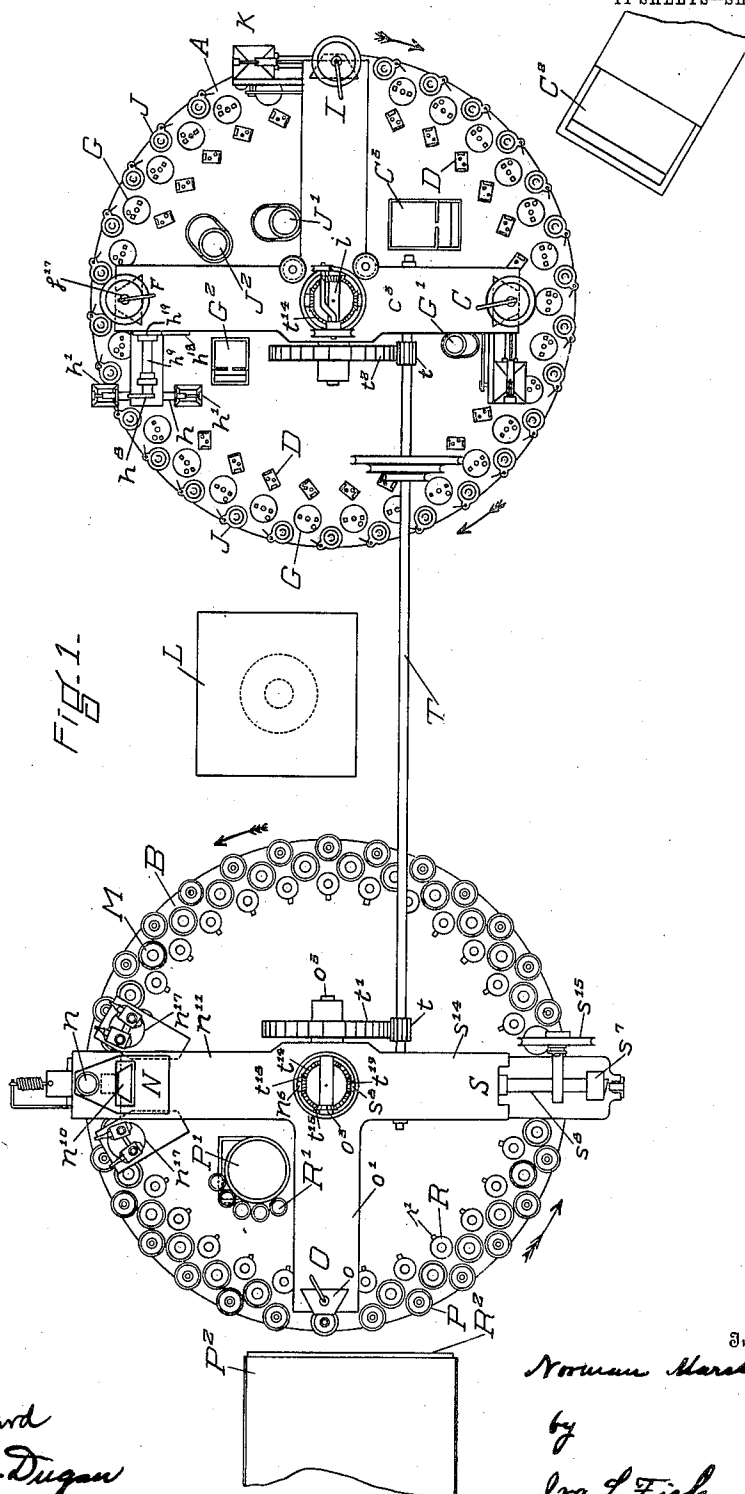


No. 821,946.

PATENTED MAY 29, 1906.

N. MARSHALL.
ASSEMBLING APPARATUS.
APPLICATION FILED JAN. 19, 1905.

11 SHEETS—SHEET 1.

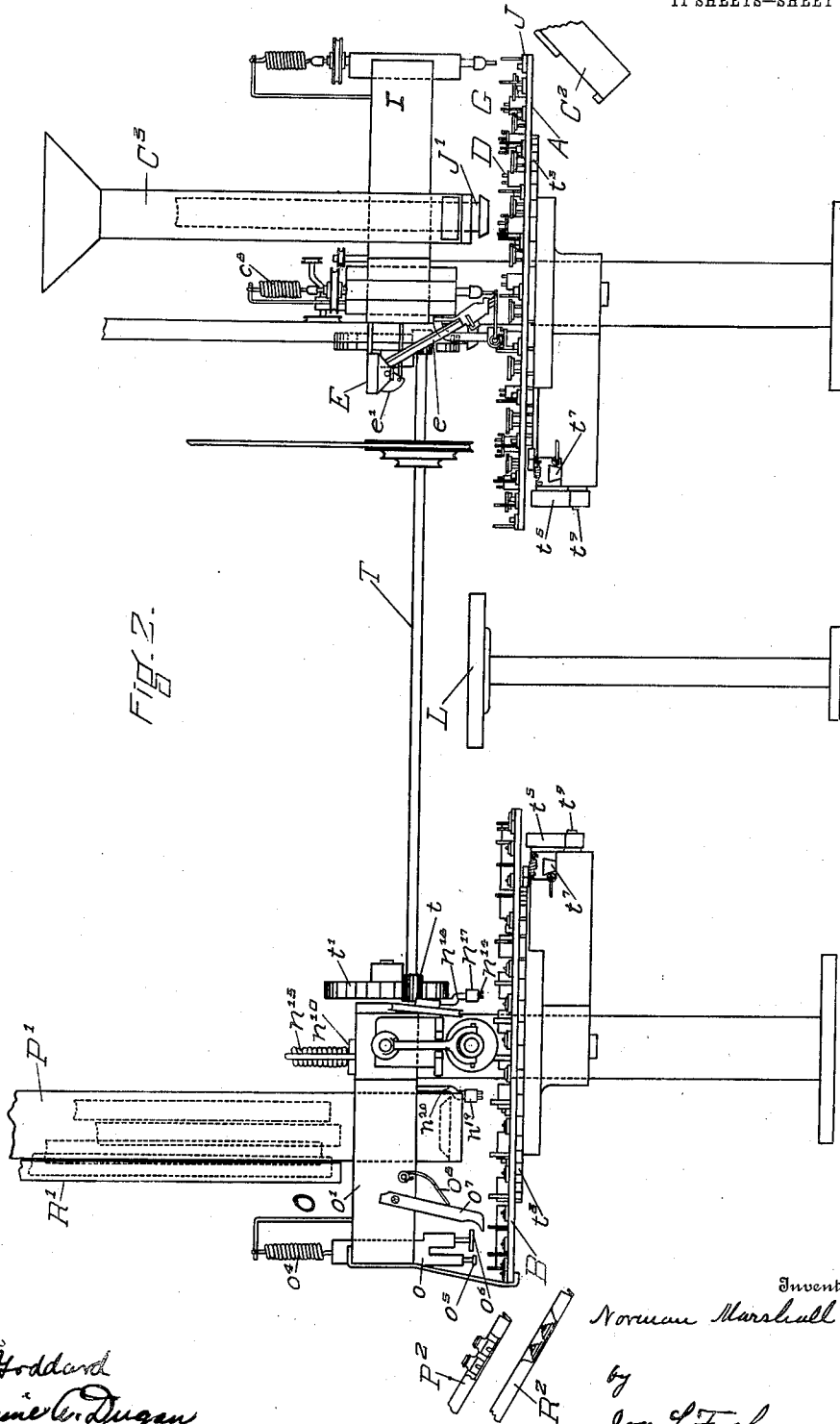


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11 SHEETS—SHEET 2.



Witnesses
Geo. N. Goddard
Katherine C. Dugan

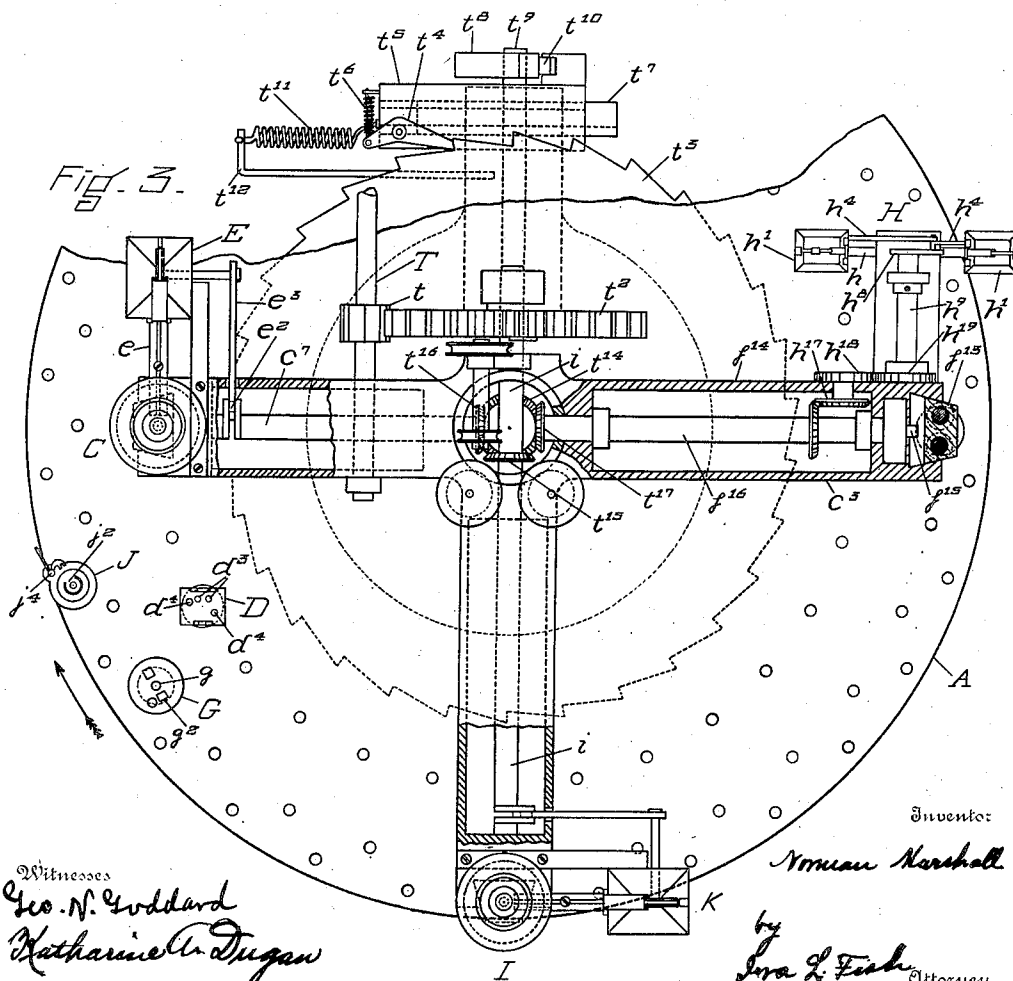
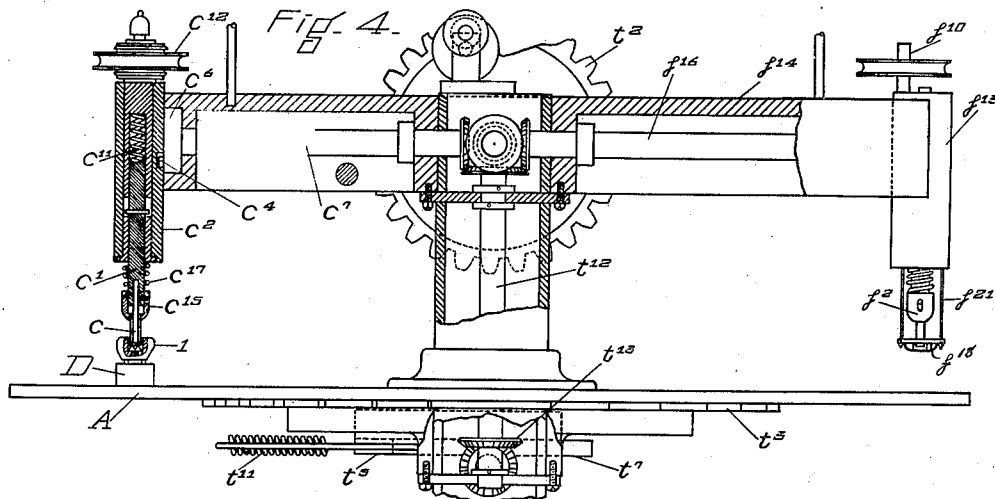
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11 SHEETS—SHEET 3.



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Witnesses

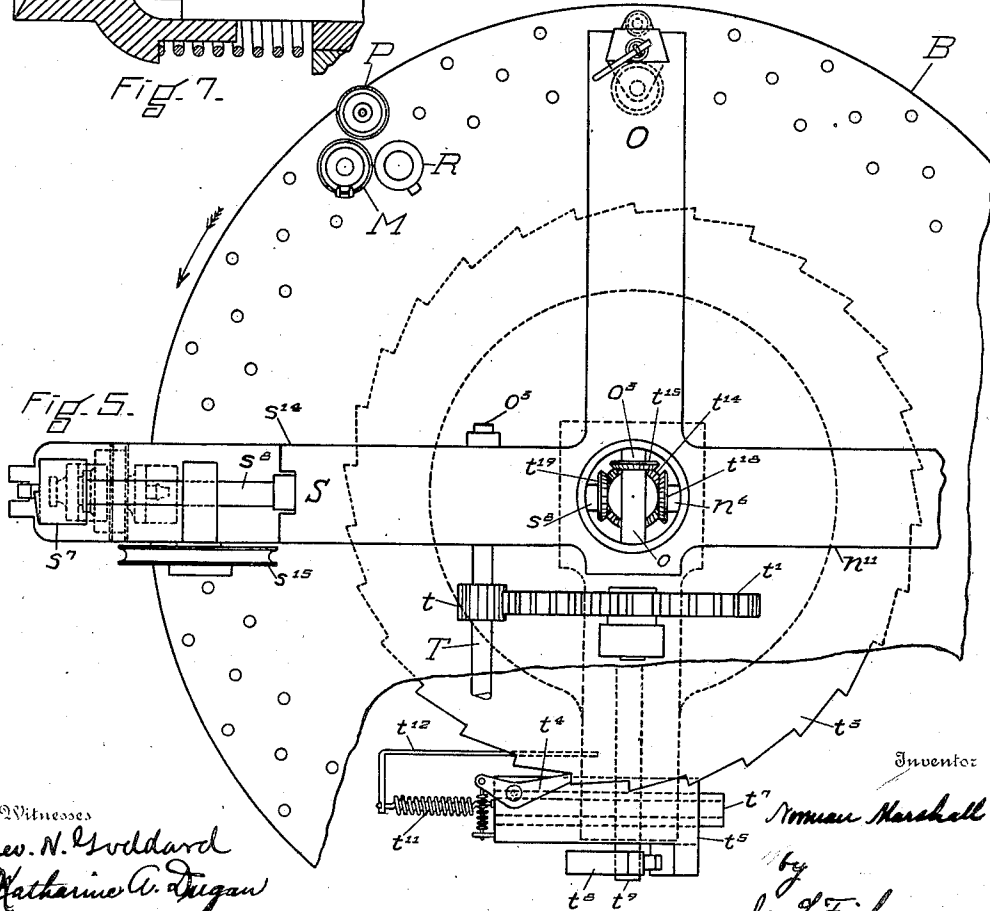
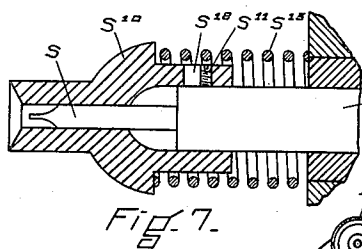
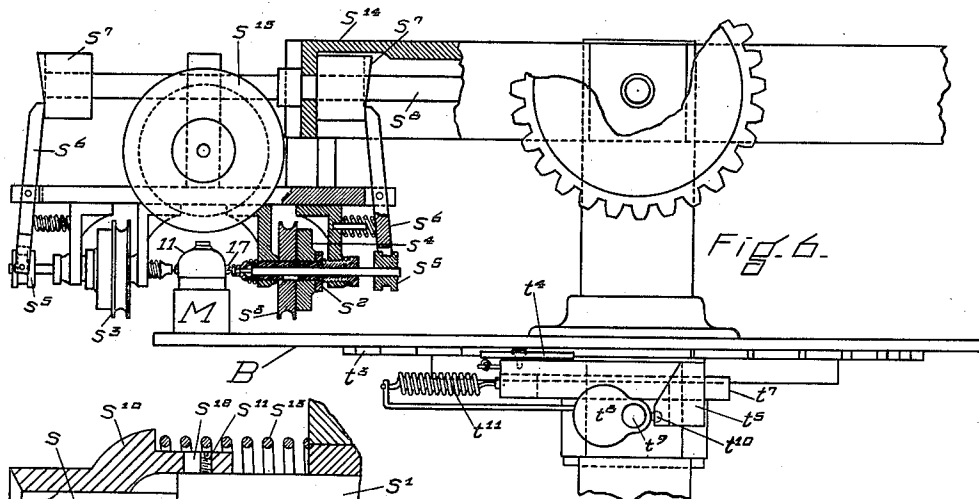
Geo. N. Goldard
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11 SHEETS—SHEET 4.



Witnesses
Geo. N. Goddard
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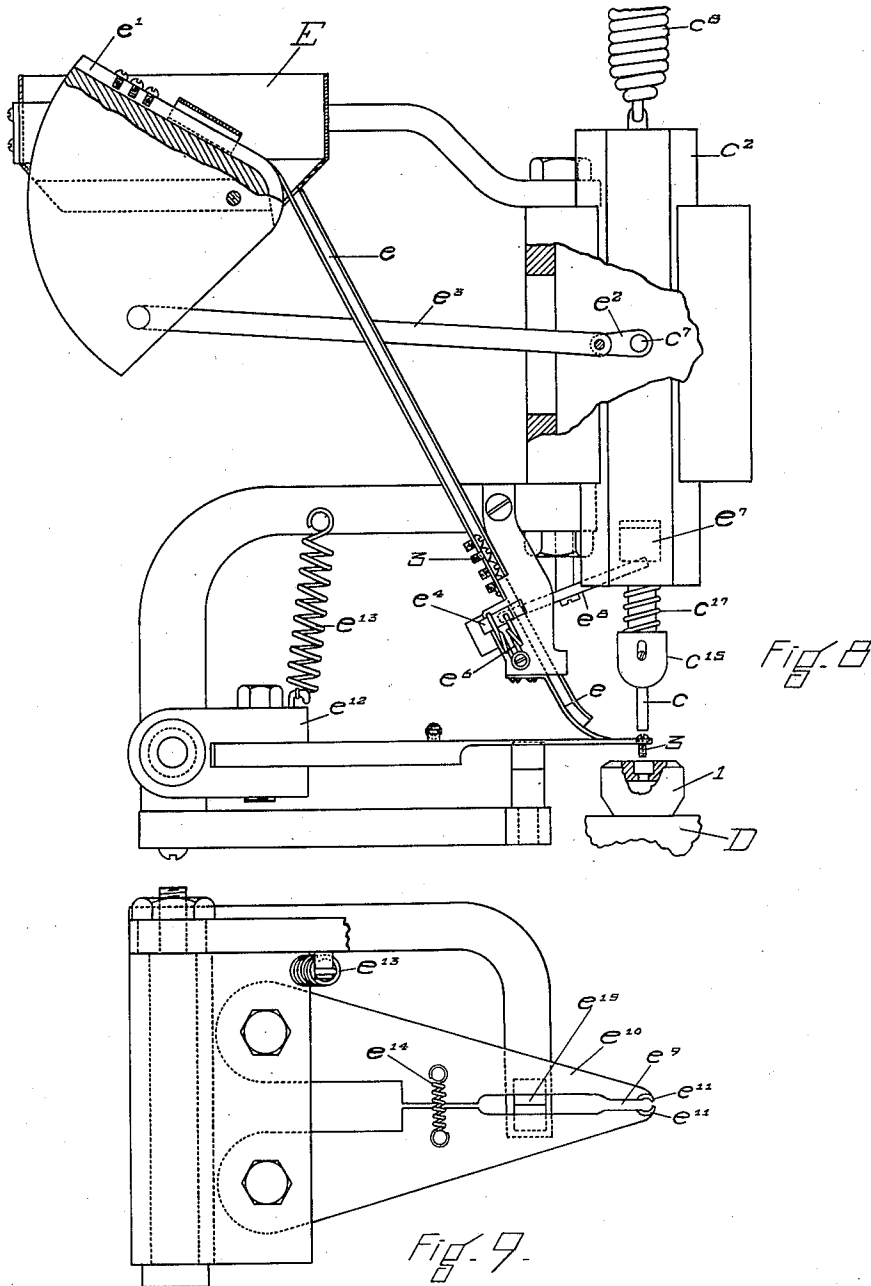
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11 SHEETS—SHEET 5.



Witnesses

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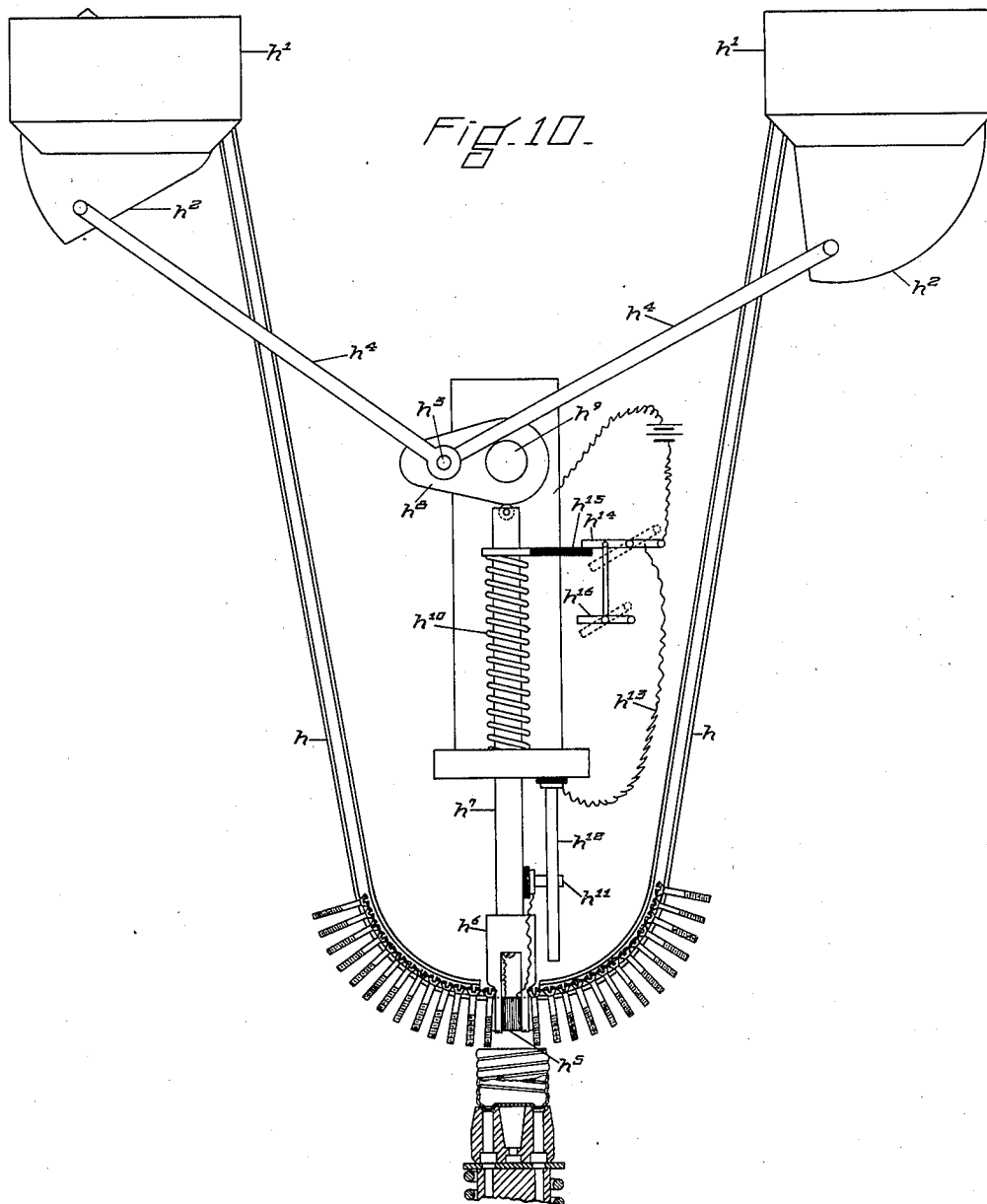
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11 SHEETS—SHEET 6.



Witnesses
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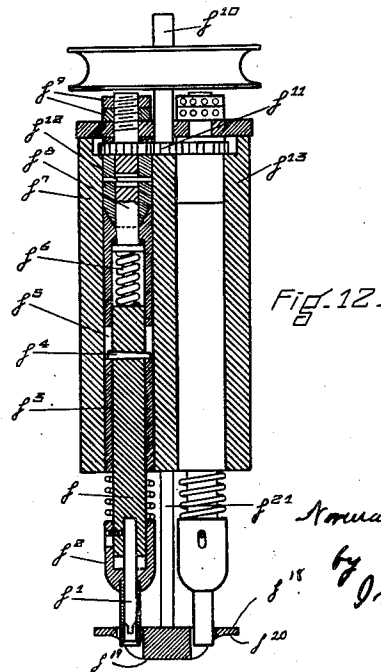
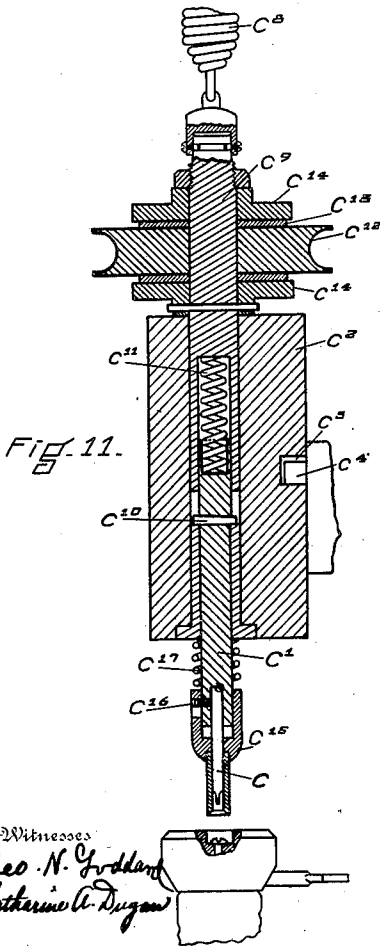
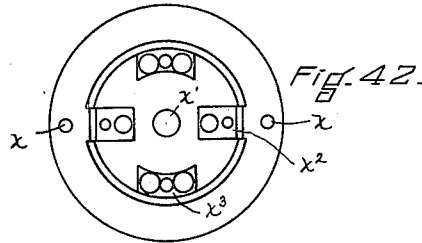
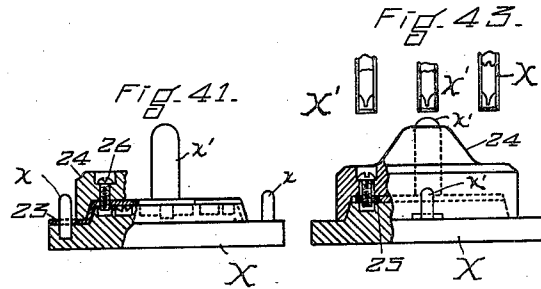
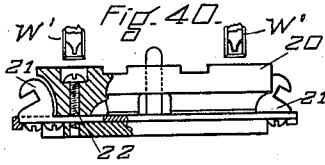
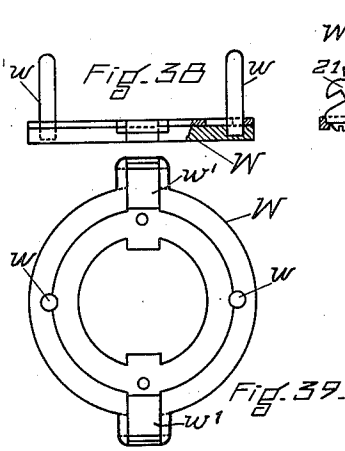
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11 SHEETS—SHEET 7.



Witnesses:
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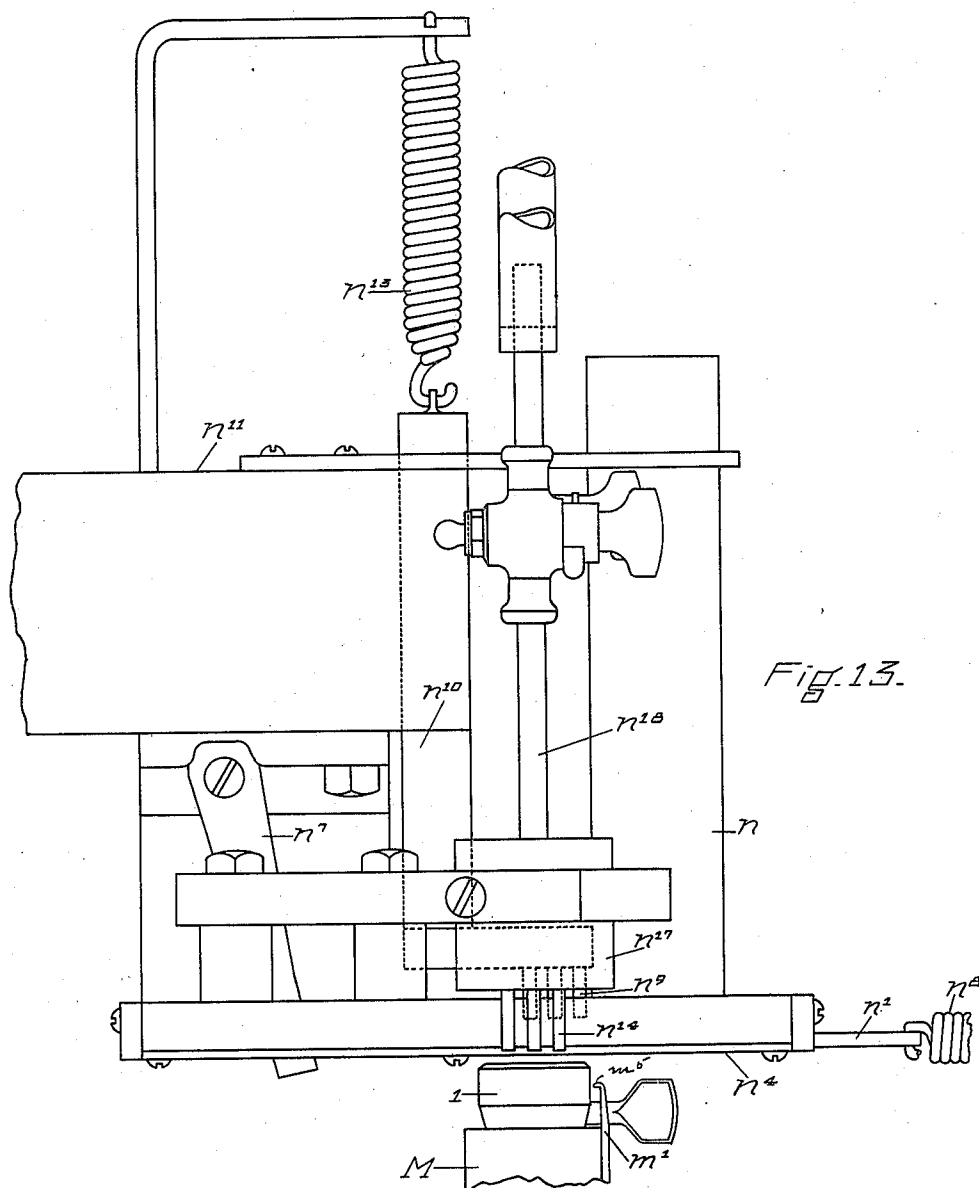
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11 SHEETS—SHEET 8.



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11 SHEETS—SHEET 9.

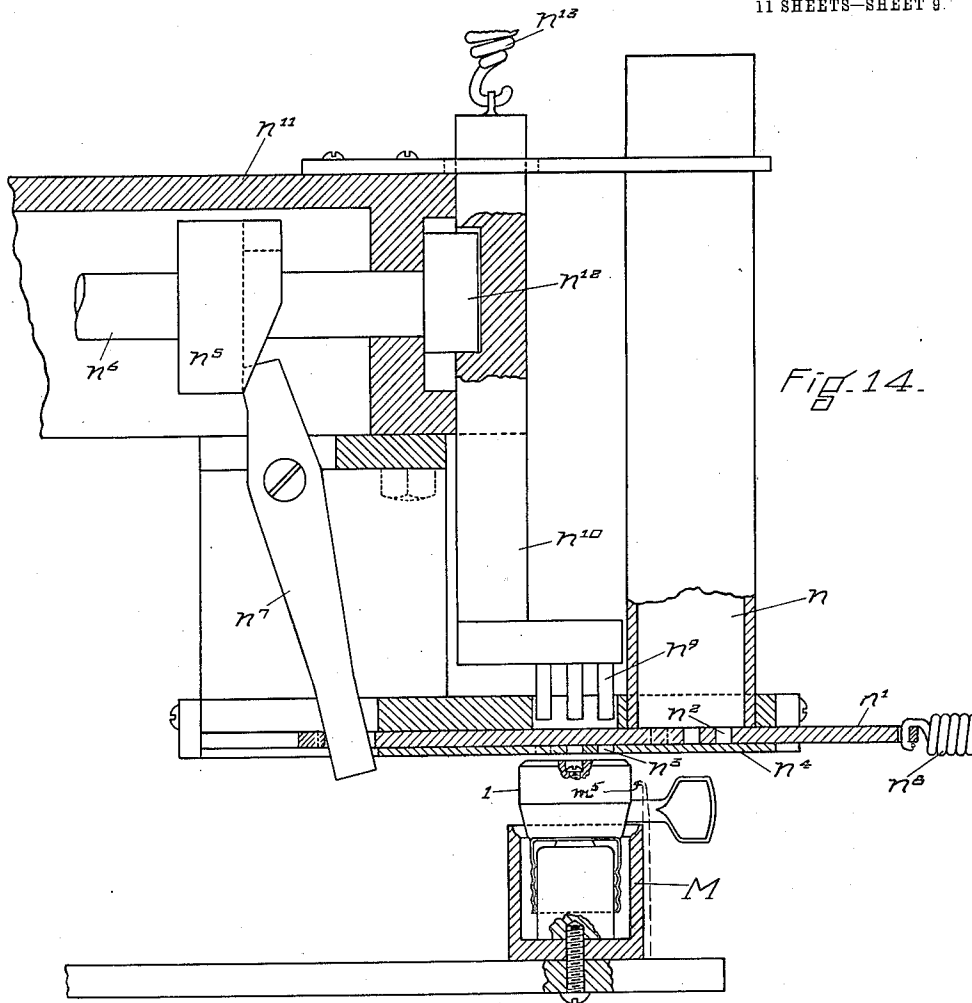


Fig. 14.

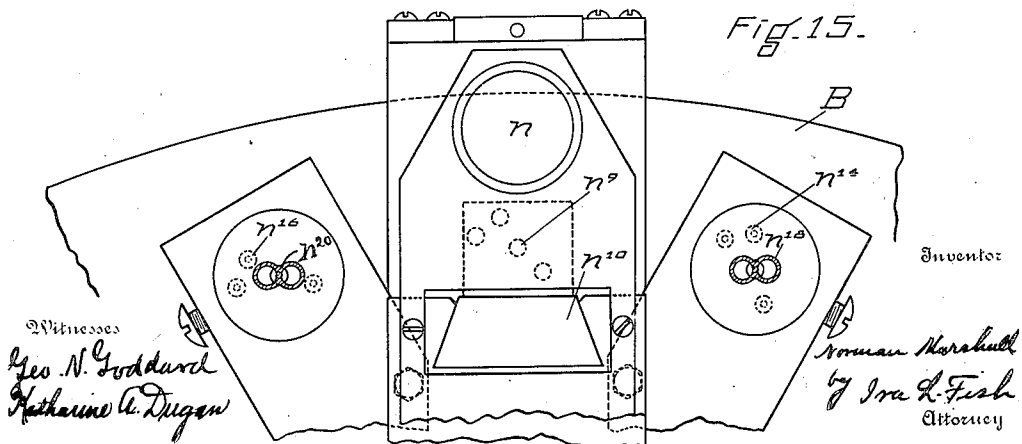


Fig. 15.

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11 SHEETS—SHEET 10.

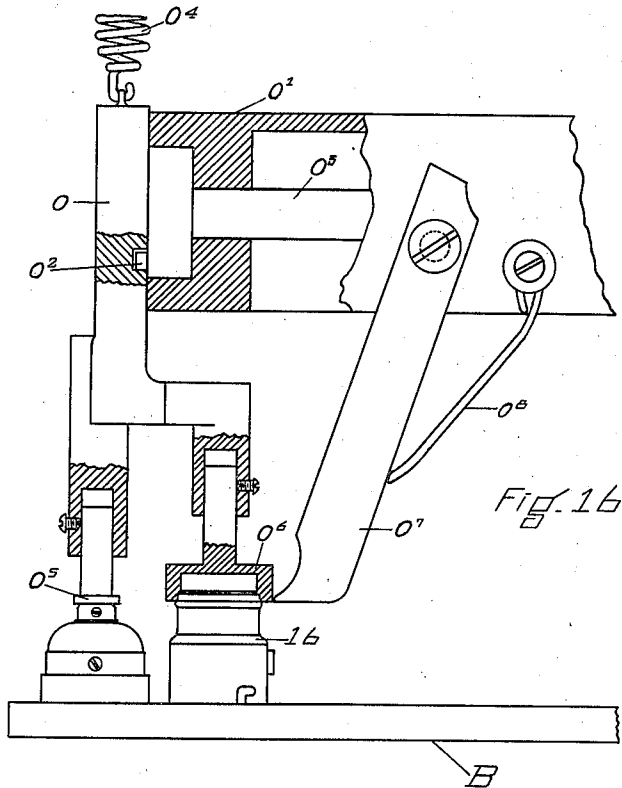


Fig. 16.

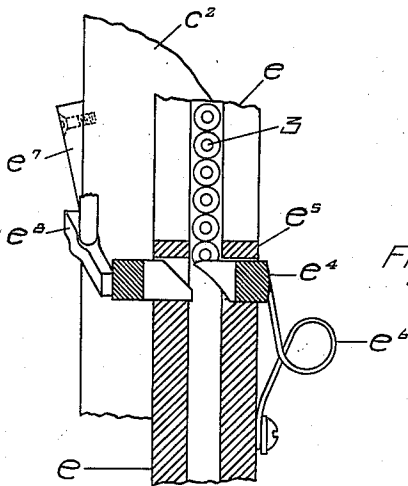


Fig. 17.

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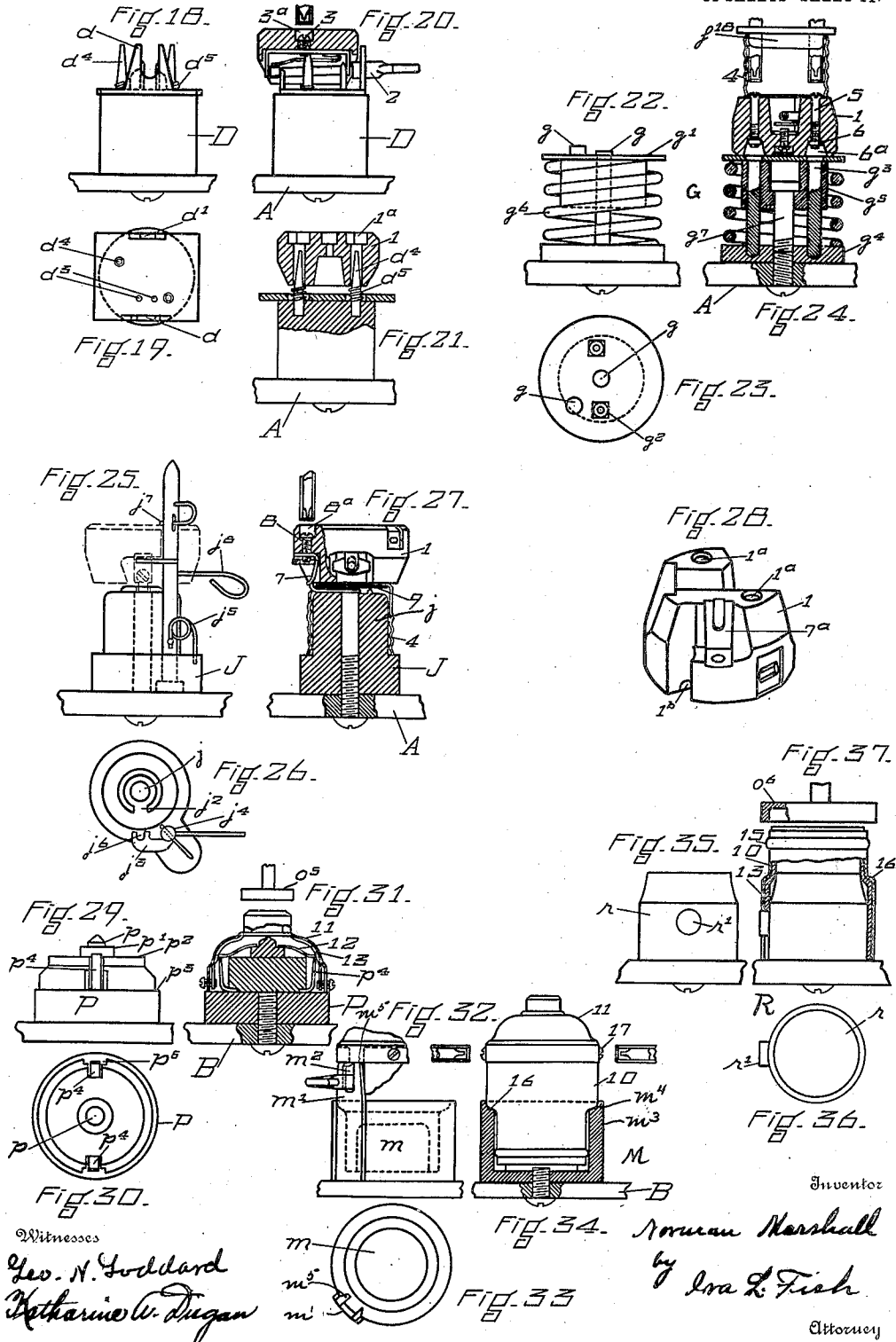
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APPLICATION FILED JAN. 19, 1906.

11 SHEETS—SHEET 11.



Witnesses

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UNITED STATES PATENT OFFICE.

NORMAN MARSHALL, OF NEWTON, MASSACHUSETTS.

ASSEMBLING APPARATUS.

No. 821,946.

Specification of Letters Patent.

Patented May 29, 1906.

Application filed January 19, 1905. Serial No. 241,884.

To all whom it may concern:

Be it known that I, NORMAN MARSHALL, of Newton, in the county of Middlesex and State of Massachusetts, have invented certain new and useful Improvements in Assembling Apparatus, of which the following is a specification.

The invention relates to a machine or apparatus for use in assembling the parts of articles used in electric lighting—such, for instance, as switches, lamp-sockets, cut-outs, plugs, and receptacles, &c.; and its object is to provide for the rapid and economical assembling and securing together of the various parts of the device being operated upon.

Heretofore in assembling the parts of such devices it has been customary to perform the various operations manually, the parts to be secured together at each operation being brought to the operator in trays and being placed in proper relation by the operator and secured together by screws driven manually. After each operation the partially-completed article has been placed in a tray and delivered to the next operator, who secures another part of the article in place, after which the article is passed on to the next operator for the next operation, and so on until all the parts have been assembled and secured in place.

At each operation the articles are counted, since all operations are not performed in exactly the same time and at any given rate, and the trays containing the partially-completed article have to be carried from one table or bench to another, and the screws used for securing the parts together are driven by hand. This manner of assembling the articles therefore requires a large number of operators for performing the various operations and transferring the partially-completed articles and parts from one bench or table to another, and also results in an unequal tightening of the screws, so that work frequently has to be sent back by the inspector.

In practicing my invention the principal operations, such as driving the screws or forcing the parts together in case they are held together by friction, are performed automatically, while the parts to be secured together or united are supported and carried by series of jigs. The jigs in each series travel successively into position to present the parts carried thereby to the screw-driving mechanism or other mechanism for operating upon the parts in performing a given

operation, and the jigs for supporting and carrying the parts during successive operations are arranged to travel adjacent to each other at the point where the transfer of the work from one series of jigs to another is performed, so that the transfer of the work from the series of jigs which carries it during the performance of a given operation to the series of jigs which carries the work during the succeeding operation may be quickly and conveniently effected. Each series of jigs may be mounted upon a separate carrier or the same carrier may support and carry several series of jigs. I prefer to employ the latter arrangement for the sake of simplicity in the operating mechanism. The various parts to be assembled are delivered by chutes or conveyers into convenient position to be applied to the jigs and may be placed upon the jigs either automatically or manually by operators. The transfer of the work from one jig to another may also be performed, either automatically or by operators, and the feeding of the screws may also be performed in either manner. I prefer, however, to feed the screws automatically and to provide for the manual placing of the parts in position upon the jigs and the manual transfer of the work from one jig to another.

For the purpose of illustrating the various features of the invention in the forms in which I prefer to use them I have shown in the accompanying drawings a machine or apparatus designed more especially for use in assembling the various parts of an incandescent-lamp socket such as is in common use and known as the "Edison" socket.

In the drawings, Figure 1 is a plan view of the machine. Fig. 2 is a front elevation; Fig. 3, a partial plan view of the right-hand table, which carries the first three series of jigs; Fig. 4, a partial sectional elevation of the same; Fig. 5, a partial plan of the left-hand table, carrying the last three series of jigs. Fig. 6 is a partial sectional elevation of the same. Fig. 7 is an enlarged detail of parts shown in Fig. 6. Fig. 8 is an enlarged detail of one of the screw feeding and driving mechanisms. Fig. 9 is a partial plan showing parts of the screw-feeding mechanism. Fig. 10 is a detail elevation showing one of the screw-feeding mechanisms. Fig. 11 is a sectional detail showing the devices for driving a single screw-driving spindle. Fig. 12 is a sectional view showing the devices for driving a two-spindle screw-driving mechanism.

ism. Fig. 13 is a side elevation showing the devices for supplying cement to the body of the socket. Fig. 14 is a partial sectional elevation showing the same device. Fig. 15 is a partial plan of the devices shown in Fig. 14. Fig. 16 is a detail elevation, partly in section, showing the devices for forcing the cap and shell onto the insulating-disk and insulating-lining, respectively. Fig. 17 is a detail of the screw-separating slide shown in Fig. 8. Figs. 18 to 21 are details showing the jig for supporting the parts during the operation of securing the key mechanism to the porcelain base. Figs. 22 to 24 are details showing the jig for supporting the work in securing the screw-shell to the porcelain base. Figs. 25 to 27 are details showing the jig for supporting the work in securing the central contact to the porcelain base. Fig. 28 is a perspective view of the porcelain base to which the current-carrying parts are secured. Figs. 29 to 31 are details showing the jig for supporting the work in assembling the metallic cap and insulating-disk. Figs. 32 to 34 are details showing the jig for supporting the work in applying the cement to the recesses in the porcelain base and for supporting the work in tightening the screws which secure the cap and outer shell together. Figs. 35 to 37 are details showing the jig for supporting the work in assembling the outer shell and the insulating-lining therefor. Figs. 38 to 40 are details showing a jig adapted to support the parts embodied in the base of a rosette, and Figs. 41 to 43 are detail views showing a jig adapted to support the parts embodied in the cap of a rosette.

The machine shown in the drawings is provided with six series of jigs for supporting and carrying the work and presenting it to the various mechanisms which take part in the successive operations necessarily performed in assembling the various parts of the incandescent-lamp socket. The carriers for these jigs are in the form of two horizontal tables A B, three series of jigs being mounted upon the table A and three series upon the table B and the jigs being so arranged with relation to each other that the work may be conveniently transferred from one series of jigs to another between successive operations. The tables are moved in unison and are given an intermittent or step-by-step movement to bring the jigs in each series successively into position to present the work carried thereby to the mechanisms for operating upon the work and corresponding to each series of jigs.

The first operation in assembling the parts of an incandescent-lamp socket is the securing of the key mechanism to the porcelain base by means of a screw passing through the porcelain base and threaded in the key-frame. This operation is performed by a screw-driving mechanism, (indicated at C,

Fig. 1,) to which the parts are presented by the series of jigs D, carried by the table A. The porcelain bases 1, Fig. 28, are conveyed to the operator by a chute C², the delivery end of which is adjacent to the table A, and the key mechanisms 2, Fig. 20, are conveyed to the operator by a chute C³, the delivery end of which is above the table A adjacent to the path of travel of the jigs D. By these chutes, therefore, the two parts—namely, the porcelain base and the key mechanism—are delivered so that they may be conveniently and quickly applied to the jigs D by an operator as the jigs pass successively during the operation of the machine.

The jigs D are provided with two upwardly-projecting plates *d d'*, provided with vertical slots in which the key-shaft of the key mechanism fits and are also provided with two upwardly-projecting pins *d³* for embracing the key-shaft and engaging one end of the key-frame, as indicated in Fig. 20. The key mechanism is thus held in place on the jig by means of the fingers formed by the sides of the slots in plates *d d'* and by the pins *d³*, the pins *d³* engaging one end of the key-frame and the fingers on the plate *d'* engaging the inner side of the contact-block carried by the key-shaft. The porcelain base 1 is held in position on the jig D and in proper relation to the key mechanism by means of two upwardly-projecting pins *d⁴*, arranged to engage the holes 1^a in the porcelain base. When in position on the jig, the porcelain base is supported upon springs *d⁵*, so that the base is held somewhat above the key-frame. This enables the screw to project through the hole in the base, so that it is accurately held by the hole in position to register with and enter the screw-hole in the frame as the screw-driving spindle forces the screw and base downward. The springs yield as the screw is forced down by the screw-driver and is driven home.

As the table A revolves an operator places a key mechanism in position on each of the jigs D and also places a porcelain base on each of the jigs, the parts being held by the jigs in the relation shown in Fig. 20. While the table is at rest between each advance movement, the screw-driving mechanism C acts to drive the screw 3, thus securing the base and key mechanism together. The screw 3 may be dropped into the recess in the porcelain base by the operator who places the base and key mechanism on the jig; but I prefer to provide mechanism for automatically feeding the screws.

The screw-driving mechanism C and the mechanism for feeding the screws 3 is shown in Figs. 4, 8, 9, and 11. As shown in these views, the screw-driver *c* is secured in a spindle *c'*, which is mounted to rotate in a vertically-reciprocating slide *c²*. The slide *c²* is mounted in suitable guides in an arm *c³*, projecting from the central standard of the ma-

chine and is operated by a crank-pin c^4 , working in a transverse slot c^5 , formed in the slide, Figs. 4 and 11. The crank-pin is carried by a disk c^6 , secured to the outer end of a constantly-rotating shaft c^7 , and the lower side of the slot c^5 is held in engagement with the crank-pin by means of a spring c^8 , connected with the slide c^2 and tending to hold said slide in its upper position. The spindle c' is yieldingly mounted in a shaft c^9 , to which it is connected by means of a pin c^{10} , passing through the spindle and into longitudinal slots formed in the shaft c^9 , the spindle being held in normal position with the pin against the lower end of the slots by means of a spring c^{11} . The shaft c^9 is continuously driven by means of a belt passing over a pulley c^{12} , which is frictionally connected with the shaft c^9 by friction-disks c^{13} , interposed between the pulley and collars c^{14} , secured to the shaft. When the crank-pin c^4 forces the slide c^2 downward, the screw-driver c engages the slot in the head of the screw 3 and drives said screw home.

When the screw has been driven, the pulley c^{12} will slip with relation to the shaft and the spring c^{11} will yield, if necessary, to accommodate any downward movement of the slide c^2 after the screw has been driven home. In order to insure the engagement of the screw-driver with the head of the screw, a guard c^{15} is mounted on the end of the spindle c' and is provided with a recess at its lower end adapted to fit over the head of the screw. This guard is connected with the spindle by means of a pin c^{16} , engaging a slot in the guard, and the guard is yieldingly held in its lower position by means of a spring c^{17} , which yields to allow the downward movement of the screw-driver with relation to the guard after the guard has engaged the head of the screw.

The screws 3 are fed into position to be inserted in the recess 3^a in the porcelain by means of the devices shown in Figs. 8, 9, and 17. The screws are supplied from a magazine or hopper E to a chute e by means of a vibrating separator-plate e' of common and well-known construction. The plate is continuously vibrated by means of a crank e^2 on the shaft c^7 , connected by means of a link e^3 with the plate. Individual screws are separated from the series of screws in the chute e by means of a reciprocating separator-slide e^4 , Fig. 17. This slide is provided with a diagonal slot e^5 for the passage of the screws and is normally held in the position shown in Fig. 17 by means of the spring e^6 . When in this position, the slide e^4 sustains the series of screws in the chute e . When the slide c^2 descends, the separator-slide e^4 is moved toward the right in Fig. 17 by means of a cam e^7 , secured to the slide c^2 and acting upon one end of a lever e^8 , the opposite end of which engages the slide e^4 . This movement of the slide e^4 brings the upper end of the inclined

slot e^5 into register with the guideway in the chute e , so that the lower screw 3 enters the slot. When the slide e^4 returns to normal position upon the upward movement of the slide c^2 , the lower end of the inclined slot e^5 is brought into register with the guideway in the chute e , so that this screw 3 passes down the guideway, the remaining screws being held back and supported by the slide e^4 .

The screw which passes down the guideway is directed by the lower end of the chute e into a slot e^9 , formed between two horizontal arms e^{10} , and passes to the outer end of these arms, where its movement is arrested by the inwardly-projecting ends e^{11} of the arms. When in this position, the screw 3 is directly above the recess 3^a in the porcelain base 1, which is under the screw-driving mechanism, and is in position to be engaged by the guard c^{15} as the screw-driving spindle descends. When the screw-driver spindle descends, therefore, the screw 3 is carried down into the recess 3^a and is screwed into the frame of the key mechanism by the screw-driver. In order to accommodate this downward movement of the screw, the arms e^{10} are carried by a pivoted frame e^{12} , which is yieldingly held in normal position with the arms e^{10} against the lower end of the chute e by a spring e^{13} . As the screw-driving mechanism carries the screw downward the frame e^{12} yields against the tension of the spring e^{13} , so that the arms move downward with the screw. During this downward movement the arms are separated so as to disengage them from the under side of the screw-head, and thus enable the screw to pass between the arms and into the recess 3^a . To enable the arms to be thus separated, they are pivoted to the frame e^{12} and are held yieldingly in normal position by means of a spring e^{14} , which connects said arms. The means for spreading the arms as they move downward consists of a wedge-shaped cam e^{15} , against which the inner sides of the arms ride as they move downward. By this mechanism a screw 3 is fed into position to enter the recess 3^a in the porcelain base at each upward movement of the spindle-carrying slide c^2 , and this screw is driven during the succeeding downward movement of the spindle-carrying slide. During the upward movement of the spindle-carrying slide c^2 the table a is moved a step forward to bring the succeeding porcelain base and key mechanism into position to receive the screw 3 and to be operated upon by the screw-driving mechanism.

The second operation in assembling the parts of the socket is the securing of the screw-shell 4, Fig. 24, to the porcelain base 1 by means of screws 5 and nuts 6. This operation is performed by a screw-driving mechanism (indicated at F, Fig. 1) to which the parts are presented by the series of jigs G, secured upon the table A and correspond-

ing in number to the series of jigs D. This series of jigs G is arranged adjacent to the series of jigs D, so that the parts assembled on the jigs D may be conveniently transferred from the jigs D to the jigs G during the travel of the jigs from the mechanism C to the mechanism F. During this travel an operator places the nuts 6 in position on the jigs G and transfers the porcelain base 1 from the jigs D to the jigs G. An operator also places the screw-shell 4 in position on the porcelain base, and the same operator may place the screws 5 in the holes 1^a in the base. I prefer, however, to provide mechanism for automatically supplying the screws 5.

The construction of the jigs G is shown in Figs. 22 to 24. As shown in these views, the base 1 is positioned upon the jig by means of two pins *g*, projecting upward from a plate *g'* and arranged to engage the recess 3^a in the base and the slot 1^b, provided in said base for the passage of one of the line-wires. The square nuts 6 are positioned so that they will register with the recesses 6^a in the base by means of recesses *g*², formed in the plate *g'*, the bottoms of the recesses being formed by rods *g*³, projecting upward from the base-plate *g*⁴ of the jig and extending through the block *g*⁵, on which the plate *g'* is secured. The carrying-plate *g'* of the jig is yieldingly supported upon a spring *g*⁶, so that the porcelain base may pass downward as the screws 5 are screwed into the nuts 6. During this downward movement of the porcelain base the rods *g*³ will pass up into the recesses 6^a, thus following the nuts *g* as the screws 5 are driven into the nuts. The block *g* and plate *g'* are held in normal position against the tension of the spring *g*⁶ by means of a bolt *g*⁷, screwed into the base-plate *g*⁴ and having its head playing in a recess in the block. The screw-shell 4 is maintained in proper position upon the porcelain base 1 by means of the projecting edges of the metal around the screw-holes, which enter the countersunk ends of the holes 1^a in the base, Figs. 24 and 28.

The square nuts 6 are conveyed to the operator by means of a chute *G*¹, the delivery end of which is adjacent to the path of travel of the jigs G and within convenient reach of the operator. The screw-shells are also delivered to the operator by means of a chute *G*², the delivery end of which is adjacent to the path of travel of the jigs and within convenient reach of the operator who applies the shells to the base.

After the parts have been placed upon the jigs G, as above indicated, they are successively brought by the travel of the table A into position to receive the screws 5. The devices for introducing the screws 5 are indicated in Figs. 1 and 3 at H and are shown in detail in Fig. 10. The screws 5 are supplied to two oppositely-arranged guide-chutes *h* from hoppers *h'* by means of the vibrating

separator-plates *h*², which are continuously vibrated by means of a crank-pin *h*³, connected with the plates by links *h*⁴.

The screws 5 at the ends of the guide-chute 6 are separated from the series of screws in the guideway and transferred to the holes 1^a in the porcelain base by means of an electromagnet *h*⁵, carried by a block *h*⁶, which reciprocates between the ends of the guide-chutes. The block *h*⁶ is secured to the lower end of a bar *h*⁷, mounted in suitable guideways and operated by a cam *h*⁸, secured to the end of a constantly-rotating shaft *h*⁹. The upper end of the bar *h*⁷ is held in engagement with the cam by means of a spring *h*¹⁰.

When the block *h*⁶ is in its upper position, as indicated in Fig. 10, the electromagnet *h*⁵ is energized and attracts the two screws 5 at the ends of the guideways *h*. When the block *h*⁶ descends, these screws are carried down by the magnet, while the sides of the block *h*⁶ above the magnet retain the succeeding screws in the guideways. The downward movement of the block *h*⁶ carries the screws 5 downward until their lower ends pass through the holes in the shell 4 and into the holes 1^a in the porcelain base. The magnet is then deenergized, so that the screws are released and drop freely into the holes 1^a. The block *h*⁶ then returns to its upper position, and as it reaches its upper position the magnet *h*⁵ is again energized to attract the screws 5 at the end of the guide-chutes.

Any suitable devices for causing the magnet to be energized and deenergized at the proper times may be employed, and in Fig. 10 I have illustrated diagrammatically one form of such devices. As shown in this view, one end of the magnet-wire is connected with the source of electrical supply through the metallic parts of the mechanism, while the other end of the magnet-wire is connected to an insulated contact-finger *h*¹, which rides against an insulated contact-bar *h*¹². The contact-bar *h*¹² is connected with the source of electrical supply through a connection *h*¹³, in which is introduced a switch *h*¹⁴. As the bar *h*⁷ reaches its upper position an arm *h*¹⁵, projecting from said bar, operates the switch *h*¹⁴ to close the electric circuit, thus energizing the magnet *h*⁵. When the bar *h*⁷ reaches its lower position, the arm *h*¹⁵ engages a lever *h*¹⁶, connected with the switch *h*¹⁴, and operates the switch to open the electric circuit and deenergize the magnet and the switch remains open until again closed by the arm *h*¹⁵ as the bar *h*⁷ and block *h*⁶ reach their upper position. By this mechanism the two screws 5 are accurately fed into proper position in the holes 1^a of the porcelain base as each jig G is brought into position under the block *h*⁶ and remains there during the interval between successive movements of the table A.

The screw-driving mechanism for driving the screws 5, and thus securing the shell 4 to

the porcelain base 1, is shown in Figs. 3 and 12. As shown in these figures, this screw-driving mechanism is provided with two spindles f , each carrying a screw-driver f' and each provided with a guard-sleeve f'' , similar to the sleeve c^{15} of the screw-driving mechanism C. The spindles f are secured to driving-shafts f^3 by means of pins f^4 passing through the spindle and engaging longitudinal slots f^5 in the shaft, and each spindle is held yieldingly in position with the pin f against the lower end of the slots by a spring f^6 . The shaft f^3 is made in two sections frictionally connected together by a friction-bearing f^7 . The lower section of the shaft is forced against the upper section by means of a bolt f^8 passing upward through the upper section of the shaft and provided with adjusting and lock nuts f^9 upon its upper end. The upper section of the shaft is continuously driven from a pulley-shaft f^{10} , with which it is connected by gearing f^{11} . The upper section of the shaft and the bolt f^8 are connected to rotate in unison by means of a pin f^{12} passing through the shaft and through a slot in the bolt. By this construction the spindles f are independently driven, and each spindle may continue to act upon the corresponding screw until that screw has been properly tightened, when that spindle may cease to rotate by reason of the frictional connection between the sections of its driving-shaft, while the other spindle may continue to rotate until the corresponding screw has been driven home.

The spindle-driving shafts and pulley-shaft f^{10} are mounted in a slide f^{13} , guided in ways formed in the overhanging arm f^{14} , which projects laterally from the central standard of the machine. This slide f^{13} is reciprocated by means of a crank-pin f^{15} , carried by the constantly-rotating shaft f^{16} and engaging a transverse slot in the back of the slide, the slide being forced yieldingly upward by a spring f^{17} , Fig. 1, similar to the spring c^8 , which acts upon the slide of the screw-driver mechanism C.

The screw-shell 4 is held firmly in position during the operation of the screw-driving mechanism F upon the screws 5 by means of a centering and positioning plate f^{18} , which is provided with a downwardly-extending projection f^{19} for fitting within the screw-shell and with an annular flange f^{20} for engaging the upper edge of the screw-shell. This plate f^{18} is carried by rods f^{21} , which extend up into the slide f^{13} , and the plate is held yieldingly in normal position by its weight. When the slide f^{13} descends, the plate f^{18} is brought against the end of the screw-shell 4, carried by the jigs G, then in position under the screw-driving mechanism, thereby accurately positioning the screw-shell with relation to the screw-driving spindles. During the continued downward move-

ment of the slide f^{13} the plate rides up the rods f^{21} to allow the slide and the screw-driving spindle carried thereby to move downward with relation to the plate f^{18} , so that the plate acts to hold the shell in position during the driving of the screws 5.

The third operation in assembling the parts of the socket is the securing of the central contacts 7, Fig. 27, to the porcelain base 1 by means of a screw 8. This operation is performed by a screw-driving mechanism I, similar to the screw-driving mechanism C, to which the parts are successively presented by a series of jigs J, carried by the table A. During the continued movement of the table A after the screw-shell 4 has been secured to the base of the socket the work is removed from the jigs G, and mica disk 9 is inserted in the screw-shell, the terminals 7 placed in the recess 7^a of the base 1, and the parts placed in position upon the jigs J. These operations are performed manually by an operator as the jigs pass successively before him. The terminals 7 are delivered to the operator through a chute J' , the delivery end of which is adjacent to the path of travel of the jigs and within convenient reach of the operator, and the disks 9 are similarly delivered through a chute J^2 , similarly arranged.

The construction of the jigs J is shown in detail in Figs. 25 to 27. As shown in these figures, the jig is provided with a central post j , adapted to fit within the screw-shell 4 and provided on its upper end with an annular rib j' , having a slot j^2 extending there-through, Fig. 26. The jig is also provided with a post j^4 for engaging the slot 1^b in the base. When the parts are in position on the jig, the post j^4 holds the base in position, while the central terminal is positioned by the slot j^2 , within which it fits. The terminal is held in position against the base by an arm j^3 , projecting from the post j^4 , which is pivoted in the base of the jig and is forced in a direction to press the end of the arm j^3 against the terminal 7 by means of a spring j^5 .

The end of the arm j^3 is provided with a slot j^6 , so that the end of the screw 8 may pass down below the upper surface of said arm as the screw is driven into the terminal 7. The post j^4 in addition to the arm j^3 also carries a spring-arm j^7 , arranged to engage the upper side of the porcelain base 1 and assist in holding the parts firmly on the jig. The post is also provided with a projecting finger-piece j^8 , by which it may be operated to swing the arms j^3 and j^7 back preparatory to applying the parts to the jig. By these jigs J the parts indicated in Fig. 27 are successively brought into position to be acted upon by the screw-driving mechanism I, the construction and operation of which is the same as the screw-driving mechanism C, already described. The screws 8 may be inserted in the recesses 8^a in the socket-base

by an operator; but I prefer to supply said screws by means of a screw-feeding mechanism, (indicated at K, Fig. 1, and corresponding in construction and operation to the screw-feeding mechanism shown in Figs. 8 and 9 and operating in the same manner.)

After the terminals 7 have been thus secured to the porcelain base 1 by the operation of the screw-driving mechanism I the succeeding movements of the table A bring the jigs J and the parts carried thereby within convenient reach of an operator, who sits at a stand L, arranged between the tables A and B and so located that the operator can readily transfer the work from the jigs J on the table A to a series of jigs on the table B. This operator removes the work from the jigs J, inspects it, and applies it to a series of jigs M, secured to the table B. By these jigs M the porcelain bases and detached parts are presented successively to a mechanism N, which fills the recesses 3^a, 6^a, and 8^a with cement, so as to cover up and insulate the metallic parts within these recesses.

The construction of the jigs M is shown in Figs. 32 to 34. As shown in these views, the jig is provided with a central post *m* for fitting with the screw-shell 4 and is also provided with an upwardly-projecting arm *m'*, provided with a slot *m''* for receiving the key-shaft, and thus positioning the parts upon the jig. This jig M is also used for supporting the parts at a later stage in the process of assembling the parts of a socket, and in Figs. 32 to 34 the parts supported by the jig are shown as they appear at this later stage.

The mechanism for filling the recesses in the porcelain base with cement are shown in detail in Figs. 13 to 15. As shown in these figures, this mechanism is provided with a receptacle *n*, containing powdered cement, and a measured quantity of this cement is transferred to the recesses in the porcelain base by means of a feed-slide *n'*, provided with holes *n''*, corresponding to the recesses in the base. This feed-slide *n'* is moved from the position shown in Fig. 14, in which the holes *n''* are in the bottom of the receptacle *n*, to a position in which the holes *n''* register with a series of holes *n'''* in the plate *n⁴*, which underlies the feed-slide, by means of a cam *n⁵*, secured to a constantly-running shaft *n⁶* and operating upon a lever *n⁷*, the lower end of which passes through an opening in the slide. The feed-slide *n'* is returned to normal position under the control of the cam *n⁵* by means of a spring *n⁸*. The holes *n'''* are so arranged that they are directly above the recesses in the porcelain base 1 when the jig M, carrying the parts, is at rest under the plate *n⁴*, as indicated in Fig. 14. When the feed-slide is moved to bring the holes *n''* into register with the holes *n'''*, the cement carried in the holes *n''* is forced down through the holes *n'''* into the recesses in the

porcelain base by means of a series of plungers *n⁹*, carried on the lower end of a slide *n¹⁰*. This slide *n¹⁰* is mounted in suitable guides in the end of an arm *n¹¹*, projecting from the central standard for the table B and is reciprocated by means of an eccentric *n¹²* on the end of the shaft *n⁶*, which engages a transverse slot in the slide, the lower side of the slot being held in engagement with the eccentric by means of a spring *n¹³*, connected with the upper end of the slide.

Previous to being brought into position to receive the cement the porcelain base 1 is subjected to the action of a series of gas-jets *n¹⁴*, which heat the walls of the recesses in the porcelain, and subsequent to the introduction of the powdered cement the porcelain is brought under a second series of gas-jets *n¹⁵*, which melt the cement. The gas-jets for effecting the preliminary heating project from a chamber *n¹⁷*, which is supplied with air and gas through a double pipe *n¹⁸*, and the jets *n¹⁶* for melting the cement project from a similar chamber *n¹⁹*, supplied with air and gas through a double pipe *n²⁰*, Figs. 2, 13, and 15. The porcelain base is moved into position under the jets *n¹⁶*, then into position to receive the powdered cement, and then into position to be acted upon by the jets *n¹⁶* by successive movements of the table B.

After the cement has been thus introduced into the recesses in the porcelain base the base and attached parts remain upon the jigs M until they are removed for the purpose of introducing them into the outer metallic shell 10 and cap 11. (Shown in Figs. 31 and 37.) Previous to inserting the base and detached parts within the shell and cap the insulating-disk 12 is introduced into the cap and an insulating-lining 13 is introduced into the outer metallic shell. The disk 12 and cap 11, as well as the shell 10 and lining, are forced together, so that they remain frictionally connected by means of a mechanism indicated at O, Fig. 1, the parts being held in position to be operated upon by this mechanism by two series of jigs P and R, the jigs P holding the cap and insulating-disk and the jigs R holding the shell and lining in proper relation as they are forced together.

The construction of the jigs P is shown in Figs. 29 to 31. As shown in these views, the jig is provided with a central pin *p*, over which the central opening in the disk 12 fits, and with a supporting-ledge *p'* for supporting the disk about the central opening. The jig is also provided with a supporting-surface *p²*, on which the outer edge of the disk 12 rests, and is provided with a ledge *p³* for limiting the downward movement of the cap 11. The disk is positioned upon the jig by means of two spring-fingers *p⁴*, arranged to engage the notches which are formed in the disk for embracing the screw-lugs 13 of the cap. In

the body of the jig between the supporting-surface p^2 and the ledge p^3 there are two diametrically opposite recesses p^5 for receiving the screw-lugs 13, and thus positioning the lugs with relation to the notches in the insulating-disk.

When the caps are forced down upon the jigs, the lugs strike the fingers p^4 , which yield radially inward as the lugs enter the notches in the disk.

The construction of the jigs R is shown in Figs. 35 to 37. This jig consists of a central post r , arranged to fit within the insulating-lining 13 and provided with a laterally-projecting pin r' for engaging the key-slot which is formed in the lining and also in the outer shell 10. This pin r' by engaging the key-slots in the shell and lining determines the position of the parts upon the jig and insures their proper relative position when forced together.

The disks 12 are placed upon the jigs P and the linings 13 are placed upon the jigs R by an operator as the jigs pass successively in front of him, the disks being delivered to the operator through a chute P' , the delivery end of which is adjacent to the path of travel of the jigs and within convenient reach of the operator and the linings being delivered to the operator through a series of tubes R' , the delivery ends of which are also adjacent to the path of travel of the jigs and within convenient reach of the operator. The caps 11 are placed upon the jigs P, and the shells 10 are placed upon the jigs R by a second operator, the caps and shells being delivered to the operator through chutes $P^2 R^2$ (indicated in Figs. 1 and 2) and arranged adjacent to the path of travel of the jigs and within convenient reach of the operator.

After the parts have been thus placed upon the jigs P and R the movements of the table B bring the jigs successively into position to present the parts to the mechanism O. The mechanism O consists of a slide o , Figs. 2 and 16, mounted to reciprocate in an arm o' , projecting from the central standard for the table B and operated by a crank-pin o^2 , carried by a constantly-running shaft o^3 and engaging a transverse slot in the slide, the lower side of the slot being held in engagement with the crank-pin by a spring o^4 , secured to the upper end of the slide. Mounted in the lower end of the slide are two plungers $o^5 o^6$, the plunger o^5 being arranged to engage the upper end of the cap 11 and force it downward and the plunger o^6 being arranged to engage the shell 10 and force it downward, so that by the downward movement of the slide o the cap and shell are forced firmly into position on the jigs which carry them. The downward movement of the cap forces the screw-lugs 13 into the notches in the disk 12, so that the disk and cap are connected together, and the downward movement of the

shell 10 forces the shell onto the insulating-lining, so that the lining is properly positioned in the shell. The shell 10 is of thin metal, and the insulating-sleeve should project slightly beyond the end of the shell, and consequently the plunger o^6 is recessed, so that it will pass down over the end of the shell and engage the beading 15 on the shell. In order to prevent any accidental removal of the shell and lining from the jig by the upward movement of the plunger o^6 , a stripping-finger o^7 is provided for engaging the shell in case it should rise with the plunger o^6 and arrest its upward movement. This stripping-finger is pivoted to the arm o' and is pressed yieldingly forward by a spring o^8 . The front edge of the finger is so shaped that the finger will be pressed backward as the plunger o^6 descends, but will move forward ready to engage the shoulder 16 on the shell as soon as the plunger rises.

After the jigs have passed beyond the mechanism O the shell 10 with the linings in them are removed from the jigs R, and the porcelain base and attached parts are removed from the jigs M and placed within the shells, and then the caps, with the attached disks, are removed from the jigs P and placed in position over the end of the shell 10, the screws 17 being interlocked with the bayonet-slots in the shell. This is done by an operator as the jigs pass in front of him, and this operator after putting the parts together as described places them again upon the jig M, as indicated in Figs. 32 and 34. The shell is positioned upon the jig by fingers m^5 , which project inwardly from the post m and engage the opposite sides of the slot, through which the key-shaft passes. In addition to the post m the jig is provided with a cylinder m^3 , surrounding the post m and provided with a seat m^4 for engaging the shoulder 16 of the shell, and thus maintaining the parts in vertical position on the jig.

The movement of the table B brings the jigs M, with the parts carried thereby, as indicated in Fig. 34, successively into position with the screws 17 in position to be operated upon by the screw-driving mechanism. (Indicated at S in Fig. 1 and shown in detail in Figs. 6 and 7.) As shown in Figs. 6 and 7, this screw-driving mechanism is provided with two oppositely-arranged screw-drivers s , carried by spindles s' . Each spindle extends through a hollow driving-shaft s^2 , with which it is connected by means of a pin projecting into a longitudinal slot in the shaft. The shaft is driven by means of a belt passing over a pulley s^3 , which is frictionally connected with the shaft s^2 by its engagement with a disk s^4 , secured to said shaft. Each spindle projects beyond the driving-shaft and is provided with a collar s^5 , having an annular groove which receives pins projecting inward from the arms of a yoke formed on the

lower end of a lever s^6 . The lever is operated to advance the spindle, and thus bring the screw-driver into engagement with the head of the screw 17 to tighten said screw by means of a cam s^7 , secured to a constantly-running shaft s^8 and engaging the upper end of the lever, the lever being held in engagement with the cam by a spring s^9 . Each spindle s' is provided with a guard-sleeve s^{10} , connected therewith by a pin s^{11} , engaging a slot s^{12} in the sleeve, the sleeve being pressed yieldingly forward by a spring s^{13} . These sleeves insure the engagement of the screw-drivers with the heads of the screws 17 and yield to allow the advance movement of the screw-driving spindles as the screws are driven home. The screw-driving mechanism is supported upon an arm s^{14} , projecting from the central standard for the table B, and is provided with a guide-pulley s^{15} , over which the driving-belt passes from one pulley s^3 to the other.

After the screws 17 have been tightened the assembling of the parts of the socket is complete, and the sockets are removed from the jigs M, properly wrapped and packed for shipment.

The tables A B, which form the carriers for the different series of jigs, are moved in unison, so that the various operations and manipulations incident to the assembling of the parts of the complete socket are performed in unison and are timed by the successive movements of the tables, each mechanism performing its operation during the interval between successive movements of the tables and each operator performing his allotted manipulations during this interval. Thus between successive movements of the tables all the operations and manipulations necessary for the assembling of a socket are performed without loss of time and with the parts presented to the operators in such a manner that the manual manipulations may be effected quickly and conveniently and with little exertion on the part of the operator. The jigs may therefore be rapidly advanced from one position to another, with a resulting increase in the number of sockets assembled and consequent reduction in the cost of manufacture.

The tables A B are driven in unison from a driving-shaft T, journaled in the arms s^{14} and c^3 and carrying pinions t , engaging gears t' t^2 , Fig. 1. The gear t' is secured to the shaft o^3 , which operates the mechanism O, while the gear t^2 is secured to the shaft i , which operates the screw-driving mechanism I. The mechanism for intermittently operating the tables A and B is substantially the same for each table, and these mechanisms are driven from the shafts o^3 and i , respectively. These mechanisms are best shown in Figs. 3, 4, 5, and 6. As shown in these views, each table is provided on its under side with

a ratchet-wheel t^3 , having a number of teeth corresponding to the number of jigs in each series upon the tables. This ratchet-wheel is acted upon by a pawl t^4 , pivoted upon a slide t^5 and held in engagement with the ratchet-wheel by a spring t^6 . The slide t^5 is guided upon suitable ways t^7 , Fig. 2, formed on an arm projecting from the central standard for the table, and is operated by a cam t^8 , secured to a shaft t^9 and engaging a roll t^{10} , carried by the slide, Fig. 6. The slide is held in engagement with the cam by a spring t^{11} , connected to a fixed arm t^{12} and to the slide.

The shaft t^9 is constantly driven from a vertical shaft t^{12} , with which it is connected by bevel-gearing t^{13} . The shaft t^{12} is constantly driven from shaft i or o^3 , as the case may be, through a gear t^{14} , secured to the upper end of the shaft and engaged by a gear t^{15} , secured to the shaft o^3 , (or i .)

The shafts c^7 and f^{10} , which operate the screw-driving mechanisms C and F, are driven continuously through gears t^{16} and t^{17} , secured to the ends of the respective shafts and engaging the gear t^{14} , corresponding to table A. Shafts n^8 s^8 for operating the mechanisms n and s are driven by similar gears t^{18} t^{19} , Fig. 1, secured to the ends of the respective shafts and engaging the gear t^{14} corresponding to table B.

The shaft h^9 , which operates the screw-feeding mechanism H, Fig. 3, is continuously driven from the shaft f^{10} by means of bevel-gears h^{17} , which connect shaft f^{10} with a short shaft h^{18} , which is in turn geared with the shaft h^9 through spur-gears h^{19} .

By the gearing described all the shafts are driven and operated in unison and the operative movements of the various mechanisms for acting upon the work are properly timed with respect to the advance movements of the jig-carrying tables A B.

The jigs are removably secured to the tables by means of screws passing through holes in the tables and engaging the bases of the jigs, and the jigs may be removed and other forms of jigs substituted in case it is desired to employ the apparatus for assembling articles other than lamp-sockets. In such case any screw-driving mechanism or mechanisms may be substituted for those shown by removing the spindle-carrying slides and substituting a different slide provided with screw-driving spindles differently arranged or of different number, so as to cooperate with the jigs secured to the table.

In Figs. 38 to 43 I have shown two forms of jigs which may be employed in assembling the parts of a rosette. The jig W (shown in Figs. 38 to 40) is provided with two pins w for engaging the two diametrically opposite holes in the porcelain base 20 of the rosette and holding said base in proper position on the jig. This jig is also provided with recesses w' for receiving the metallic parts 21 and

holding them in proper position with relation to the porcelain base 20. The screws 22 may be fed by the operator or may be fed automatically by mechanisms similar to those previously described. The screws are driven by properly-arranged screw-driving spindles, (indicated at W' in Fig. 40,) which may be arranged and operated in a manner similar to the screw-driving spindles shown in Fig. 12.

10 The jig X (shown in Figs. 41 to 43) is provided with two pins x for engaging holes in the metallic pieces 23 and is provided with a central pin x' for engaging the central recess in the porcelain cap 24 of the rosette. The jig is also provided with recesses x^2 x^3 , the recesses x^2 being arranged to receive the metallic pieces 23 and the recesses x^3 being arranged to receive the metallic pieces forming the fuse-contacts 25 of the rosette. The cap of the rosette is recessed to receive the metallic line-wire contacts 23 and is positioned in proper relation upon the jig by engagement of these recesses with said contact-pieces. The four screws 26 for securing the contacts to the porcelain cap-piece may be driven simultaneously by four screw-driving spindles, (indicated at X' in Fig. 43,) mounted and driven by independent frictional driving devices in a manner similar to the construction shown in Fig. 12.

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

1. An assembling apparatus comprising mechanisms for performing successive operations upon the work, a series of work-supporting jigs corresponding to each mechanism for carrying the parts and presenting them to the corresponding mechanism, and mechanism for intermittently advancing said series of jigs in paths adjacent to each other at one or more points in their travel.

2. An assembling apparatus comprising mechanisms for performing successive operations upon the work, a series of work-supporting jigs corresponding to each mechanism, a carrier for said series of jigs, and mechanism for intermittently advancing said carrier to bring the jigs in each series successively into position to cooperate with the corresponding mechanism for operating upon the work, and means for operating said mechanisms during the interval between successive movements of the carrier.

3. An assembling apparatus comprising a plurality of mechanisms for performing successive operations upon the work, a plurality of series of work-supporting jigs corresponding to said mechanisms, a rotary table upon which said jigs are carried, mechanism for intermittently advancing said table, and means for operating said plurality of mechanisms during the intervals between the advance movements of the table.

4. An assembling apparatus comprising a plurality of screw-driving mechanisms, a se-

ries of work-supporting jigs corresponding to each mechanism for carrying the parts to be secured together and presenting them to the corresponding screw-driving mechanism, and means for intermittently advancing said series of jigs in adjacent paths.

5. An assembling apparatus comprising a plurality of screw-driving mechanisms, a series of work-supporting jigs corresponding to each mechanism for carrying the parts to be secured together and presenting them to the corresponding screw-driving mechanism, a carrier for said series of jigs, and mechanism for intermittently advancing said carrier to bring the jigs in each series successively into position to cooperate with the corresponding screw-driving mechanism.

6. An assembling apparatus comprising mechanisms for performing successive operations upon the work, a series of work-supporting jigs corresponding to each mechanism for carrying the parts and presenting them to the corresponding mechanism, mechanism for intermittently advancing said series of jigs in adjacent paths, and means for delivering the parts to be applied to the jigs adjacent to the paths of travel of said jigs.

7. An assembling apparatus comprising a rotary carrier, two or more series of jigs carried by said carrier, mechanism for intermittently advancing said carrier, mechanisms for operating on the parts carried by the jigs corresponding to each series, and mechanism for intermittently operating said mechanisms.

8. An assembling apparatus comprising a rotary table, two or more series of jigs carried by the table, mechanism for intermittently advancing the table, mechanisms for operating on the parts carried by the jigs corresponding to each series, and means for delivering the parts to be assembled adjacent to the paths of travel of the jigs.

9. An assembling apparatus comprising two screw-driving mechanisms, a carrier, two series of jigs secured to said carrier corresponding to said screw-driving mechanisms, mechanism for intermittently advancing the carrier, a screw-feeding mechanism corresponding to each screw-driving mechanism, and mechanisms for intermittently operating the screw-driving mechanisms.

10. An assembling apparatus comprising two screw-driving mechanisms, a series of jigs provided with devices for holding the key-frame and base of a socket in proper relation, a second series of jigs provided with devices for holding the base and screw-shell-securing nuts in proper relation, mechanism for bringing each series of jigs successively to a screw-driving mechanism, and means for intermittently operating said screw-driving mechanisms.

11. An assembling apparatus comprising three screw-driving mechanisms, a series of

jigs provided with devices for holding the key-frame and base of a socket in proper relation, a series of jigs provided with devices for holding the base and screw-shell-securing-nuts in proper relation, a series of jigs provided with devices for holding the base and center terminal in proper relation, mechanism for bringing the jigs in each series successively to a corresponding screw-driving

mechanism, and mechanisms for intermittently operating the screw-driving mechanism.

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

NORMAN MARSHALL.

Witnesses:

IRA L. FISH;

GEO. N. GODDARD.