No. 864,039. PATENTED AUG. 20, 1907.

C. W. SPONSEL.

ROPE LAYING MACHINE.

APPLICATION FILED JULY 3, 1905.

8 SHEETS—SHEET 1.

FIG. 1.

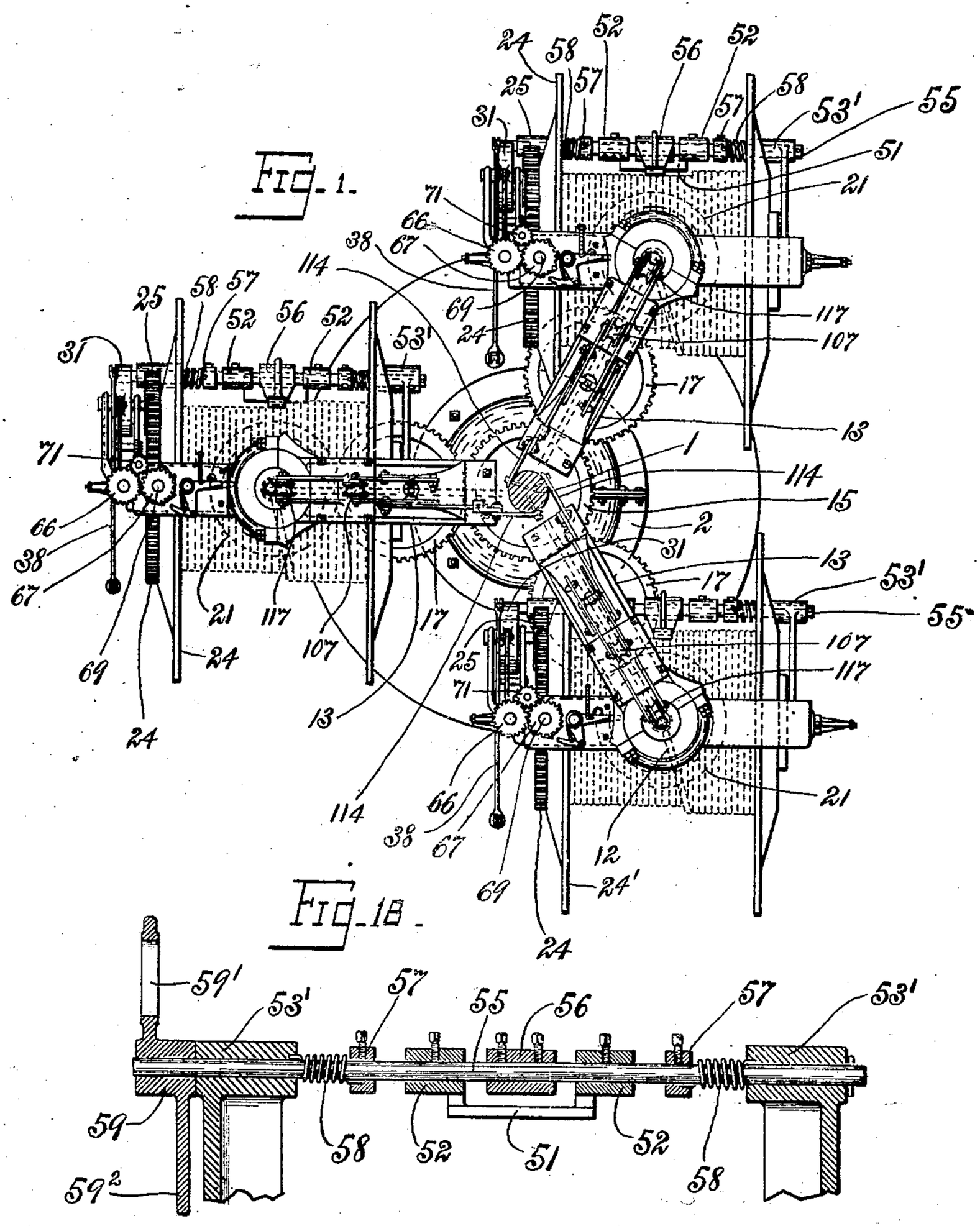

FIG. 1a.

WITNESSES.

F. E. Anderson.

S. S. Grotta

INVENTOR

Chas. W. Sponsel,

By Munn & Hodgett

ATTORNEY.

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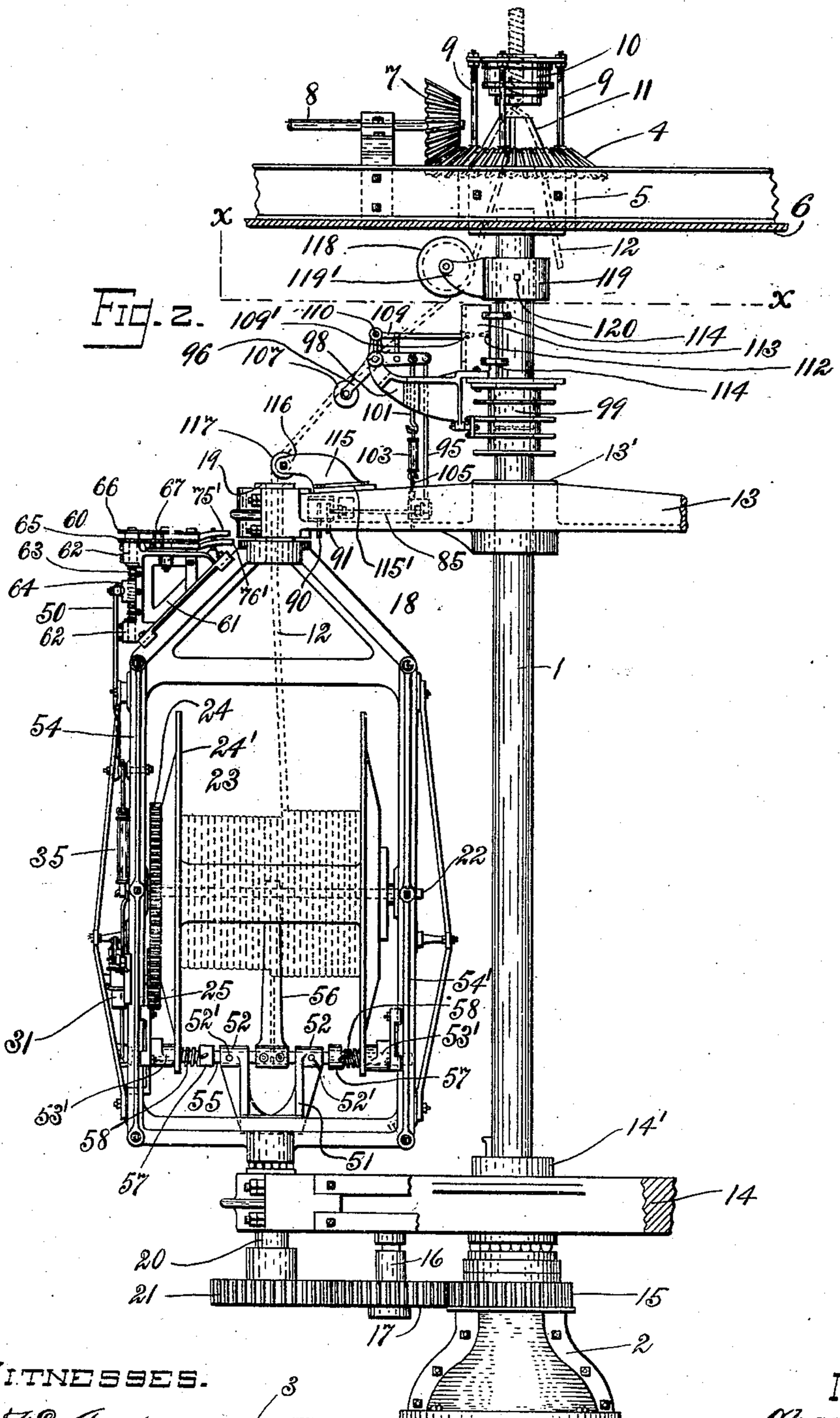
8 SHEETS—SHEET 2.

FIG. 2.



WITNESSES.

H. E. Anderson.

S. S. Grotta.

INVENTOR.

Chas. W. Sponsel,

By Wm. H. Hodgett

ATTORNEY.

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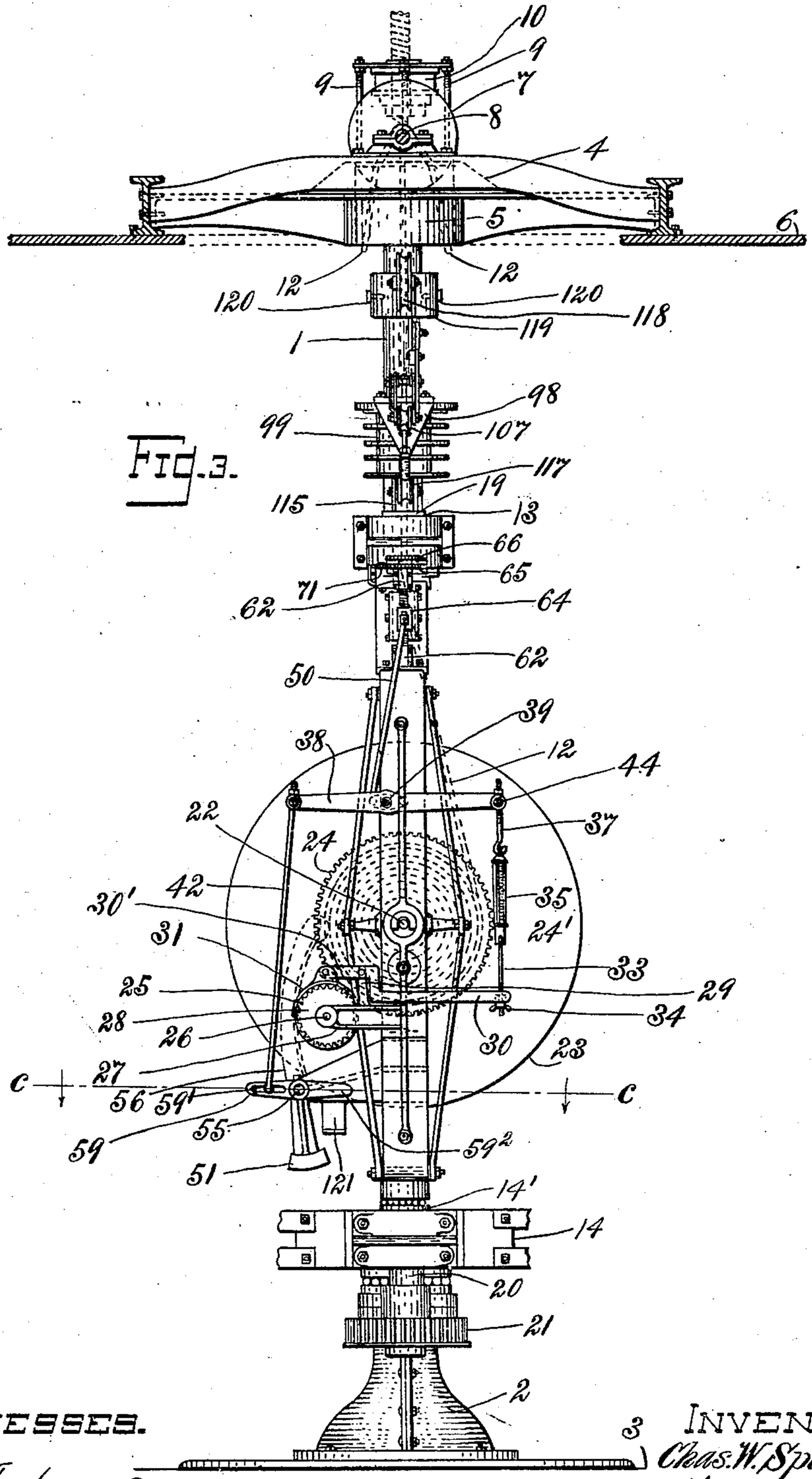
8 SHEETS—SHEET 3.

FIG. 3.



WITNESSES.

H. E. Anderson.

S. S. Grotta.

INVENTOR.

Chas. W. Sponsel,

By Mary L. Stodgell

ATTORNEY.

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C. W. SPONSEL.

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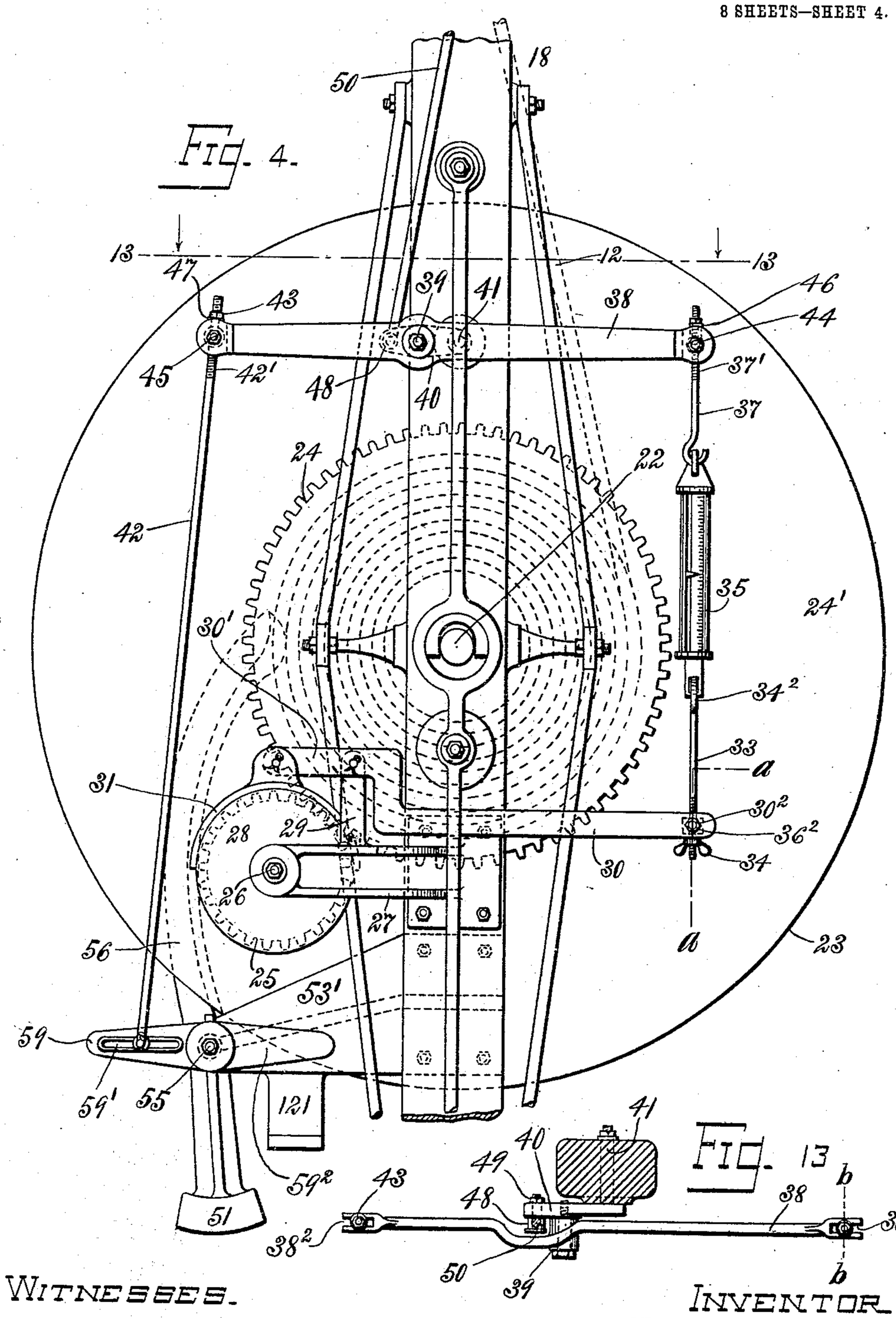
8 SHEETS—SHEET 4.

FIG. 4.



WITNESSES.

F. E. Anderson.

L. L. Grotta.

INVENTOR

Chas. W. Sponsel,

By Morsey & Stodgell

ATTORNEY.

No. 864,039. PATENTED AUG. 20, 1907.

C. W. SPONSEL.

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8 SHEETS—SHEET 5.

FIG. 14.

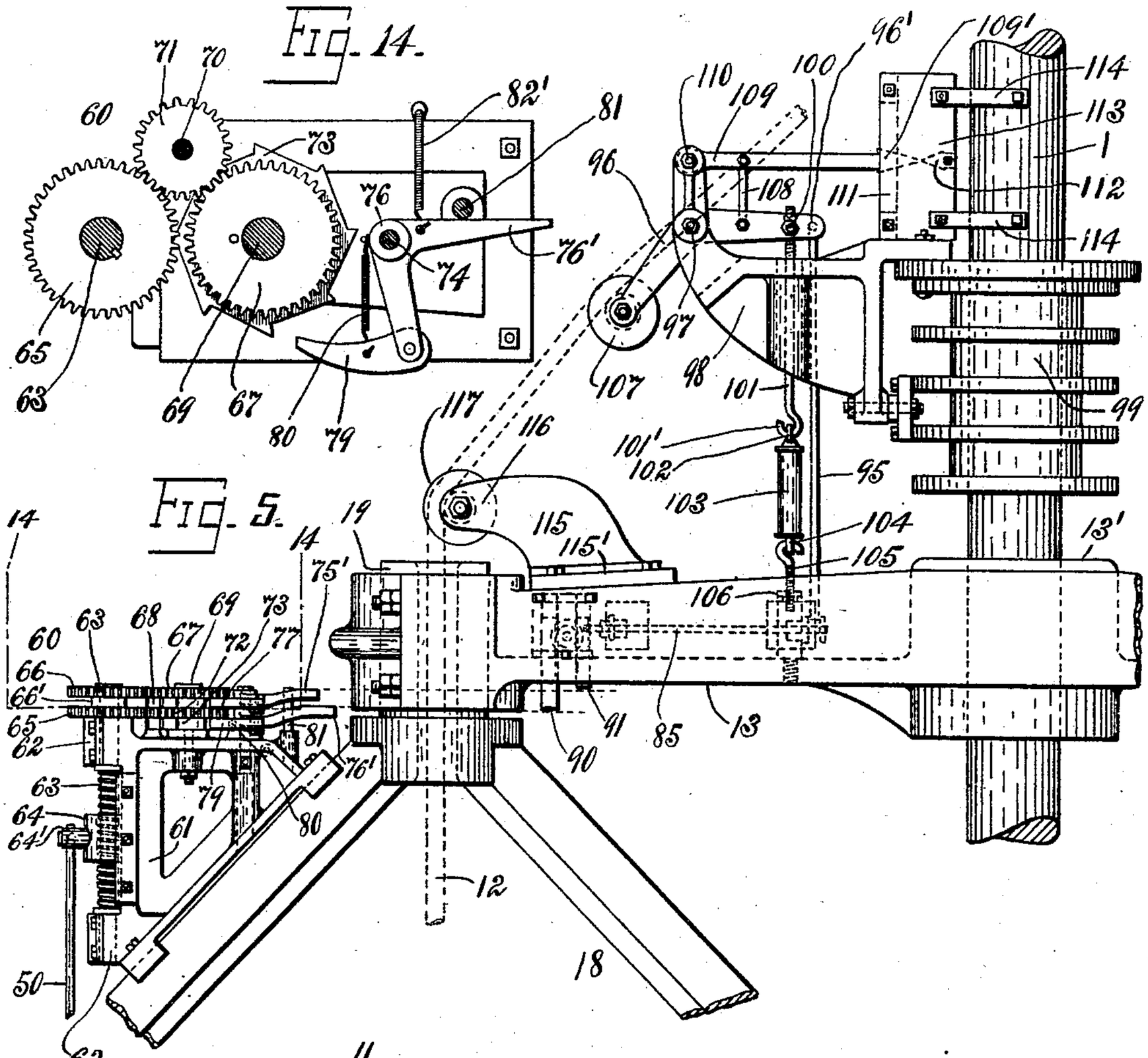
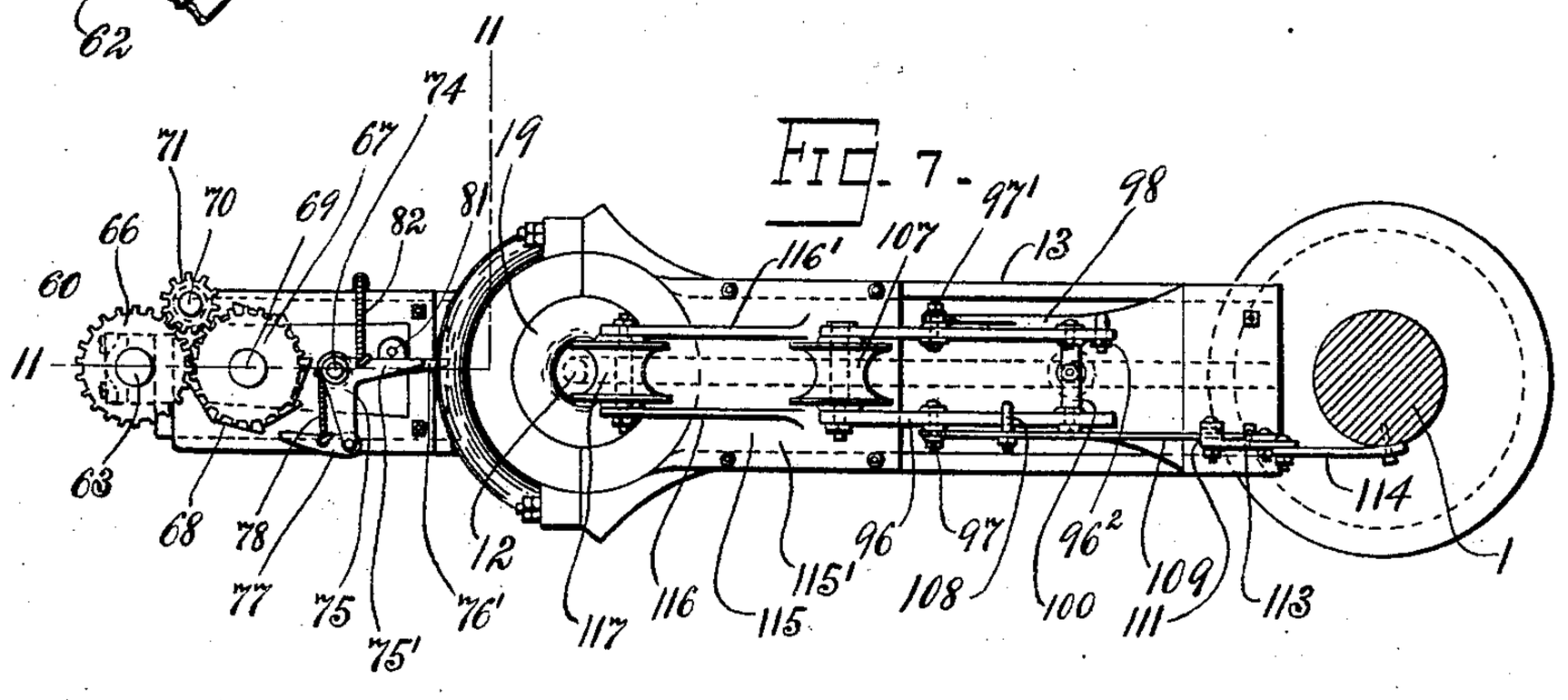


FIG. 5.

FIG. 7.



WITNESSES.

F. E. Anderson.

S. S. Grotta.

INVENTOR.

Chas. W. Sponsel,

By Wm. H. Hodgett

ATTORNEY.

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C. W. SPONSEL.

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8 SHEETS—SHEET 6.

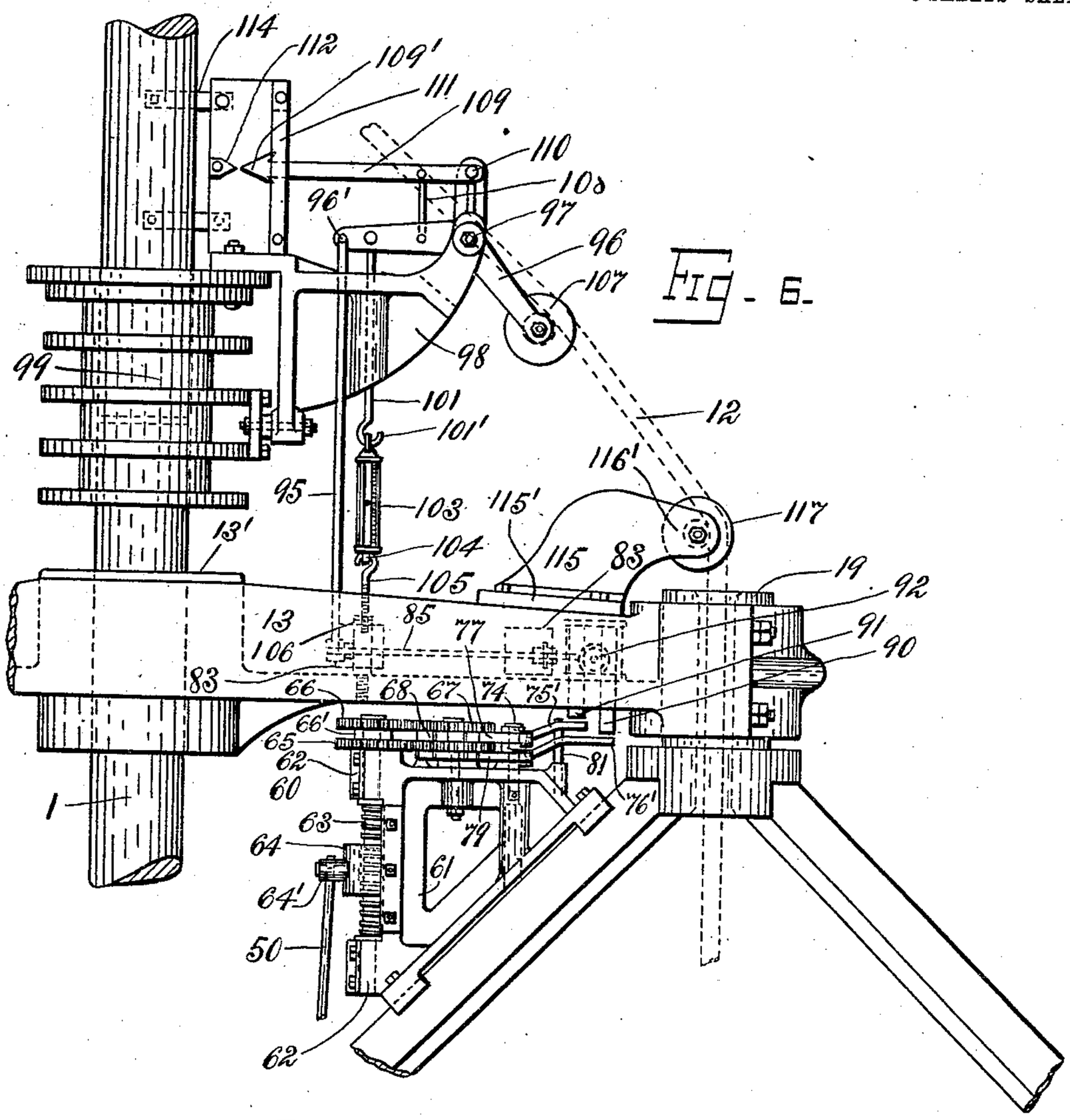


FIG. 6.

FIG. 16.

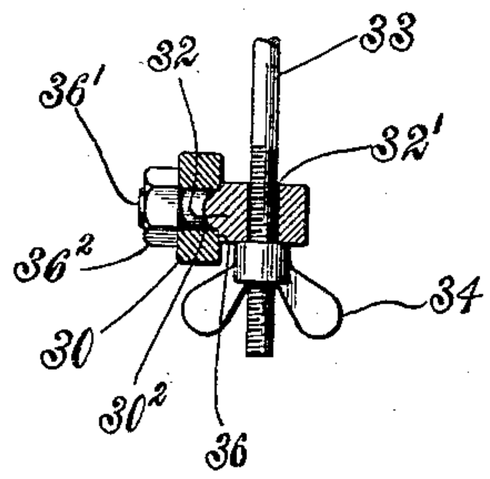
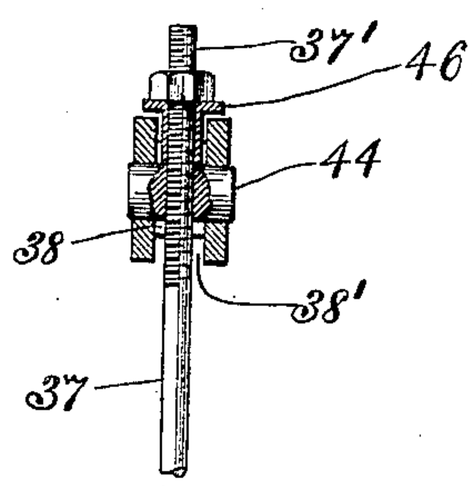


FIG. 17.



WITNESSES.

F. E. Anderson.

L. L. Grotta.

INVENTOR

Chas. W. Sponsel,

By Munn & Dodge

ATTORNEY.

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C. W. SPONSEL.

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APPLICATION FILED JULY 3, 1905.

8 SHEETS—SHEET 7.

FIG. 8.

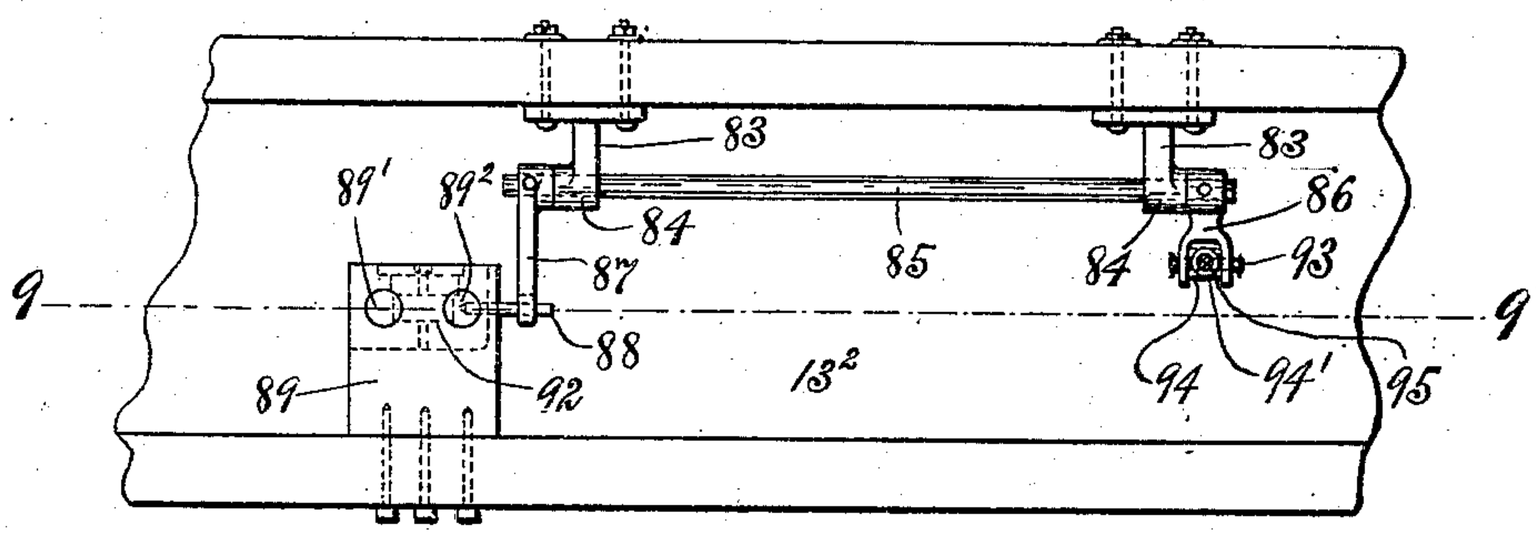
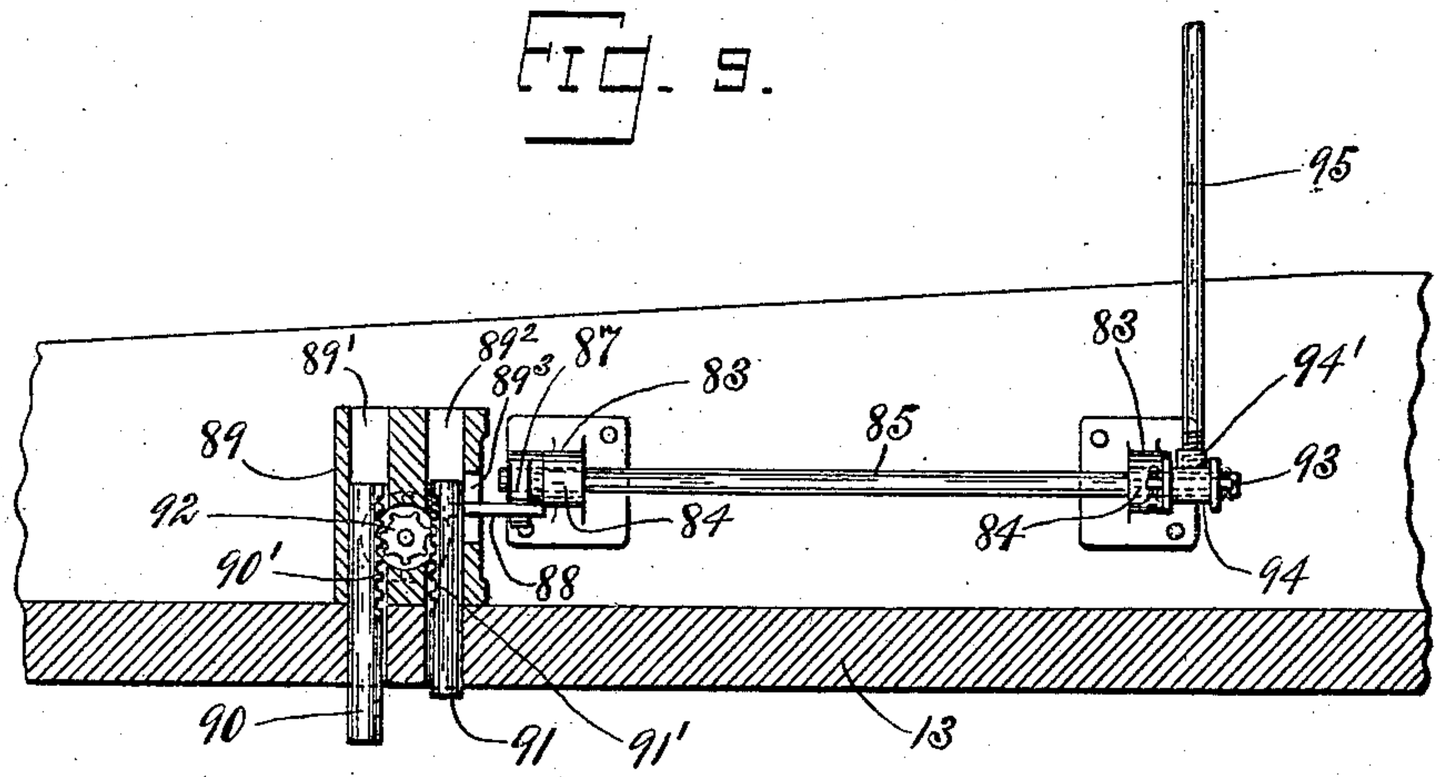


FIG. 9.



WITNESSES.

H. E. Anderson.

L. L. Grotta.

INVENTOR

Chas. W. Sponsel.

By Wm. F. Stodgell

ATTORNEY.

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APPLICATION FILED JULY 3, 1905.

8 SHEETS—SHEET 8.

FIG. 10.

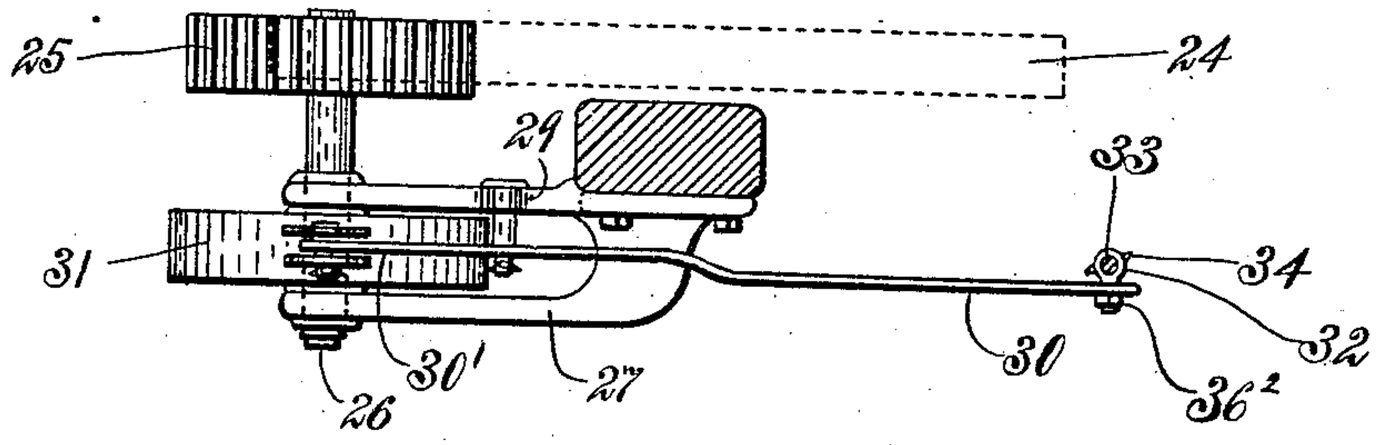


FIG. 11.

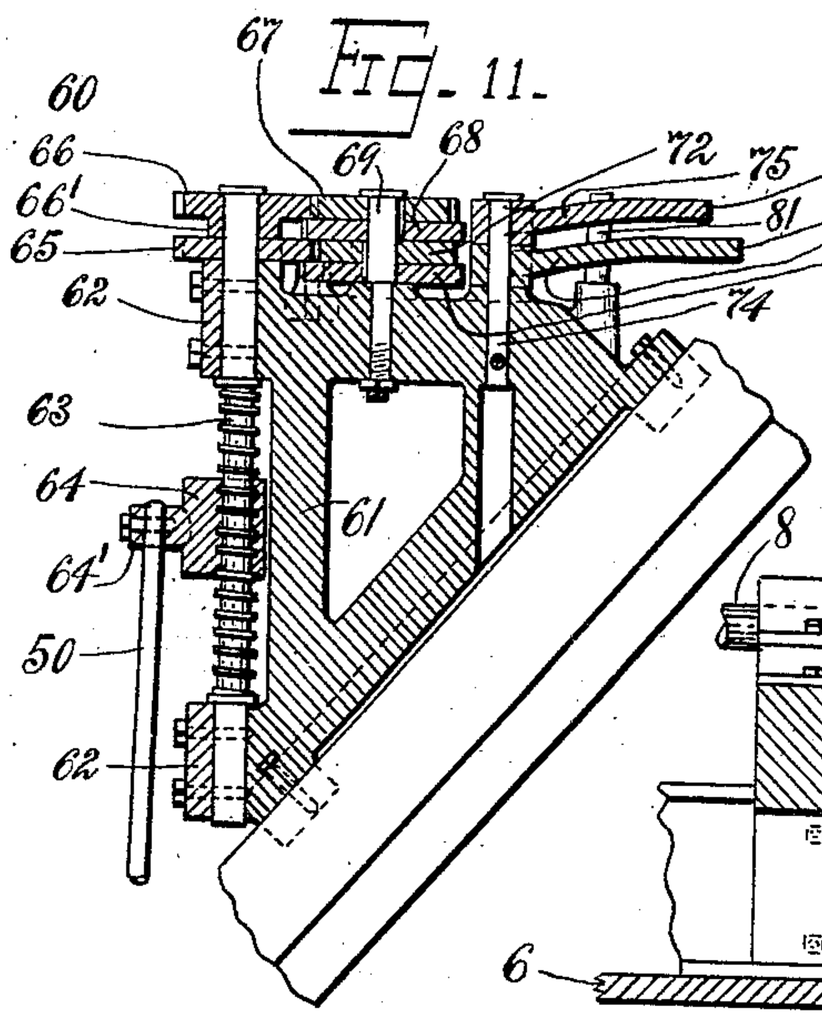


FIG. 12.

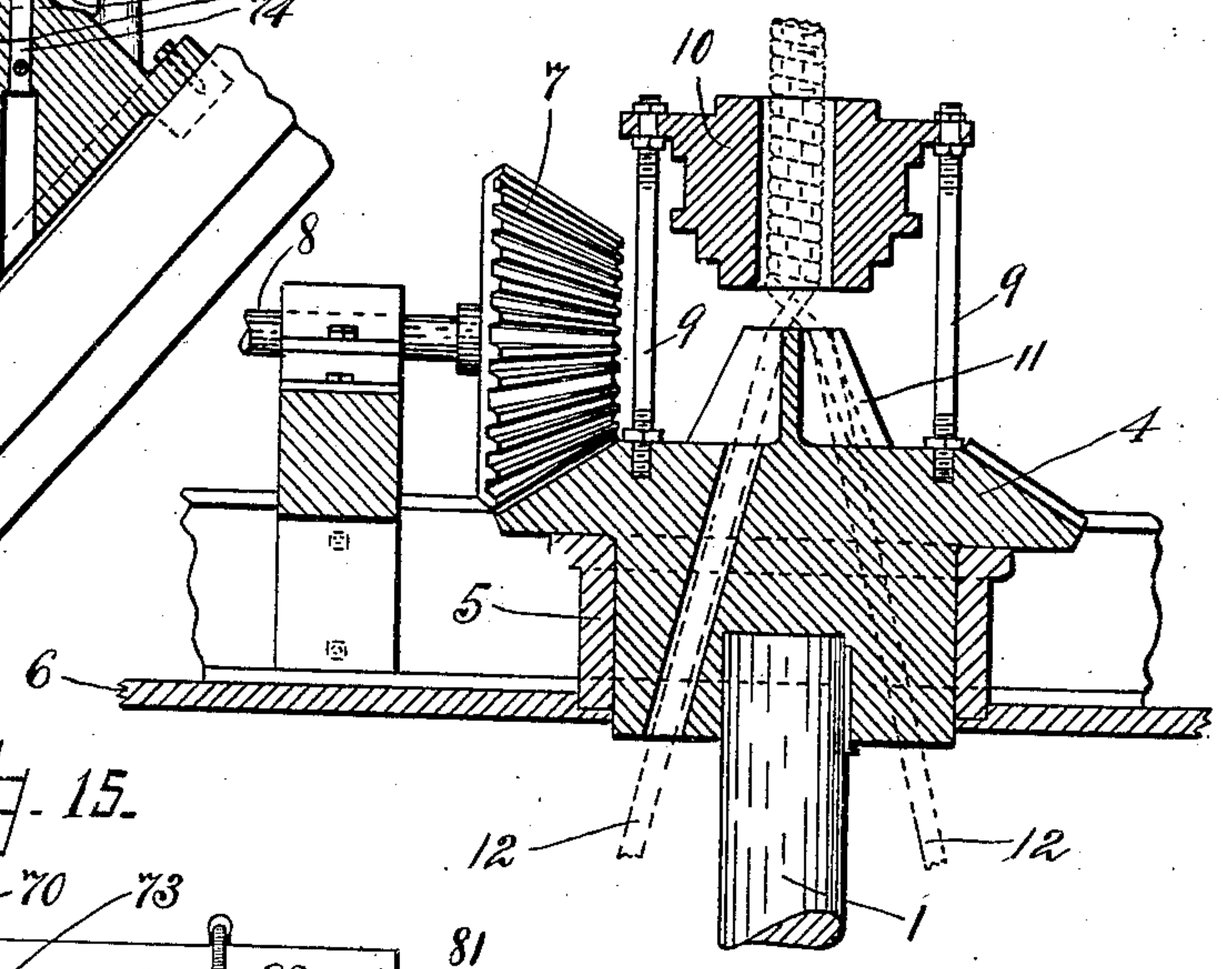
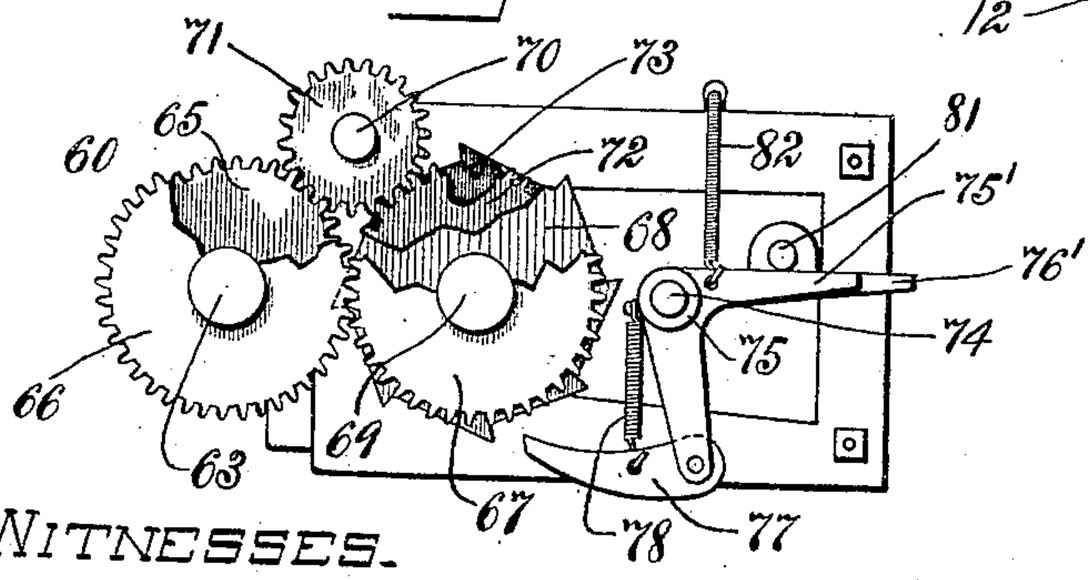


FIG. 15.



WITNESSES.

F. E. Anderson

S. S. Grotta.

INVENTOR.

Chas. W. Sponsel,

By Mann & Schlitz

ATTORNEY.

UNITED STATES PATENT OFFICE.

CHARLES W. SPONSEL, OF HARTFORD, CONNECTICUT, ASSIGNOR TO COLUMBIA ROPE COMPANY, OF AUBURN, NEW YORK, A CORPORATION OF NEW YORK.

ROPE-LAYING MACHINE.

No. 864,039. Specification of Letters Patent. Patented Aug. 20, 1907.

Application filed July 3, 1905. Serial No. 268,134.

To all whom it may concern:

Be it known that I, CHARLES W. SPONSEL, a citizen of the United States, residing at Hartford, in the county of Hartford and State of Connecticut, have invented certain new and useful Improvements in Rope-Laying Machines, of which the following is a specification.

This invention relates to rope-making and analogous machinery, and has for its principal object the provision of means for so controlling the tension of the various strands that unevenness in the lay will be entirely avoided.

In the prior art of rope or cordage manufacture, difficulty frequently arises in the proper twisting of the strands, and frequent variations in the "lay" result, so that one part will be of the required degree of twist, while another part will be loosely connected, thus impairing the strength of the cordage and producing imperfect work.

It is important in the class of work for which the invention is designed to apply equal tension to each strand as the cord or rope is being formed, to indicate automatically the degree of tension applied, and to regulate automatically the tension-devices, so that they will always operate in the same way and with the same degree of pressure upon the strands being made into a rope, and that too, whether the bobbins carried by the fliers be filled or partially filled.

To accomplish these results in a reliable and accurate manner is another object of the present invention, which includes regulatable tension or pressure-devices and their correlated elements, so proportioned and arranged, that the strand from each bobbin will have applied to it a pressure sufficient to cause the cord or rope produced to be of homogeneous twist throughout, and so that the pressure applied to one strand will be exactly equal to that applied to each of the other strands of the series.

A further object of the invention is the provision of means for automatically governing the passage of the strands from the bobbins, said means including a brake and devices for controlling the same, so that whether the bobbin be filled, or partially filled, the strand therefrom will always be under the same degree of tension and each strand will be in like pressure-condition, as the cord or rope is formed from the series of strands, whereby an even lay is produced and a rope or cord having the same homogeneous degree of twist is the result.

A further object of the invention is the provision in cordage machinery, of means for automatically detecting variations in the lay of the strands, and for automatically correcting defects in such lay.

A further object of the invention is the provision of spring scales for indicating the degree of pressure applied to each strand.

A further object of the invention is the provision in connection with the pressure-indicating or tension-devices of a follower in engagement with the coil on the reel or bobbin.

A further object of the invention is the provision of a spring-actuated brake, operating to govern the torque required to cause rotation of the bobbin as the strand leaves the same.

Other objects of the invention will be set forth in the following description.

In the accompanying drawings, Figure 1 is a plan view of rope-laying machinery embodying the features of my invention, the vertical shaft being in section on line *a*—*a* of Fig. 2. Fig. 2 is a view in elevation, the spiders being broken away, and one of the fliers and its bobbin being illustrated. Fig. 3 is a side elevation. Fig. 4 is an enlarged detail view of the brake-controlling mechanism. Fig. 5 is an enlarged view illustrating part of one of the fliers, an arm of one of the spiders, and the tension-indicating and controlling-mechanism out of operative position. Fig. 6 is an enlarged detail view similar to Fig. 5, showing the tension-indicating and controlling-mechanism in operative position. Fig. 7 is a plan view of the parts illustrated in Fig. 5. Fig. 8 is a plan view of an arm of one of the fliers, showing the movable stops or plungers for controlling the operation of the compensating mechanism. Fig. 9 is a longitudinal vertical section on line 9—9 of Fig. 8, the stops or plungers being in elevation. Fig. 10 is a detail partially in section of the brake-mechanism. Fig. 11 is a detail in longitudinal vertical section, taken on line 11—11 of Fig. 7, of the compensating mechanism. Fig. 12 is a detail in longitudinal vertical section of the conical head, and parts coöperating therewith in laying the strands into a rope, the driving-gear and its shaft being in elevation. Fig. 13 is a sectional detail on line 13, 13 of Fig. 4. Fig. 14 is an enlarged longitudinally-divided sectional view of the compensating mechanism taken on line 14, 14 of Fig. 5. Fig. 15 is an enlarged plan view of the compensating mechanism, parts being broken away. Fig. 16 is a section on line *a*—*a* of Fig. 4. Fig. 17 is a section on line *b*—*b* of Fig. 13, and Fig. 18 is a section on line *c*—*c* of Fig. 3.

Like numerals designate similar parts throughout the several views.

Referring to the drawings, the numeral 1 designates a sectional shaft stepped into a base 2 on one of the floors 3 of a building, the sections being united by a coupling hereinafter described, and said shaft carrying on its upper section a bevel or other gear 4, the hub of which is seated in a bearing 5 on another floor 6, said gear 4 being actuated by a pinion 7, rigid with the end of a driving-shaft 8.

Rising from the gear 4 are rods 9 carrying a tubular

guide 10, and either integral with or attached to said gear is a conical head 11, having passages for the strands 12 of the cordage, as shown in Figs. 2 and 12.

Rigid with the sectional shaft 1 between the two floors 3 and 6 are spiders 13 and 14, each spider being composed of multiple arms projecting from a common hub 13′, 14′ keyed to said shaft.

On the base 2 is a fixed gear 15, and projecting from each arm of the lower spider 14 is a stud 16, upon which is sleeved an idler 17 in mesh with said gear 15.

Journaled in each vertically-alined pair of arms of the spiders is a flier 18, and as each flier contains the same elements, like numerals will be employed to designate like parts on all of the fliers of the series employed. On their upper extremities the fliers are each provided with a tubular trunnion 19, journaled in a bearing in each arm of the spider 13, and on their lower ends with a trunnion 20 which projects from the lower cross-bar of each flier, and these trunnions are journaled in the free ends of the arms of the spider 14. Each trunnion 20 carries at its lower end a gear 21, in engagement with the idler 17, and as said idler is in mesh with the fixed gear 15, and the spiders are rigid with the rotary shaft 1, it will be seen that each of the fliers has a compound movement—*i. e.* a revolving movement and an axially-rotating movement, said movements being necessary to the proper lay and twist of the strands 12, as will be obvious on inspection of Figs. 2 and 12 of the drawings. In the skeleton-frame of each of the fliers, about midway of the side-bars thereof, is detachably secured a shaft 22, and upon this shaft is loosely mounted a bobbin 23, loaded with a coil from which the strand 12 is conducted. Each bobbin carries a gear 24 on the exterior surface of one of its end-plates or flanges 24′, and this gear engages a gear 25 on a shaft 26, journaled in a bracket 27 of the flier-frame, said shaft carrying a brake-pulley 28, for a purpose hereinafter described.

To the top of a vertical standard 29 of the bracket 27 is pivoted a lever 30 having an offset end 30′, to which is articulated a concave brake-shoe 31 conforming to the surface of the brake-pulley 28. At its end opposite the point where the brake-shoe is attached the lever 30 is perforated at 30^2, and in the arm of said lever is mounted a stud 32 perforated at 32′, and through the eye of this stud is passed a rod 33, upon which is mounted below the lever a wing-nut 34, said rod having at its upper end a hook 34^2 engaging an eye on the sliding part of spring-scales 35, illustrated in Figs. 2, 3 and 4. This stud has a straight surface 36 bearing against the lever 30 and is reduced at 36′, where it passes through the lever, the reduced part being provided with a thread to receive a jam-nut 36^2, as shown in Fig. 16.

Hooked to the other part of the spring-scales is a rod 37, a threaded portion 37′, of which passes through an open slot 38′ in the free end of a lever 38, attached at 39 to a link or crank-arm 40, said link being pivoted at 41 to one of the side bars of the flier. At its end opposite the slot 38′ the lever 38 is also bifurcated at 38^2 to receive the threaded end 42′ of a rod or link 42, said rod being held in place by a nut 43. Swivel-nuts 44 and 45 are seated in perforations in the bifurcated ends of the lever 38, and are transversely perforated to receive the threaded rods 42 and 37, said nuts being held against displacement by flange tubes or washers 46 and 47, as illustrated in Figs. 4 and 17 the lower ends of the tubes bearing against said nuts when forced downward by nuts 37^2 applied to the threaded rods, as illustrated in said Fig. 17. In the end of the crank-arm 40 is a perforated bolt 48, having a nut 49 for securing it in place. Designated by 50 is a rod, the lower end of which is secured to said crank-arm by the eye-bolt 48 in any desired manner, and the upper end of which is articulated to an element of compensating-mechanism hereinafter described.

Designated by 51 is a bifurcated weight, having bearings 52 and clamp-screws or pins 52′ by which it is secured to a rock-shaft journaled in bearings 53′ of the side-frames 54—54′ of the flier, said rock-shaft being designated by 55. Rigidly secured to the rock-shaft between the arms of the weight is a curved follower 56, the free end of said follower bearing against the coil carried by the bobbin, as shown in Figs. 2, 3, and 4. Secured to the rock-shaft 55, one on each side of the weight 51, are collars 57, and surrounding the said rock shaft are coiled torsion-springs 58, one end of each of which is connected to a bearing 53′ of the flier-frame and the other end to said collars 57, 57′, said springs tending constantly to turn the shaft, and to hold the follower 56 against the coil on the bobbin as the strand is paid off therefrom. (See Fig. 18). Rigid with one end of each rock-shaft 55 is an arm 59, in a slot 59′ of which is hooked a flattened extremity of the rod 42, and depending from each rock-shaft is the weight 51 just described, which acts as a counterbalance to prevent the displacement of the follower under the action of centrifugal force, due to the rapid rotation of the flier. In other words, as the flier rotates centrifugal force will tend to throw the weight 51 outward, and consequently to turn the rock-shaft 55 to which the weight is secured inward, and thus cause the follower 56 constantly to bear on the coil on the bobbin.

Having thus described the fliers, bobbins, and followers attention will now be given to what is termed "the compensating-mechanism" for automatically regulating and controlling the passage of the strands from the bobbins, so that all of said strands will be under equal tension. This compensating-mechanism is designated in a general way by the numeral 60, and is carried by a frame or stand 61, bolted to the upper inclined portion of the side frame of each of the fliers, as illustrated in Figs. 2, 5, 6, and 11. Journaled in bearings 62 in the side of the frame 61 is a screw-shaft 63, which engages a nut in a traveler 64, said traveler having a lateral stud 64′ perforated to receive the upper end of the rod 50, above described, and being secured in place by a belt 64^2, the lower end of said rod being hooked into the perforated belt 48. To the screw-shaft 63 above the upper bearing 62 are rigidly secured gears 65 and 66, the gear 66 having a depending hub 66′ by which it is spaced apart from the gear 65. In mesh with the gear 66 is a gear 67, having rigid with its hub a ratchet-disk 68, shown as connected to said gear 67 by a key 67′ said gear 67 and its ratchet-disk being loosely mounted on a stationary stud shaft 69 secured to and projecting from the upper part of the frame 61. Designated by 70 is a short, stationary stud shaft projecting vertically from frame 61, and upon which is sleeved an idler-pinion 71 in mesh with the gear 65 of screw 63, and also with a gear 72 loose upon the sta-

tionary shaft 69 and carrying a ratchet-disk 73,—the united gear 72 and ratchet-disk 73 being located on said shaft 69 below the similar gear 67 and ratchet-disk 68, as illustrated in Fig. 11. Projecting from the frame 61, is a stationary shaft 74, and sleeved at their hubs upon said shaft are angle-levers 75 and 76 located one above the other. To one arm of the angle-lever 75 is pivoted a pawl 77 held to position to engage the ratchet-disk 68 when the angle-lever is rocked by a spring 78, and to the like arm of the angle-lever 76 is pivoted a pawl 79 held in position to engage the ratchet-disk 73 by a spring 80, as shown by Fig. 14, the inward movement of said pawls being limited by suitable stops, for instance, by the walls of the bifurcated ends of the levers in which the pawls are pivoted. A post 81 projects from the frame 61, and against said post the inwardly-projecting arms 75′, 76′ are held, each by a spring 82, 82′ as illustrated in Figs. 14 and 15. For a purpose hereinafter described the arm 75′ is slightly shorter than the arm 76′ (see Figs. 5 and 11). As will be observed the screw 63 is of lefthand pitch and, therefore, when the gear 65 is actuated the traveler 64 will be forced downward, and when the screw is reversed by gear 66, said traveler will rise on the screw, thus through the connections described, in one instance causing the brake 31 and follower 56 to bear with greater pressure on the brake-pulley and coil on the bobbin, to retard the passage of the strand, and in the other instance, retracting said elements under the influence of the spring-scale 35 and connections described to permit of a more free passage of said strand from the bobbin.

Each arm of the spider 13 is channeled at 13^2 and secured to one wall of the channel are brackets 83 having bearings 84 in which is journaled a rock-shaft 85 carrying a bifurcated crank-arm 86 at one end, as shown in Figs. 8 and 9. At its opposite extremity the rock-shaft 85 is provided with a bifurcated crank-arm 87 engaging a laterally-projecting pin or rod 88.

Secured to the base of each arm of the spider 13 is a block 89, longitudinally bored at 89′, 89^2 and having a slot 89^3 for the reception of the pin 88, which projects from the plunger hereinafter described. In the bore 89′ is mounted a stop-plunger 90 having a rack 90′, and in the bore 89^2 is located a shorter stop-plunger 91 carrying the pin 88 and having a rack 91′. Journaled in the block 89 is a pinion 92 in mesh with both of the racks 90′ and 91′, so that the longer stop-plunger 90 will always be actuated in a direction opposite to that of the shorter stop-plunger 91, when the latter is operated by the rock shaft in a manner hereinafter described.

Loose on the pin 93 passing through the arms of the crank 86 is a sleeve 94, and threaded into a tubular boss 94′ of said sleeve is the lower end of a rod 95, as illustrated in Figs. 8 and 9, the upper extremity of said rod being hooked into a perforation 96′, where it is held by a nut 96^2 in the rear end of one of the arms of a double angle-lever 96. This angle-lever is pivoted on bolts 97, 97′ to the inner sides of the arms of a bracket 98 secured to and projecting from a coupling 99 uniting the two sections of the shaft 1.

Threaded into a swiveled cross-bar 100 uniting the two arms of the angle-lever 96 adjacent to their rear ends is a rod 101 having a hook 101′ at its lower extremity, said hook being inserted in an eye 102 on the barrel of a spring-scale 103, while in an eye on the rod 104 of said spring scale is hooked a threaded rod 105, in threaded, adjustable engagement with a nut 106 on the arm of the spider, as shown in Fig. 5.

Journaled in the outer end of the double angle-lever 96 is a roller 107, over which the strand from the bobbin passes, as shown by dotted lines in said Fig. 5. A link 108 is connected at one end to one of the arms of the double angle-lever 96, and at its other extremity to a pointer 109 pivoted at 110 to an upward extension of the bracket 98, and carrying at its end opposite the pivot a pointer 109′ working in a guide 111, and coöperating with an indicating point 112 on a standard 113, resting upon the top of the bracket 98, and connected by straps 114 to the section of the shaft 1 above the coupling 99, as illustrated in Fig. 6.

Adjacent its outer end each channeled arm of the spider 13 is bridged by the base 115′ of a bracket 115, said bracket having arms 116, 116′ between which a roller 117 is journaled, the strand passing over said roller, as shown in Figs. 2, 5, 6, and 7.

A guide-roller 118 is journaled in the arms 119′ of a bracket 119, the hub of which is secured at 120 to the shaft 1, and the strand passes under said roller on its way to the head 11.

A stop 121 depending from a bracket 53′ prevents, by contact with arm 59^2, rigid with shaft 55 the follower 56 from inward movement beyond a certain point when the bobbin is removed.

As illustrated the strands are all supposed to be under equal tension, and both stop-plungers 90 and 91 are in normal position, and are removed from the paths of travel of the arms 75′ 76′ of the levers 75 and 76.

In the operation of the improved machine, filled bobbins are placed between the arms of each flier-frame, and the shafts 22, upon which the bobbins rotate, are inserted through said bobbins, and are secured in position. Strands from the bobbins are then drawn through the tubular trunnions 19, over the roller 117, and 107, under the rollers 118 and through the passages or grooves in the head 11, when the machine is set in motion and the strands are twisted together to form the cordage, which as completed passes through the tubular guide 10, and from thence to any point desired, for instance, to a device for forming the rope into a coil, or upon a reel.

As stated in the general description, a follower 56 is secured to a rock-shaft 55 journaled in bearings 53′ of the side bars of each flier-frame, and torsion-springs 58 tend constantly to hold said follower against the coil, and to maintain it thereon as the diameter of said coil is reduced, and as also stated each bobbin is geared with a brake-wheel 28, upon which a brake-shoe 31 is arranged to bear, said brake-shoe being under the control of the compensating-mechanism, and the pivoted lever 30, by which the shoe is carried being connected to the spring-scale, or it may be other, tension-device, 35, the tendency of which is to rock the lever, and vary the pressure of the shoe upon the brake-wheel. This tension-device 35 is also connected to one of the arms of the pivoted lever 38, controlled by said compensating-mechanism, and the other arm of lever 38 is connected by a rod 42 with an arm 59 rigid with the rock-shaft 55 carrying the follower 56. As the strands 12 from the bobbins each pass over a roller 107 held

under tension by the spring-scale 103, the lever 96 carrying said roller being connected with the compensating-mechanism aforesaid, it is obvious that if any strand should be too slack greater pressure must be applied to the brake-wheel, and if too tight less pressure must be applied to said wheel. Assuming the strand to be under insufficient tension this will be immediately indicated by the pointer 109, which will drop below the point 112, and the lever 96 will under the stress of the spring-scale 103 be rocked on its pivot to throw the roller 107 further outward. As this takes place the rear arm of said lever connected to the spring-scale aforesaid, and by the rod 95 to the rock-shaft 85, will actuate said rock-shaft, rocking it downward and through the bifurcated arm 87 and pin 88 sliding the stop-plunger 91 downward and the stop-plunger 90 upward, thus locating said stop-plunger 91 in the path traversed by the arm 75′ of lever 75 revolving with the flier-frame around the shaft 1, and rotating with said frame as above explained.

When the arm 75′ engages said stop-plunger 91, lever 75 will be rocked on its pivot 74, and the pawl 77 will engage a tooth of the ratchet-wheel 68, thereby rotating said ratchet-wheel and its connected pinion 67, and through the gear 66 in mesh with said pinion actuating the screw 63 and causing the follower 64 to rise on said screw. Inasmuch as this follower is connected by the rod 50 with the arm 40, pivoted at 41 to a part of the flier-frame, and carrying the pivoted lever 38, it will be seen that as said rod 50 rises the lever 38 will partake of the same movement, and as said lever is connected at one end by the rod 37, spring-scale 35, and rod 33 to the pivoted brake-lever 30, and at its opposite extremity by rod 42, and slotted arm 59 to the rock-shaft 55, it will be seen that the brake 31 will be applied with greater pressure to the brake-wheel 25, and the curved follower 56 with greater pressure to the coil on the bobbin, thus retarding the passage of the strand therefrom, and causing said strand to leave the bobbin under the requisite tensional condition.

If at any time a strand should be paid off from a bobbin under too great tensional condition the roller 107 carried by pivoted lever 96 will be forced back and the pointer 109 connected by link 108 with said lever will rise above the indicating-point 112. This movement of said lever will raise the rod 101, and produce greater tensional resistance on the spring-scale 103, and will also lift the rod 95 and rock the crank-arm 86 and rock-shaft 85 in such direction that the stop-plunger 91 will be raised, and the pinion 92 will be rotated by the rack on said plunger 91 from right to left, thereby depressing the stop-plunger 90 to a point where it will engage the arm 76′ of the lever 76. Now, as the flier rotates the arm 76′ of pivoted lever 76 will engage said stop-plunger 90, the said lever will be rocked and its pawl 79 will turn the ratchet-disk 73 and its connected gear 72 in mesh with the idler 71, and the gear 65 on the screw-shaft 63 will be turned in the same direction as the gear 72, thereby imparting motion to the screw 63 in a direction opposite to that in which it is driven by the gears 66, and 67, and thus lowering the follower 64 and rod 50, forcing down the lever 38, and the connections therefrom to the pivoted brake-lever 30, and rock-shaft 55, and relieving the pressure of the brake 31 on the brake-wheel 28, and of the follower 56 upon the coil, thus enabling the strand more freely to leave the bobbin. When the strand is in normal condition the pointer 109′ will be opposite the indicating-point 112, and when the pressure on said strand varies it can immediately be detected by the position of the pointer either above or below said indicating-point.

As will be understood the springs 82, 82′ normally hold the arms 75′, 76′ of the pivoted pawl-carrying levers 75 and 76 against the post 81, and after one of said lever-arms passes the stop-plunger then in lowered position it will immediately snap back against said post.

By adjusting the screw-rods 33 and 37 the tension of the spring-scale 35 may be regulated as desired, so that the pressure applied by the brake 31 (through lever 30) and by the follower 56 (through lever 38, rod 42 and lever 59,) will produce the required pressure on the strand as it is drawn from the bobbin. To illustrate, when a filled bobbin is in position between the parts of the flier-frame the follower 56 should bear upon the coil with a pressure say of one-hundred and eighty pounds, and the indicator of the spring-scale 35 should indicate this number of pounds, and as the coil is reduced in diameter this pressure should progressively vary, until, finally, when or thereabouts, the coil is exhausted, and the follower is in contact with the drum of the bobbin the scale should indicate about one-sixth of the starting-pressure *i. e.* thirty pounds. In other words, the pressure on the lower scale 35 is reduced proportionately to the leverage exerted by follower 56 upon the coil.

An equal tension on the strand 12 must be maintained at all times, and therefore, as the power necessary to draw the strand from the bobbin constantly increases as the diameter of the coil on the bobbin diminishes, it is obvious that the pressure applied by the brake 31 must also constantly diminish, or be reduced proportionately to the leverage on the bobbin.

Any suitable means may be substituted for the spring scale illustrated and described, the invention not being limited in this respect. So too, the compensating-mechanism may be varied within wide limits, and various devices different from those shown may be employed for controlling the passage of the strands, so that an even lay thereof will be effected, and the cordage will be of standard twist throughout, without departure from the invention.

Changes may be made in the form, proportions, and various details of the machine, and many of the details thereof may be employed in arts different from that of cordage manufacture, and still be within the purview of my invention.

Having thus described my invention, what I claim is:

1. The combination, of the following instrumentalities revolving and rotating fliers; bobbins on said fliers; and means for controlling the speed of each strand as it leaves the bobbin; mechanism carried by the fliers for actuating said controlling means; and means operative on the rotation of the fliers for operating said mechanism.

2. The combination, of the following instrumentalities: revolving and rotating fliers; bobbins carrying the coiled strands, and one mounted for rotation on each flier; compensating-mechanism; means controlled by said compensating-mechanism for maintaining the tension of the strand as it leaves the bobbin; and means carried by the flier-support for operating said compensating-mechanism.

3. The combination, in cordage-laying mechanism, of bobbins containing the coils of strands; fliers for the bobbins; means mounted on each flier for holding the strand under tension as it leaves its bobbin; mechanism carried

by each flier for controlling said means, whereby each of the strands will be maintained in equal tension as the lay is formed; and plungers on each flier-support for actuating said controlling-mechanism.

4. In a cordage laying machine, the combination, with a series of fliers, of means for revolving said fliers around a common axis; means for rotating said fliers; bobbins carrying the coils of strands, and mounted one on each flier; means for laying the strands; means for maintaining each strand under the same degree of tension as the cordage is being formed; compensating mechanism carried by each flier for controlling the tension-devices; and means on the flier-support for actuating the compensating-mechanism.

5. The combination, with a flier and its bobbin, of means for controlling the torque necessary to rotate said bobbin; compensating-mechanism carried by the flier for actuating said means; and means including a pair of plungers for actuating said compensating-mechanism.

6. The combination, with a flier, and its bobbin, of compensating-mechanism carried by the flier; means independent of the flier, and controlled by the strand passing from the coil on the bobbin for actuating said compensating-mechanism; and brake-mechanism operated by said compensating-mechanism for controlling the rotary movement of the bobbin.

7. The combination, with a flier and its bobbin, of compensating-mechanism; means independent of the flier controlled by the strand passing from the bobbin for actuating said compensating-mechanism; a brake controlling the movement of said bobbin; and brake-controlling-devices operated by said compensating-mechanism.

8. The combination, with a flier and its bobbin, of brake-mechanism for controlling said bobbin; compensating-mechanism carried by the flier; and instrumentalities including plungers controlled by the strand issuing from the bobbin for intermittingly-actuating said compensating-mechanism, and thereby the brake.

9. The combination, with a flier, and its bobbin, of brake-mechanism for controlling the bobbin; compensating-mechanism carried by the flier; means for connecting the compensating-mechanism with said brake-mechanism; a stop-plunger; means actuated by the strand for operating said stop-plunger; and means actuated by said stop-plunger for operating the compensating-mechanism.

10. The combination, with a flier, and its bobbin, of brake-mechanism for controlling the movement of the strand from the bobbin; means for actuating said brake-mechanism; a yielding device constituting a part of said means; compensating-mechanism; means, including plungers, for actuating said compensating-mechanism; and devices connecting the compensating-mechanism with the means for actuating the brake.

11. The combination, with a flier and with a bobbin carried thereby, of a brake-wheel connected with the bobbin; a brake; a lever for actuating said brake; a spring-scale, one part of which is connected with said lever; a lever connected with the other part of said spring-scale; means for actuating said lever; and a follower held against the coil on the bobbin by said lever.

12. The combination, with a flier, and with a bobbin carried thereby, of a brake-wheel connected with the bobbin; a brake; a lever for actuating said brake; a spring-scale, one part of which is connected with said lever; a movable device connected with the other part of said spring-scale; compensating-mechanism connected to said movable device; and means controlled by the strand issuing from the bobbin for actuating said compensating-mechanism.

13. The combination, with a flier, and with a bobbin mounted for rotation thereon, of a pivoted lever; a roller carried by said lever, and over which the strand passes; a spring-scale connected with one arm of the pivoted lever; an indicator actuated by said pivoted lever; compensating-mechanism; devices operated by said spring-scale for actuating said compensating-mechanism; and devices actuated by said compensating-mechanism for regulating the passage of the strand from the bobbin.

14. The combination, with a rotary shaft, and with spiders rigid therewith, of a flier journaled in the spiders; means for axially rotating said flier; a bobbin carried by the flier; a pivoted lever; a roller carried by said lever, and over which the strand from the bobbin passes; a device for holding said lever under tension; compensating-mechanism carried by the flier; and controlled by said pivoted lever, means operated by said lever for controlling the movement of the bobbin as the strand leaves the same.

15. The combination, with a flier, and with a bobbin mounted thereon, of a follower; a shaft journaled in the flier-frame, and carrying said follower; compensating mechanism carried by the flier, and connected with said shaft; and a torsion-spring connected to the shaft at one end, and to a part of the flier-frame at its other end, said spring serving to rock the shaft and hold the follower in constant yielding engagement with the coil on the bobbin.

16. The combination, with a flier, and with a bobbin mounted thereon, of a follower; a shaft journaled in the flier-frame, and carrying said follower; a torsion-spring connected to the shaft at one end, and to a part of the flier-frame at its other end, said spring serving to rock the shaft, and hold the follower in constant yielding engagement with the coil on the bobbin; and a weight secured to said shaft.

17. The combination, with a flier, and with means for rotating and revolving said flier, of a bobbin mounted on the flier; compensating-mechanism carried by the flier; a lever actuated by the compensating-mechanism means for connecting said compensating mechanism with said lever; a rock-shaft journaled in the flier-frame; a follower rigid with the rock-shaft; and a connection between the lever and rock-shaft.

18. The combination, with a rotary and revolving flier, and with a bobbin mounted on said flier, of a follower; means for holding said follower in constant yielding connection with the coil on the bobbin; and a weight carried by said means, and preventing the displacement of the follower under the action of centrifugal force.

19. The combination, with a flier, and with means for rotating and revolving the same, of a bobbin mounted on the flier; brake-mechanism for controlling the passage of the strand from the bobbin; compensating-mechanism controlled by the strand; a screw constituting part of said compensating-mechanism; and means operated by said screw for controlling the operation of the brake-mechanism.

20. The combination, with a flier, and with mechanism for actuating the same, of a bobbin mounted on the flier; a brake-wheel geared to the bobbin; a brake; compensating-mechanism; means controlled by the strand for actuating said compensating-mechanism; and means actuated by the compensating-mechanism for operating the brake.

21. The combination, with a flier, and with mechanism for actuating the same, of a bobbin mounted on the flier; a brake-wheel geared to the bobbin; a brake; compensating mechanism; means controlled by the strand for actuating said compensating-mechanism; a follower bearing on the coil carried by the bobbin; a rock-shaft carrying said follower; and means actuated by the compensating-mechanism for operating said brake and said rock-shaft.

22. The combination, with a flier, of a rock-shaft journaled in the frame thereof; a bobbin mounted on the flier; compensating-mechanism carried by the flier; a follower carried by the rock-shaft; means for connecting said compensating-mechanism with the rock-shaft; and torsion-springs connecting the rock-shaft and said frame, and serving to hold the follower in contact with the coil on the bobbin.

23. The combination, with a flier, and its bobbin, of a rock-shaft; brackets on the frame of the flier in which said rock-shaft is journaled; collars rigid with the rock-shaft; a bifurcated weight depending from the rock-shaft between said collars; torsion-springs surrounding the rock-shaft, and connecting the collars and brackets; and a follower carried by said rock-shaft, and held against the coil on the bobbin by said torsion-springs.

24. The combination, with a flier, of a bobbin mounted thereon; a follower; means for normally holding said follower under pressure against the coil on the bobbin; and stop-devices for preventing the follower from dropping beyond a certain point when a bobbin is removed from the flier.

25. The combination, with a flier, and its bobbin, of a rock-shaft; brackets on the frame of the flier in which said rock-shaft is journaled; collars rigid with the rock-shaft; a bifurcated weight depending from the rock-shaft between said collars; torsion-springs surrounding the rock-shaft and, connecting the collars and brackets; compensating-mechanism; a follower carried by said rock-shaft, and held against the coil on the bobbin by said torsion-springs; and means for connecting said compensating-mechanism with the rock-shaft.

26. The combination, with a flier, of a bobbin mounted thereon; a follower; means for normally holding said follower under pressure against the coil on the bobbin; and stop-devices including an arm on the rock-shaft, and a stop on the flier, for preventing the follower from dropping when a bobbin is removed from the flier.

27. The combination, with a flier, of a bobbin thereon; a follower; a rock-shaft to which the follower is secured; means for normally actuating the rock-shaft to cause the follower constantly to engage the coil on the bobbin; an arm projecting from the rock-shaft; and a stop-device for engaging the arm, and thus limiting the movement of the rock-shaft.

28. The combination, with a flier, of a bobbin thereon; a follower; a rock-shaft to which the follower is secured; means for normally actuating the rock-shaft to cause the follower constantly to engage the coil on the bobbin; an arm projecting from the rock-shaft; a stop-device for engaging the arm, and thus limiting the movement of the rock-shaft; and a weight carried by the rock-shaft, and serving to prevent displacement of the follower during the rotation of the flier.

29. The combination, with a flier, of an arm pivoted to the frame thereof, a lever pivotally mounted on said arm; means carried by the flier for actuating said lever; a bobbin; brake-mechanism for controlling the movement of said bobbin; and means for connecting said brake-mechanism with said lever.

30. The combination, with a flier, of an arm pivoted to the frame thereof; a lever pivotally mounted on said arm; means for actuating said lever; a bobbin; brake-mechanism for controlling the movement of said bobbin; and a spring scale and connections between said brake-mechanism and said lever.

31. The combination, with a flier, of an arm pivoted to the frame thereof, a lever pivotally mounted on said arm; means for actuating said lever; a bobbin; a rod in adjustable connection with an end of said lever; a spring-scale, part of which is connected to said rod; and brake-mechanism connected with the other part of said spring-scale, said brake-mechanism serving to govern the passage of the strand from the coil on the bobbin.

32. The combination, with a flier-frame, and with a bobbin mounted for rotation thereon; of brake-mechanism for said bobbin; a pivoted lever; means for operating said lever; and adjustable connections, including a spring-scale between said lever and brake-mechanism.

33. In a rope-laying machine, the combination, with a flier, of an arm pivoted to said flier; a lever mounted for movement on said arm; means for actuating the arm, and thereby said lever; a bobbin mounted for rotation on the flier; brake-mechanism for controlling the movement of the bobbin; a rod in adjustable connection with one end of the lever; a spring-scale, part of which is connected to said rod; and an adjustable rod connecting the other part of said spring-scale with an element of the brake-mechanism.

34. In a rope-laying machine, the combination, with a flier and its bobbin, of a brake-wheel in geared connection with said bobbin; a lever pivoted to the flier-frame; a brake connected to said lever; an adjustable rod also connected to said lever; a spring-scale, one part of which is connected with said rod; a second pivoted lever; means for actuating said second pivoted lever; and an adjustable connection between the second pivoted lever and the other part of said spring-scale.

35. In a rope-laying machine, the combination, with a flier, of a bobbin mounted for rotation on said flier; a lever; means controlled by the strand for raising and lowering said lever; brake-mechanism for regulating the passage of a strand from the bobbin; a spring-connection between said lever and an element of the brake-mechanism; a follower adapted to bear constantly against the coil on the bobbin; a shaft on which the follower is mounted; and means operated by said lever for actuating said shaft.

36. In a rope-laying machine, the combination, with a flier, of a bobbin mounted for rotation on said flier; a lever; means controlled by the strand for raising and lowering said lever; brake-mechanism for regulating the passage of a strand from the bobbin; a spring-connection between said lever and an element of the brake-mechanism; a follower adapted to bear constantly against the coil on the bobbin; a shaft on which the follower is mounted; means operated by said lever for actuating said shaft; and a weight depending from said shaft, and serving to prevent displacement of the follower during the rotation of the flier.

37. In a rope-laying machine, the combination, with compensating-mechanism including a screw, of a traveler on said screw; a lever; a connection between said lever and said traveler; brake mechanism for the bobbin; and a connection between said lever and an element of said brake-mechanism.

38. In a machine of the class described, the combination, with a flier of a bobbin mounted for rotation thereon; an arm pivoted to the flier-frame; a lever pivoted to said arm; means controlled by the strand for raising and lowering said lever; brake-mechanism; a follower; and means for connecting said lever with the brake-mechanism and with the follower.

39. The combination, in a rope-laying machine, of a flier; a bobbin; a screw carried by the flier; means controlled by the strand for intermittingly actuating said screw; a traveler actuated by the screw; a brake for the bobbin; and means actuated by the traveler for operating the brake, and thus keeping the tension of the strand constant.

40. The combination, with a flier, of a bobbin mounted for rotation thereon; a roller over which the strand passes; a pivoted lever carrying said roller; a rod connected to said lever; oppositely-movable-plungers a rock-shaft to which the rod is connected and connections from said rock-shaft for operating the oppositely-moving plungers; mechanism actuated by said plungers; a brake for the bobbin; and means actuated by said mechanism for controlling the brake.

41. The combination, with spiders, of a flier and its bobbin; a pivoted, spring-actuated lever; a device on said lever over which the strand from the bobbin passes; a rock-shaft journaled on one of the spiders; a connection between said rock-shaft and said spring-actuated lever; stop plungers carried by one of the spiders, and operated by said rock-shaft; compensating-mechanism; a brake for the bobbin; and means actuated by the compensating-mechanism for operating said brake.

42. The combination, with rotary spiders, of a flier journaled therein; and having a tubular trunnion; a bobbin mounted for rotation on the flier; a brake for controlling the bobbin; and means controlled by the moving strand after it passes through said tubular trunnion for actuating said brake.

43. The combination, with rotary spiders, of a flier journaled therein, and having a tubular trunnion; a bobbin mounted for rotation on the flier; a brake for controlling the bobbin; a follower bearing on the coil on the bobbin; and means controlled by the strand for actuating both the brake and the follower.

44. The combination, with a flier, and with means for rotating and revolving the same, of a bobbin; a screw carried by the flier-frame; sets of gearing for actuating the screw in opposite directions; means for operating said sets of gearing each set at different intervals; a brake for the bobbin; and means operated by the screw for actuating the brake.

45. In a machine of the class described, the combination, with a flier, of a bobbin mounted thereon; a screw carried by the flier; a brake; means actuated by the screw for operating the brake; gearing for operating the screw in one direction; gearing for operating the

screw in an opposite direction; independent pawl-and-ratchet devices for operating said gearing; and means controlled by the strand for actuating one of the pawl-and-ratchet devices when the tension thereof is excessive, and for actuating the other of said devices when the tension of the strand is insufficient.

46. The combination, with a flier and its bobbin, of means for braking said bobbin; a screw; a traveler on said screw; gearing for actuating the screw in one direction; gearing for actuating the screw in an opposite direction; independent pawl-and-ratchet devices for actuating said gearing; stop-plungers for actuating said pawl-and-ratchet devices at different times; and means controlled by the strand for depressing said stop-plungers.

47. The combination, with a pivoted lever having a swivel-nut; of a rod in threaded engagement with said swivel-nut; means for actuating said lever; a flier on which the lever is mounted; a bobbin carried by the flier; brake-mechanism also carried by the flier; and a yielding connection between the brake-mechanism and said pivoted lever.

48. The combination, with a flier-frame, of an arm pivoted to said flier-frame; compensating-mechanism carried by the flier for actuating said arm; a lever pivoted to the arm; swivel-nuts carried by said lever; a rod in adjustable engagement with one of said swivel-nuts; a rock-shaft; a follower carried by the rock-shaft; an arm on the rock-shaft to which the other end of the rod is connected; a bobbin; brake-mechanism for said bobbin; and means including a spring-scale for connecting the other swivel-nut with an element of said brake-mechanism.

49. The combination, with a flier and its bobbin, of an arm pivoted to the flier-frame; a lever pivoted to said arm; means for actuating the arm; a pivoted connection for one end of said lever; brake-mechanism for the bobbin; and means for connecting the other end of said pivoted lever to an element of said brake-mechanism.

50. The combination, with a flier and its bobbin, of an arm pivoted to the flier-frame; means for actuating said arm; a lever pivoted to the arm; brake-mechanism for the bobbin; and swinging connections between said lever and an element of the brake-mechanism.

51. The combination, with a follower; of means for actuating said follower; a lever; and swinging connections between the lever and an element of the follower-actuating means.

52. The combination, with a flier and its bobbin, of compensating-mechanism; an arm pivoted to the flier-frame; connections between said arm and said compensating-mechanism; a lever pivoted to the arm; brake-mechanism; a follower bearing on the coil on the bobbin; and means operated by the pivoted lever for simultaneously actuating the brake-mechanism and the follower.

53. The combination, with a flier and its bobbin, of an arm pivoted to the flier-frame; means for actuating the arm; a lever pivoted to the arm; swivel-nuts mounted in each end of said lever; a follower bearing on the coil on the bobbin; a rock-shaft carrying said follower; a rod in threaded engagement with one of the swivel-nuts at one end; an arm on the rock-shaft with which the other end of said rod is loosely connected; a rod in threaded engagement with the other swivel-nut; a spring-scale part of which is connected to said rod; a rod connected to the other part of said spring-scale; and brake-mechanism actuated by said rod.

54. The combination, with a flier, and its bobbin, of a gear on said bobbin; a shaft journaled in the flier-frame; a brake-wheel, and a gear on said shaft, said gear being in mesh with the gear on the bobbin; a pivoted lever; a brake-shoe carried by said lever; a spring-scale connected to the end of said lever opposite the brake-shoe; and means for actuating said spring-scale, and thereby operating said pivoted lever.

55. The combination, with a flier and its bobbin, and with brake-mechanism for the bobbin, of a screw; a traveler on said screw; devices connecting said traveler with the brake-mechanism; gears secured to the screw; a stud-shaft; gears, each carrying a ratchet-wheel, loose on said stud-shaft; an idler between one of the gears on the stud-shaft and one of the gears on the screw; pawls for actuating the ratchet-wheels; and means controlled by the tension of the strand for actuating the pawls.

56. In apparatus of the class described compensating-mechanism comprising a screw; gears rigid with said screw; a pair of loosely-mounted gears, one directly in mesh with a gear on the screw; an idler connecting the other loosely-mounted gear with the other gear on the screw; ratchet-wheels, one rigid with each loosely-mounted gear; angle-levers; pawls carried by said angle-levers; and means for actuating said angle-levers, to cause the pawls to engage.

57. The combination, with a flier-frame, of a stand secured thereto; a screw journaled in bearings of the stand; a traveler actuated by the screw; superposed gears rigid with the screw; superposed gears loosely-mounted on the stand; one of which is in direct engagement with a gear of the screw; an idler driven by the other loosely-mounted gear, and engaging the other gear of the screw; a ratchet rigid with each loosely-mounted gear; a pair of pivoted angle-levers; a spring-actuated pawl carried by each angle-lever, each pawl engaging a ratchet when its lever is thrown forward, and means for actuating the angle-levers.

58. The combination, with a flier-frame, of a stand secured thereto; a screw journaled in bearings of the stand; a traveler actuated by the screw; superposed gears rigid with the screw; superposed gears loosely-mounted on the stand, and one of which is in direct engagement with a gear of the screw; an idler driven by the other loosely-mounted gear, and engaging the other gear of the screw; a ratchet rigid with each loosely-mounted gear; a pair of pivoted angle-levers; a spring-actuated pawl carried by each angle-lever; means for actuating the angle-levers, to cause the pawls to engage the ratchets; an abutment carried by the stand; and springs for normally holding the arms of the angle-levers against said abutment.

59. The combination, with a flier-frame, of a stand mounted on said frame; a screw journaled in the stand; gearing for driving the screw in opposite directions; pawl- and ratchet-mechanisms for actuating said gearing; angle-levers carrying the pawls of said mechanisms, the rear arm of one of said angle-levers being shorter than the similar arm of the other angle-lever; oppositely-acting stop-plungers; a revolving spider carrying said plungers; and means for raising and lowering said plungers.

60. The combination, with a rotary shaft, and with spiders secured thereto, of a flier journaled for rotation in the spiders; stop-plungers, each having a rack, mounted on one of the spiders; a pinion connecting the racks of said stop-plungers; guides for the stop-plungers; means controlled by the tension of the strand for operating said pinion; a bobbin carried by the flier; brake-mechanism for the bobbin; and means operated by said stop-plungers for actuating said brake-mechanism.

61. The combination, with a flier having a tubular trunnion, of a bobbin; a pivoted lever; a device carried by the lever, over which the strand passes; and a device for indicating the degree of tension of the strand. and operated by said pivoted lever; compensating-mechanism; means operated by the pivoted lever for actuating said compensating-mechanism; and means operated by the compensating-mechanism for controlling the passage of the strand from the bobbin.

62. The combination, with a flier having a tubular trunnion, of a bobbin on the flier; spiders in which the flier is journaled; a pivoted lever; connections including a spring-scale from an arm of said lever to one of the spiders; a roller on the other arm of said lever, and bearing against the strand; and an indicator operated by said pivoted lever.

63. The combination, with a flier, and its bobbin, of a rotary shaft; means carried by the shaft for supporting the flier; a bracket rigid with said shaft; a guide carried by the bracket; an indicating-point on the guide; a pivoted lever; a roller journaled in one arm of said lever, and over which the strand from the bobbin passes; a device for normally holding the lever under tension; and an indicator actuated by said lever.

64. The combination, with a rotary shaft, and with spiders secured thereto, of fliers journaled in the spiders; a bobbin mounted on each flier; means for automatically maintaining all the strands issuing from the bobbins under constant equal tension; said means including compensating mechanism; and means controlled by the strand after it leaves the flier for actuating said compensating-mechanism.

65. The combination, with a shaft, and with spiders secured thereto, of brackets carried by one of the spiders; a rock-shaft journaled in the brackets, and having crank-arms; a guide-box secured to the spider; oppositely-moving stop-plungers, one of which is of different length from the other, mounted in the guide-box; gearing connecting said stop-plungers; means for connecting one of the stop-plungers with a crank-arm of the rock-shaft; compensating-mechanism actuated by the stop-plungers; means controlled by the tension of the strand for operating said rock-shaft; a flier a bobbin on the flier; and means actuated by said compensating-mechanism for applying brake-pressure to, and relieving it from, the bobbin.

66. The combination, with a rotary shaft, of spiders rigid therewith; a flier journaled in said spiders; a bobbin on said flier; a guide-roller carried by the spider; a tension-roller adapted to bear on the strand; compensating-mechanism controlled by the tension-roller; and means actuated by said compensating-mechanism for controlling the passage of the strand from the bobbin.

In testimony whereof I affix my signature in presence of two witnesses.

CHARLES W. SPONSEL.

Witnesses:

DANIEL WESTIN,

S. WARREN POTTS.