No. 764,844. PATENTED JULY 12, 1904.

H. W. HARPER.

MACHINE FOR MAKING INCANDESCENT ELECTRIC LAMP BULBS.

APPLICATION FILED APR. 30, 1904.

NO MODEL. 2 SHEETS—SHEET 1.

Fig. 1.

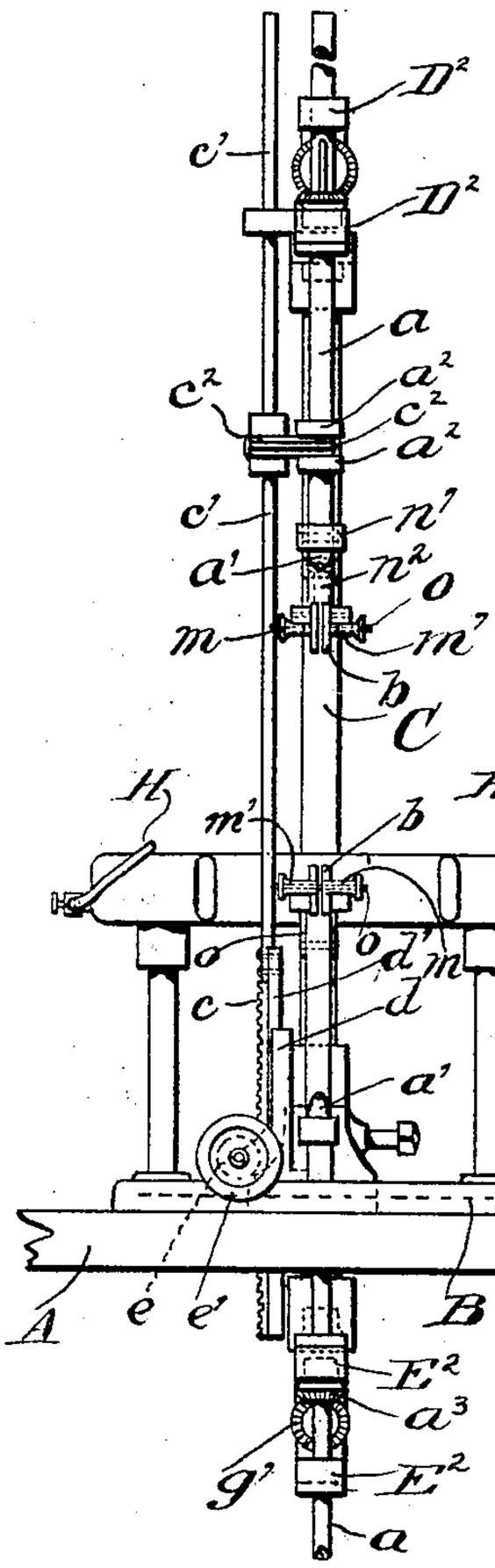
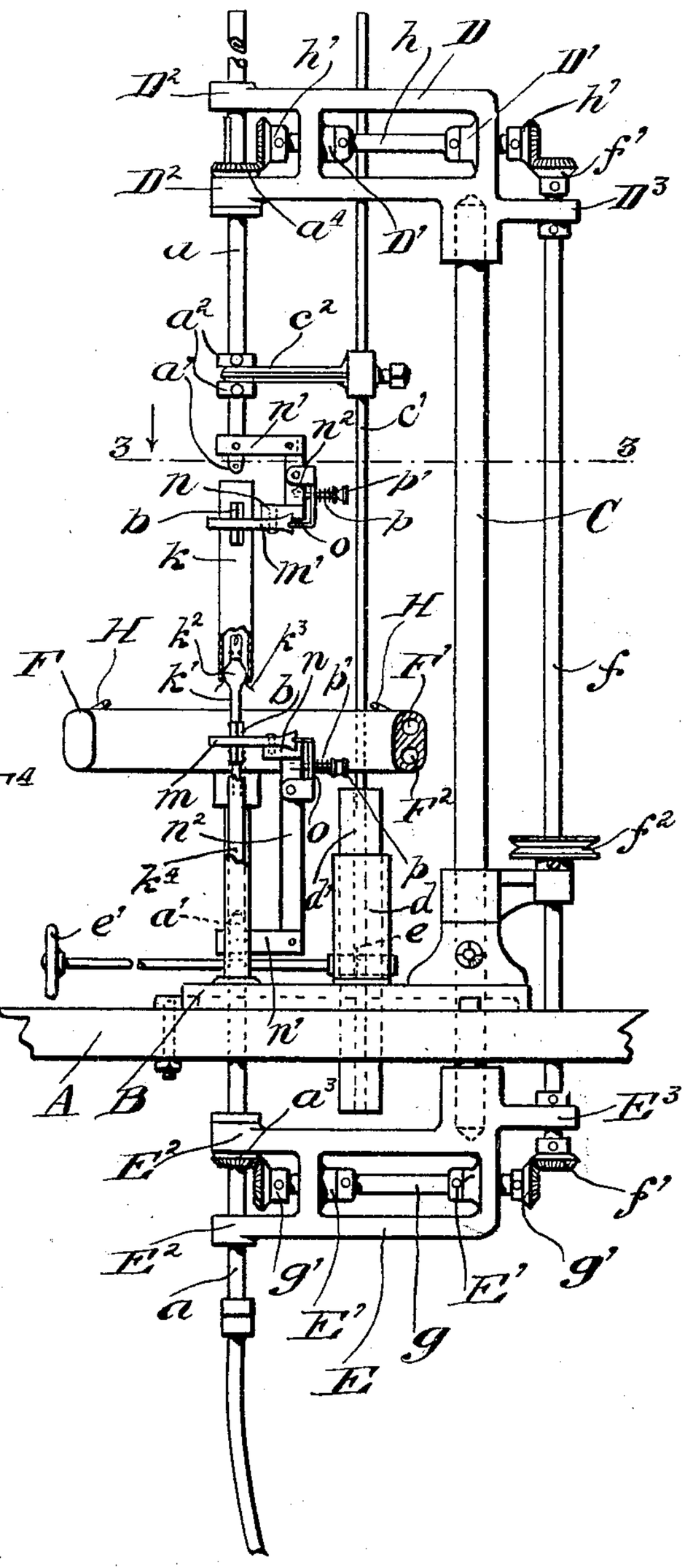


Fig. 2.



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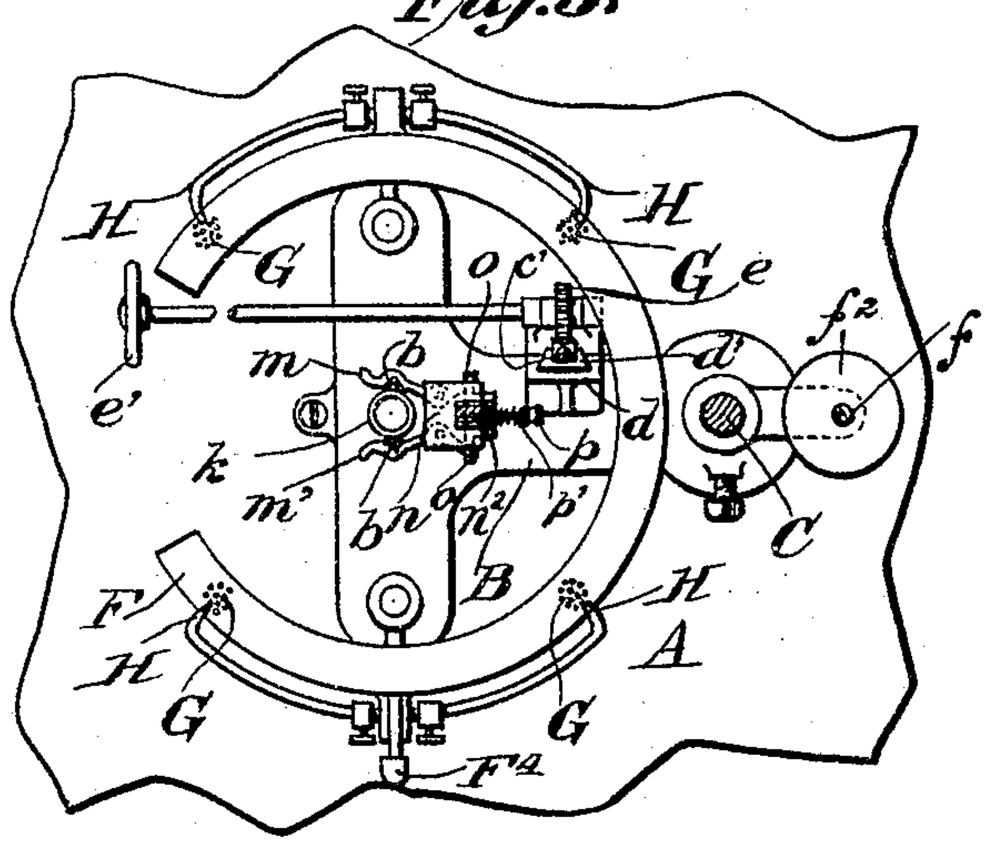
NO MODEL. 2 SHEETS—SHEET 2.

Fig. 3.



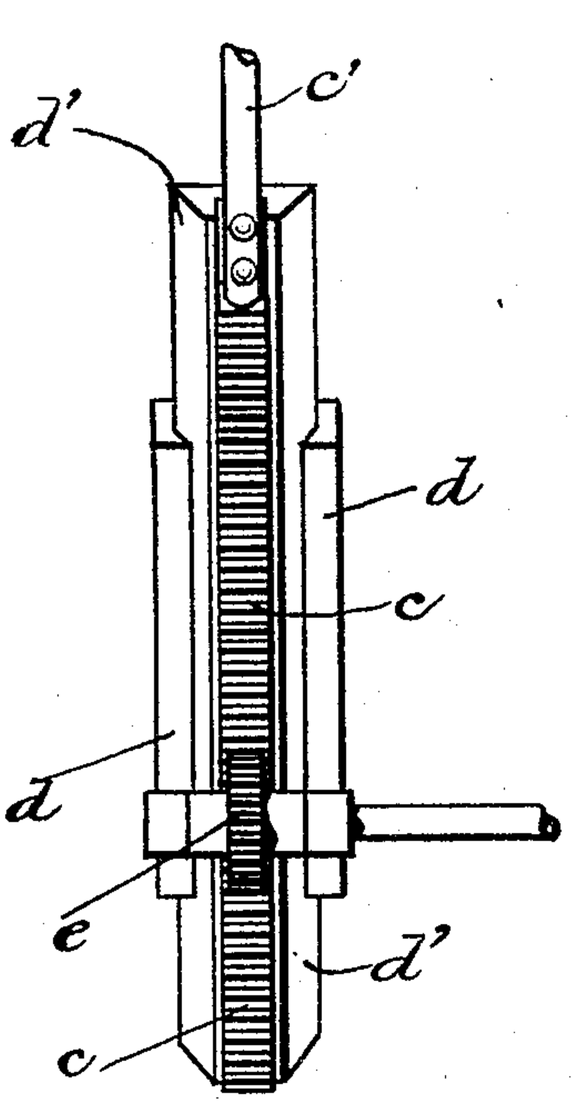


Fig. 4.

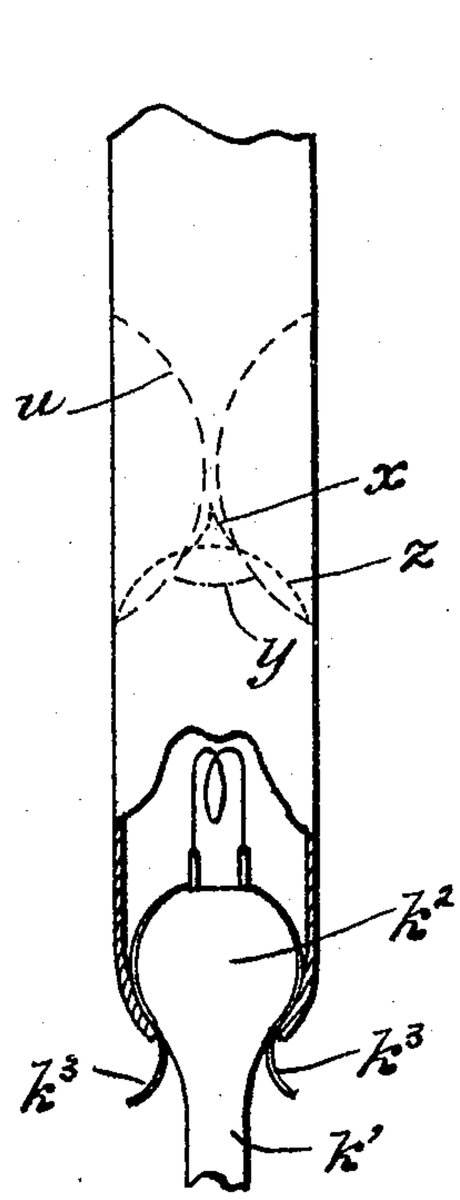


Fig. 5.

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UNITED STATES PATENT OFFICE.

HARVEY W. HARPER, OF EAST ORANGE, NEW JERSEY, ASSIGNOR TO HOWARD MINIATURE LAMP COMPANY, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK.

MACHINE FOR MAKING INCANDESCENT-ELECTRIC-LAMP BULBS.

SPECIFICATION forming part of Letters Patent No. 764,844, dated July 12, 1904.

Application filed April 30, 1904. Serial No. 205,768. (No model.)

To all whom it may concern:

Be it known that I, HARVEY W. HARPER, a citizen of the United States, residing at East Orange, in the county of Essex and State of New Jersey, have invented certain new and useful Improvements in Machines for Making Incandescent-Electric-Lamp Bulbs, of which the following is a specification, reference being had therein to the accompanying drawings, which form a part thereof.

My invention relates to machines for making incandescent-electric-lamp bulbs, and more particularly to a type of such machines for making tipless bulbs.

In the electrical art for certain purposes it is desirable to use substantially straight bulbs of small dimension, particularly in telephone-switchboards and surgical instruments and other portable lighting appliances. In such connections the light-rays from the filament radiate from the top of the bulb and are usually augmented by lenses or reflectors or both. In such bulbs as are now commonly used the process of manufacture results in the formation on the top of the bulb of a small tip of considerable comparative thickness relative to the remaining portions of the bulb which casts irregular shadows when the filament becomes incandescent to the serious loss of efficiency in the lamp. To obviate this difficulty, bulbs have been made by a hand process without such a tip; but the expense of manufacture has been found to be sufficiently great to prevent the general adoption in the arts of such lamps.

The main object of this invention is to provide a machine which can be utilized to produce tipless incandescent-lamp bulbs, particularly of the class above referred to, at a small cost of production.

A further object is to provide such a machine wherein the several processes necessary to the production of a bulb preparatory to the exhaustion of air therefrom may be consecutively performed without reheating or rehandling the glass tube and without that degree of skill required in the hand production of tipless bulbs.

A still further object is to provide a simple mechanism by which the drawing and the holding clutch may be revolved synchronously and during such rotation at the required instant separated to so divide the tube as to permit the formation of the bulb.

A still further object is to provide such a machine wherein the inside part may be sealed within the tube with the same mechanism required to form the bulb.

A still further object is to provide clutches so disposed relative to their axes as to not obstruct the space necessary for the tube, and which, furthermore, may be so regulated as to their strength of grip as to permit the adaptation of the machine to bulbs of various diameters.

A still further object is to provide such a machine wherein the blower-pipe necessary to the formation of the tube is rotatable synchronously with the clutches and the contained tube to facilitate the application of a removable connection between such and the exhaust-tube of the inner part; and a still further object is to provide a machine of this character which will be simple in construction, durable in use, and operated by a mechanism which is not complicated and can be actuated by comparatively unskilled labor.

The invention consists, primarily, in the combination, in a machine of this character, of opposed clutches or holders, means whereby said clutches or holders may be separated to divide the bulb from the original tube, and a blowpipe adapted to be removably connected with the exhaust-tube of the inner part, with means whereby the tube is heated and fused during the formation of the bulb, and in such other novel features of construction and arrangement of parts as are hereinafter set forth and described, and more particularly pointed out in the claims hereto appended.

Referring to the drawings, Figure 1 is a front elevation of a machine embodying my invention. Fig. 2 is a side elevation thereof. Fig. 3 is a sectional plan view on the line 3 3 of Fig. 2. Fig. 4 is an enlarged perspective view of the mechanism for separating the clutches or

holders, and Fig. 5 is a view of a tube illustrating the several steps in the formation of a tipless bulb.

Like letters refer to like parts throughout the several views.

In the drawings, A indicates a table upon which the bed B of the machine is mounted. A standard C, provided with parallel hanger-frames D E, one disposed above and one below the table A, is mounted to the rear of the machine-bed B. Each frame D E is provided with bearings D′ D′ E′ E′, parallel with the bed B, and D^2 D^3 E^2 E^3, arranged at opposite ends of the frame and perpendicular to said first-mentioned bearings. Also mounted on the bed B is a semicircular burner-tube F, of ordinary construction, comprising a gas-chamber F′ and a compressed-air chamber F^2, burner-plates G, disposed concentrically about an imaginary center in alinement with the bearings D^2 E^2, and blowpipes H for projecting the flames of the several burner-plates G toward the center, above referred to.

Gas and air under pressure is fed to the chambers F′ F^2, respectively, through tubes F^3 F^4, the tube F^3 being provided with an ordinary pinch-valve F^5, by means of which the pressure through the several blowpipes H is regulated.

The details heretofore described are either matters of mere mechanical expediency or else are well known to the arts, and are not therefore material to the invention.

Mounted in the bearings D^2 E^2, respectively, are shafts *a*, carrying oppositely-disposed clutches or holders *b b*, both of which shafts, preferably, are hollow to form an air-conduit to permit the blowing of the tube into shape. Each said shaft is provided with a discharge nipple and nozzle *a′ a′*. The glass tube and its exhaust-tubes are held in the holder *b b*, and after being properly heated said tubes must be drawn to divide the tube properly to form the bulb. This drawing operation I provide for by so mounting said shaft *a a*, or preferably the upper of each shaft only, as to permit axial movement thereof to accomplish the separation of the holders *b b*. The mechanism I preferably employ for this purpose is a rack *c*, mounted in a way *d′*, formed in an extension *d* of the bed B, a pinion *e*, also mounted in said extension, a hand-wheel *e′*, projected forwardly of the machine to be readily accessible to the operator, a rod extension *c′* of the rack *c*, having an upper bearing in the frame D, and a yoke c^2, adapted to straddle the shaft *a* and engage oppositely-disposed abutments a^2 thereon.

To insure the even heating of the glass of the tube, it is essential to constantly subject the entire circumference of the tube adjacent to the point of subsequent division to the same degree and duration of heat. The simplest way of accomplishing this is to turn the tube constantly and evenly during such heating, although I apprehend that similar effects can be produced by rotating the burners about the tube as a center. I prefer to rotate the tube-holding mechanism, however, and for this purpose provide the shafts *a a* each with a bevel-gear a^3 a^4, one of which, as a^4, is splined thereon to permit the axial movement of the shaft, herein referred to. Mounted in the bearing D^3 E^3 is a main shaft *f*, having bevel-gears *f′ f′* on the opposite ends thereof and a driving-pulley f^2. Mounted in bearings D′ D′ and E′ E′, respectively, are counter-shafts *g h*, carrying on each end thereof a bevel-gear *g′ h′*, meshing, respectively, with a gear *f′* and with the gear a^3 a^4. The manner of mounting said shafts and keying said gears and said pulley thereto is immaterial to this invention.

Each clutch *b* is the duplicate of the other in structure and mode of operation, and the description of but one of them in the interests of brevity will be entered into. Inasmuch as it is requisite that the tube *k* and its exhaust-tube *k′* project beyond the clutch or holder *b*, it is necessary to provide a space to accommodate such. The clutch proper comprises oppositely-disposed arms *m m′*, pivoted to a support *n*, which is offset from the shaft *a* by means of a block *n′* and hanger n^2. The long arm of each arm *m* is provided with an elongated V-shaped jaw, which is through its form adapted to grasp tubes of different diameters. The short end of each arm projects beyond the support *n* and is engaged by a swinging cross-head *o*, pivoted to the hanger n^2 and forced against the arms *m* by a spring *p*, thus normally maintaining the jaws closed. The said spring is carried by a set-screw *p′*, mounted in the hanger n^2, and acts against the head of said screw. It will readily be observed that said spring may be tensioned by said set-screw and the grip of the jaws thus regulated to adapt them to various sizes of tubes. The block *n′* and the various parts carried thereby are rotatable with the shaft *a*. To facilitate the insertion and withdrawal of the tube from the clutches *b*, the outer ends of the arms *m m′* are outwardly flared.

The operation of the machine will be best understood when considered in connection with Fig. 5, wherein the result of each distinct operation upon the tube is illustrated. For convenience of expression the upper clutch or holder will be termed the "drawing-clutch" and the lower the "holding-clutch." Preparatory to putting the machine in operation the inner part k^2 of the bulb carrying the filament k^3 is inserted in the lower end of the tube *k*, with the filament-terminals placed between said inner part and said tube, as shown. The parts thus assembled are placed in the clutches *b*, the drawing-clutch engaging the tube toward its free end and the holding-clutch engaging the exhaust-tube *k′* of the inner part. This is accomplished by simply press-

ing said tubes against the outwardly-flared ends of the levers $m\,m'$, thus opening said jaws against the tension of the spring p exerted thereon through the cross-head o. The said jaws automatically close upon said tubes, and the strength of grip may then be regulated to avoid undue pressure on the tubes and insure the proper action of each in subsequent operations. The drawing-clutch requires slightly-greater pressure than the holding, as the latter must permit the exhaust-tube to slide therein after the sealing of the inner part to bring the tube to form the top of the bulb within the tire. A rubber tube k^4 is then inserted upon the nipple a' and the end of the exhaust-pipe k'. The tubes $k\,k'$ and their appurtenances being in place, the pinion e is rotated by the wheel e' to either raise or lower the drawing clutch or holder through the rack c, rod c', and yoke c^2 to bring the lower part of the tube k about opposite the several burner-plates, the tube k^4 flexing to permit this. The opposed clutches are then rotated synchronously by the various bevel-gears and shafts, heretofore described, power being applied through the pulley f^2 and any desired belt-shifting mechanism. The flame is then diverted by the various blowpipes H, the strength of the jet being regulated by the operator through the pinch-valve F^5. The jets are thus centered upon the lower end of the tube k, the repeated rotation of which subjects all parts thereof to the flame-jets, causing the fusing of the glass of the tube in a manner to cause the bottom tube to collapse about the inner part k^2, thus effectually sealing this part with its filament k^3 in said tube. Thereafter the pinch-valve is opened to reduce or remove the air-pressure forming the flame-jets and the drawing-clutch lowered, as before, until that point of the tube k which will form the top of the bulb is opposite the several burners G. The tube being in the proper position, gas-jets are formed as before, which fuse the glass of the tube to an equal degree of softness throughout at the point within the influence of said jets through the continued rotation of the opposed clutches. When the glass is thoroughly heated or fused, the tube collapses, as at a, Fig. 5, whereupon the wheel e' and rack-and-pinion mechanism is used to separate the holders b, thus drawing the tube and dividing the upper part thereof and the part which is to form the bulb, which operation forms temporarily a central tip, as at x, Fig. 5. This tip, however, with the central top portion of the embryo bulb, immediately sags, as at y, Fig. 5, and becomes diffused, so as to have the entire top of substantially the same thickness. After this stage the drawing-clutch and separating mechanism become inoperative, and it remains to merely form the top of the bulb. Air under low pressure is conducted through the lower shaft a and discharged into the bulb (with its top still heated) through the tube k^4, exhaust-tube k', and inner part k^2, blowing up the sagged portion y, Fig. 5, until it is well rounded, as at z, Fig. 5, and perfectly smooth throughout. The bulb is then complete and ready to have the air exhausted therefrom and the butt applied thereto in the usual manner, the function of this machine being merely to form the bulb, as described.

I have described the operation of the machine where the lower clutch-shaft and its air connection are used for forming or blowing the top; but, if desired, the air connection may be made with the upper shaft a and the tube k and its appurtenances reversed in position. This would require a reversal of the movement of parts necessary to the several operations; but the mode of operation in each instance and the results attained will be the same.

Herein I employ the expression "separating the opposed clutches," by which I refer to that axial movement of either of the shafts a (or both, if desired, if the design of the machine be varied to require such) necessary to divide the bulb from the balance of the tube. When the burners are stationary, it is necessary in order to insure the proper diffusion of the heat throughout the tube k that one of the clutches shall revolve about a center fixed relative to the burners.

The detailed description of the burner F forms no part of this invention, and I make no claim to such. That shown is well known to the art; but various other types of such burners can be used without affecting the function and mode of operation of the machine described. Various other details of construction may be altered without similar effect, and it is therefore not my intention to limit the invention to such detail.

A machine such as described will produce tipless bulbs rapidly and, owing to a possibility of using short length of tubes k, on account of the mechanical handling of such tubes, with a minimum loss of material.

Having described my invention, what I claim as new, and desire to have protected by Letters Patent, is—

1. In a machine of the class described, the combination with opposed clutches or holders, means whereby said clutches or holders may be separated to divide the bulb from the original tube, and an air-conduit adapted to be connected with the exhaust-tube of the inner part of a bulb, of means whereby a tube is heated and fused.

2. In a machine of the class described, the combination with opposed clutches or holders, means whereby said clutches or holders may be separated to divide the bulb from the original tube, a driving mechanism for rotating said clutches or holders synchronously and an

air-conduit adapted to be connected with the exhaust-tube of the inner part of a tube, of means whereby a tube is heated and fused.

3. In a machine of the class described, the combination with a drawing and a holding clutch or holder, disposed oppositely each other, means whereby said drawing clutch or holder is moved away from said holding-clutch or holder to divide the bulb from the original tube, and an air-conduit adapted to be connected with the exhaust-tube of the inner part of a bulb, of means whereby a tube is heated and fused.

4. In a machine of the class described, the combination with a drawing, and a holding clutch or holder disposed oppositely each other, means whereby said drawing clutch or holder is moved away from said holding-clutch or holder to divide the bulb from the original tube, a driving mechanism for rotating said clutches or holders synchronously and an air-conduit adapted to be connected with the exhaust-tube of the inner part of a bulb, of means whereby a tube is heated and fused.

5. In a machine of the class described, the combination with opposed clutches or holders, means whereby said clutches or holders may be separated to divide the bulb from the original tube and a tubular support for one of said clutches adapted to be connected with the exhaust-tube of the inner part of a bulb, of means whereby a tube is heated and fused.

6. In a machine of the class described the combination with a drawing, and a holding clutch or holder disposed oppositely each other, means whereby said drawing-clutch or holder is moved away from said holding-clutch or holder to divide the bulb from the original tube, a driving mechanism for rotating said clutches or holders synchronously and a tubular support for said holding-clutch adapted to be connected with the exhaust-tube of the inner part of a bulb, of means whereby a tube is heated and fused.

7. In a machine of the class described, the combination with a drawing, and a holding-clutch or holder, disposed oppositely each other, a rack-and-pinion mechanism and connections between said rack and said drawing-clutch or holder whereby said drawing-clutch or holder is reciprocated relative to said holding-clutch or holder, a driving mechanism for rotating said clutches or holders synchronously and a tubular support for said holding-clutch adapted to be connected with the exhaust-tube of the inner part of a bulb, of means whereby a tube is heated and fused.

8. In a machine of the class described, the combination with oppositely-disposed axially-alined shafts one of which is tubular, a drawing, and a holding clutch carried by the adjoining ends of said shafts, said tubular shaft being adapted to be connected with the exhaust-tube of the inner part of a bulb, a gear splined upon the shaft of said drawing-clutch, a gear mounted on said tubular shaft, a main driving-shaft provided with means whereby it may be rotated and gears of equal diameter mounted on the opposite ends thereof, counter-shafts carrying gears of equal diameter respectively, meshing with a gear on said main driving-shaft and the gears carried by the respective clutch-shafts, a rack-and-pinion mechanism and connections between said rack and said shaft supporting said drawing-clutch, of means whereby a tube is heated and fused.

9. In a machine of the class described, the combination with opposed clutches or holders, supports therefor offset relative to the jaws of said clutches, means whereby said clutches or holders may be separated to divide the bulb from the original tube, and an air-conduit adapted to be connected with the exhaust-tube of the inner part of a bulb, of means whereby a tube is heated and fused.

10. In a machine of the class described, the combination with oppositely-disposed axially-alined shafts, one of which is tubular, means whereby said shafts are rotated synchronously, means whereby one of said shafts is moved axially, supports carried by said shafts respectively, offset relative to said shafts and a clutch carried by said supports respectively in alinement with said shafts, said tubular shaft being adapted to be connected with the exhaust-tube of the inner part of a bulb, of means whereby a tube is heated and fused.

11. In a machine of the class described, the combination with oppositely-disposed axially-alined shafts, one of which is tubular, means whereby said shafts are rotated synchronously, means whereby one of said shafts is moved axially, supports carried by said shafts respectively, offset relative to said shafts, a clutch carried by said supports respectively in alinement with said shafts and means whereby said clutches are automatically closed, said tubular shaft being adapted to be connected with the exhaust-tube of the inner part of a bulb, of means whereby a tube is heated and fused.

12. In a machine of the class described, the combination with oppositely-disposed axially-alined shafts one of which is tubular, means whereby said shafts are rotated synchronously, means whereby one of said shafts is moved axially, supports carried by said supports respectively offset relative to said shafts, a clutch carried by said supports respectively in alinement with said shafts, means whereby said clutches are automatically closed and means whereby the grip of said clutches may be regulated, said tubular shaft being adapted to be connected with the exhaust-tube of the inner part of a bulb.

13. In a machine of the class described, a clutch mechanism comprising a suitable support, oppositely-disposed pivoted lever-arms, a gripping-jaw carried by one arm of each

said lever-arm, a movable cross-head engaging the other arm thereof, and a spring acting on said cross-head whereby said jaws automatically close.

14. In a machine of the class described a clutch mechanism comprising a suitable support, oppositely-disposed pivoted lever-arms, a gripping-jaw carried by one arm of each said lever-arm, a movable cross-head engaging the other arm thereof, a spring acting on said cross-head whereby said jaws automatically close, and means regulating the tension of said spring whereby the grip of said jaws is regulated.

15. In a machine of the class described, a clutch mechanism comprising a suitable support, oppositely-disposed pivoted lever-arms, a gripping-jaw carried by one arm of each said lever-arm, the ends of said arms beyond said jaw being outwardly flared, a swinging cross-head pivoted on said support and engaging the other arm thereof, a screw carried by said support and a spring seated between the head of said screw and said swinging cross-head whereby said jaws automatically close and the grip of said jaws is regulated.

In witness whereof I have hereunto affixed my signature this 22d day of April, 1904.

HARVEY W. HARPER.

Witnesses:
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F. T. WENTWORTH.