirely independent therefrom, located in the center of the roadbed and connected to the switches by buried insulated branch feeders. Fig. 11 is a plan view of a part of the structure illustrated in Fig. 10, showing the top of one of the switch-boxes closely adjacent to one of the tram-rails. Fig. 12 is a plan view of a modified form of the tubular rotary switches in which two spiral grooves are utilized to enable a car to run in either direction. Fig. 13 is an enlarged sectional view of one of the switch-boxes and one of the tram-rails, the supporting-tie therefor and the structural arrangement of the apparatus inside the box being shown in elevational view, the switch-actuating trolley for controlling the movement of the switch and two of the positions of the contacting spring of the switch being shown in elevational view in dotted lines. This sectional view is taken on the broken line L M, Fig. 15, and as seen looking thereat from left to right in the direction of the arrows. Fig. 14 is a detail sectional view of the end of one of the rotary switches, taken on the line O P, Fig. 15, and as seen looking thereat from left to right in the direction of the arrows, the means for causing the rotary switch to assume a definite position with relation to the slit of the conduit being shown in elevational view. Fig. 15 is a longitudinal sectional view taken on the line J K, Fig. 13, and as seen looking thereat from right to left in the direction of the arrows, the ends of two adjacent rotary switches, their journals, the ball-bearing supports, and the structure of the apparatus inside the switch-box illustrated in Fig. 13 being shown in side elevational view.

Referring now to the drawings in detail and first to Figs. 1 to 6, inclusive, *b* represents one of the cross-ties, and *t t* the tram-rails, of an electric railway, *e* being a wooden stringer located in the middle of the road-bed and supporting two T-rails *a a*, secured to said stringer by bolts and adapted to constitute a conduit for a series of tubular rotary switches *f f*, having transverse grooves *v v* at stated intervals, (see Fig. 5,) *w w* being ball-bearings and *q* supporting-cradles secured directly to the T-rails, the arrangement being such that the switches are supported in the conduit in such manner that they may be rotated in either direction a definite distance with as little friction as possible. Each of these tubular rotary switches *f* is provided on its upper surface with a spiral groove *g* of a definite depth and of a width corresponding to a similar groove made by the adjacent edges of inclosing third rails *r*, which constitute the cover of the conduit and are secured to the T-rails *a* by bolts, as shown in Fig. 2. The inner lower surfaces of said T-rails are slightly curved to fit snugly over the corresponding curved surfaces of the tubular rotary switches, the arrangement being such that when all of the parts are secured together, as clearly illustrated in the drawings, the rotary switches may be moved with as little friction as possible and without any possibility of the admission of dirt into the conduit proper. The opposite ends of the tubular rotary switches *f* are journaled, and said journals rest each in two-part journal-bearings *o o*, the lower halves of said journal-bearings being of metal and supported by the sides *m* of the switch-boxes, which are preferably of treated wood or other good insulating material, while the upper halves of said journal-bearings are of insulating material, such as hard rubber or vegetable fiber, it being important in this form of the apparatus that the ends of the rotary switches, the T-rails *a*, and third rails *r* should be carefully insulated from each other. The bottom

and main portion of the switch-boxes are of metal and of cradle shape, the ends *n* thereof being grooved vertically, as shown, so as to receive the wooden or insulating sides *m* between them, corresponding grooves being also provided in the bottoms for the wooden sides. Lugs or ears are also cast integral with the metal portion of the box for securing the entire box to the stringer *e*, as clearly shown in Fig. 4 in full lines and in dotted lines in Fig. 5. *l* represents the lid or cover of the box, which is made of a single piece of metal and constructed with a longitudinal groove which is in alinement with the groove between the third rails *r* and is of a depth equal to the combined depth of the aforesaid groove and the spiral groove *g* in the tubular rotary switches, as will be apparent on inspection of Figs. 4 and 5 of the drawings. Each of the third rails *r* and the covers *l* of the boxes is provided with a raised surface and a lateral groove, the arrangement being such that when the rails and covers are in position in alinement a continuous angular-shaped bearing *u* is provided on each side of the slot for guiding and maintaining the switch-actuating trolley always in a definite relation to the grooved rotary switches, as will be described more in detail in connection with Figs. 7 and 8 of the drawings. To the opposite ends of each tubular rotary switch *f* is secured an arm *h*, extending downward in its particular switch-box to a point near the bottom of the box, and said arms are connected in turn with strong spiral springs *j* to the inner surface of the end *n* of the switch-box, but insulated therefrom. Each rotary switch is provided at each end with a lug *x*, (see Fig. 8,) adapted to bear against the under surface of one of the third rails *r* when the switch assumes its normal position, where it is held by the retractile action of the springs *j j*, one at each end. The base of each switch-box is lined with insulating material *i*, of hard rubber, vulcanite, or the like, and to the center of this insulating-lining is pivotally secured by a bolt a movable terminal *s*, *k* being a spring adapted to maintain said terminal in either of two positions against stop-pins, as clearly indicated in Fig. 6. On the under side of the movable terminal *s* is a pair of springs, one of which is electrically connected directly with the insulated feeder or main *c*, the other end thereof being adapted to yieldingly make contact with a fixed terminal 8 in the bottom of the switch-box directly connected to the tubular rotary switch *f* by a conductor 2, which in turn is electrically connected through the ball-bearings with the T-rails *a*, and hence the sectional or third rails *r*. It will be noticed on inspection of Figs. 5 and 6 that the insulated feeder or main *c* passes out of the ends of the adjoining tubular rotary switches and is connected directly with the movable terminal *s*, also that the adjacent ends of the tubular rotary switches are connected by a flexible sleeve *s'*, the function of which is to make the structure a continuous line of tubing through which hot air or steam, preferably hot air, may be forced from a source of hot-air supply, located at the power-house or elsewhere, for conveying to the entire system sufficient heat to effect better insulation and also to avoid any deposit of snow or ice in the grooves of the conduit and the rotary switches. If hot air alone is used, the sleeves *s'* may be omitted, it being obvious that advantageous insulating effects may be had therefrom in the switch-boxes. From an inspection of Figs. 2 and 3 of the drawings it will be apparent that in this form of the invention the spiral groove *g* in each tubular rotary switch inclines in opposite directions from its center, the ends of said groove lying normally in direct alinement with the corresponding grooves between the third rails *r r* and the like grooves in the lids or covers *l* of the switch-boxes, it being understood, as before stated, that there is one continuous guiding-groove for the switch-actuating trolley between the rails *r r* and in the lids or covers of the intermediate switch-boxes and that the tubular rotary switches *f* are held normally in the position shown in Figs. 2, 3, and 4 by the action of the spiral springs *j j* in their corresponding switch-boxes, so that the lugs *x* rest against the under surfaces of the rails *r*, thus leaving the grooves in position for the entrance of the trolley-rollers *tr*, as clearly illustrated in Fig. 8.

Referring now to Figs. 7, 8, and 9, I will describe in detail the structure of the switch-actuating trolley and its relation to the third rails *r r*, which support and guide it in such manner as to operate the switches positively in both directions, and thereby avoid any possibility of leaving any switch in such position that a circuit is left closed between any third rail and the current feeder or main after the trolley has passed over or away from said third rail. *fr* represents the supporting-frame of the switch-actuating trolley, to which is secured by pairs of bolts two rectangular cross-bars *cb*, extending downward from a trolley-head *th* and so bent at their lower or free ends as to constitute bearings for the journals of grooved guide-rollers *gr gr*, the grooved faces of which are designed to fit with reasonable accuracy over the continuous angular-shaped bearings *u* of the third rails *r r*. *tr tr* are trolley-rollers, so supported by yokes in the trolley-head *th* as to have universal movement, each being provided with a spiral spring between its yoke and the under surface of the trolley-head, so as to admit of slight vertical movement. The trolley-head is provided with any preferred means for connecting it to the under surface of a car, it being obvious that such connection should be sufficiently flexible to permit of such inequalities of movement as might be encountered in passing around curves. In the opposite ends of the supporting-frame *fr* is secured in front of each trolley-roller *tr* a steel-wire brush *br* for main-

taining the groove *g* and the guide-slot between the rails *r* free from obstructions. Said brushes might of course be replaced by any proper device for effecting a like result. The operation of this form of the invention is as follows: The switch-actuating trolley is put in position by removing any one of the lids or covers *l* and rolling the trolley into place thereon, with the trolley-rollers *tr* in the central or guiding groove of the box-lid, the guide-rollers *gr gr* resting against the angular-shaped bearings of the box-lid, which correspond to the angular-shaped bearings *u* of the third rails *r*, in the manner shown in Fig. 8 of the drawings. The movable terminal *s* in the switch-box is turned to the position shown at the center of Fig. 3 of the drawings, after which the lid or cover is secured in position with the trolley thereon. The car is now put in position over the trolley, and it is connected thereto. Suppose it to be moving from left to right in the direction of the arrow and the circuit closed, as shown, in the switch-box over which the car now stands. There is therefore a current from the dynamo *d* through the current feeder or main *c*, branch feeder 1, movable terminal *s*, conductor 2 to the tubular rotary switch *f*, and thence to the third rails *r*, thence by the trolley and a front or second trolley and conductors 4 4 5 to the motor and return to the dynamo. As the car advances the trolley-roller *tr*, moving in the spiral groove *g*, rotates the tubular rotary switch *f* to the left until it reaches the central point thereof, before which, however, the arm *h* at the extreme advance end of the switch has acted upon the movable terminal *s* in the next succeeding switch-box and rotated it in a reverse direction of the hands of a watch until the spring *k* caused the movable terminal to snap into the closed position, so that the branch feeder 1 at that point is now connected through the conductor 2 with the next rotary switch *f*. At the same time that the arm *h* at the extreme front end of the switch rotated the movable terminal *s* in the manner described the corresponding arm *h* at the rear end of said switch rotated the movable terminal *s* in the direction of the hands of a watch until the spring *k* snapped it into the position now shown in the drawings for the other terminals—namely, in such manner as to open the circuit. At this time, however, the front trolley has made contact with the third rails of the next section in advance. Consequently as the trolley advances each switch in advance is closed and each switch in the rear is opened, and by reason of the positive action of the trolley-rollers *tr* in the grooves *g* there is no possibility that any rotary switch can be left in any other than a normal position, with the movable terminals of the switches thrown into their disconnected or open positions. The spiral springs *j j* aid in the restoring of each rotary switch *f* to its normal position and maintain it in that position until gradually moved by the trolley-rollers. It will also be apparent that should the trolley by any possibility be disconnected from its supporting third rails *r r* the springs *j j* will immediately act to restore the particular switch over which it may be located at that time to its normal or disconnected position. Owing to the fact that the switches in that form of the apparatus shown in Figs. 1 to 6, inclusive, are positively actuated in both directions by the trolley, the structure is peculiarly applicable to a double-track system.

Referring now to Figs. 10 to 13, inclusive, I will describe a modified form of the invention adapted for use either with a single or double track system. In this form the tubular rotary switches, the third rails, which carry the trolley, and the switch-boxes are located as closely adjacent as possible to one of the tram-rails *t*, and the conducting third rails *r* are located in the center of the roadbed and secured upon an additional stringer, said third rails being connected with switching mechanism in the boxes by branch conductors 2. The tubular rotary switches, however, are so constructed that their adjacent ends overlap each other, as clearly shown in Fig. 12, each rotary switch being provided with two spiral grooves *g g*, located a definite distance apart, preferably such a distance that when the switches are held in their normal positions by the spiral springs *j j* and arms *h h* no part of the spiral grooves *g* will be exposed or open. In other words, the only actual slot existing under normal conditions is the slot between the third-rail sections *r r*. This condition of affairs will be more fully explained in connection with the description of the mode of operation of this form of the invention. The switch-boxes are of solid iron with a removable cover 1, as before, and the ends of the rotary switches *f* are journaled directly in journal-bearings in the sides of the boxes. For the purpose of properly maintaining the rotary switches in definite operative positions each end of each switch is provided with a shoulder on opposite sides, and the arms *h h* are secured to sleeves provided with similar opposing shoulders, respectively, so located that one of said arms will be rotated positively with the switch when its shoulder is caused to bear against the corresponding shoulder on the switch, the other arm remaining stationary. To the free ends of these arms are attached spiral springs *j j*, having their opposite ends secured to the inner surfaces of the switch-boxes, the arrangement being such that the springs normally tend to draw in opposite directions and to hold their respective arms and sleeves with the shoulders thereof bearing firmly against the corresponding shoulders on the opposite sides of the switches, *p* being a pin secured in the side of the switch-box between the two arms in such position as to act as a centering-pin. In this form I have illustrated a preferred form

of circuit-interrupting terminals for effecting the circuit-interruption in the box without arcing, as does the circuit-interrupting terminals s^8 in Figs. 2 to 6, inclusive, of the first-described modified form of the invention. To one end of each of the rotary switches *f* is secured by a yoke *y* and screws the movable terminal *s* in the nature of a strong leaf-spring held in insulating material between the opposite ends of the yoke. (See Figs. 13 and 15.) At the upper end of the movable terminal *s* is a binding-post *z*, to which is secured the branch conductor 2, running to the third rail *r* in the middle of the track. Secured to the insulating material *i* in the bottom of the box is the fixed terminal 8, which is connected by a binding-post directly to the current feeder or main *c*. This fixed terminal has two oppositely-disposed curved faces 9 and ledges or projections 10, 11 being an intervening block of insulating material and 12 a metal groove secured in the insulating material for giving to the free end of the movable terminal *s* a snap-like action, as will be described in connection with the description of the mode of operation of this form of the invention. Under normal conditions the spiral springs *j j* hold the rotary switches *f* in such position that the free ends of all of the movable terminals *s* are located in the metal grooves 12, as shown in Fig. 13. The plain metal surfaces between the grooves *g g* of all the rotary switches are located directly below the groove between the third rails which support the trolley, and the adjacent overlapping ends of these switches are located at definite distances apart, as shown at the extreme right of Fig. 12. In this figure of the drawings the trolley is just passing a switch-box at the extreme left, the two trolley-rollers *tr tr* being shown in dotted lines. The rear trolley-roller is just in the act of leaving the groove *g* in one of the switches, while the front trolley-roller is just in the act of entering the groove *g* in the next switch adjacent. When the trolley was passing over the switch which it has just left, it caused that switch to rotate a sufficient distance to the left to bring the overlapping ends mechanically together and to rotate the next switch to the left a distance sufficient to place the movable terminal *s* in the first position shown in dotted lines, Fig. 13, thereby making a circuit to the third rail adjacent to this particular switch. As it continued to advance the next overlapping end gave to the next rotary switch in advance a movement to the left sufficient to put the movable terminal of that rotary switch into the first position shown in dotted lines, Fig. 13, as just described, while at the same time the particular movable terminal over which the trolley is passing has assumed the position shown on the extreme right in dotted lines, Fig. 13. As the trolley passes off this section the rotary switch will be returned to its normal position under the action of the strong spiral springs *j j*, and the free end of the movable terminal *s* will come into the position shown in straight dotted lines, Fig. 13, and ultimately snap back into the position shown in full lines, with its free end in the groove 12. This snapping action, which avoids arcing, occurs with this type of movable terminal for rotation of the switch in either direction when the free end of the terminal leaves the groove 12 and passes either of the ledges 10 and avoids any possibility of arcing between the fixed and the movable terminals. It will be apparent that a car may travel in a reverse direction after it has passed a given section, the trolley-rollers then entering the companion grooves *g* and rotating the rotary switches reversely in the same manner as has already been described, it being noted that the overlapping ends of each section always rotate the movable terminal into electrical connection with the fixed terminal before the trolley reaches that switch and that the several steps are effected, as is obvious on inspection of Figs. 12 and 13, no matter which way the car may travel. The trolley may be put in place and removed from the system upon the removable lid or cover 1 in the manner already described. In this form, however, it is to be noted that by reason of the action of the spiral springs *j j* it is necessary that the advance trolley-roller shall assume its operative position in the groove of the switch into which it is just entering before the rear trolley-roller is disconnected from the groove in the switch it is just leaving, as will be apparent on inspection of Figs. 12 and 15.

I do not limit my invention to the especial details of construction hereinbefore described, and illustrated in the accompanying drawings, as a number of the features thereof are equally applicable for use in connection with electric railways generally. I believe it is broadly new with me to provide a mechanically-actuated electric switch in which the axis of the switch is substantially parallel with the tram-rails of a railway and which is given gradual continuous rotary motion by mechanical means carried by the car during the time that said means is passing the switch, said rotary motion being the effect of gradual application of power in such manner as to avoid damaging effects, and my claims are generic as to this mechanical application of transmitting power to rotary switches generally.

I am aware that heretofore a rotary switch has been devised for sectional third-rail systems of electric railways in which the switches are journaled in the road-bed, with their axes of rotation parallel with the tram-rails and the rotary motion imparted thereto by a plow or collecting-trolley, as disclosed in United States Patent No. 455,956, granted to S. P. Wilcox and J. D. Partello July 14, 1891, and I make no claim hereinafter broad enough to include such a structure in which the rotary motion is imparted to the switch by the action of such plow or collecting-trolley which gives

a sudden blow or impact to the switch, my most generic claim contemplating an arrangement of rotary switches in which the motion imparted thereto by the trolley is gradual and continuous during the entire time that the trolley or shoe is passing thereover, thereby avoiding any possibility of shock or damaging action to the switch.

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

1. In an electric railway a switch journaled with its axis of rotation substantially parallel with the track-rails and provided with means for adapting it to be rotated gradually and continuously about its axis of rotation as a car passes over or by it, substantially as described.

2. In an electric railway a rotary switch journaled with its axis of rotation substantially parallel with the track-rails and provided with a spiral thread or groove in the direction of its length and of such pitch as to be given a gradual rotation as a car passes over or by it, substantially as described.

3. In an electric railway a rotary switch journaled with its axis of rotation substantially parallel with the track-rails and provided with means for adapting it to be gradually and continuously rotated about its axis of rotation as a car passes over or by it; in combination with a movable circuit making and breaking terminal adapted to be operated thereby, substantially as described.

4. In an electric railway a current feeder or main extending over the route and a series of third rails or sectional conductors normally disconnected therefrom; in combination with a series of rotary switches journaled with their axes of rotation substantially parallel with the track-rails and provided with means for giving them gradual and continuous rotation about their axes as a car travels over or by them; together with circuit connections whereby said third rails or sectional conductors are electrically connected to and disconnected from the current feeder or main in sequence and without damaging mechanical effects, substantially as described.

5. In an electric railway a series of rotary tubular switches inclosing a current feeder or main and constituting a conduit therefor, substantially as described.

6. In an electric railway a series of rotary tubular switches journaled in alinement with each other and constituting a means for conveying a heating medium for effecting better insulation and avoiding the evil effects of accumulated snow or ice, substantially as described.

7. In an electric railway a series of rotary tubular switches journaled in alinement with each other and with intervening switch-boxes inclosing circuits and circuit connections, the arrangement being such that a heating medium, as dry air, may be admitted through the tubular switches to the boxes, better insulation effected, and the system protected from evil effects of snow and ice, substantially as described.

8. In an electric railway a series of rotary switches journaled in alinement with each other and with their axes of rotation substantially parallel with the track-rails; in combination with a switch-actuating trolley adapted to impart gradual and continuous rotary movement to said switches, and means for maintaining said trolley always in a fixed relation to the switches, substantially as described.

9. In an electric railway a series of rotary switches journaled with their axes of rotation substantially parallel with the track-rails and operatively connected with circuits and circuit connections running to conducting third rails or conductors and a current feeder or main; in combination with a switch-actuating trolley having one or more mechanical trolley-rollers for controlling the movement of the switches; guide-rollers together with guiding means therefor adapted to maintain the trolley always in a fixed relation to the switches, substantially as described.

10. In an electric railway a series of rotary switches journaled with their opposite ends in adjoining switch-boxes and provided each with means for giving rotary motion thereto as a car passes over them; in combination with movable circuit making and breaking terminals operated by said switches, substantially as described.

11. In an electric railway a rotary switch journaled with its axis of rotation parallel with the tram-rails and provided with a spiral thread or groove in the direction of its length; in combination with means for yieldingly holding said switch and groove in a definite position, substantially as described.

12. In an electric railway, embracing a current feeder or main and sectional third rails or conductors, a series of rotary switches having their axes of rotation parallel with the tram-rails, said switches being provided each with a spiral thread or groove in the direction of its length; in combination with yielding means adapted to hold each of said switches with its thread or groove in a definite position; together with movable circuit making and breaking terminals operated by the switches and adapted to connect the third rails or conductors to and disconnect them from the current feeder or main, substantially as described.

13. In an electric railway a series of rotary switches having their axes of rotation parallel with the tram-rails, said switches being provided with means for rotating them as a car or vehicle passes thereover; in combination with ball-supporting bearings and means for yieldingly holding the switches in definite positions; together with movable circuit making and breaking terminals controlled thereby, substantially as described.

14. In an electric railway a series of rotary

switches provided each with a spiral thread or groove extending in the direction of its length; in combination with a conduit inclosing said switches and having a guiding trolley-slot located above the thread or groove, substantially as described.

15. In an electric railway a series of rotary switches provided each with a spiral groove in the direction of its length; in combination with a conduit surrounding the same, said conduit having a slot bearing a definite or fixed relation to the grooves; together with a switch-actuating trolley adapted to always maintain a fixed relation to the grooves and the slot, substantially as described.

16. In an electric railway a series of rotary switches having their opposite ends journaled in adjoining switch-boxes, said switches being each provided with a spiral groove in the direction of its length; in combination with a conduit surrounding and supporting the switches and provided with a slot having a definite relation to the grooves; together with removable switch-box covers provided each with a slot located, when in position on the boxes, in alinement with the conduit-slot, substantially as described.

17. In an electric railway a series of rotary switches having their opposite ends journaled in adjoining switch-boxes, said switches being each provided with a spiral groove in the direction of its length; a conduit surrounding and supporting the switches and provided with a slot having a definite relation to the grooves; in combination with removable switch-box covers provided each with a slot located, when in position on the boxes, in alinement with the conduit-slot; together with a switch-actuating trolley so constructed and arranged with relation to the conduit and the switches that it always maintains a definite or fixed relation thereto, substantially as described.

18. In an electric railway a series of tubular rotary switches journaled with their opposite ends in adjoining switch-boxes and provided each with means for giving rotary motion thereto as a car passes over them; in combination with movable circuit making and breaking terminals operated by said switches and a current feeder or main inclosed within said tubular switches, said current feeder or main being composed of sectional parts having their opposite ends secured in the switch-boxes and so arranged that any section of the feeder may be removed and repaired or replaced without disturbing the other sections thereof, substantially as described.

19. In a sectional contact system for electrical railways, successive, rotary, contact-sections extending longitudinally of the line of way and having each a spiral path extending longitudinally thereof, means for supplying current to the sections and cutting it off therefrom, and a device carried by the car for following the spiral paths and rotating said sections.

20. In a sectional contact system for electrical railways, a longitudinal rotary contact-section provided with a spiral web extending lengthwise thereof, means for supplying current thereto, and means carried by the car for engaging said web to rotate said section and take current therefrom.

21. In a sectional contact system for electrical railways, longitudinal rotary contact-sections arranged in succession along the line of way having spirally-arranged projections by which to rotate them, and circuit-controlling switches operated by the rotation of the sections.

22. In a sectional contact system for electrical railways, longitudinal rotary contact-sections arranged in succession along the line of way each having a spiral path extending along it, and circuit-controlling switches operated by said section in combination with means carried by the car and adapted to travel said spiral paths for rotating the sections and taking current therefrom.

23. In a sectional contact system for electrical railways, the combination with a conduit along the line of way, of rotary switches located therein for each section and provided with spiral projections and means carried by the car for entering said conduit and engaging said projections for rotating said switches, for the purpose set forth.

24. In a sectional contact system for electrical railways, the combination of the conduit in insulated sections, a rotary contact-section journaled in each section of conduit, means for supplying current to each section, and a current-collector carried by the car for engaging the rotary sections successively.

25. In a sectional contact system for electrical railways, rotary contact-sections extending along the line of way and provided with spiral paths extending longitudinally thereof, means for feeding current to said sections successively, and a current-collector carried by the car and following said spiral paths, for the purpose specified.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

CHARLES J. KINTNER.

Witnesses:
JAMES P. J. MORRIS,
M. F. KEATING.