No. 657,432. **Patented Sept. 4, 1900.**

J. MELZER.

ELECTRIC ARC LAMP.

(Application filed Apr. 2, 1900.)

(No Model.) **5 Sheets—Sheet 1.**

Fig. 1.

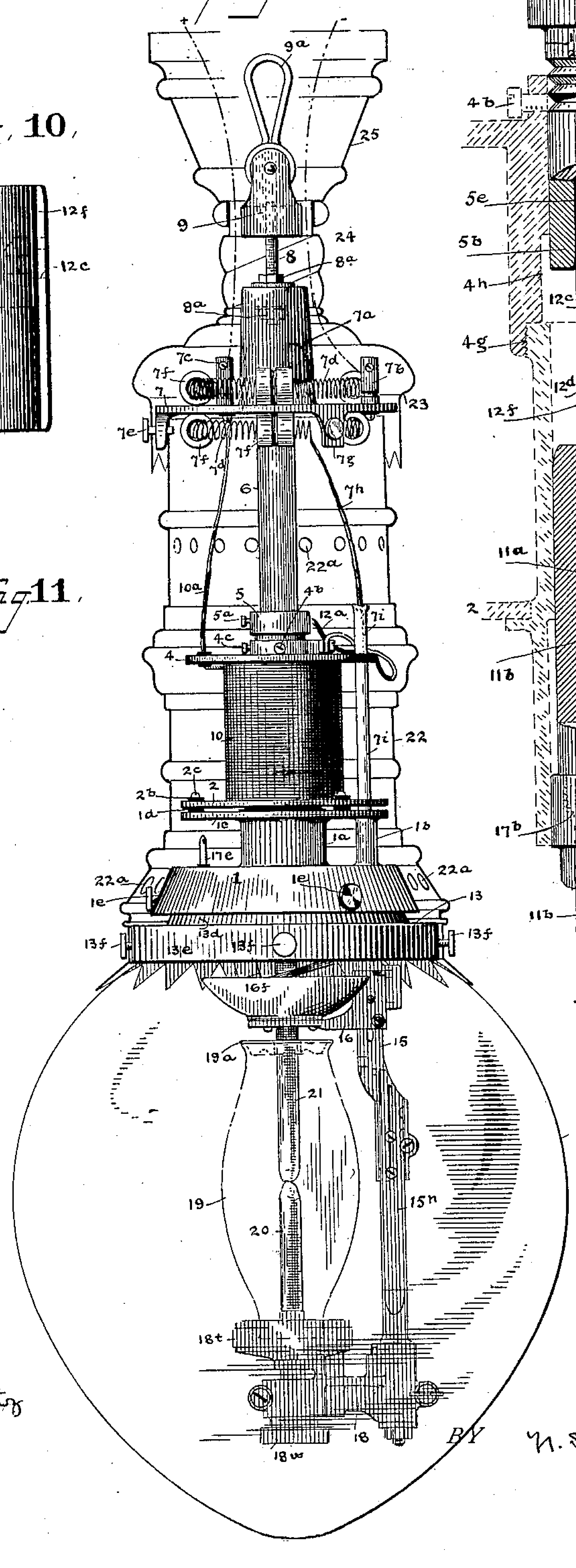


Fig. 9.

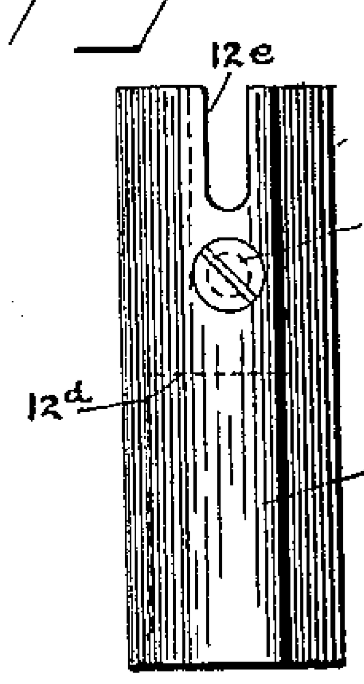
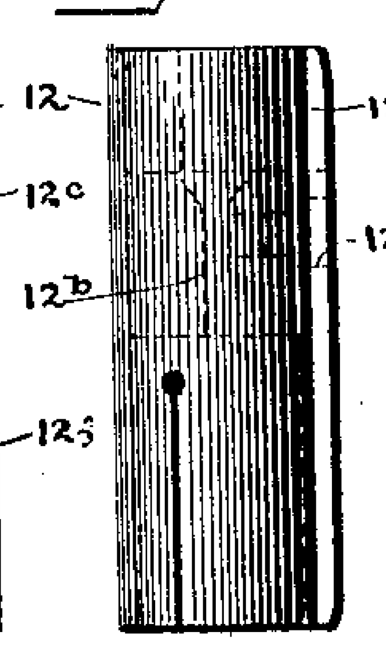


Fig. 10.



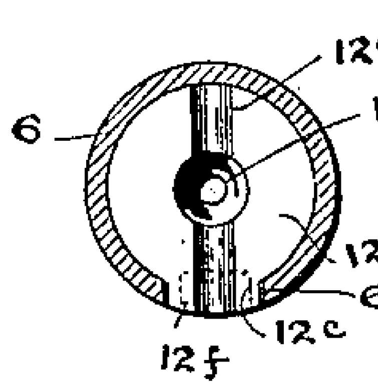
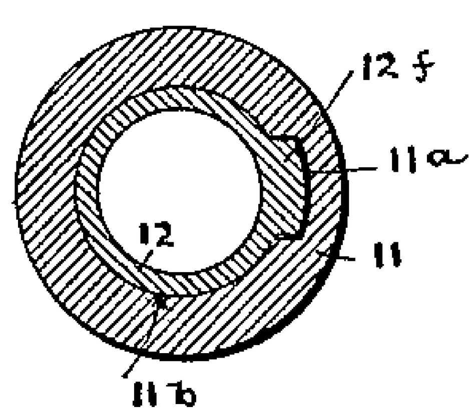


Fig. 11.

Fig. 12.



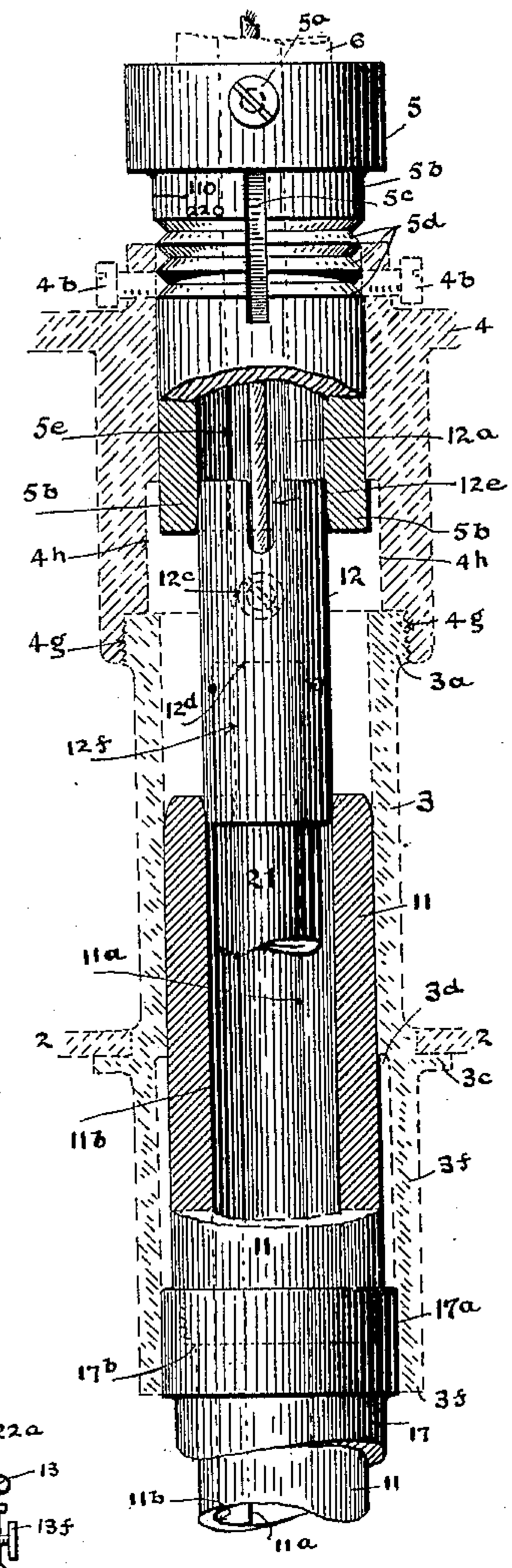


Fig. 8.

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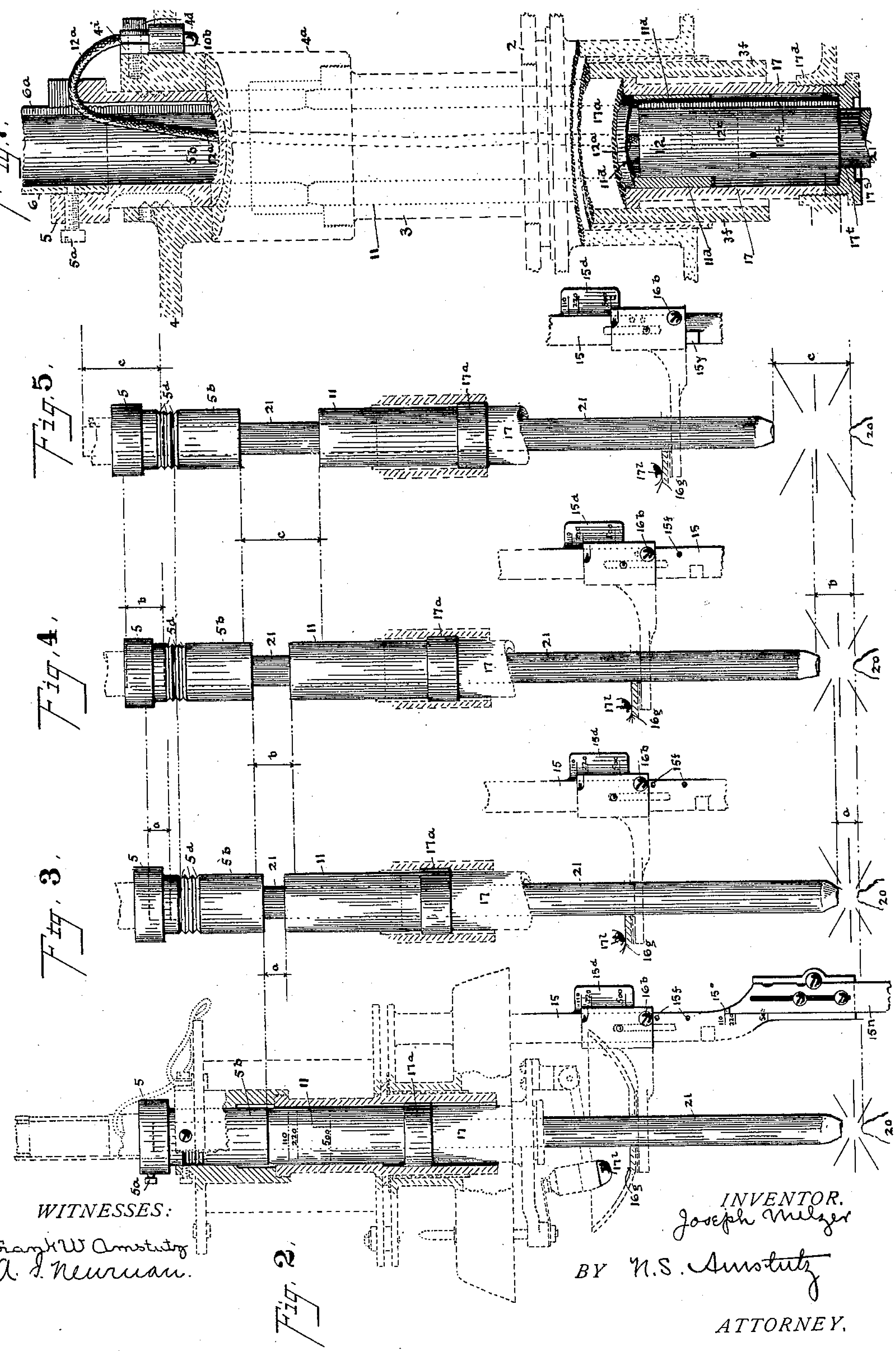
(Application filed Apr. 2, 1900.)

(No Model.)

5 Sheets—Sheet 2.



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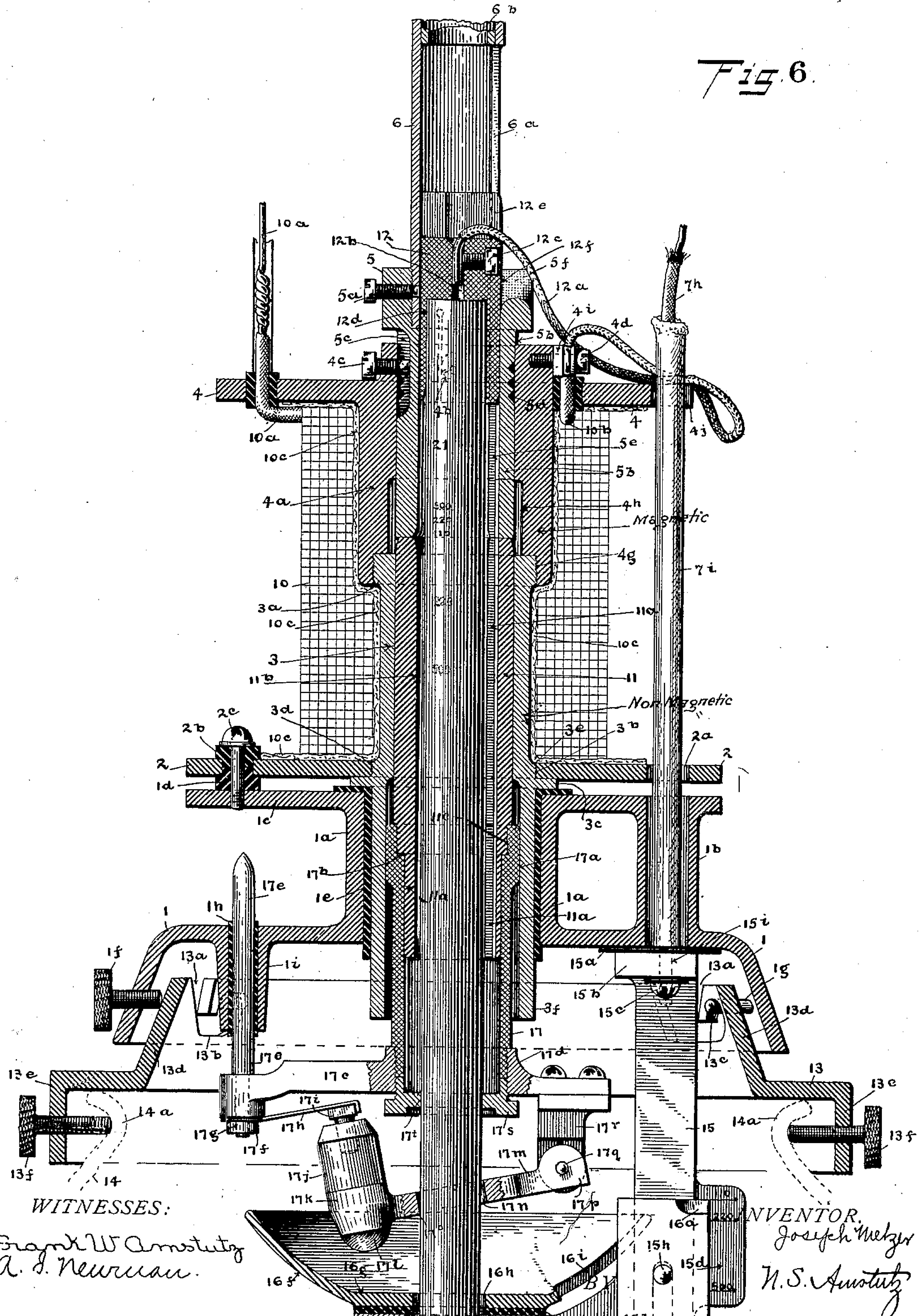
(No Model.)

5 Sheets—Sheet 3.

Fig. 6.



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(Application filed Apr. 2, 1900.)

(No Model.) 5 Sheets—Sheet 4.

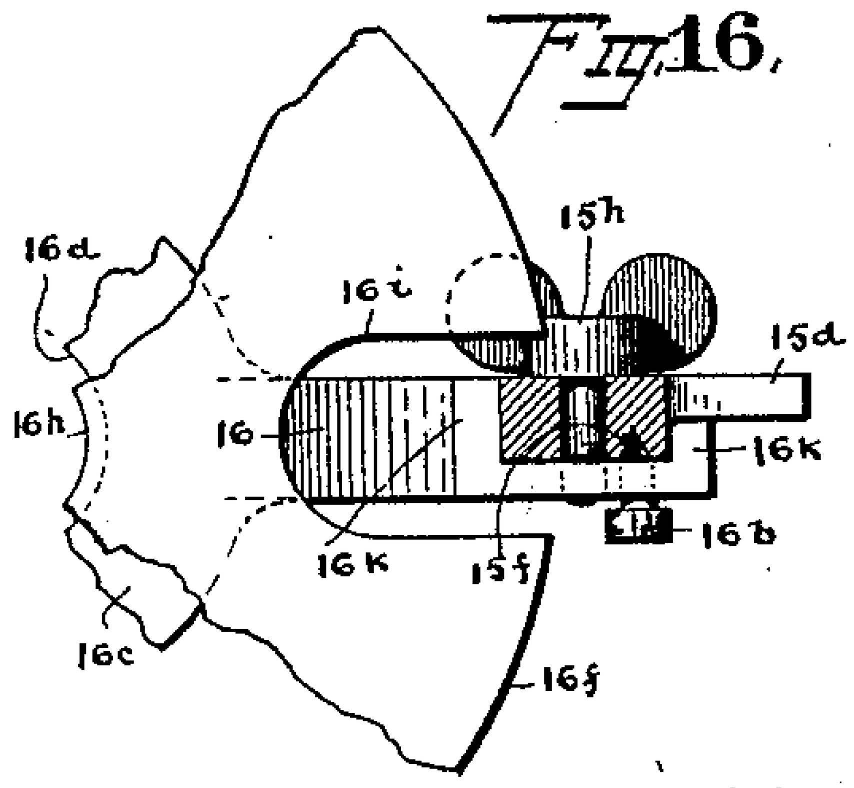

Fig. 16.

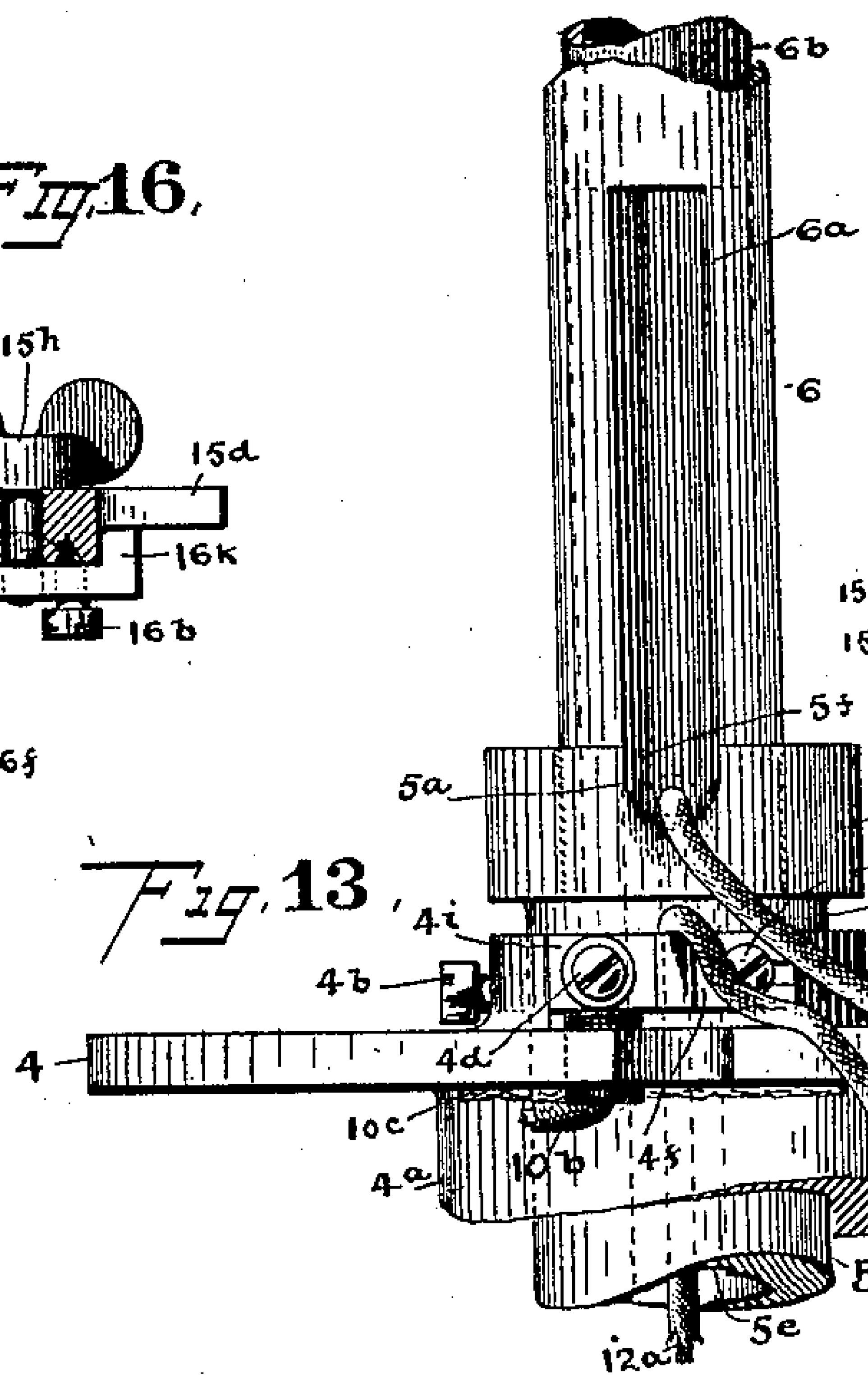

Fig. 13

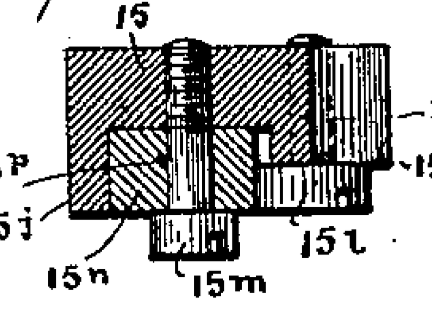

Fig. 19.

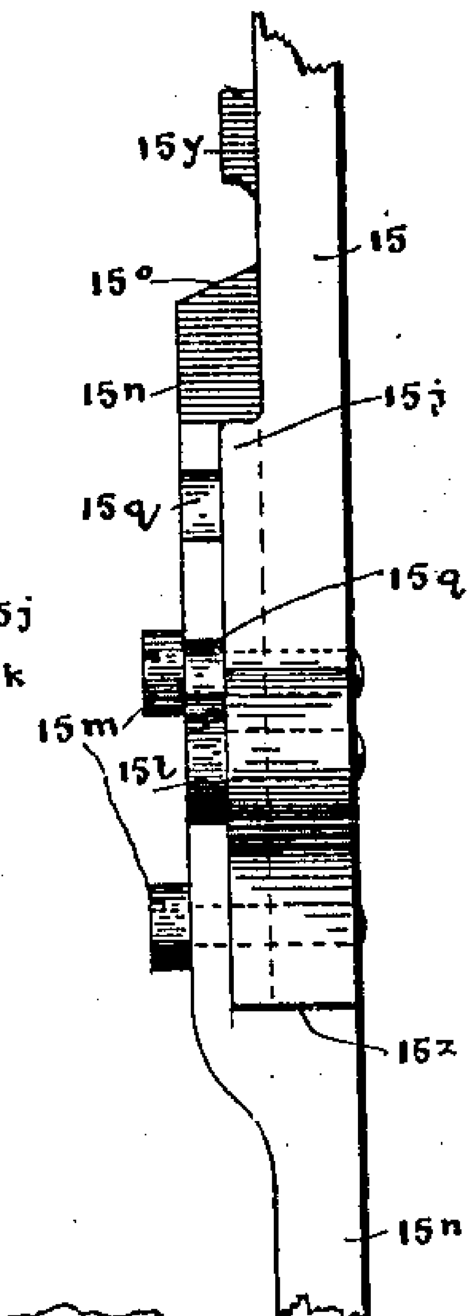

Fig. 20

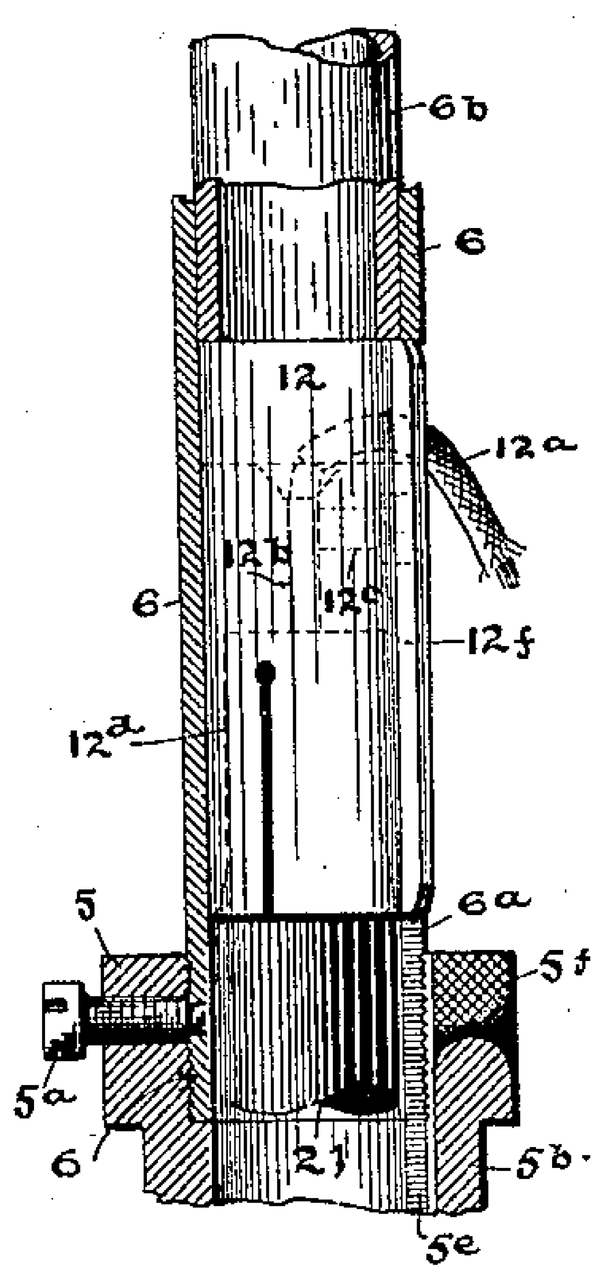

Fig. 15.

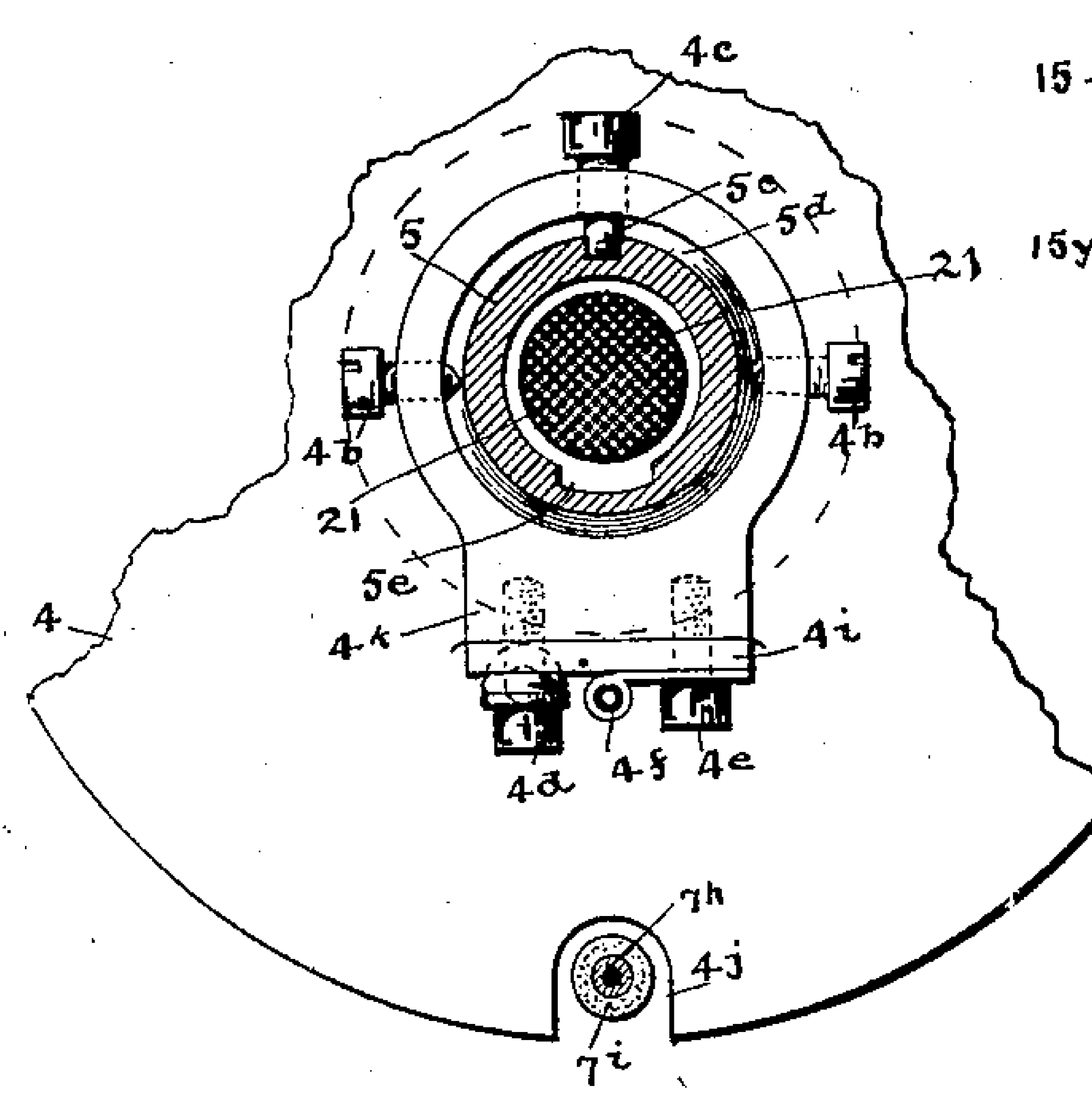

Fig. 14

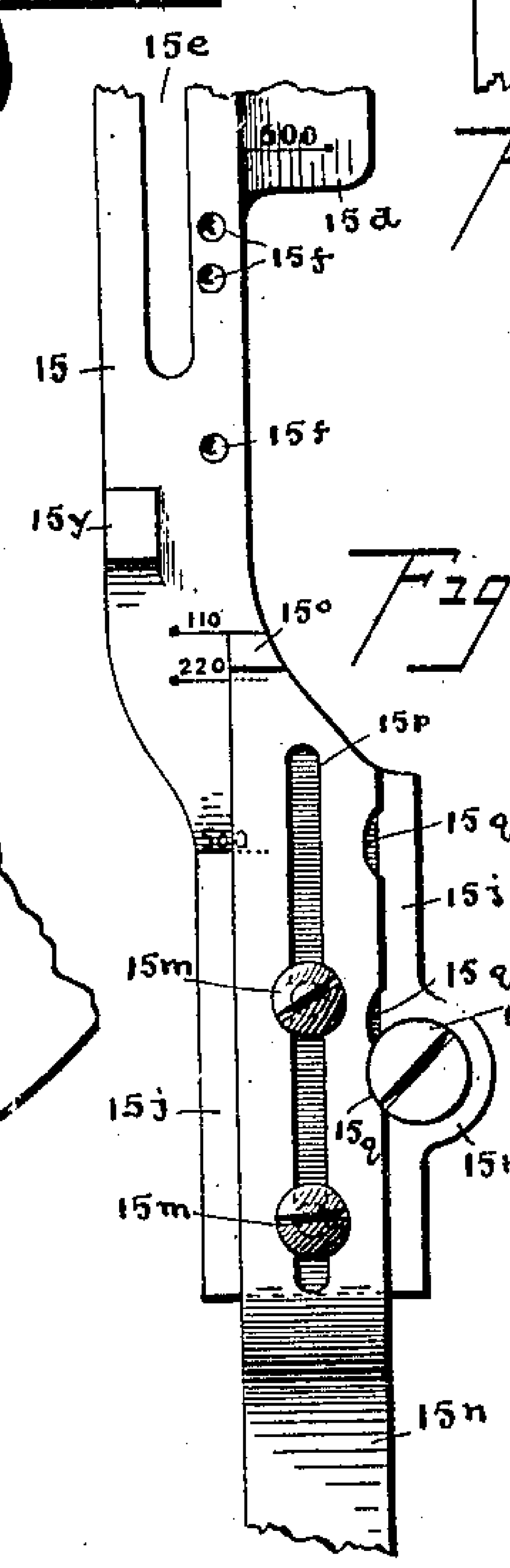

Fig. 18.

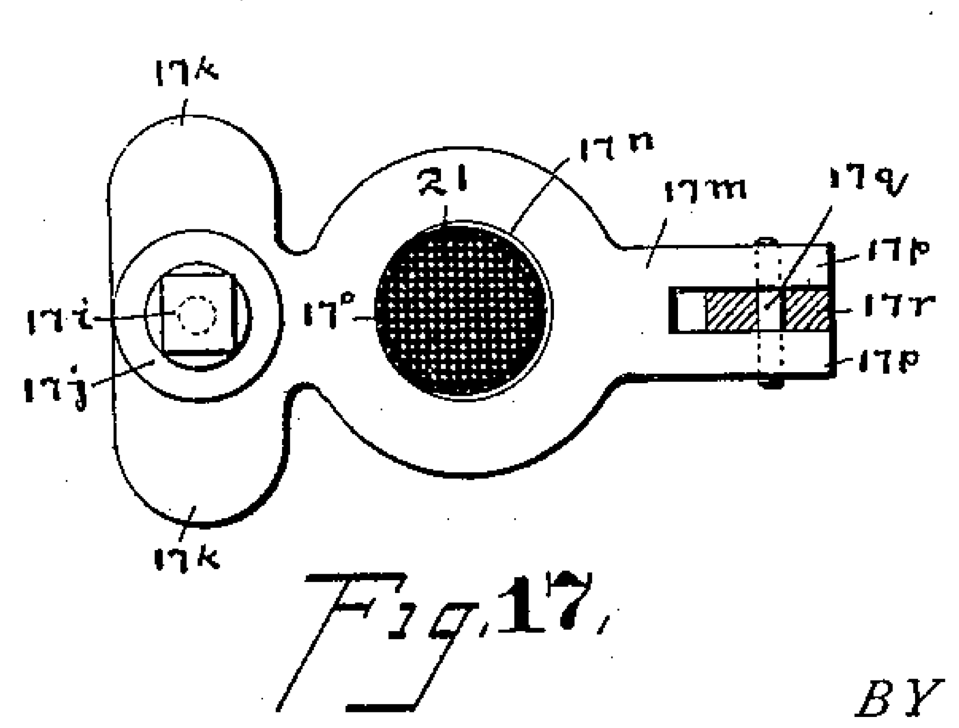

Fig. 17.

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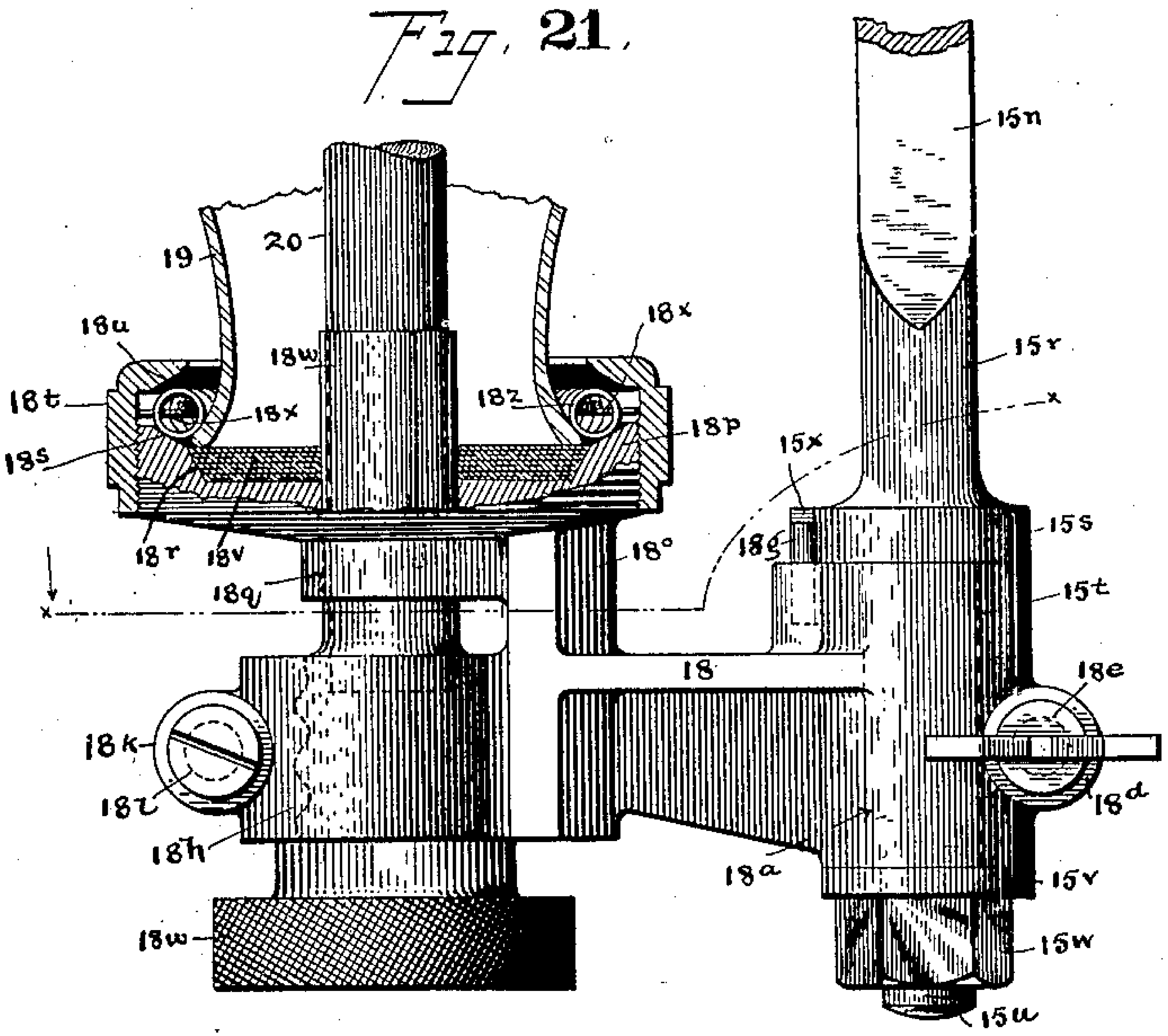
ELECTRIC ARC LAMP.

(Application filed Apr. 2, 1900.)

(No Model.) 5 Sheets—Sheet 5.

Fig. 21.



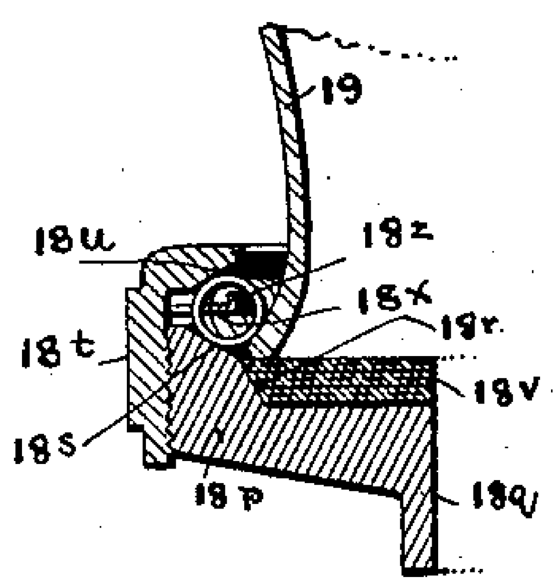


Fig. 23.

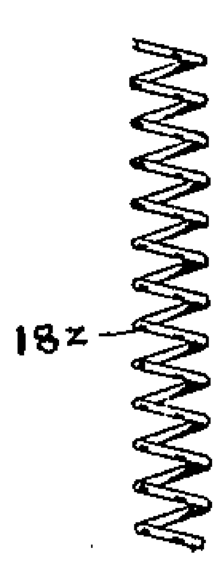


Fig. 25.

Fig. 22

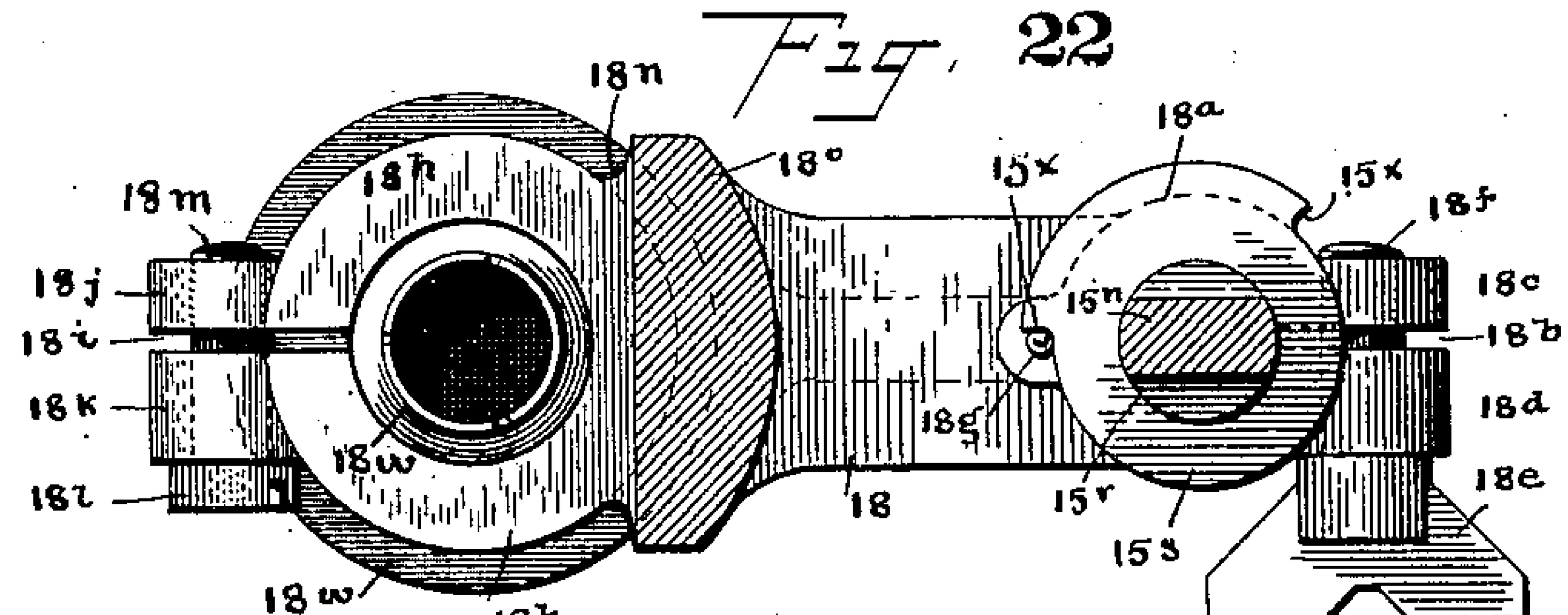
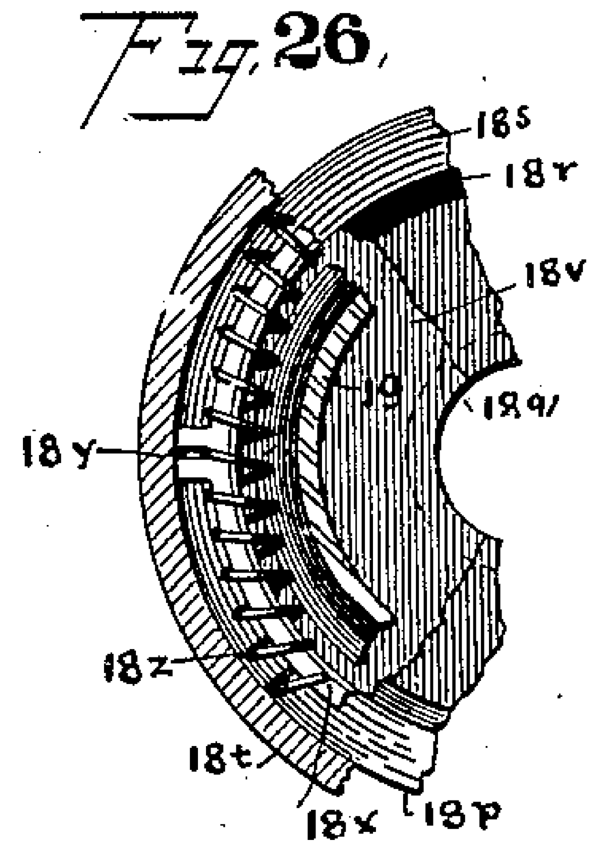


Fig. 26.



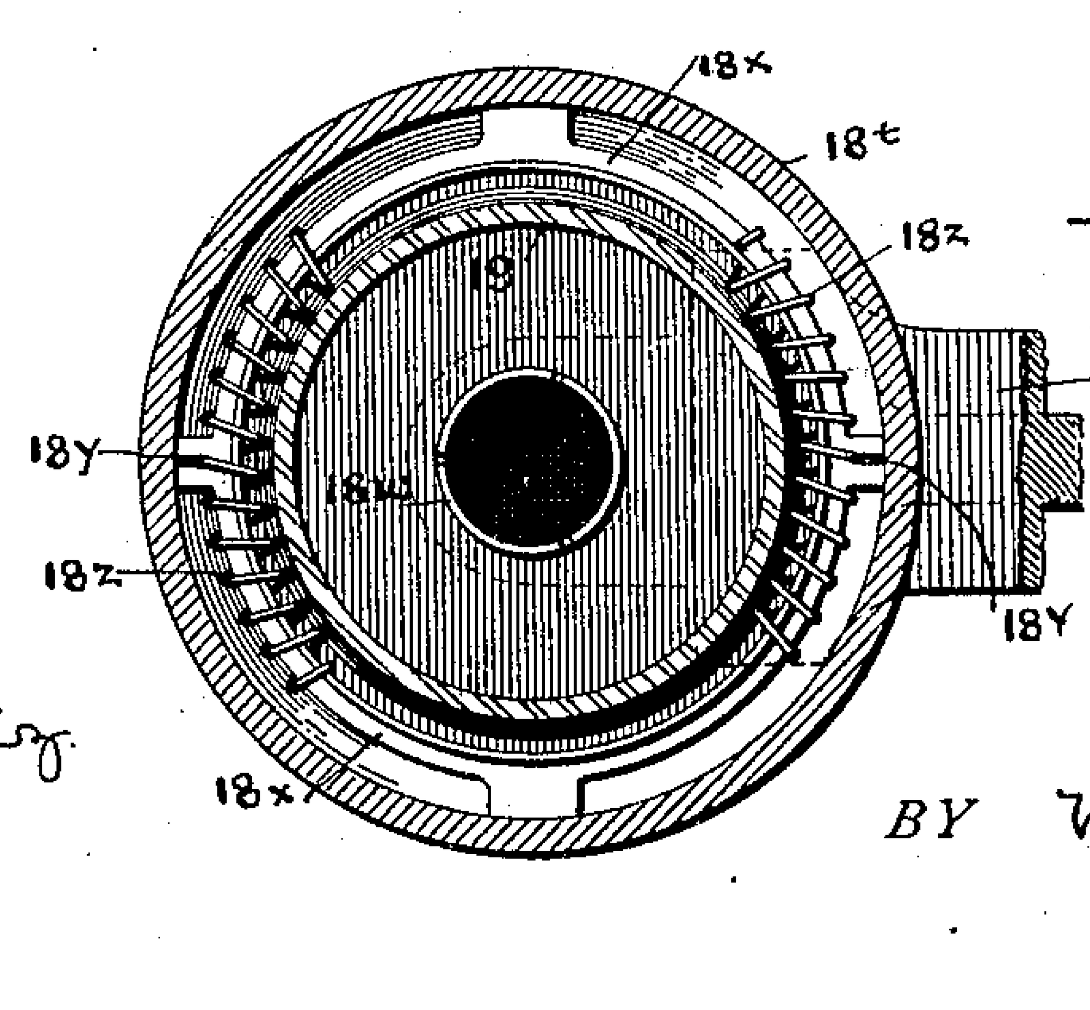


Fig. 24.

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UNITED STATES PATENT OFFICE.

JOSEPH MELZER, OF CLEVELAND, OHIO, ASSIGNOR TO THE INTERSTATE ELECTRIC COMPANY, OF SAME PLACE.

ELECTRIC-ARC LAMP.

SPECIFICATION forming part of Letters Patent No. 657,432, dated September 4, 1900.

Application filed April 2, 1900. Serial No. 11,153. (No model.)

To all whom it may concern:

Be it known that I, JOSEPH MELZER, a citizen of the United States, residing at Cleveland, in the county of Cuyahoga and State of Ohio, have invented new and useful Improvements in Electric-Arc Lamps, of which the following is a specification.

My invention relates to improvements in electric-arc lamps, and it appertains to the special features pointed out in the annexed claims.

The object of my present invention is to produce an electric lamp that shall be serviceable on circuits of widely-varying voltages. It is equally applicable for use on five-hundred-volt circuits as on one-hundred-and-ten-volt circuits. Hitherto it has been deemed impracticable to use a single arc-lamp in parallel connection on a five-hundred-volt circuit without using a very large energy-consuming rheostat in series with the lamp, thus making the most inefficient combination for arc-lamp-illumination purposes, but forming a most efficient electric heater on account of the large amount of energy that must be dissipated in the form of heat. This sort of a combination is manifestly impracticable where great efficiency of operation is desired. My improved lamp does not use a relatively-greater rheostat capacity for a five-hundred-volt lamp than I use on a one-hundred-and-ten-volt lamp. Thus I am enabled to provide a lamp that will operate at a high efficiency and one that gives great steadiness of regulation, whether burning on five hundred volts with an arc of about one and three-eighths inches in length or when burning on a one-hundred-and-ten-volt circuit with an arc of only about three-eighths of an inch in length. The reason I am able to produce a magnet that is adaptable to such wide variations of voltage is that I form the magnet-spool with a head of high magnetic permeability, from which there depends a hollow hub of large radial extension and great cross-sectional area. To the hub is secured a hollow tube of high magnetic reluctance, having a reduced radial extension and consequent reduction of cross-sectional area. To the tube is secured the other head of the magnet or spool. This is of high magnetic permeability. The depending hub extends into the wire-space to such an extent that more than fifty per cent. of its cross-sectional area around the tube is occupied with wire which is nearer the magnetic axis than that wound around the depending hub. Taking the cross-sectional area of the armature which is placed within the tube as 1, then the relative area of the tube will approximate .92 and the area of the depending hub will approximate relatively 2.25.

Heretofore it has been the practice to construct cores of magnets with equal radial extension as the armatures. Reference is had to solenoid-magnets; but I have found this form of construction impracticable for both one-hundred-and-ten and five-hundred volt work, as the arc when drawn is maintained inconstant, soon breaking because of the great magnetic density axially coincident with the armature. With my construction the path of magnetic lines between the permeable head and armature is a more or less diagonal one, thereby making the same magnet adaptable to high or low voltages. With conical cores and armatures the predominating lines are substantially parallel with the armature-axis, the only modification of magnetic density being produced by a lengthening of the air-gap between the core and armature. Consequently for long-arc work the armature is soon out of the field of necessary density to maintain the armature in working position, when the result will be only successions of "pumpings." If the relation of the parts were made such as to accommodate a long arc, then they would not be properly disposed for maintaining a short arc. My lamp operates practically on five-hundred-volt circuits, with an arc of about one and three-eighths inches in length, under imperceptible feeding periods at as high a relative efficiency as when on a low-voltage circuit. The magnetizing force is the same whether used at one hundred and ten, two hundred and twenty, or five hundred volts. The smaller current of only .55 to 1 ampere used at five hundred volts produces the same magnetizing force as at one hundred volts by using more ampere-turns on the magnet. This relation follows laws of electromagnetism well known and understood. Since the same magnetizing force is used in all cases, the magnet may be said to be the same for all conditions.

In the accompanying drawings, Figure 1 is a partial sectional view in elevation of an electric lamp embodying the features of my invention. Figs. 2, 3, 4, and 5 are diagrammatic views showing the relative positions of the different coöperating parts under one-hundred-and-ten, two-hundred-and-twenty, and five-hundred volt conditions. Fig. 6 is an enlarged cross-section in elevation of the magnet construction and clutch-operating mechanism. Fig. 7 is a cross-sectional elevation of the central portion of the magnet, showing the flexible cable connection to the upper carbon when the carbon is in its lowest position. Fig. 8 is a sectional view showing the relation between the arc-striking stop, the carbon-terminal cap, and the armature. Figs. 9, 10, 11, and 12 relate to the positive-carbon-terminal cap. Figs. 13 and 14 relate to the flexible cable connections and the arc-striking stop. Fig. 15 relates to the carbon-terminal cap when a new carbon is being placed therein. Figs. 16 and 17 relate to the means for adjusting the clutch-pan. Figs. 18, 19, and 20 relate to the adjustments for the lower-carbon bracket or supporting rod. Figs. 21, 22, 23, 24, 25, and 26 show the globe-holding mechanism with its interrelated parts.

In order that the different parts of the lamp may be easily followed, I have selected a series of index-figures, which always precede the reference-letters, so as to locate the different parts more readily. These index-figures and the parts to which they refer are as follows:

1 represents the lamp-base, which is placed between the magnet and the ring that supports the outside globe.

2 represents the lower-magnet head.

3 represents one-half of the magnet-spool, a brass tube which serves as a guide for the armature and in connection therewith forms a dash-pot. 4 is the upper-magnet head, which has a depending hollow hub that forms the other half of the magnet-spool.

5 is the limit-stop tube that determines the arc-striking distance.

6 is the suspension-tube that joins the arc feeding and regulating mechanism to the rheostat-frame.

7 is the rheostat-frame and the different connections.

8 and 9 are the suspension ends from which the lamp is suspended.

10 is the magnet winding and terminal connections.

11 is the armature that slides within the tube 3 and which controls the clutch mechanism.

12 is the positive or upper carbon terminal cap, which slides down through the tube 6, the stop-tube 5, and the armature 11.

13 is an exterior globe-ring detachable from the base 1.

14 is the outside globe, which is supported from 13.

15 is the bracket or rod that is insulated and depends from 1 to support the lower carbon and the arc-inclosing globe, as well as the clutch-pan mechanism. This rod is in two parts.

16 is the clutch-pan device, which releases the carbon from the clutch when it is necessary to feed the same.

17 is the tube connecting the armature to the clutch.

18 is the inner-globe holder, which is pivotally held by 15^n.

19 is the inner globe supported on 18. 20 is the lower carbon, also supported by 18.

21 is the upper carbon, regulated by the clutch-lever 17^m.

22, 23, 24, and 25 are the several sheet-metal ornamented inclosing casings.

Detailed description.

1 is the base. It comprises a flaring depending flange in which inwardly-projecting pins 1^g are fastened. These pins serve to hold the annular globe-supporting ring 13. A hollow hub 1^a is cast onto the base, and a tie-tube 1^b is also cast thereon. The tube 1^b is integral with the flange 1^c and the hub 1^a. Flange 1^c is separated and insulated from head 2 by bushings 1^d. The hub 1^a is also insulated from the tube 3^f by insulation 1^e. Screws 1^f serve to hold ring 13 in position against being raised, thereby holding it on the pins 1^g very securely. A boss 1^i depends from the lower side of 1. Within this boss is an insulated sleeve 1^h, which surrounds the clutch guide-rod 17^c.

2 is the lower-magnet head, made of highly-permeable material. It screws on the threaded hub 3^b up to and against the flange 3^c. This head rests on bushings 1^d, that are clamped between 2 and flange 1^c by screws 2^c. These screws pass through bushings 2^b and 1^d and thread into flange 1^c. A hole 2^a affords passage for the insulated terminal tube 7^i, which incloses the connecting-wire from the rheostat to the lower carbon.

3 is a brass tube forming the lower half of the magnet-spool, Fig. 6, which is of less diameter than the upper half 4^a. This tube has formed an enlarged head or end 3^a, which is threaded and fastens in the screw-threads 4^g. About midway of its length screw-threads 3^b are formed, upon which the head 2 is secured. After the head is screwed into place the metal of tube 3 is spun over at 3^c to prevent the parts from having movement with respect to each other. The metal of 4^a may be similarly spun over the head 3^a for the same purpose. At 3^d the hole of tube 3 is enlarged. This forms a dash-pot having the usual functions. In order that the tube 3 may be long enough to accommodate the armature 11 in its extreme downward position, it is extended at 3^f through the insulation-bushing 1^e. This form of construction in-

sures the permanent alinement of the working parts of the lamp.

4 is the upper head of the magnet. It is made of highly-permeable material, and it has a depending hollow hub which forms the upper half of the magnet-spool. This hub 4^a supports the brass tube 3 by screw-threads 4^g, Fig. 6. At 4^h the hub is enlarged internally, so that the armature shall not touch the hub when the armature is at the highest position of its movement—when drawing a "five-hundred-volt" arc. The head 4 has formed on its upper face a short hub which projects to one side at 4^k, forming a boss upon which the terminal screws 4^e and 4^d are secured. The screw 4^d secures the magnet-terminal 10^b against plate 4^i, and the screw 4^c holds terminal end 4^f of flexible cable 12^a against the same plate. Screws 4^b are conical-ended. They pass into threaded holes in the short hub of the head 4, and their ends will engage any one of the **V**-grooves 5^d. By means of the **V**-grooves the arc-striking stop 5 is easily adjusted to its proper predetermined position, and when so adjusted the lock-screw 4^c assists screws 4^b to support the weight of the lower portion of the lamp. Screw 4^c enters groove 5^e, thereby preventing the tube 5 from turning in the head 4. At one side of the head a slot is formed at 4^j, so as to allow the insulating-tube 7^i to pass therethrough.

5 is an arc-striking limit-stop. It is tubular in form, having a flange at its upper end and a tubular extension 5^b of the same diameter as the armature 11. This tube enters the hole of head 4. Its bottom end forms a stop which limits the length of the arc the armature can draw. Below the head a series of **V**-grooves 5^d is formed. For ease of construction these grooves are extended around the entire circumference, Figs. 6, 8, and 14. On one side of the upper face of the head, at 5^f, a groove is formed to accommodate the flexible cable 12^a. A second groove 5^e is formed lengthwise of the whole inside of the tube. This groove registers with the first one 5^f. In order that the grooves 5^f and 5^e shall always face properly, a groove 5^e is formed on the opposite external surface, where it is engaged by the screw 4^c.

6 is a suspension-tube that threads into tube 5, where it is held from turning by screw 5^a, Figs. 13 and 15. This tube joins the rheostat-frame 7 with tube 5. It has a slot 6^a formed therein, and an inner tube 6^b is fastened in it. The tube 6^b forms a stop against which the carbon-cap 12 can abut while the lamp is being trimmed and a new carbon is being inserted.

7 is a rheostat-frame having a hub 7^a formed thereon. Tube 6 screws into this hub, and suspension-bolt 8 and nuts 8^a connect it with the suspending-head 9. Binding-posts 7^b and 7^c are secured to and insulated from the frame 7. The negative terminal connects with 7^b and the positive terminal with 7^c, Fig. 1. Binding-post 7^b also connects with the rheostat-coils 7^d, and 7^c connects by wire 10^a with magnet 10. The coils 7^d are threaded through the insulators 7^f, which are held by frame 7. Lugs 7^g depend from the frame 7. From screws 7^e, placed in these lugs, sheet-metal casings 22 and 23 are supported. The unnoted end of the rheostat-wire 7^d leads by 7^h through tube 7^i to the bracket 15, thus making connection with the lower carbon.

8 is a short threaded connecting-bolt between 9 and 7^a. It and the nuts 8^a serve to form a strong vertical extension to the hub 7^a for the easy attachment of the suspension-head.

9 is a suspension-head threaded upon 8. It supports an insulator, as shown in Fig. 1, around which the suspension-eye 9^a is formed.

10 is the magnet-winding, which comprises the wire on the magnet-spool 3 and 4^a and the leading-in wire 10^a and the leading-out wire 10^b. Thin asbestos or other insulating material 10^c is placed between the wire and the parts 2, 3, and 4, Fig. 6. There are a number of extra layers of wire nearer the magnetic axis around the highly-reluctant tube 3 than there are around the highly-permeable hub 4^a of head 4. This construction enables me to produce a magnet that will properly draw the arc, feed the carbon by lowering of the armature the distance the arc is long, and subsequently control the clutch-feeding of the carbon to maintain an arc of constant length, whether subjected to one hundred and ten or five hundred volts, with a steadiness of action as pronounced in the one case as the other. The lamp, on account of this facility of adaptation, is easy to construct for these widely-varying conditions with a certainty of practical result hitherto only approximated, as only a change in size of wire on the magnet and rheostat is needed to adapt the lamp to the varying conditions stated. All other parts of the lamp are adapted by the various adjustments described.

11 is the armature that strikes the arc, feeds the carbon the length of the arc, and then controls the clutch-feed so as to hold the length of the arc constant. It has a hole 11^b, in which carbon-cap 12 slides. A groove is formed lengthwise of the armature at 11^a, Fig. 12, to accommodate a corresponding projection of the cap 12. The lower end of 11 is formed of a reduced diameter 11^d, which forms an alining-guide for the dash-pot plunger 17^a as it is screwed on the portion 11^c. The various positions of the armature are approximately shown in Figs. 2, 3, 4, and 5 that obtain when the lamp is operated under the different conditions, with the relative positions of the interrelated adjustments also shown.

12 is the upper-carbon-terminal cap, which has a hole 12^d formed therein. This hole is bounded with spring side walls that hold the carbon 21. A small hole 12^b admits the end of a flexible cable 12^a, Fig. 6. This cable passes through slot 12^c before entering hole

12^b, where it is held by set-screw 12^c, whose head passes into a counter-bored hole formed in the radial projection 12^f, Figs. 9, 10, and 11. The cap is held against turning by the projection 12^f, which slides in the slot 6^a, and grooves 5^e and 11^a, thereby drawing the cable 12^a through the slots 6^a and 5^f centrally.

13 is the outer-globe supporting ring, which comprises a central portion cast integral with an upwardly-flaring flange 13^d, that passes within the depending portion of the base 1. A downwardly-projecting flange 13^e is also formed thereon and globe-holding screws 13^f are threaded therein. The upper flange 13^d is cut away at 13^a to admit pins 1^g, and the cutting in depth proceeds to 13^b. From this point a lateral slot leads into an enlarged opening which is partially separated from 13^a by a hook end 13^c, that prevents the accidental displacement of ring 13 from off pins 1^g before the set-screws 1^f are screwed up.

14 is the outer globe, that has a curving flange 14^a, that rests upon the supporting-screws 13^f of the ring 13.

15 is the bracket, extending from the base 1 to the inner-globe holder 18. It is insulated from 1 at 15^a between the fastening-flanges 15^b. The holding-screw 15^c is also insulated therefrom. Wire 15^i, which is a continuation of 7^h, terminates in 15, thus forming electrical connection from the lower carbon to the rheostat. The bracket 15 extends about the half of the distance to 18, and it has its continuation in rod 15^n, which is adjustably secured thereon. Clutch-pan support 16 is secured on 15 about midway of its length. It has a grooved head with sides 16^k, that slide on the bracket or rod 15, Figs. 6 and 16. A thumb-screw 15^h holds the clutch-pan support against 15. This screw has movement in slot 15^e as the support 16 is raised or lowered. A projection 15^d is graduated "110," 220," "500," so that by means of the index-face 16^a the position of the adjustment may be seen at any moment. In order that the adjustment of 16 may be more positively maintained at predetermined points, depressions 15^f are formed in 15. Screw 16^b has a conical end that seats in these depressions. A stop 15^y limits the downward movement of 16, thus preventing the accidental lengthening of the arc to such an extent that the armature will be abnormally lowered and carbon-cap 12 is no longer of sufficient length to bridge across from 5^b to 11, Fig. 8. Below this point bracket 15 swerves to one side and terminates in side walls 15^j. One of these side walls has formed thereon a boss 15^k, in which a screw 15^l is placed. The edge of the screw-head projects beyond the inner face of flange 15^j into round grooves 15^q, formed in 15^n. Screws 15^m are also secured in 15. These screws pass through slots 15^p, and they serve to keep the parts 15 and 15^n together. An index-face 15^o is formed at the upper extremity of 15^n, which in connection with marks "110," "220," "500" show at what position the bracket extension 15^n is placed. Screw 15^l limits the adjustment to predetermined positions when it is screwed home. A shoulder 15^z, formed on 15^n, limits the upward movement of 15^n. The bracket extension 15^n is rounded at 15^r, and it has a flange 15^s formed thereon. This flange has stops 15^x, which coact with pin 18^g, limiting the distance 18 can be swung around laterally. Below the flange 15^s a round projection 15^t is formed, upon which 18 is adjustably secured. A washer 15^v and nut 15^w, screwed onto 15^n, hold 18 against the shoulder 15^s.

16 is the clutch-pan support, which has a side projection, with flanges 16^k formed thereon, between which the bracket 15 is held in place by the screw 15^h. An index-face 16^a shows the position of parts, and a screw 16^b holds 16 at predetermined positions. Concentric with the carbon 21 support 16 has formed thereon a ring 16^c, which has a hole 16^d, through which the carbon 21 passes without engagement therewith. Above this ring the clutch-pan 16^g is placed, insulated by 16^i from and secured to 16^c by screws 16^e. A hole 16^h is formed in 16^g, through which the carbon 21 passes. The under side of the clutch-pan is formed into a reflecting-surface 16^f. This surface at 16^f is discontinuous where a slot is formed to free 16^g from 16^k, Fig. 16.

17 is the clutch-mechanism tube, connected to the armature 11. This tube has a shoulder 17^b, that abuts against 11 as the plunger 17^a is screwed into 11^c. Hub 17^d is screwed onto the tube 17. A lateral extension 17^c, Fig. 6, supports the guide-rod 17^e, which slides into 1^h. This rod has a shouldered end 17^f and is held in place by a nut 17^g. A spring 17^h is clamped under nut 17^g. This spring gently presses against square-headed screw 17^i, so as to prevent jarring from feeding carbon 21. The spring 17^h has a downward projection which prevents the screw 17^i from changing the position into which it is adjusted. The screw 17^i is held by post 17^j, which in turn rests upon 17^k, Fig. 17. Under 17^k 17^l is formed, rounded so as to touch 16^g only at a point when clutch-lever 17^m needs to be released. 17^k are side projections cast onto 17^m and with 17^l add considerable weight to its outer end. The lever 17^m has a hole 17^n, one side of which, 17^o, engages carbon 21 in connection with carbon-encircling ring 17^s, and its flange 17^t holds the carbon from dropping until released, when 17^l engages 16^g. The other end of 17^m is slotted, forming side portions 17^p, through which the pivot-pin 17^q passes. This pin is supported by depending bracket 17^r from a side projection of 17^d.

18 is the inner-globe and lower-carbon support. It has a hub 18^a, that encircles 15^t. This hub is split at 18^b, forming threaded cheek 18^c and screw-abutting cheek 18^d, against which clamping-screw 18^e seats itself. The threaded portion of this screw 18^f is about coextensive with 18^c. A pin 18^g abuts stops

15^x, thus bringing 18 in position where its carbon-axis corresponds with the armature-axis in one position and in the other prevents 18 from turning around 15^t beyond the fixed point 15^x while removing the inner globe. The hub 18^h is concentric with carbon 20, and it is slotted at 18^i, forming threaded cheek 18^j for screw 18^m. The other cheek 18^k allows the screw-head 18^l to abut against it, thereby affording means for clamping the lower-carbon holder 18^w to any desired degree. The hub 18^h is threaded with a coarse-pitch rounded thread to conform to the thread of the carbon-holder 18^w, which terminates in a thumb-nut end below 18^h and in a tube with spring sides within globe 19. Grooves 18^n give elasticity to the sides of 18^h. An upper projection 18^o supports head 18^p. This head has a hole 18^q for the passage therethrough of the upper end of the carbon-holder. This head is threaded externally. It has a recess for cushion 18^v, with sloping boundary wall 18^r. It also has a beveled face 18^s, against which springs 18^z lie. A screw-cap 18^t, with beveled face 18^u, abuts the springs on their upper side. An inelastic ring 18^x is formed with a stiffening-rim and with several radial projections, which serve to hold the ring about central within cap 18^t. Two of these projections have slots 18^y, in which the springs 18^z are held. Springs 18^z, Fig. 25, are wound straight, and when threaded over ring 18^x they assume position shown in Fig. 26, whereby the bottom of the globe 19 is overlapped by the center portion of the springs sufficiently to give considerable stability to the globe before the cap 18^t is screwed down. When the cap is screwed down the springs are moved, as shown in Fig. 24. With a continuous spring-ring all in one piece this is not possible, and there is nothing to hold the globe until the cap is screwed down, while with my device the globe is held as soon as it is pressed against 18^v, thus preventing accidental breakages of globes. The carbon-holder 18^w can be removed entirely and the clamp-screw 18^e loosened and 18 swung around, so that globe 19 can easily be removed.

19 is the arc-inclosing globe, which has a cover-plate 19^a through which the upper carbon has free passage.

20 and 21 are the lower carbon and the upper carbon, respectively.

22, 23, 24, and 25 are the several portions of an ornamental casing. Casing 22 has ventilating-holes 22^a formed therein.

The grooves of the armature and arc-striking stop-tube could equally well be formed on the carbon-terminal cap and a corresponding registering projection formed on the armature and tube without departing from the spirit of the invention as related thereto. The adjustment of the arc-striking stop and the clutch-trip into predetermined interrelated positions is made independent of the magnet, so that the working position of the armature is not modified except by the adjustments referred to.

The term "solenoid-magnet" as used in this specification is intended to mean an electromagnet of the solenoid variety in which the core is made of magnetic material, such as iron, and the armature adapted to move within the coil and be within the influence of the magnetic core.

What I claim as my invention, and desire to secure by Letters Patent, is—

1. In an arc-lamp, the combination with permeable magnet-heads, of a two-part spool therefor, one part of said spool being of permeable material having a large external diameter, and the other part of non-permeable material having a relatively-smaller diameter, substantially as set forth.

2. In an arc-lamp, the combination with permeable magnet-heads, of a two-part spool-tube having about the same internal diameter throughout its length, one part of permeable material and of large cross-section, and the other part of non-permeable material and small cross-section, substantially as set forth.

3. In an arc-lamp, the combination with an armature-tube of small external diameter, of an annular disk secured thereon some distance from the end, and a continuation of the tube of dissimilar material comprising a hub of large external diameter secured to the end of the armature-tube, said hub terminating in a second disk or head, substantially as set forth.

4. In an arc-lamp, the combination with an upper magnet-head having a depending hollow hub of large radial dimensions outside of the hole therein, of a tube of dissimilar material having a small external diameter and an internal diameter about the same as that of the hub, fastened to the said hub, of a lower magnet-head secured to said tube about the same distance from the hub as the hub projects out from its head, substantially as set forth.

5. A solenoid-magnet comprising a discontinuous spool, one end of said spool being of high magnetic permeability and of large external diameter outside of the hole formed therein, and the other end of low magnetic permeability and relatively-reduced external diameter, substantially as set forth.

6. In an arc-lamp, a solenoid-magnet, a discontinuous core comprising one head and about one-half of said core of highly-permeable material the core being of large external diameter, in combination with a second head of similar permeability, and a non-permeable joining-tube of small external diameter, substantially as set forth.

7. In an arc-lamp, a solenoid-magnet having a hollow core therein, a hollow limit-stop within such magnet, a hollow armature operating in opposition to said stop, in combination with means for adjusting the stop into different positions, thereby adapting said

lamp to operate under widely-different voltages, substantially as set forth.

8. In an electric-arc lamp adapted for use with widely-different voltages, an arc forming and regulating armature, a limit-stop determining the length of arc drawn by the armature, a clutch controlled by the armature, and an external stop or clutch release, in combination with means independent of the magnet for adjusting the limit-stop and clutch-release to different interrelated positions, substantially as set forth.

9. In an electric-arc lamp, a movable armature, an arc-striking limit-stop therefor, a clutch mechanism carried by said armature to control an upper carbon, a clutch-release, and a lower-carbon support, in combination with means independent of the magnet for adjusting the limit-stop, clutch-release and lower-carbon support to interrelated different positions, substantially as set forth.

10. In an electric-arc lamp, a solenoid-magnet and a hollow core therein, a limit-tube within the core, a hollow armature movable in opposition to said tube, registering grooves formed in the tube and in the armature, in combination with a sliding carbon-terminal cap having a projection adapted to engage the grooves, substantially as set forth.

11. In an arc-lamp, a solenoid-magnet with a hollow core and a limit-tube therein, a hollow armature movable in the core opposite the limit-tube, in combination with a carbon-terminal cap adapted to move in the armature and stop-tube and means for maintaining non-revoluble relation between said cap and the parts through which the same passes, substantially as set forth.

12. A globe-holder comprising a base, an adjustable cap thereon and a series of disconnected springs within the cap and a common supporting-ring passing through all the springs and constructed to hold them against longitudinal displacement, substantially as set forth.

13. A globe-holder comprising a base, an adjustable cap thereon, a series of disconnected springs within said cap, a ring passing through the series of springs and notched lugs projecting from said ring and having convolutions of the springs passing through them.

14. In an arc-lamp, a regulating-magnet, a hollow core therein, a movable armature in said core, an axial opening in the armature and a guideway in said opening, in combination with a supporting-tube for said magnet having a similar guideway formed therein and means for keeping the two guideways in axial alinement, substantially as set forth.

15. In an arc-lamp, a solenoid-magnet, a supporting-tube and hollow core therefor, an armature movable in said core, a carbon contact-cap adapted to slide through the supporting-tube and the armature, in combination with stops placed at or beyond the ends of the armature-movement space, adapted to limit the movement of the carbon-terminal cap, substantially as set forth.

16. A solenoid-magnet, comprising permeable heads, and a permeably-discontinuous core, in combination with a minimum wire area around the permeable portion of said core and a maximum wire area around the non-permeable portion of said core, substantially as set forth.

17. A solenoid-magnet having a hollow core, one portion of said core having a greater external diameter than the remaining portion and a winding on said core having substantially-uniform external diameter from end to end.

18. A solenoid-magnet comprising a coil, a hollow core therein consisting of permeable and non-permeable sections disposed in axial alinement with each other, and an armature.

19. A solenoid-magnet, comprising a permeably-discontinuous core, in combination with dissimilar external diameters to said core, substantially as set forth.

20. A solenoid-magnet, a permeably-discontinuous core therein, in combination with maximum and minimum diameters to said core within the length thereof, substantially as set forth.

21. In arc-lamps, in combination, a solenoid-magnet, comprising suitable heads therefor and a permeably-discontinuous core formed therein, substantially as set forth.

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

JOSEPH MELZER.

Witnesses:
LEE J. ULLMAN,
A. J. NEWMAN.