Dec. 20, 1927. 1,653,381

J. B. WHITMORE ET AL

MACHINE FOR FORMING CONSTRICTIONS IN EXHAUST TUBES

Filed Feb. 5, 1921 3 Sheets-Sheet 1

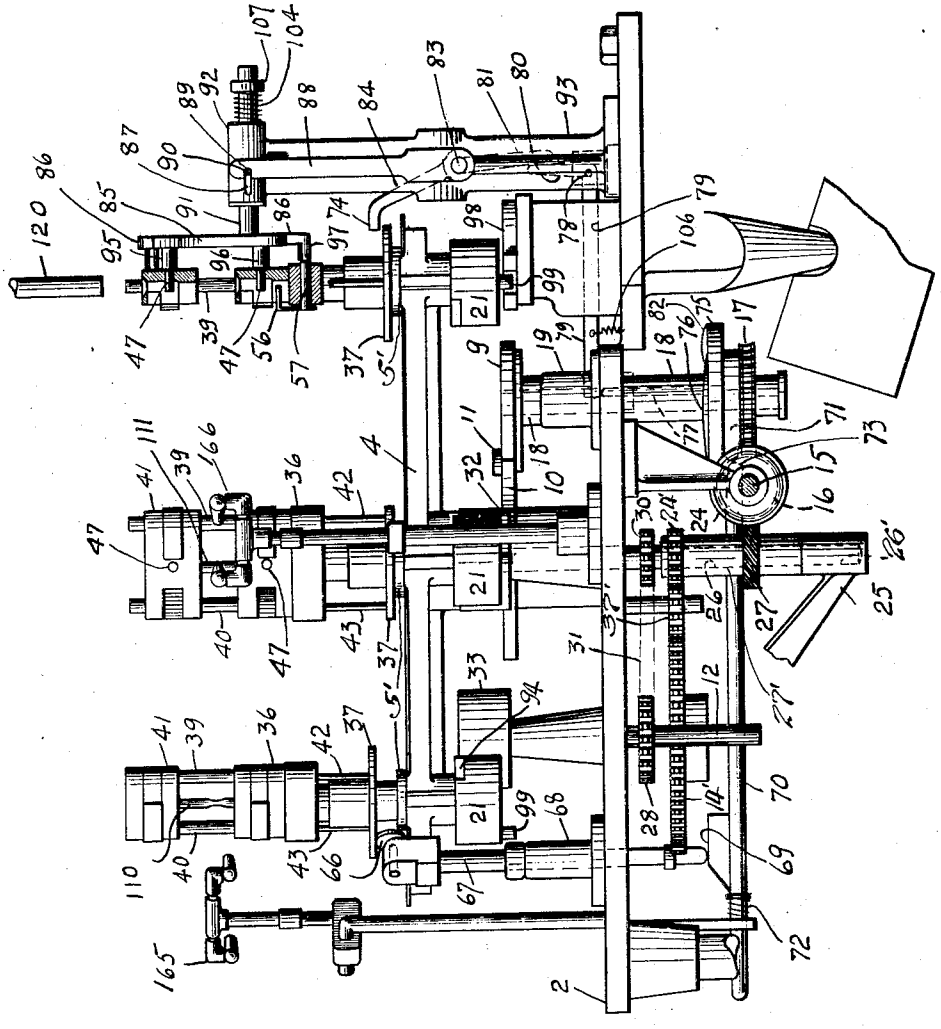


FIG. 1

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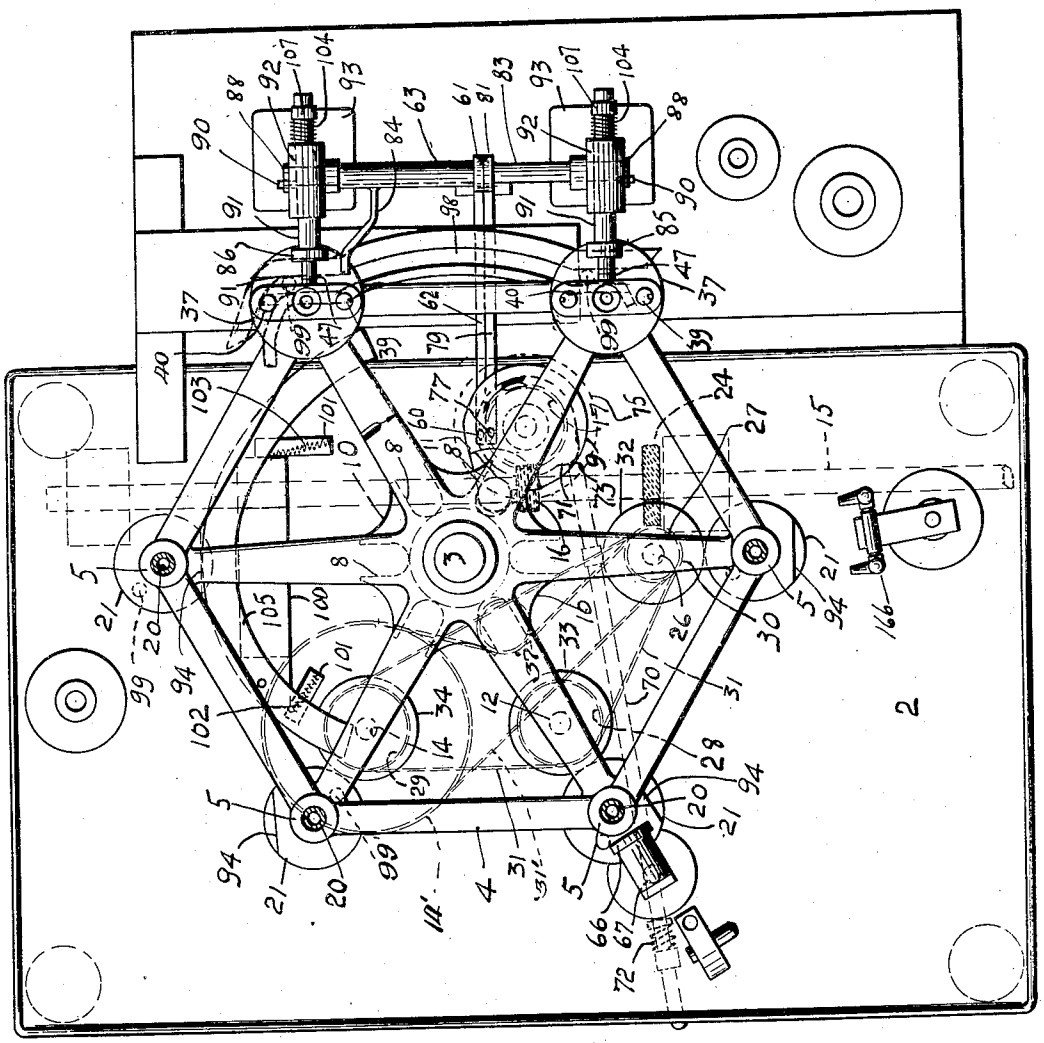


FIG. 2

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FIG.3

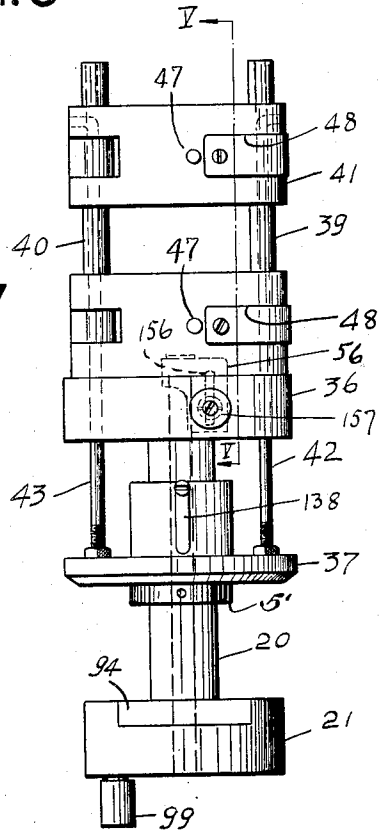


FIG.4

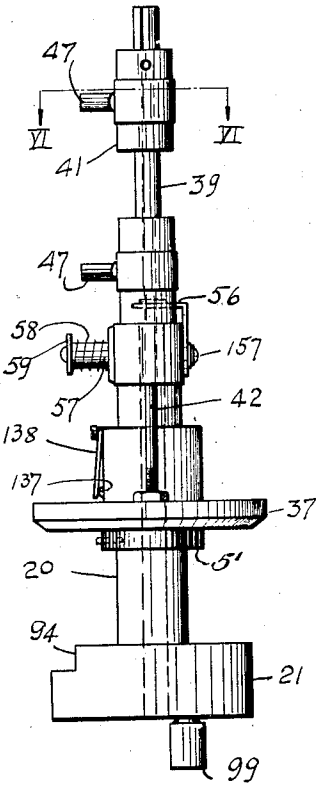


FIG.7



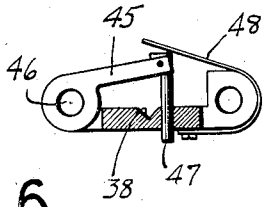


FIG.6

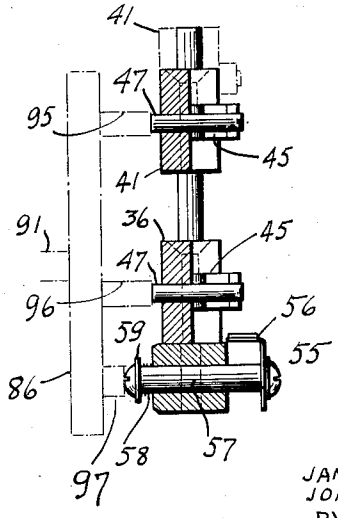


FIG.5

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UNITED STATES PATENT OFFICE.

JAMES BRYANT WHITMORE AND JOHN EBLING FERGUSON, OF BLOOMFIELD, NEW JERSEY, ASSIGNORS TO WESTINGHOUSE LAMP COMPANY, A CORPORATION OF PENNSYLVANIA.

MACHINE FOR FORMING CONSTRICTIONS IN EXHAUST TUBES.

Application filed February 5, 1921. Serial No. 442,810.

This invention relates to machines for altering the calibre of a portion of the length of a tubular body and is especially applicable for the production of such constricted glass tubes as used in connection with the manufacture of tipless incandescent lamps.

In the manufacture of lamps of this character, the bulb is exhausted from the end to which the base is subsequently attached. This construction consequently requires that an exhaust tube be incorporated into the lamp-stem, and that the tube be provided with a constricture positioned a substantial distance from the end which is in consolidation with the stem. In the formation of this constriction, certain features are desirable, as, for example, that the constricted or attenuated portion be substantially cylindrical and of uniform wall thickness, and it is the object of this invention to provide an automatic machine capable of forming constrictions in tubes which will meet the above-mentioned requirements.

In the accompanying drawing, Fig. 1 is a side elevation of my machine; Fig. 2 is a plan view of Fig. 1, with several of the constriction-forming heads and one of the burners removed; Fig. 3 is an elevation of one of the constriction-forming heads; Fig. 4 is a side view of the head shown in Fig. 3; Fig. 5 is a vertical cross-sectional view of the head taken on line V—V in Fig. 3 and showing a jaw in an open position; Fig. 6 is a cross sectional view of the head taken on line VI—VI in Fig. 4; and Fig. 7 is a view of a constricted tube.

Similar numerals indicate like parts throughout the several views.

The invention includes a table 2, upon which is located a hub or bearing having a spindle 3 mounted rotatably therein. Rigidly secured to the spindle is a hexangular carriage 4 provided with a hub 5 located at each corner. The six hubs are adapted to furnish bearings for a corresponding number of rotatable members which will be hereinafter termed constriction-forming heads; consisting, in part, of upper and lower chucks 36 and 41. The heads will be more fully described below.

The carriage is revolved step-by-step, in successive stages, by means of a Geneva stop mechanism, composed of a slotted plate 10 secured to the hub of the carriage 4. The motion is transmitted by the engagement of slots 8, in plate 10, with a roller 11 carried on a driving wheel 9, pinned or otherwise secured to a shaft 18 which passes through a suitable bearing 19 integral with the table 2. The lower end of the shaft 18 is equipped with a worm wheel 17 that meshes with a worm 16, fast to a main driving shaft 15 which may be harnessed to any suitable source of power.

The heads are rotatably supported on the carriage by means of shafts 20 that are integral with the heads and are journaled in the hubs 5. Collars 5′ may be pinned to the shafts 20 to prevent a downward movement of the heads in the hubs. Cylinders 21 are secured rigidly to the lower ends of the shafts 20 to cause rotation of a head when the said cylinders are drawn into frictional engagement with one of a series of continuously rotating rollers 32, 33 and 34 which are rotated by means of their connection with the main driving shaft 15.

Connection between the rollers and the main drive is provided by suitable mechanism including a worm wheel 24 secured to the shaft 15, and adjacent to the shaft 15 is a depending bearing 25 in which a shaft 26 is rotatably mounted.

Attached to the upper end of the shaft 26, which projects above the table 2, is a roller 32, and similar rollers 33 and 34 are located at different points above the table and are attached to shafts 12 and 14, respectively.

The shafts and rollers are rotated by means of a helical gear-wheel 27 secured to a sleeve 27′ which is rotatably mounted upon the shaft 26 and may bear upon the upper end of the hanger or bearing 25. The gear-wheel 27 being in mesh with a helical-gear-wheel 24 secured to the driving shaft 15, transmission of motion to the rollers is effected by means comprising a chain sheave 24′ secured to the sleeve 27′ and a sheave 14′ fastened to the spindle 14 (see Fig. 2). The sheaves 24′ and 14′ may be connected by an endless chain 31′. Thus a rotation of the sleeve 27′ will result in a rotation of the shaft 14 and since the diameter of the sheave 14′ is relatively large, it will be un-

derstood that the shaft 14 may be driven at a considerably lower rate of speed than that of the driving sheave 24'. An idler 37' may be provided to maintain the chain 31' taut.

This reduced motion is transmitted to the shafts 12 and 26 through an endless chain 31 which engages with chain sheave 29 on the shaft 14 and with sheaves 28 and 30 on the shafts 12 and 26 respectively. As illustrated, the sheave 30 is of less diameter than the sheaves 28 and 29, thus the rotation of the shaft 26 and consequently the roller 32 will be at a greater rate of speed than the other rollers and a head when reaching this point will be rotated faster, which may be desirable at the first heating stage. It is obvious, however, that all the sheaves may be of a uniform diameter to give a uniform rate of rotary motion to the heads.

The constriction-forming heads, in which a tube is supported and elongated, include upper and lower chucks 41 and 36, respectively. The lower chuck 36 is stationary and is secured at the upper end of the vertical shaft 20. Fastened at each side of the chuck 36 and projecting upwardly therefrom, are positioned slotted guides 39 and 40, and the upper chuck 41 is mounted to slide vertically upon the said guides. The actuation of the movable chuck 41 is controlled by the movement of a plate 37 arranged for vertical reciprocation upon the shaft 20 and connected to chuck 41 by rods 42 and 43 which move in the slots of the guides 39 and 40. A change in the position of the plate 37 will thereby cause a corresponding change in the location of the movable chuck. The end of a pin 137 is held tensionally in contact with the shaft 20, by the action of spring 138, to provide a brake whereby the plate 37 is held in an upper position.

Each chuck is adapted to secure the end of a tube and, for this purpose, is provided with a movable jaw 45 hinged on a pin 46. (See Fig. 6.) At the end of, and pivoted to, the jaw 45 is a sliding pin or plunger 47 arranged to be moved transversely of the chuck to open the jaw 45 in opposition to a spring 48 provided to retain the jaw in a normally closed position. A V-shaped recess 38, vertically disposed upon the side of the chuck opposite the jaw, acts, in the case of a cylindrical object, such as a glass tube 110, to center it in the head.

It will, therefore, be seen that, when the plungers 47 have been moved from their normal positions, the jaws are opened, and a release of the plunger permits the tension springs 48 to move the jaws 45 and secure the ends of a glass tube when inserted between the jaw 45 and in the recesses 38. For the purpose of temporarily supporting a tube applied to the open jaws of the head, the downward movement of the tube is obstructed by a stop 55. The stop is composed of a stop-plate 56 adjustably secured to, and movable with, a sliding rod 57 which normally retains the stop-plate in the path of the work, through the action of a helical spring 58 disposed between a collar 59 and the body of the chuck.

When the head is in position on the carriage, it may be moved in operative relation to mechanism for automatically actuating the jaws of the chucks simultaneously, for the insertion or removal of the work blanks, and the stop 55 is also adapted for automatic movement at the proper moment, previous to the opening of the jaws, in order that the treated tubes may drop through a suitably located passage and into a receptable. The stop 55 is adapted for vertical adjustment, the vertical portion of the member 56 being secured to the rod 57 by means of a screw 157 which passes through a vertical slot 156 in the said member thus providing for the vertical movement of the stop. It will, therefore, be seen that by adjusting the position of the stop, heat may be applied to any predetermined point lengthwise of the tube and the position of the constriction may be varied.

A work blank is inserted and secured in the head when the movable chuck 41 is in its lower position. Heat is applied to the work by properly positioned burners 165 and 166 arranged to heat the work at one or more stages of the carriage, at which places the rotation of the head and work is effected by a contact of the driving rollers 32, 33 and 34 with cylinders 21. At the stage where the rotating work or blank 111 has been rendered sufficiently plastic, the plate 37 contacts with roller 66, (see Fig. 1) which is supported at the upper end of a rod 67 slidable in a bearing 68. The lower end of the rod is in contact with a movable cam surface 69 which acts to lift the roller 66, thereby raising the plate 37 to effect the upward movement of the chuck 41 to elongate the plastic portion of the tube. It will be understood that roller 68 permits the rotation of the head during the lifting action of the cam 69 and during the alongation of the tube. The cam 69 is carried on a rod 70, which is reciprocated by means of a cam surface 71 laterally disposed about the driving shaft 18 and in contact with the end 73 of the rod 70, the contact being maintained by the action of spring 72 disposed between a collar, fixed to the rod, and the bearing in which the rod is slidably supported.

Mechanism for automatically separating the jaws to release or receive the work and to return the chuck 41 to its lower position is controlled by the shaft 18 which is actuated by means of its connection to the main

drive shaft 15, as hereinbefore described. Upon the shaft 18 is secured a disc 75, the upper surface of which is provided with raised or undulated portions 76 and 82 lying in concentric paths. Slidably mounted in bearings on the table 2, are vertically disposed rods 60 and 77 (see Fig. 2) having the lower ends thereof in contact with the upper surface of disc 75. Each of the said rod ends is positioned in the path of movement of one of the above mentioned undulations in such a manner that the movement of the disc 75 will cause the reciprocation of the rods 60 and 77 in a given successive order, governed by the location of the undulations.

In contact with rods 60 and 77 and pivoted on a pin 78, are bell-cranks 62 and 79 provided with springs 106 which act to maintain the horizontal arms of the cranks in contact with the rods and thereby tensionally maintain the rods in contact with the surface of the disc 75. An upwardly projecting arm 80 of the crank 79 is arranged to contact with a lever 81 fixed to a trunnion or shaft 83 supported at its ends in bearings of two standards 93. Secured to the opposite ends of the trunnion 83, are rocking arms 88 having notches 89 adjacent to the upper ends thereof and arranged to engage with pins 90 on slidable rods 91 supported in bearings 92 at the upper ends of the standards 93, the said bearings being provided with slots 87 to permit the movement of the pins 90.

Rigidly attached to the rods 91 and upon the end adjacent to the heads, are positioned uprights 85 and 86, and, suitably located upon the uprights, are projections or pins 95 and 96 located in alinement with the plungers 47 which operate the jaws 45. The uprights are retained in normal position by means of helical springs 104 disposed between a collar 107 and the bearings 92.

The rotation of the disc 75 causes the upward movement of the rod 77 and a consequent transmission of motion to the trunnion 83 which, in turn, effects a movement of the uprights 85 and 86 toward the head, moving pins 95 and 96 into contact with the plungers 47 of the jaws to open the chucks 36 and 41. The upright 86, which operates the head at the work-delivering stage, is provided with a lug 97 arranged to contact with the rod 57 to move the stop plate 56 from the path of the tube, slightly in advance of the opening of the jaws 45, and a continued movement of the upright 86 actuates the chucks 36 and 41 subsequent to the removal of the stop 55 to effect the release of the tubular body.

The chucks are opened for the insertion of work by the action of the upright 85, the operation of which is similar to that of the upright 86, except that the lug 97 is omitted, and the stop plate 56 obstructs the passage of a tube and supports it in position to be secured by the chucks 36 and 41.

Means for returning the upper chuck 41 of each head to its lower position is provided by crank 62 and rod 60 which are actuated in a like manner to that of rod, 77 and crank 79, arranged to contact with and move a lever 61 which is similar to the lever 81 and is fixed to a sleeve 63 loose on the trunnion 83. Integral with the sleeve 63 is a lever 84 having its end 74 extended a sufficient distance toward the head to be located above the edge of the circular plate 37 during the stationary positions of the carriage 4. The action of the lever 84, when rocked by means of its connection with the disc 75, is to cause the end 74 to bear upon and move the plate 37 and thus return the chuck 41 to its lower position subsequent to the release of the finished work and previous to the insertion of a new blank.

It is obviously necessary to provide a means for maintaining the head in a fixed position relative to the carriage 4 during the work-releasing and inserting operation and this is accomplished, as shown in Figs. 1 and 2, by providing a track 98 into which a stud 99 (integral with but eccentric to the cylinder 21 of the head) is arranged to pass, during the period of movement of the carriage in which the jaws are operated.

For the purpose of insuring the correct position of the stud 99 for entrance to the track 98, a segment is removed from the cylinder 21 to provide a flat portion 94 whereby the rotation of the cylinder is interrupted when moved away from contact with the roller 34 and the said flat portion contacts with and slides upon a guide 105. The roller is thus maintained in the proper relation to the track, and the stud may enter therein and maintain the head in its required position during the actuation of the chucks. The guide 105 is pivoted on a support 100 and is held tensionally in a normal position by means of springs 102 and 103 which are connected to the support 100 and to suitably extended arms 101 upon the guide.

In practice, the constriction-forming machine is operated in the following manner. A chute 120 is arranged for feeding blanks from a hopper having any suitable form of automatic feed mechanism. The carriage 4, which is rotated step-by-step in a clockwise direction, by means of its connection to the driving shaft 15, operates to bring the head in line with the chute, at which place the jaws of the chucks are opened by contact with lugs 95 and 96 upon the movable upright 85.

A blank 111 is then permitted to drop into the head and be temporarily supported by the stop 55, while the lugs on the upright

are receding from contact with the jaw plunger pins and allowing the jaws to close upon and secure the ends of the blank for further operation. A blank thus secured is carried about the table through the agency of the Geneva drive which causes the carriage to remain stationary during each complete revolution of the shaft 18. At suitable points during one or more stationary periods of the carriage, heat is applied locally to the blank by means of the burners 165 and 166.

When a tube has been permitted to remain in the heated region for a given length of time and has been rendered plastic, the upper chuck is moved away from the lower chuck, causing a reduction in the calibre of the heated portion of the tube and thereby forming the constriction in the finished tube as shown. (See Fig. 7.)

Although heat may be applied to the work at a plurality of stages, it has been found preferable to make such application of heat at two stages or steps during the rotation of the carriage, and burners for this purpose are shown and are indicated by the reference numerals 165 and 166. The burners 166, as illustrated, act to give a preliminary heat to the tube, and the burner 165 supplies the final heat at the position where the elongation of the tube is made. After the upper chuck has been lifted and the heated portion attenuated, the carriage rotates until the head is again opposite the jaw-opening mechanism, namely, the movable upright 86. When in such position, the head registers the tube above a suitably disposed outlet in the table, below which is located a receiving receptacle.

The upright 86 is then moved toward the head and the lug 97 thereon contacts with the rod 57 to remove the stop-plate 56 in advance of the opening of the jaws of the chucks, which is effected by the contact of their plungers 47 with lugs 95 and 16 upon the upright. The mechanism for actuating the uprights and rods which carry the same is timed, by means of the various mechanical movements, to open the jaws of the chucks at the required points.

It is evident that the jaws of the chucks must be opened when the upper chuck is in its higher position, and it is, therefore, necessary to return the chuck to its lower position before a blank is inserted in the head. The lever 84, therefore, actuates, intermediate to the tube-inserting and removing positions of the head, to draw the upper chuck downwardly by contact of the lever 84 with the disc 37, thereby leaving the head in the proper position for the insertion of a blank.

It will be understood that a tube may be automatically delivered to the head, carried in a circular path, rotated in one or more heated zones and then elongated by a separation of the chucks to form a constricted tube. The constricted tube is conveyed to a position above a receiving receptacle, and the chucks which hold the tubes are operated and the tube is delivered as a finished product.

Where it is necessary to treat objects in quantity, as in the case of the present exhaust tubes, it is of great importance to provide a machine which will automatically perform the necessary functions for such purpose, with but a small amount of attention or exercise of skill on the part of an operator, and this result is attained by the invention.

It will be understood that the number of constricted tubes produced in a given time will depend upon the number of heads supported upon the carriage. We may, therefore, if desirable, multiply the number of heads to increase production.

It is also obvious that, when desirable, the heads, as employed in the construction, may be made non-rotatable or fixed in the hubs, in which case, the driving rollers 32, 33 and 34 and the chain 31, by which they are driven, may be removed. If necessary, the burners may be disposed at both sides of the path of the moving work to provide a heated zone of greater area.

While we have illustrated a preferred embodiment of our invention, it is obvious that many structural changes may be effected therein, and it is, therefore, to be understood that our invention is to be limited only by the scope of the appended claims.

What is claimed herein is:

1. A machine for producing tubular bodies with constricted portions intermediate their ends comprising a plurality of work-holding heads, a pair of gripping members for holding bodies in vertical positions, means for moving said heads successively to receive said bodies, means for locally heating the bodies, cylindrical members connected with the heads, driving rollers to engage with said members to rotate the heads during heating of the bodies, means for positively stretching the bodies and means for limiting the stretching operation to provide constrictions at the heated portions and means for actuating said gripping members to release the bodies for discharge endwise by gravity from the machine.

2. A machine for producing a constricted portion intermediate the ends of a tube comprising a rotary carrier, a plurality of heads mounted on said carrier, upper and lower pairs of tube gripping members incorporated in each head, means for moving the heads successively to position to receive a bulb, means for actuating the gripping members to secure a tube at the ends thereof, means for softening a portion of the tube be-

tween the pair of gripping members and means for positively moving at least one of said pairs of gripping members to stretch the softened portion of the tube until the diameter thereof is less than the diameter of the portions of the tube secured between the gripping members and means for discharging said constricted tube members and means for automatically actuating said members to release a tube for discharge by gravity from the machine.

3. In a machine for providing a length of a glass tubing with a constricted portion intermediate its ends, the combination of a rotatable carriage, a plurality of heads mounted on said carriage, each head being provided with a plurality of pairs of upper and lower gripping members, means for automatically actuating said members to receive and grip a tube to hold the same in a vertical position, means for applying heat to render plastic a tube secured by said gripping members, means for separating the respective pairs of gripping members to stretch said tube to constrict the plastic portion thereof, means for automatically actuating said gripping members to release the constricted tube for discharge by gravity and a chute for guiding the tube from the machine.

4. A machine for providing a portion of the length of a tubular body with a constriction intermediate its ends comprising a conveyor, a plurality of heads mounted on said conveyor, upper and lower gripping means associated with said heads for securing the ends of a tube, means for automatically actuating the gripping means to secure a tube, means for softening a portion of the tube intermediate the ends, means for positively operating the gripping means to stretch the softened portion and produce a constricted portion and means for automatically actuating the gripping members to release a tube for discharge by gravity endwise from the machine.

5. A machine for providing a length of a tubular body with a constricted portion intermediate its ends, the combination of a rotatable carriage, means for imparting a step by step movement to the carriage, rotatable heads mounted on the carriage, said heads being provided with upper and lower chucks to grip the ends of the tubular bodies to vertically support the same, means for applying heat to render plastic a portion of the supported body, means for automatically actuating the upper and lower chucks to stretch the plastic portion and means for automatically releasing the body for discharge from the machine by gravity and a guide to maintain a movement of said body in an endwise direction.

6. In a machine for altering the calibre of a portion of the length of a glass tube, the combination of a rotatable carriage and a support therefor, means for imparting an intermittent rotary motion to the carriage, a plurality of heads journaled in hubs spaced at intervals adjacent to the periphery of the carriage, cylinders connected with the said heads, driving rollers disposed below the carriage and arranged to rotate the heads at given stages during a cycle of the carriage, upper and lower chucks, means for automatically operating said chucks to receive and secure a tube, means for applying heat locally to said tube and means for automatically operating the said chucks to alter the calibre of the heated portion of the tube.

7. In a machine for changing the calibre of a portion of the length of a glass tube, the combination of a rotatable carriage, a plurality of heads comprising a pair of work-holding chucks mounted upon the carriage, means for operating said chucks to secure tubes, a driving cylinder secured to said heads, means for applying heat to a portion of the tube when secured by the chucks, means for moving the said driving cylinder into frictional contact with a power wheel to rotate the heads during the application of heat to the tube and means for automatically separating the said chucks during a rotation thereof to attenuate the heated portion of the tube.

8. A machine for reducing the calibre of a glass tube comprising a carriage arranged to revolve upon a spindle, a plurality of hubs disposed at intervals adjacent the periphery of said carriage, heads rotatably mounted in the hubs, a vertically reciprocable chuck and a stationary chuck arranged upon each head, means for intermittently rotating the carriage, means for elevating said reciprocable chuck during a movement of said carriage.

9. In a machine for forming a constriction in a tubular body, the combination of a rotatable support, a plurality of constriction-forming heads comprising one stationary and one movable chuck rotatably mounted upon said support, driving wheels to intermittently rotate the heads, a power wheel adapted to impart a step-by-step movement to the support, means for automatically operating the chucks to secure a tubular body fed thereto therein, burners arranged adjacent to the path of movement of the tubular body to provide heated zones wherein the body may be temporarily retained during several stationary positions of the support, means for automatically separating the chucks to elongate the heated tubular body and means for automatically discharging said elongated body.

10. In a machine for forming constrictions in tubular bodies, the combination of a rotatable carriage, constriction-forming

heads mounted rotatably upon the carriage, said heads comprising a pair of chucks, means for automatically operating the chucks to secure tubular bodies, driving cylinders integral with the heads, means for imparting a step-by-step movement to the carriage to provide a plurality of stages, a plurality of burners arranged adjacent to one or more of said stages to provide heated regions in which the bodies may be temporarily retained, continuously rotating rollers adapted to contact with the cylinders of the heads to rotate the heads during the application of heat and means for automatically separating the chucks to elongate the said heated bodies during a rotation thereof.

11. In a machine for reducing the calibre of a portion of the length of a tubular body, the combination of a rotatable carriage, having a plurality of rotatable heads mounted thereon, each of said heads being adapted to carry one stationary chuck and one movable chuck, means for maintaining the movable chuck in alignment with the fixed chuck, means for imparting an intermittent rotary movement to the carriage, a plurality of burners arranged to provide heat zones in the path of the tubular body to heat the same, means for separating the chucks to elongate the heated body, means for maintaining the heads in a given relation with the carriage during a partial movement thereof and means for operating the chucks to release the elongated body.

12. In a machine for reducing the calibre of a portion of the length of a tubular body, the combination of a rotatable carriage, having a plurality of rotatable heads mounted thereon, each of said heads being adapted to carry one stationary chuck and one movable chuck, means for adjusting the tubular body vertically in the chucks to vary the position of the constricted portion, means for imparting an intermittent rotary movement to the carriage, a plurality of burners arranged to provide heat zones in the path of the tubular body to heat the same, means for separating the chucks to elongate the heated body, means for maintaining the heads in a given relation with the carriage during a partial movement thereof and means for operating the chucks to release the elongated body.

In testimony whereof, we have hereunto subscribed our names this 4th day of February, 1921.

JAMES BRYANT WHITMORE.
JOHN EBLING FERGUSON.