Oct. 16, 1928. 1,687,690

J. PETRY

DENTAL CROWN

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FIG. 1

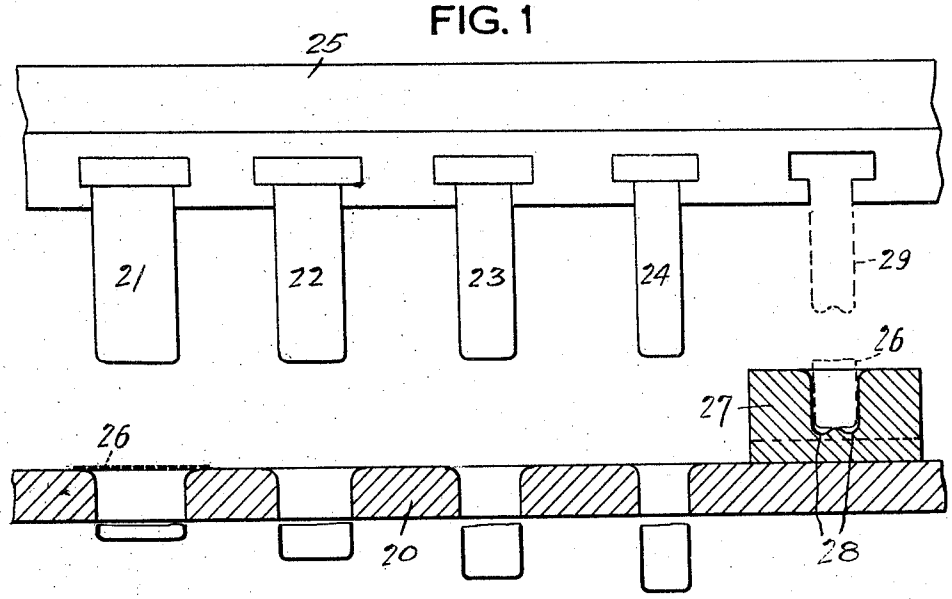


FIG. 2

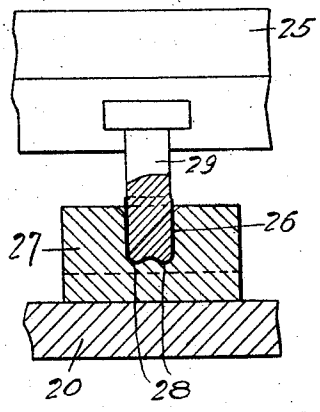


FIG. 3

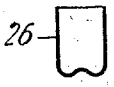


FIG. 4

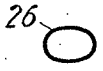


FIG. 5

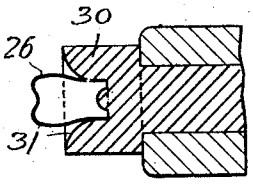


FIG. 6

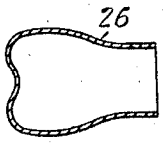
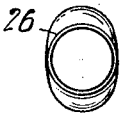


FIG. 7



INVENTOR

Jacob Petry

By Kay, Totten & Martin,

Attorneys.

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FIG. 8

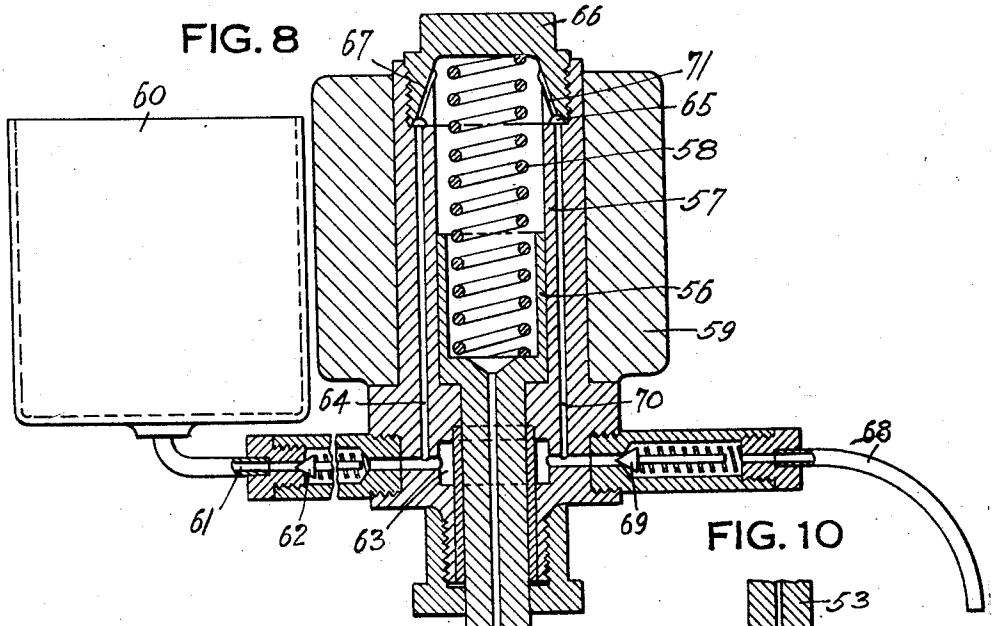


FIG. 10

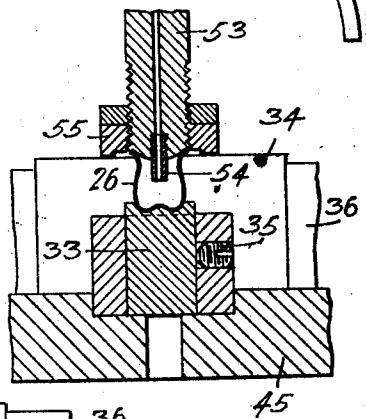
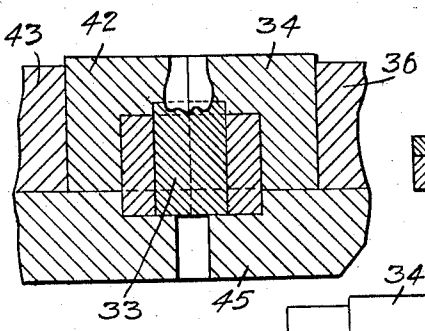
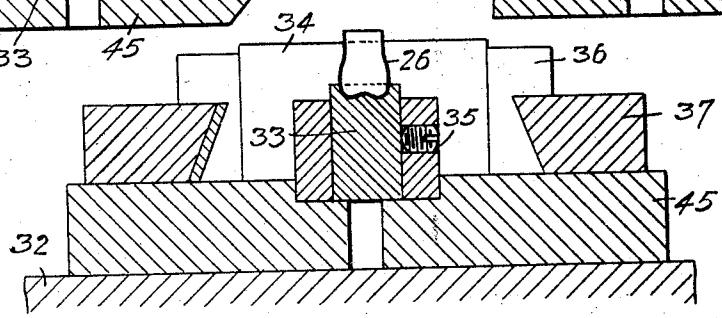


FIG. 9





INVENTOR

Jacob Petry

By Kay, Totten & Martin,

Attorneys.

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FIG. 11

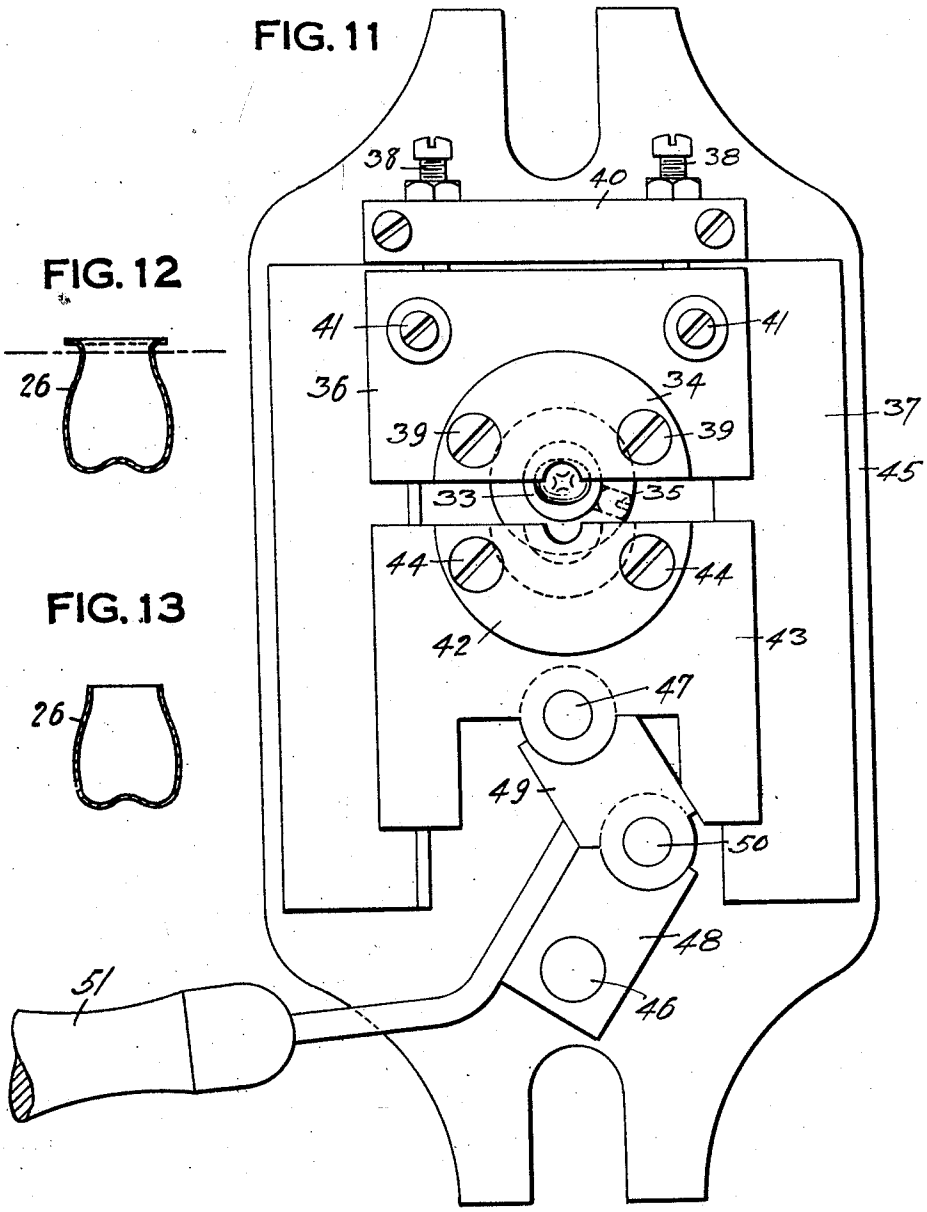


FIG. 12

FIG. 13

INVENTOR

Jacob Petry

By Kay, Tolles & Martin,

Attorneys.

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J. PETRY

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FIG. 14

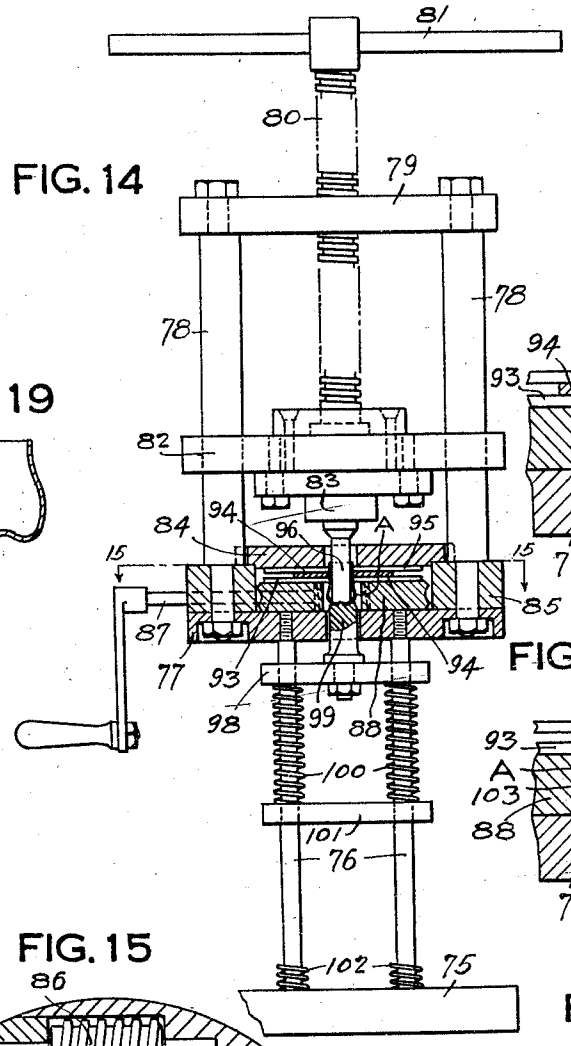


FIG. 17

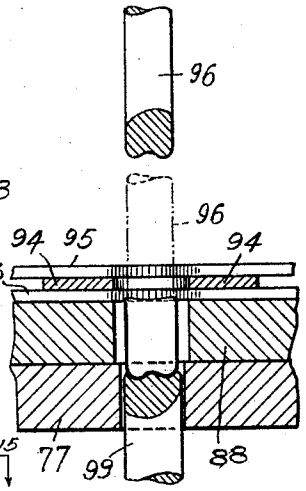


FIG. 19

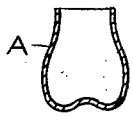


FIG. 18

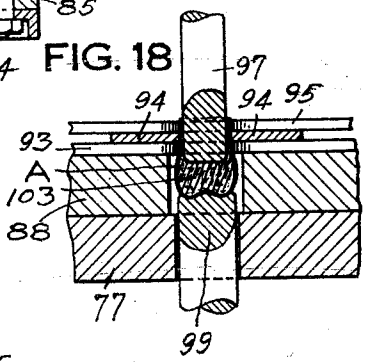


FIG. 15

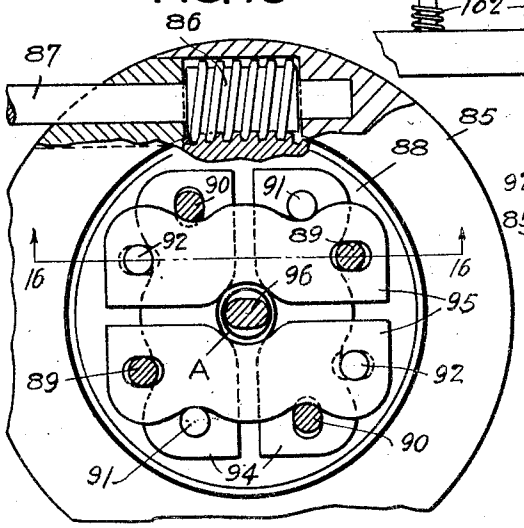
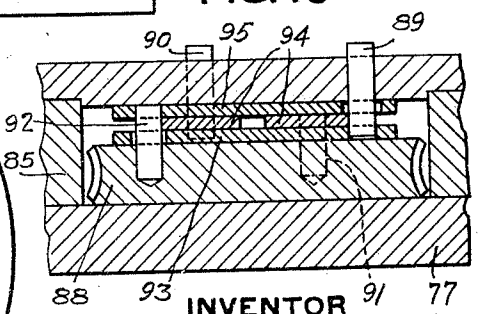


FIG. 16



INVENTOR

Jacob Petry

By Ray, Totten & Martin,

Attorneys.

Patented Oct. 16, 1928. 1,687,690

UNITED STATES PATENT OFFICE.

JACOB PETRY, OF PITTSBURGH, PENNSYLVANIA.

DENTAL CROWN.

Application filed December 8, 1925. Serial No. 74,203.

My invention relates particularly to tooth crowns such as are employed in dentistry.

My invention has for its object the provision of an improved apparatus for and a method of making tooth crowns, whereby a better fitting crown is obtained, and one which is free from various imperfections heretofore commonly present therein.

Another object of my invention is to simplify and improve generally the construction of and form of dental tooth crowns.

In making the tooth crowns it is desirable that the occlusal portion be provided with a chewing surface that shall be of such diameter or width as to leave no space between it and adjacent teeth or crowns, in order to present a substantially continuous chewing surface and to avoid the unsightly appearance which would result in cases where a considerable space was present. Such spaces not only result in collection of food particles and the breeding of germs, but the gum tissues at those points will be irritated through pressure while masticating food, causing bleeding and receding of the gums, as well as unnecessary pain.

The natural tooth at the gingival or gum line is ordinarily of smaller diameter than at its outer or occlusal end. Therefore, in order that a crown may fit properly, it is necessary that it tapers from its occlusal portion to its gingival opening.

Crowns are commonly made from what might be termed "cartridges" of gold or other suitable metallic substance that are of substantially uniform diameter from their closed ends to their open ends. The problem then is to reduce the diameter thereof toward the open end, but difficulty has been experienced by reason of the fact that in making such reduction in diameter objectionable irregularities, such as indentations, creases or fold-lines, and the like occur. In some cases the crown has been split for a portion of its length and the edges of the split portion overlapped and soldered in order to cause it to closely embrace the tooth at the gingival line. In either instance, it is almost impossible to secure the desired closeness of fit between the crown and the tooth, so that destructive foreign matter finds its way into the space between the crown and the teeth and decay results.

It has also been customary to expand the occlusal end of the crowns somewhat but, by the methods heretofore employed, such expansion often results in excessive thinning of the metal so that the finished crown is weakened to an objectionable degree and perhaps even torn when expanded.

In the manufacture of seamless crowns, it has been the custom to employ male and female die members of such form that the upper or open end of the crown is of at least as great diameter as the lower or occlusal end thereof, and usually of slightly greater diameter, owing to the necessity of removing the expanded crown from a female die member. This is directly the opposite of the shape desired, that is, in the completed form the crown should be wider at its base, and relatively narrow at its open or gingival end. By employing the dies shown in the accompanying drawing, it is possible to form a crown with a relatively large lower end, in a mold or die having only two movable parts, and nevertheless permit convenient removal of the crown from the dies without distortion.

In the accompanying drawing I have shown some of the ways in which my invention may be practiced. Fig. 1 is a schematic view showing the manner in which the crown blank may be passed through the early stages of formation; Fig. 2 is a view showing the manner in which a blank is operated upon by the occlusal forming die of Fig. 1; Fig. 3 is a vertical sectional view of the blank, removed from the die of Fig. 2; Fig. 4 is a plan view thereof; Fig. 5 is a view showing one manner in which the open or gingival end of the blank may be reduced in diameter; Fig. 6 is a sectional view, on an enlarged scale, of the blank of Fig. 5; Fig. 7 is a plan view thereof; Fig. 8 is a vertical sectional view of apparatus for performing a further step in the formation of the blank; Fig. 9 is a transverse sectional view of a portion of the apparatus of Fig. 9; Fig. 10 is a view of a portion of the apparatus of Fig. 8, but showing the plunger head in operative position with respect to a blank carried by the dies; Fig. 11 is a plan view of the dies of Fig. 8; Fig. 12 is a view showing the form of the tooth crown after it has been operated upon by the plunger head and dies of Fig. 8; Fig. 13 is a view showing the blank of Fig. 12 trimmed and ready for use by the dentist; Fig. 14 is an elevational sectional view of a

modified form of apparatus for forming crowns; Fig. 15 is a sectional plan view, on an enlarged scale, taken on the line 15—15 of Fig. 14; Fig. 16 is an elevational sectional view taken on the line 16—16 of Fig. 15; Fig. 17 is a sectional view, on an enlarged scale, of a portion of the apparatus of Fig. 14, showing one stage of the method; Fig. 18 is a similar view showing the process at another stage of the operation, and Fig. 19 is a view showing a completed crown.

Referring to Figs. 1 and 2 of the drawing, I show a die block or plate 20 that is provided with a number of holes with which plungers 21, 22, 23 and 24 cooperate. The plungers are shown as mounted on a vertically reciprocable head 25 that may be operated in any desired manner, to move the plunger into holes in the plate 20.

In making tooth crowns, a disc 26 of gold or other suitable metal is placed in the position shown, and the plunger head 25 brought down to depress said disc. The partially formed cartridge is then moved into the next smaller hole and its diameter reduced by the plunger 22. In the drawing I have shown four plungers of progressively smaller diameter, but a greater or less number may be provided, depending upon the size and character of the crown to be formed. The plungers are all preferably oval in cross section and the lower or occlusal end of the blank has its greatest diameter substantially equal to the greatest diameter of the finished crown, so that excessive expansion of the lower or closed end of the cartridge in order to form the usual enlarged occlusal surface, with consequent thinning of the metal, is avoided.

After the crown has been operated upon by the plunger 24 it is placed in a die 27 that is provided with depressions 28 which have the general form of the occlusal surface desired for the crown. A plunger 29 is provided with complementary surfaces and is brought into engagement with the crown, as shown more clearly in Fig. 2. The crown 26 is then of the form shown in Figs. 3 and 4.

The diameter of the gingival or open end of the crown is then reduced in order to bring it to substantially the diameter of the tooth at the gingival or gum line. This reduction in diameter should be made in such manner that there are no irregularities formed in the crown, such as creases or indentations. One manner in which the reduction may be made is indicated diagrammatically in Fig. 5 wherein a die 30 is provided. The die has a tapering mouth or opening 31 into which the open end of the crown 26 may be gradually inserted, the crown and the die meanwhile being given relative rotative movement through any suitable means. The crown, after being operated upon by the die 30, is in the form shown in Figs. 6 and 7, such views, however, being on an enlarged scale.

The next step in the formation of the crown consists in placing it in the die and subjecting the same to hydraulic pressure sufficient to expand the metal of the crown and in order to bring it to the desired contour and smoothness. This expansion is accomplished by means of apparatus shown in Figs. 8 to 11, inclusive. In these views I provide a base 32 to which is rigidly connected a bottom die 33 and a laterally disposed die 34. The die 33 is movably held in place by a set screw 35 which permits convenient substitution of dies 33 of various sizes and forms. The lateral die 34 is supported by a block 36 which has dove-tail connection with a plate 37 and is adjustable horizontally by means of adjusting screws 38 (Fig. 11). The lateral die 34 may also be readily replaced, since it is secured to the block 36 by screws 39. The set screws 38 operate through a block 40 that is secured to the base of the dies structure and the die block 36 is locked in position by means of set screws 41.

A second lateral die 42 is provided, such die being bolted to the block 43 that has dove-tail connection with the members 37. This die, as in the case of the dies 33 and 34 may be readily replaced by a die of other form, since it is attached to the block 43 by means of screws 44.

The members 37 are secured to a plate 45 which is in turn supported by the base 32. A pivot pin 46 extends upwardly from the plate 45 and a pivot pin 47 is carried by the block 43. Toggle links 48 and 49 are joined to the pivots 46 and 47, respectively, and are pivotally connected to one another at 50. A handle 51 is secured to the link 48. When the handle 51 is swung about the pivot 46 as an axis, the link 48 will be actuated to move the link 49 and shift the block 43 laterally.

The hydraulic plunger apparatus which cooperates with the dies just described, comprises a plunger 53 that has a longitudinal passage and a nozzle 54 communicating with said passage. A collar 55 has screw threaded engagement with the bottom of the plunger and is adjustably longitudinally thereof to adapt it to metals of different thicknesses or to dies of different dimensions.

The plunger 53 is enlarged at its upper end to form a piston-like portion 56 that reciprocates in a cylindrical casing 57, the plunger being normally held in its lowermost position by a compression spring 58 interposed between the upper end of the cylinder 57 and the plunger 53. The cylinder 57 is carried in a head block 59 that is reciprocated vertically in any desired manner in order to bring the lower end of the

plunger 53 into operative relation with respect to the dies therebeneath.

A reservoir 60 is provided for containing oil or any other suitable fluid and communicates through a passage 61 and an inwardly opening check valve 62 with a passage 63 in the wall of the cylinder 57, the passage 63 extends for some distance circumferentially of said wall and has communication with a plurality of vertically extending passages 64 which are formed in the wall of the cylinder 57. The passages 64 in turn communicate with an annular passage 65 in the underside of the cylinder head 66. The cylinder head is provided with a plurality of passages 67 that communicate at their upper ends with the interior of the cylinder 57.

An exhaust pipe 68 has communication, through an outwardly opening check valve 69 with a vertical passage 70 formed in the wall of the cylinder. The vertical passage 70 communicates with the interior of the cylinder through a passage 71, formed in the cylinder head 66.

When a crown 26 has been passed through the stages shown in Figs. 1 to 7 inclusive, it is placed in the dies 33, 34 and 42 in a manner as shown in Fig. 8. The oil from the reservoir 60 has been previously drawn into the cylinder 57 by moving the piston 56 and plunger 53 carried thereby to their extreme upper position against compression of the spring 58 and then permitting such piston to descend under the action of the spring, thus drawing in a charge of oil from the reservoir. With a crown in place in the die and a charge of oil present in the cylinder, the head 59 is lowered to bring the lower end of the plunger 53 into engagement with the upper edge of the crown 26. As such lowering movement continues, the lower end of the plunger, by reason of its conical form, expands the upper end of the crown 26 in the manner shown in Fig. 10. The crown being of relatively soft metal, a tight seal is thereby provided which prevents the escape of the oil that is forced through the plunger into the crown, by continued downward movement of the head 59. The fluid is placed under sufficiently high pressure to expand the cartridges so much as may be necessary to completely fill the dies. The lower face of the collar 55 may be provided with a seating surface that engages the upper sides of the dies 34 and 42 to effect a still more complete sealing action against the escape of oil.

Usually the volume of oil within the cylinder 57 is in excess of the amount required and it is desirable that provision therefore be made to permit the escape thereof when the head 59 is forced downward a considerable distance. This escape is effected through the conduits 71 and 70 and the check valve 69, to the drain pipe 68, from whence it may be returned to the reservoir 60. As the check valve 62 opens inwardly toward the cylinder, oil will be drawn from the reservoir upon downward movement of the piston but will be prevented from flowing back into the reservoir upon upward movement of the piston. On the other hand the valve 69 opens outwardly so that air will not be drawn into the cylinder to the exclusion of oil from the reservoir and to permit the expulsion of surplus oil, as above explained.

When the crown has been operated on, as shown in Fig. 10, the plunger 53 is retracted and the handle 51 turned to slide the die block 43 to inoperative position. The crown may then be readily removed without moving the dies 33 and 34. I believe this manner of forming an article with an enlarged inner end, between two lateral and one bottom die of such form that the article can be removed from the dies simply by removing one of the lateral dies, is new.

When the crown has been removed from the finishing dies it is of the form shown in Fig. 12. The final operation consists in cutting off the flared upper end of the crown, thereby bringing it to the form as shown in Fig. 13.

In Figs. 14 to 19, inclusive, I have shown a modified form of apparatus by which dental crowns similar to those shown in Fig. 13 may be formed. This latter form of apparatus is particularly suitable for reducing the diameter of the crowns above the occlusal surfaces thereof, and involves radially moving dies or plates that are gradually drawn inward to reduce the spaces therebetween, as the crown is moved downwardly between them. This form of reducing mechanism may be substituted for the spinning operation in the conical die of Fig. 5.

The apparatus of Fig. 14 is mounted upon a base 75 which supports a framework, only a portion of which is shown. The portion shown comprises uprights 76, to the top of which is secured a block 77 above which extend guide posts 78 upon which is mounted a head block 79 that has screw threaded engagement with a screw shaft 80 which is provided with a handle 81. The screw shaft 80 is connected to a cross head 82 which is movable vertically along the guide posts 78. The cross head 82 carries a chuck 83 of any desired form, for holding plunger dies to be hereinafter described.

A stud plate 84 is provided with diametrically disposed recesses, the walls of which partially embrace the posts 78, so that it will be non-rotatable with respect to the posts. The plate 84 is removable when the cross-head 82 has been raised sufficient distance to

permit the plate 84 to be tilted so that the edges thereof will clear the inner sides of the posts 78.

An annular gear case member 85 is mounted upon the block 77 and is held in place thereon by the lower ends of the guide posts 78. The member 85 is recessed for the reception of a worm 86 and is provided with suitable bushings for a shaft 87 by means of which said worm is operated. A worm gear 88 is mounted within the gear case 85 and meshes with the worm 86.

The block 84 is provided with two pairs of studs 89 and 90 and the worm gear 88 is provided with two pairs of studs 91 and 92, the studs 92 being longer than are the studs 91.

Three pairs of radially movable die plates 93, 94 and 95 are provided, resting upon the worm gear 88. Each die plate is provided at one end with a circular opening that closely engages one of the studs, and at its opposite end is provided with a slot whose longer walls engage one or more of the studs, but whose end walls normally do not come in contact with the studs. The round holes in the plates of each pair are disposed at opposite ends of such plates, or in other words diagonal with respect to each other. For instance, the round holes of the plates 94 are engaged by the upper ends of the studs 91, while the studs 90 pass through the slotted openings in said plates. Similarly the upper ends of the studs 92 have close-fitting engagement with the upper plates 95; the downwardly extending studs pass loosely through the slots in the plates 95; the lower extremities of the studs 89 closely engage holes in the plates 93, and the studs 92, intermediate their ends, pass through the slots in the plates 93.

The studs 89 and 90 are rigidly supported in the plate 84 and therefore are held against movement about the axis of the gear wheel 88. The studs 91 and 92 are rigidly secured to the gear wheel 88 and are therefore rotatable therewith. It will be seen therefore that if the worm 86 be so turned as to rotate the gear wheel 88, in a counter clock-wise direction, as viewed in Fig. 2, the studs 91 and 92 of the gear wheel will each be so moved as to carry one end of the plates 95 and 94, respectively, toward the vertical and horizontal diametric lines, respectively, of the gear wheel (Fig. 2), the opposite end of each plate being held against movement by means of the studs 90 and 89, respectively, that are carried by the fixed plate 84. The mid portions of such plates will therefore be moved toward the axis of the gear wheel 88, thus reducing the openings between said plates. The plates 93 will be similarly moved, by reason of their engagement with the studs 89 and 92.

Each of the plates at its inner edge has a curved recess, although the curvature of the recesses in the plates 95 and 93 are more oval than are the recesses in the plates 94. When the gear wheel 88 is moved in a clockwise direction (Fig. 2), the mid portions of the die plates will of course move radially outward, to enlarge the spaces between the pairs of plates.

The chuck 83 is adapted to detachably support the plunger dies 96 and 97 while a die block 98 supports a bottom die 99. The block 98 is supported by means of springs 100 which are compressed by a vertically slidable plate 101 that may be held in elevated position in any desired manner, and which will fall upon cushioning springs 102 when released, permitting the die block 98 to fall.

In the operation of the device, a crown blank or cartridge, usually of uniform diameter and closed at one end, is provided and is mounted upon the bottom die 99 as shown in Fig. 14 whereupon the screw 80 to which the plunger die 96 is secured is moved down, forcing said plunger die into the cartridge, which is represented by the letter A, to press the bottom or occlusal portion thereof to the desired form, which in the present case is represented by two curved lines. The die 96 is then withdrawn and another die or mandrel 97 inserted in the chuck 83. The die 97, particularly at its lower end, is of smaller cross section than is the lower end of the die 96. Therefore wax or other suitable material 103 is introduced into the partially formed crown A to prevent distortion of the previously formed occlusal portion. The die 97 is then caused to move downwardly by turning the handle 81 and at the same time the shaft 87 is rotated slowly in order to gradually draw in the lateral dies 93, 94 and 95. By reason of the simultaneous movements just referred to, the upper portion of the crown is gradually shrunk around the mandrel or die 97, as will appear more clearly in Figs. 1 and 5. The mandrel 97 may be oval in cross section as shown in Fig. 2, or may be of other cross sectional form, depending upon the shape of the particular tooth for which the crown is desired.

The mandrel 97 may be replaced by another mandrel of still smaller cross sectional area, in order to effect still further reduction of the gingival portion of the crown. While the desired reduction in diameter of the crown may in some cases be effected by the employment of but a single mandrel 97, two or more successively smaller mandrels may be required, particularly where considerable reduction in diameter of the crown is desired, since a too great reduction in diameter on a single pass may result in folds or dents in the crown.

After each pass of a reducing mandrel

the crown is moved up slightly by pressure of the springs 100, the lateral dies being retracted slightly, if necessary, to permit such movement. Upon the next drawing operation the crown is given another longitudinal downward movement, simultaneously with another inward movement of the lateral dies.

After completion of the drawing operation, the wax may be removed by heat, chipping it out, by acid, or in any other desired manner.

It will be apparent that the process may be performed by various other means than that shown in the drawing, and that it may be employed in other arts than that of dentistry.

I claim as my invention:

1. Die structure for forming cartridge-like members having their closed ends of greater diameter than their open ends, comprising a bottom die member, a lateral die member normally fixed relative to said bottom die member, and a second lateral die member movable with respect to the other members.

2. Die structure for forming cartridge-like members having their closed ends of greater diameter than their open ends, comprising a bottom die member, a lateral die member normally fixed relative to said bottom die member, and a second lateral die member movable with respect to the other members, one of said members being undercut.

3. Die structure for forming cartridge-like members having their closed ends of greater diameter than their open ends, comprising a bottom die member, a lateral die member normally fixed relative to said bottom die member, and a second lateral die member movable with respect to the other members, the said lateral die members having undercut portions.

4. Die structure for forming cartridge-like members having their closed ends of greater diameter than their open ends, comprising a bottom die member, and two lateral die members, one of which is movable relative to the other members and one of the lateral die members being undercut.

In testimony whereof I, the said JACOB PETRY, have hereunto set my hand.

JACOB PETRY.