United States Patent

[11] 3,612,352

[72] Inventor **Donald G. Smith**
299 Alhambra Circle, Coral Gables, Fla. 33134

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[45] Patented **Oct. 12, 1971**

[54] **AMALGAM CARTRIDGE AND METHOD OF MAKING SAME AND METHOD AND APPARATUS FOR DISPENSING AMALGAM FROM A CARTRIDGE**
48 Claims, 44 Drawing Figs.

[52] U.S. Cl. ..... **222/1,** 32/60, 141/77, 206/47 A, 222/94, 222/107
[51] Int. Cl. **B67b 7/30,** G01f 13/00
[50] Field of Search ..... 222/1, 94, 107; 53/113; 259/54, 72; 206/47 A; 264/294, 313; 83/607, 608, 609; 214/305, 310; 141/69, 77; 32/60; 24/255.1; 137/68; 138/177

[56] **References Cited**

UNITED STATES PATENTS

677,205	6/1901	Hackett	83/609 X
911,410	2/1909	Lane et al.	83/608 X
1,256,426	2/1918	Baltzley	24/255.1
1,417,743	5/1922	Kempton	264/294
2,195,967	4/1940	Liebmann	24/255.1
2,564,093	8/1951	Bijl	138/177
2,625,283	1/1953	Watts	214/310
3,028,000	4/1962	Clements	222/94 UX
3,487,965	1/1970	Gale	214/305 X

FOREIGN PATENTS

418,691	10/1934	Great Britain	141/77
697,723	9/1953	Great Britain	222/107

Primary Examiner—M. Henson Wood, Jr.
Assistant Examiner—Edwin D. Grant
Attorney—Shoemaker and Mattare

ABSTRACT: An amalgam cartridge comprises a closed flexible body means having a pair of separate chambers containing amalgam powder and mercury respectively. The body means includes a passage means for providing communication between the chambers, and deformable closure means normally closes off the passage means but can be deformed to permit mixing of the powder and mercury when desired.

An amalgam cartridge mixing and dispensing apparatus includes compression means for compressing a portion of an amalgam cartridge and deforming same to force the contents in the two chambers of the cartridge into engagement with one another. Mixer means is provided for engaging exterior of the cartridge to deform the cartridge in such a manner as to cause intimate mixing of the materials within the cartridge. Reshaping means engages the cartridge to reshape the mixed body of material within the cartridge to a desired configuration. Cutter means is provided for cutting off opposite ends of a cartridge within the apparatus, and ejection means is provided for ejecting the mixed body of material from the cartridge.

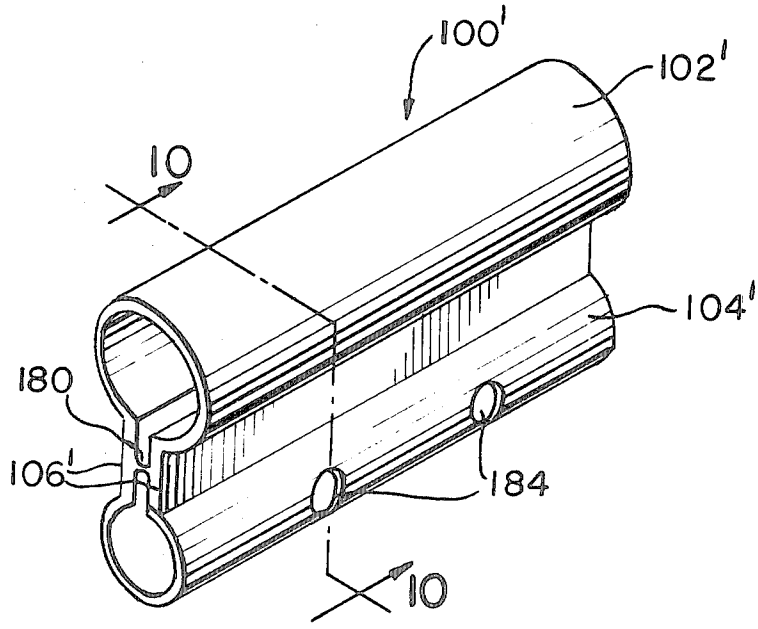
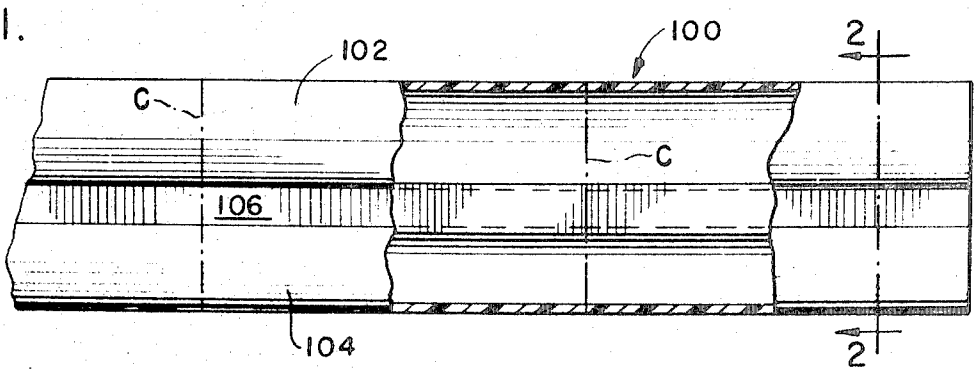


FIG. 1.



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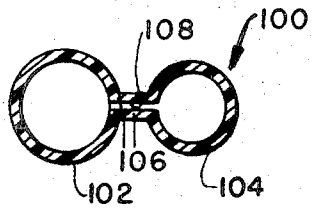

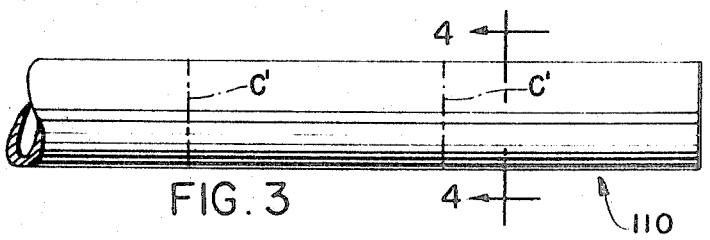

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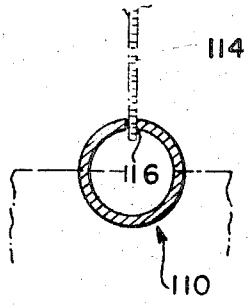

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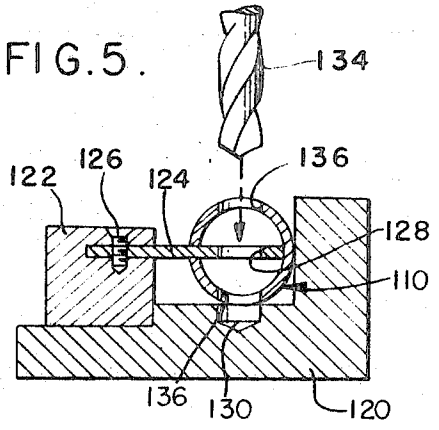

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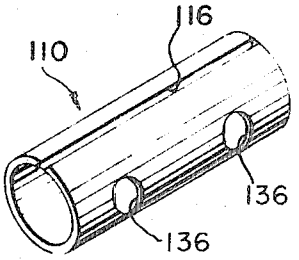

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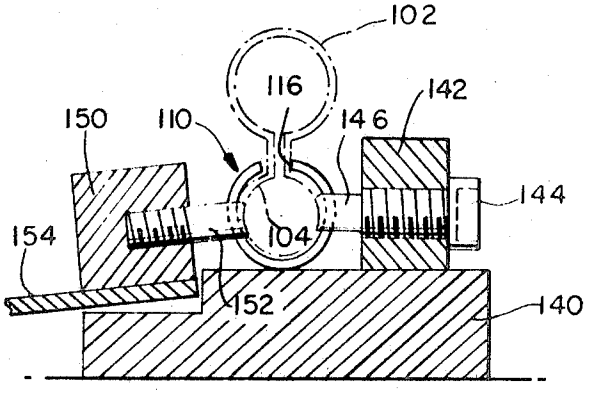

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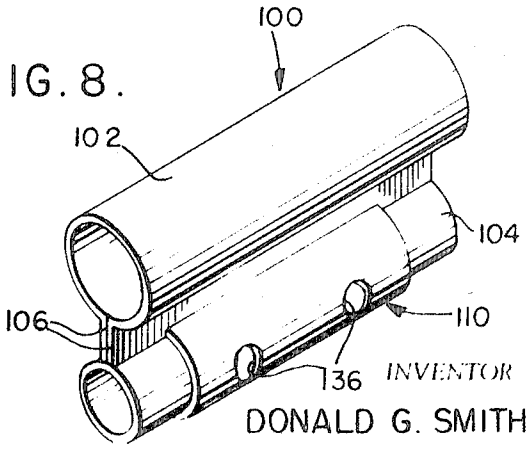

INVENTOR
DONALD G. SMITH

BY Shoemaker and Mattare

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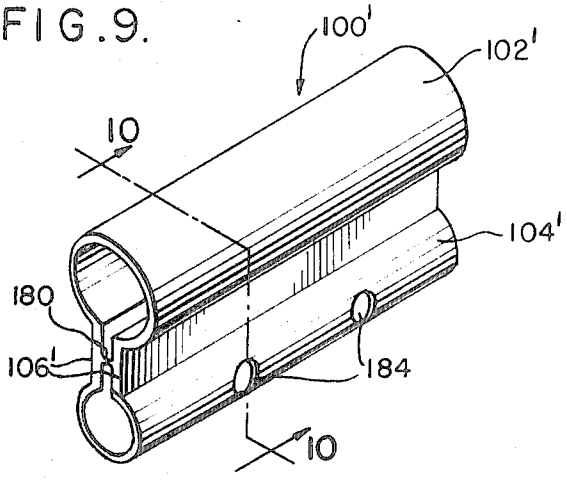
FIG. 9.



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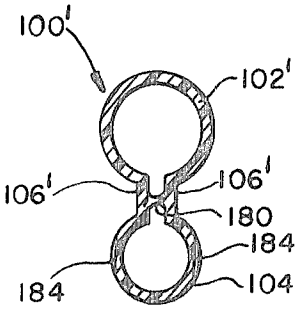

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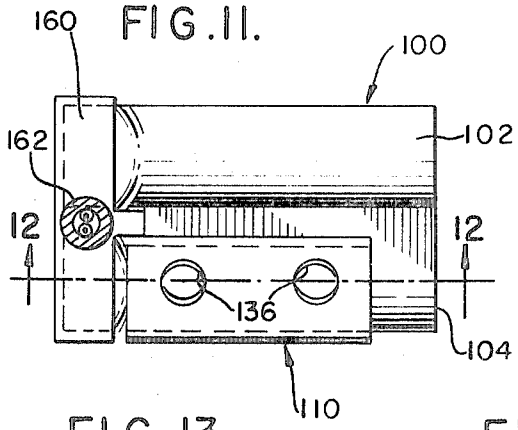

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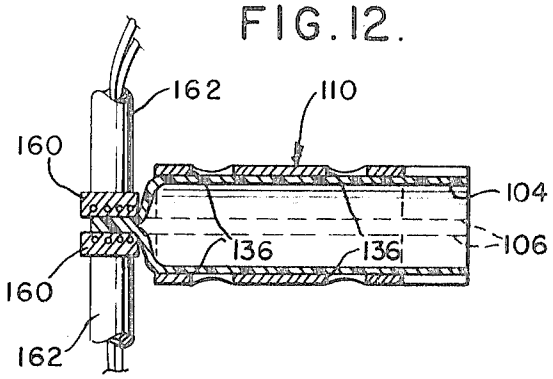

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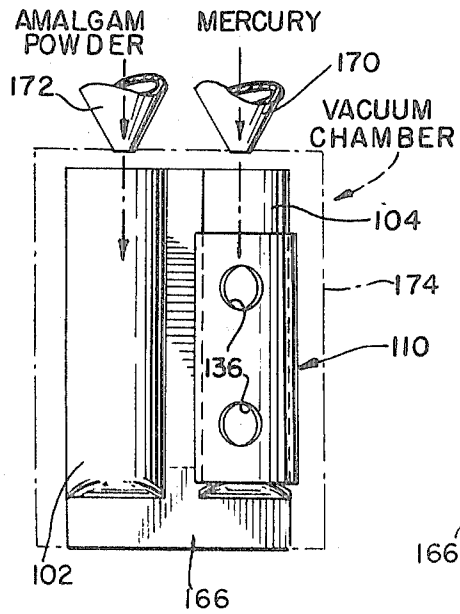

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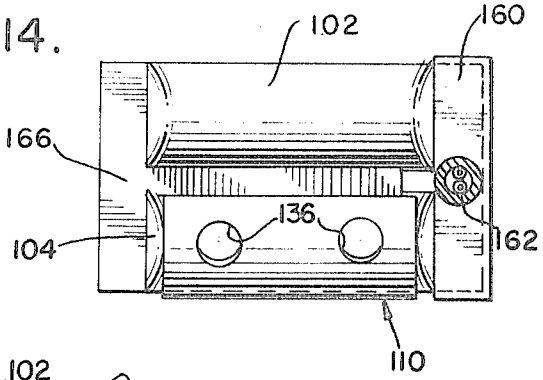

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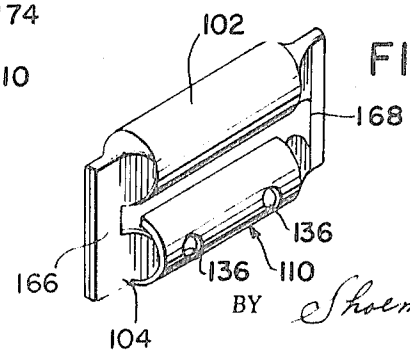
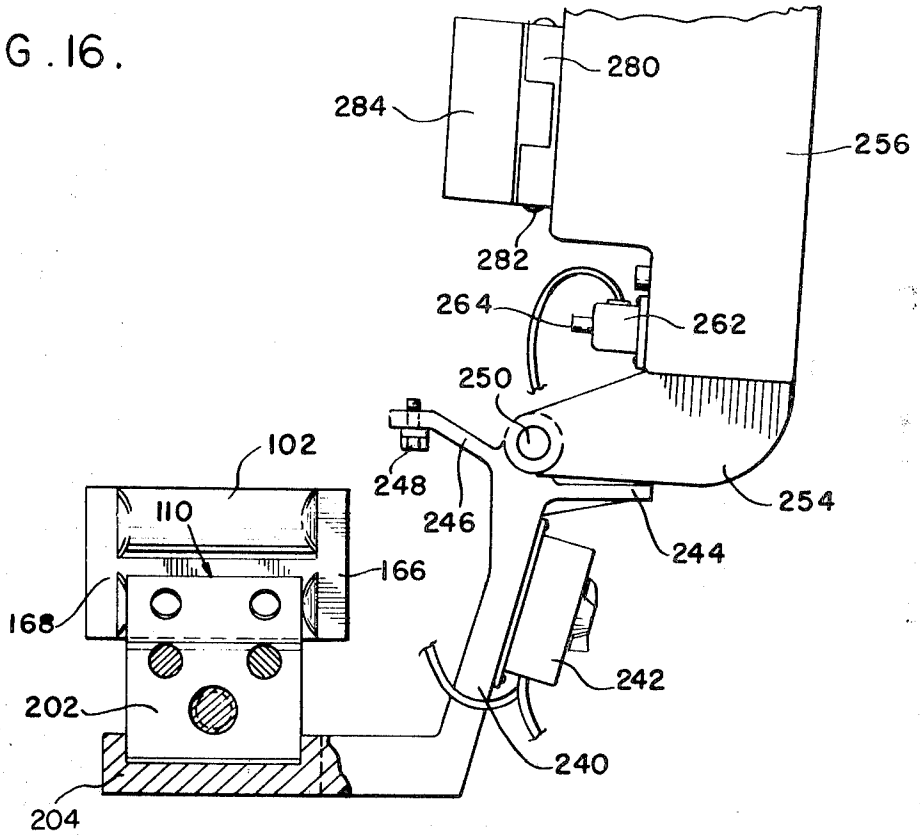


INVENTOR
DONALD G. SMITH
BY Shoemaker and Mattare
ATTORNEYS

FIG. 16.



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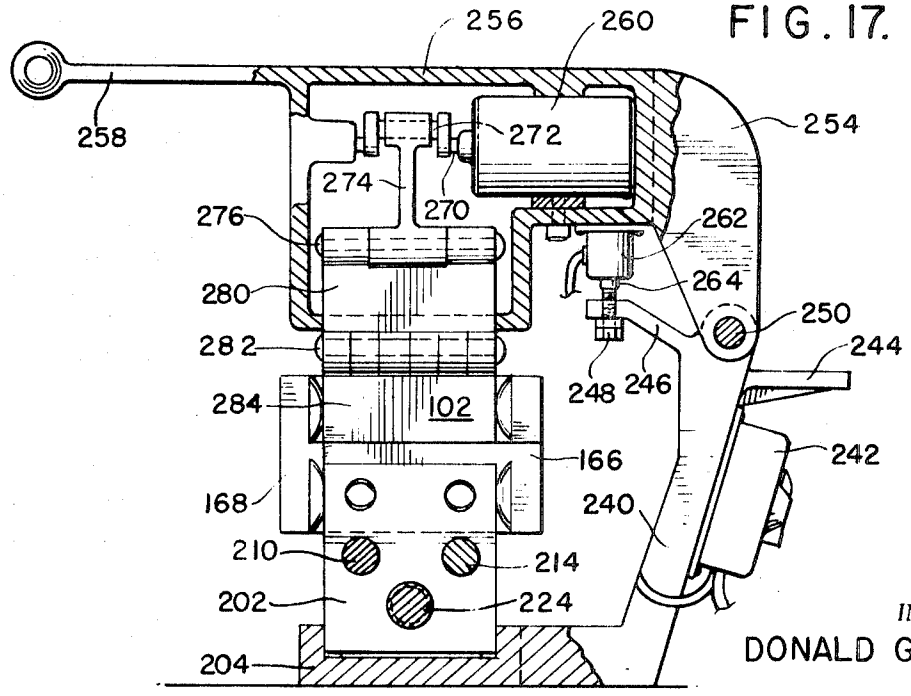
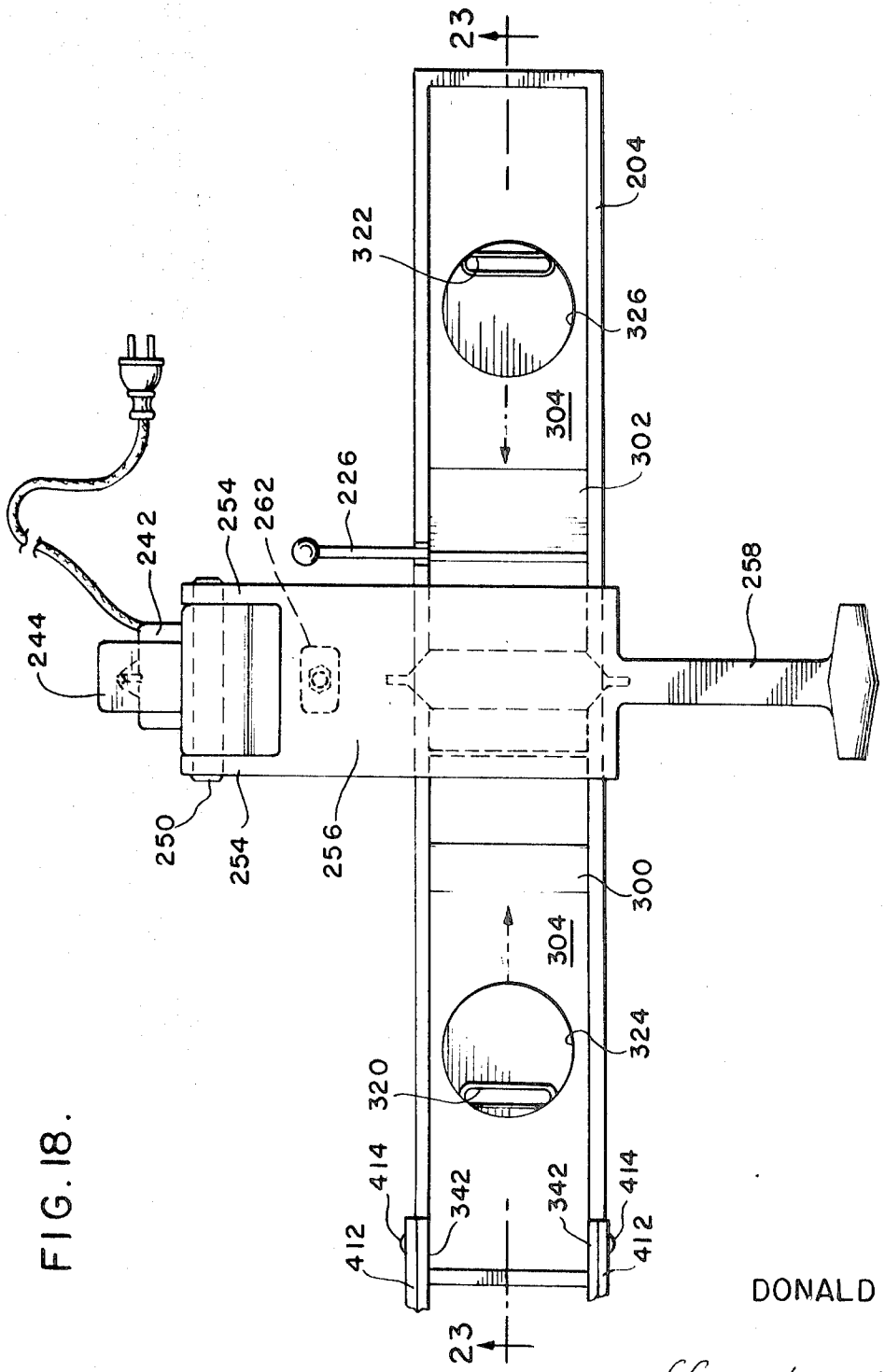


INVENTOR
DONALD G. SMITH

BY Shoemaker and Mattare

ATTORNEYS



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DONALD G. SMITH

BY Shoemaker and Mattare

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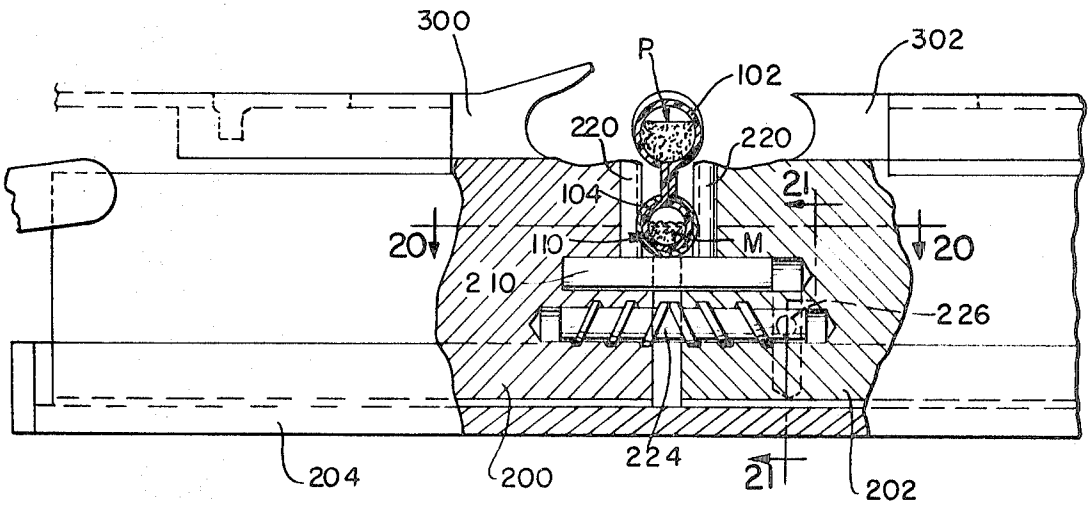
FIG. 19.



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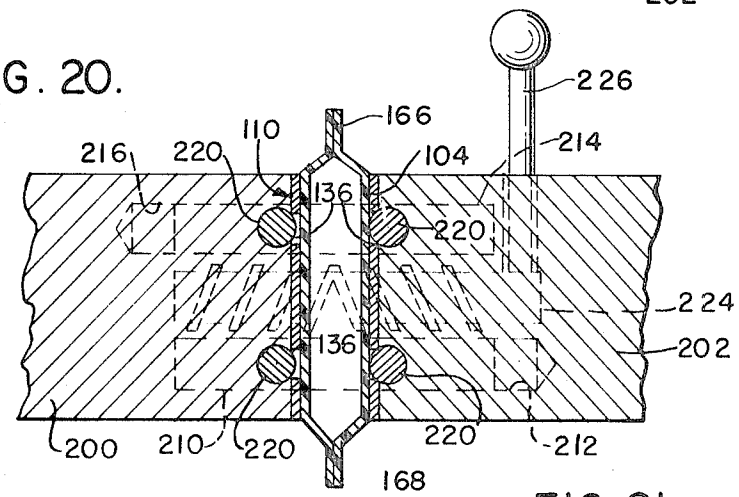

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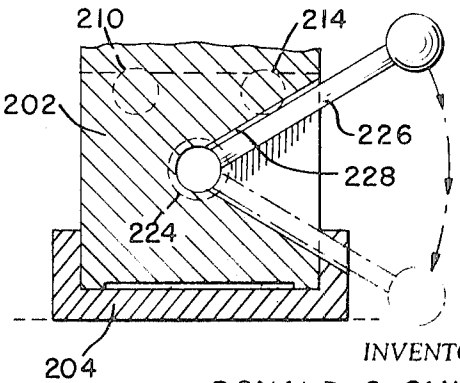

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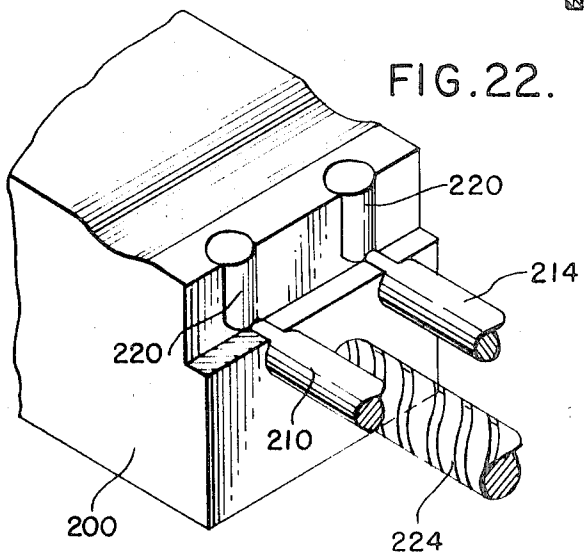
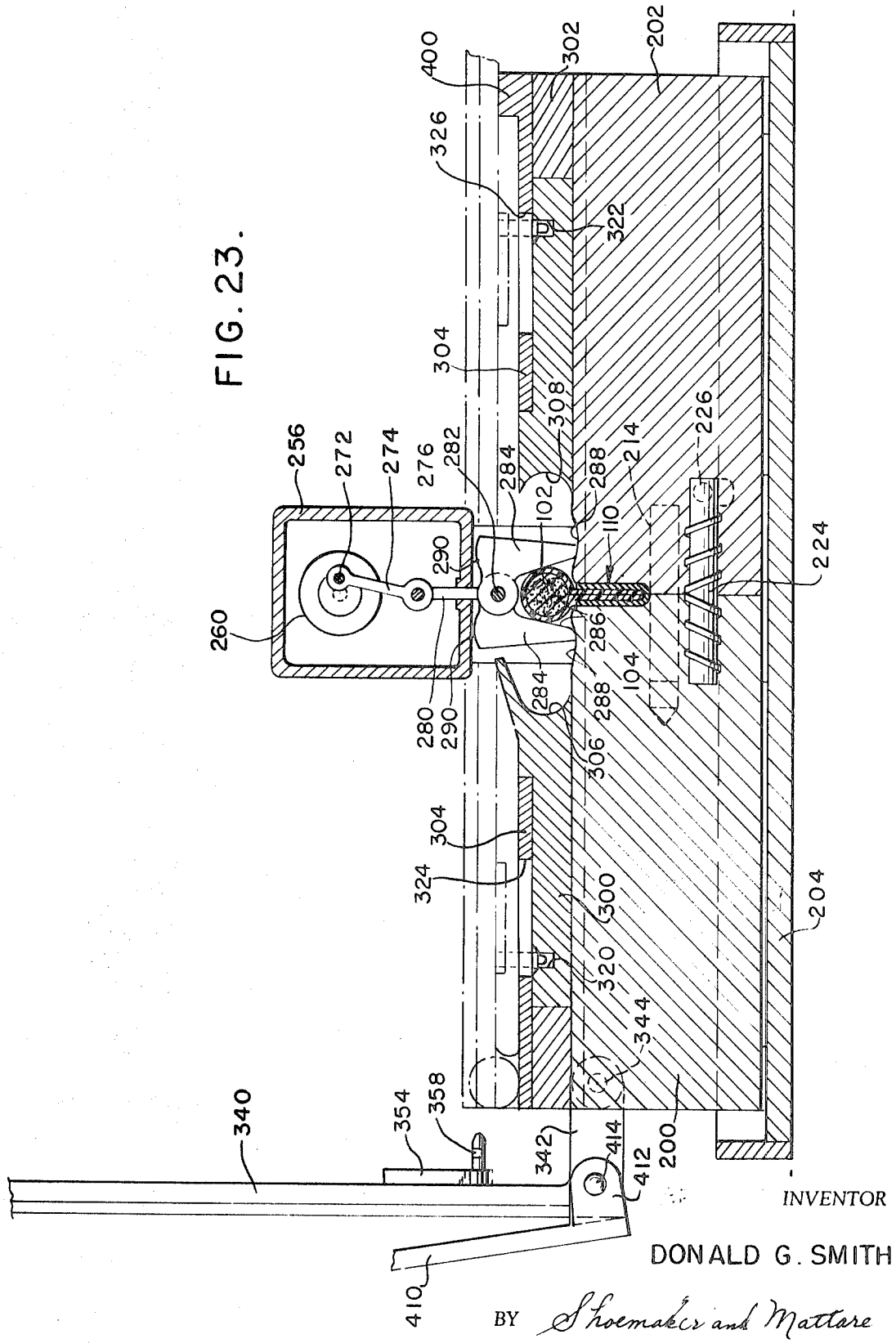


INVENTOR
DONALD G. SMITH

BY Shoemaker and Mattare

ATTORNEYS

FIG. 23.



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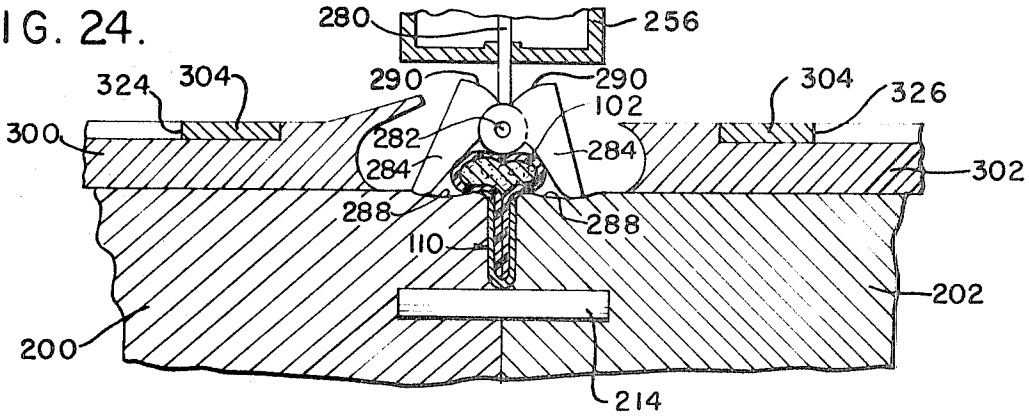
DONALD G. SMITH
BY Shoemaker and Mattare
ATTORNEYS

FIG. 24.



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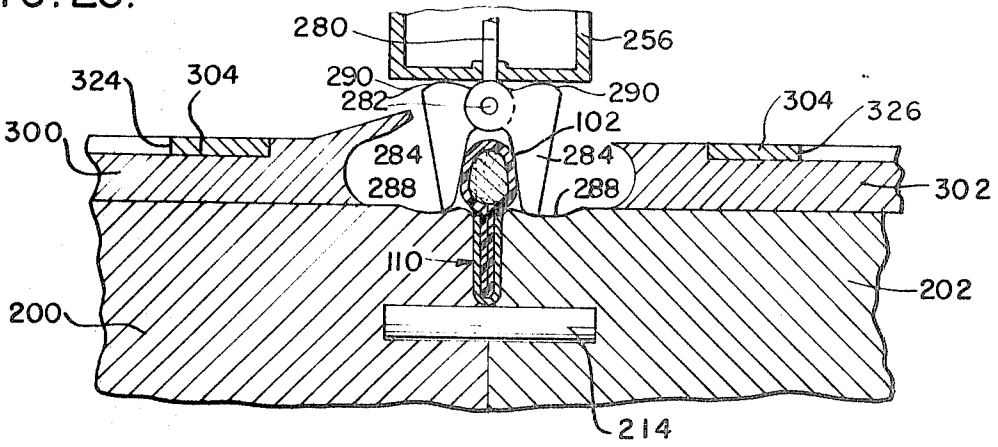

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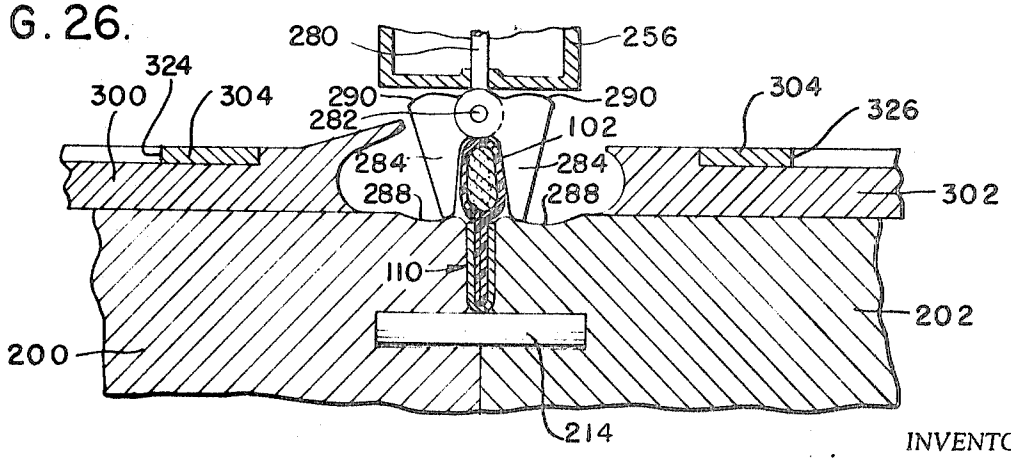
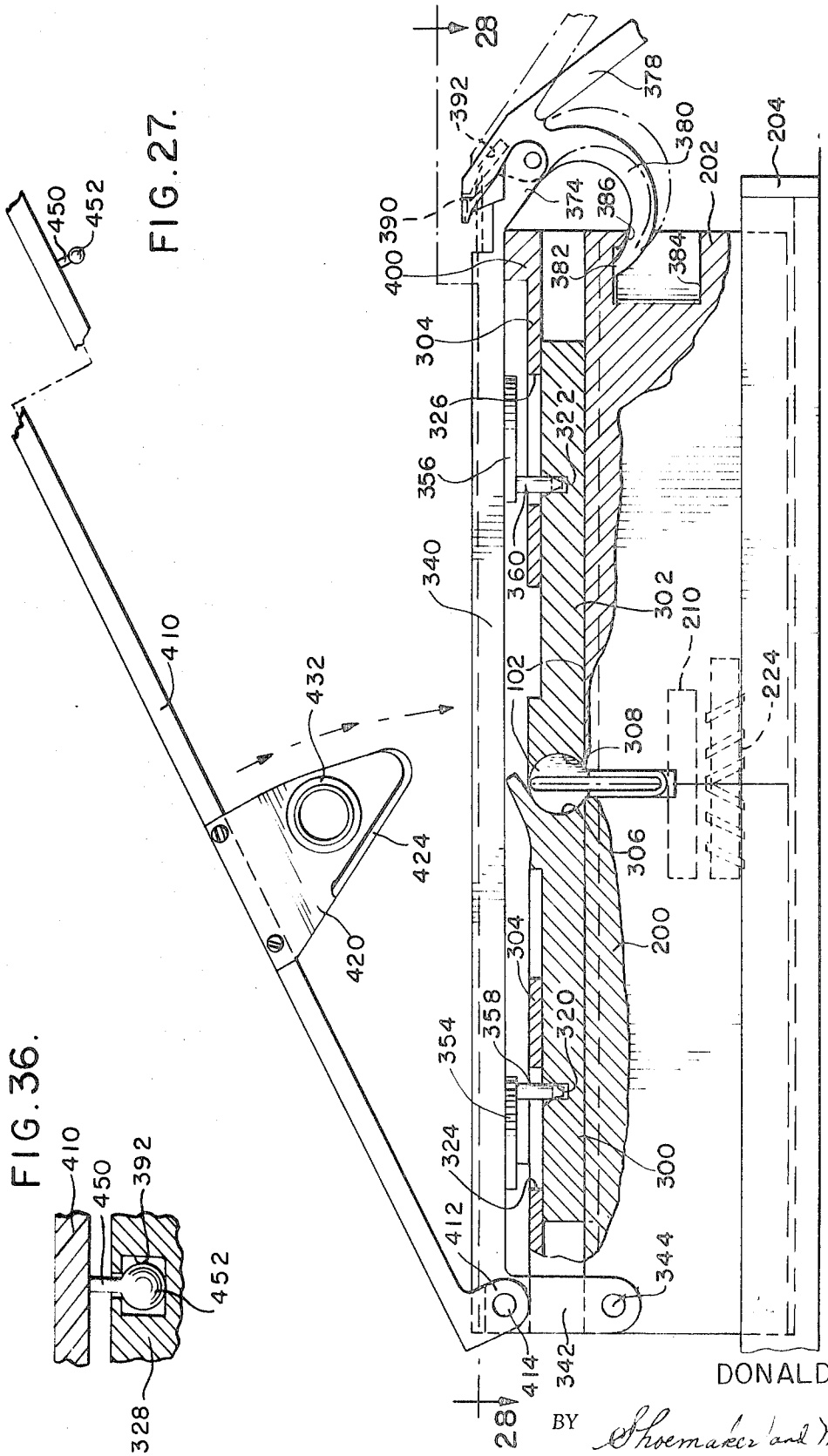


INVENTOR
DONALD G. SMITH

BY Shoemaker and Mattare

ATTORNEYS

FIG. 27.



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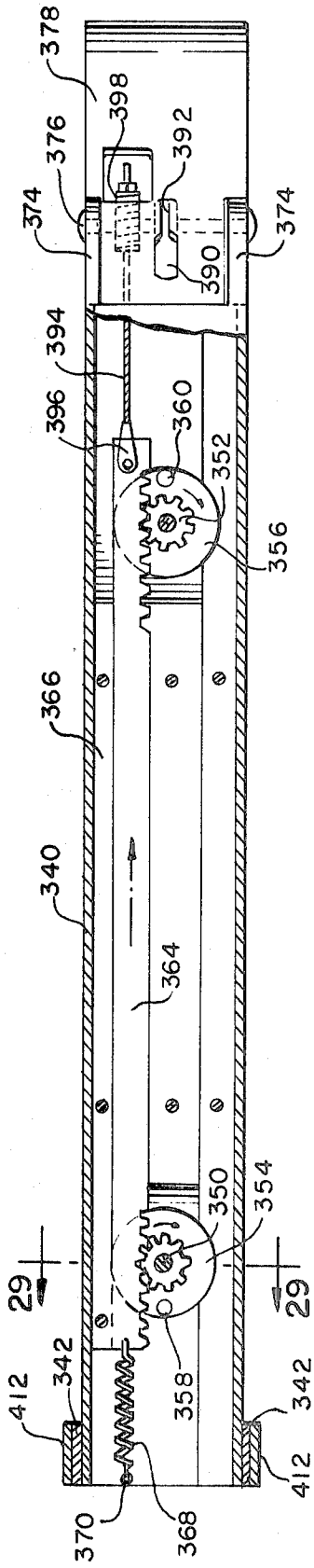
INVENTOR

DONALD G. SMITH

BY Shoemaker and Mattare

ATTORNEYS



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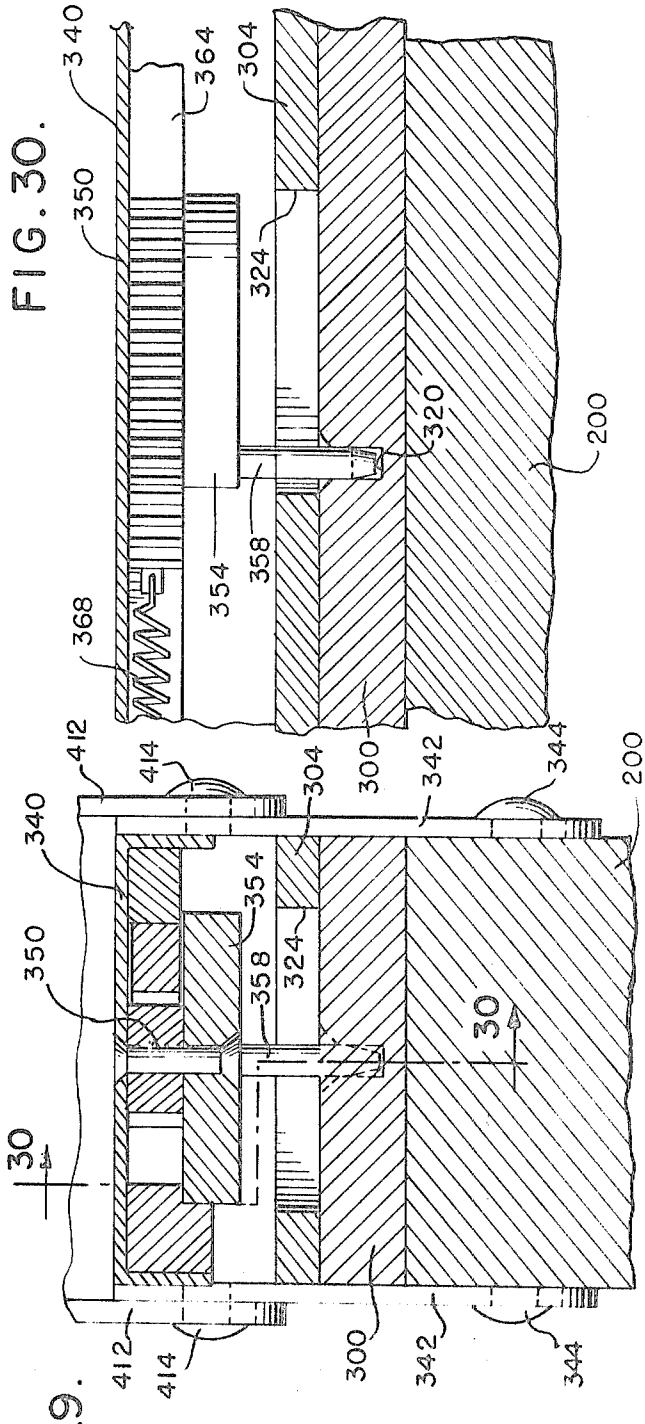

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INVENTOR
DONALD G. SMITH

BY Stoemaker and Matiare

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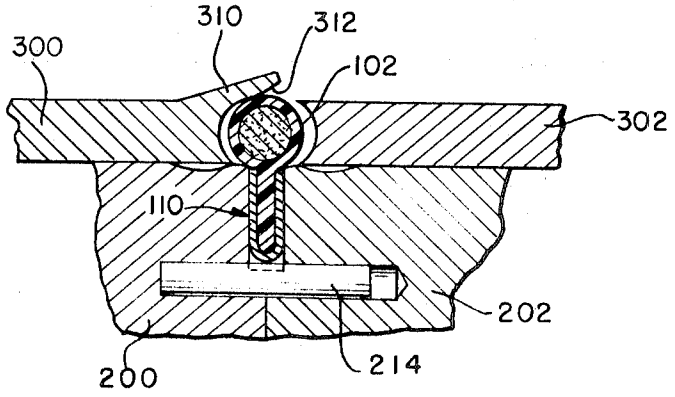
FIG. 31.



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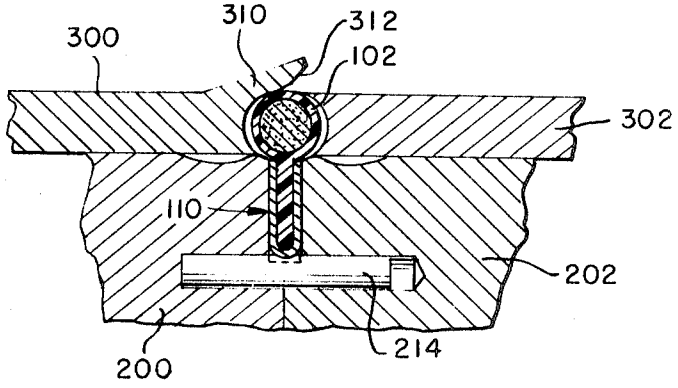

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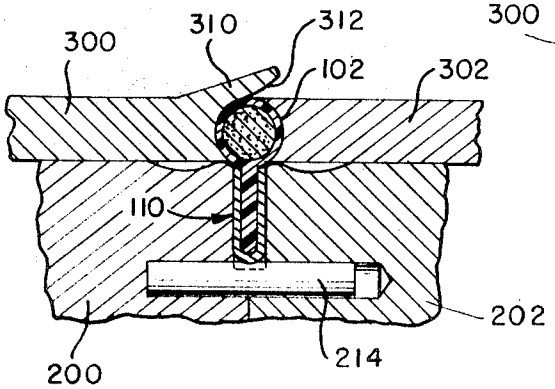

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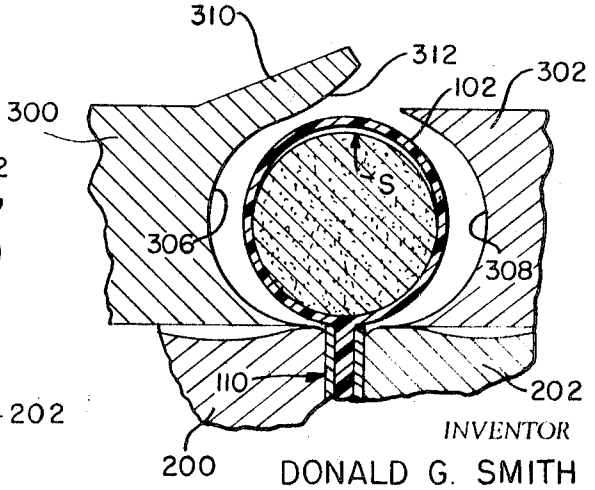


INVENTOR
DONALD G. SMITH

BY Shoemaker and Mattare

ATTORNEYS

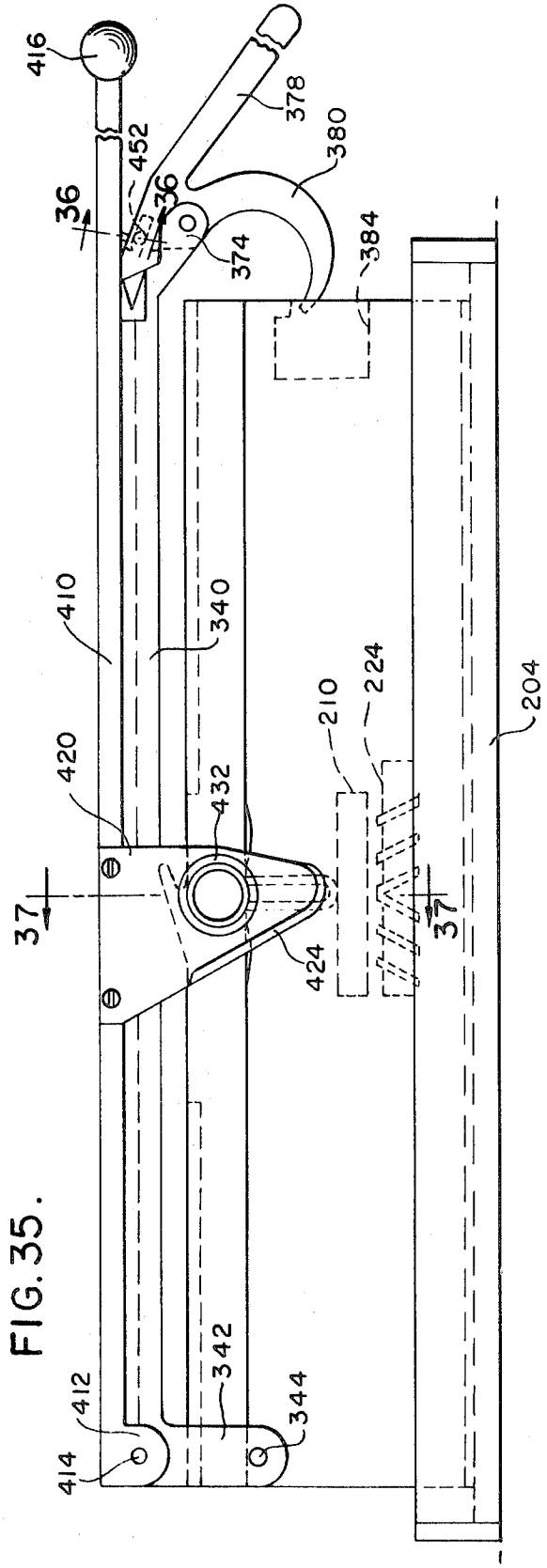
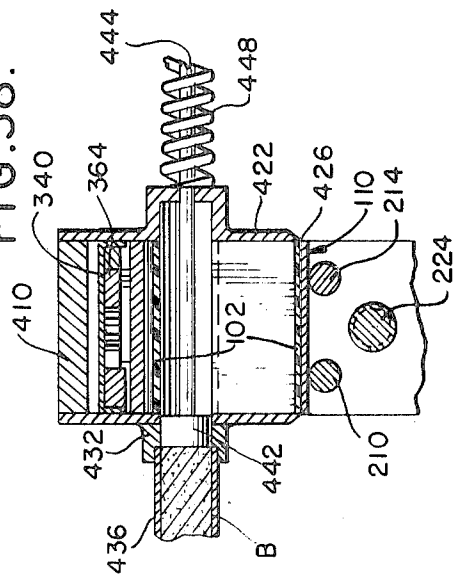


FIG. 35.



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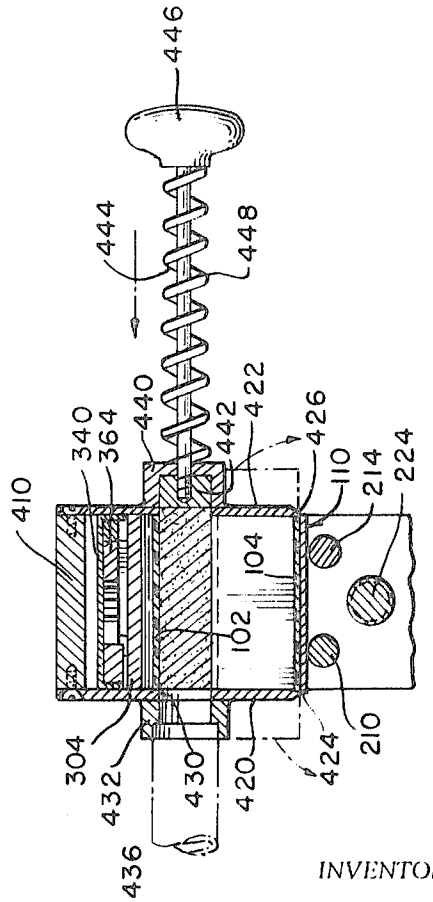

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INVENTOR

DONALD G. SMITH

BY Shoemaker and Mattare

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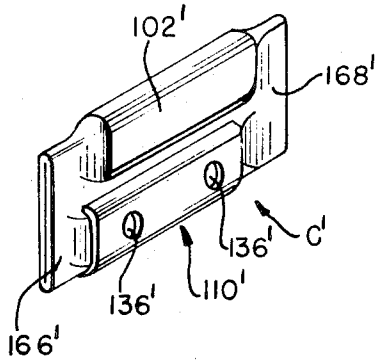
FIG. 39.



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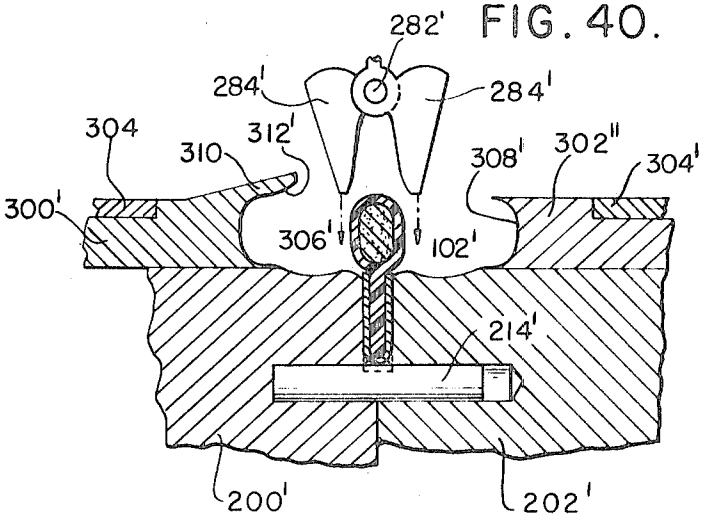

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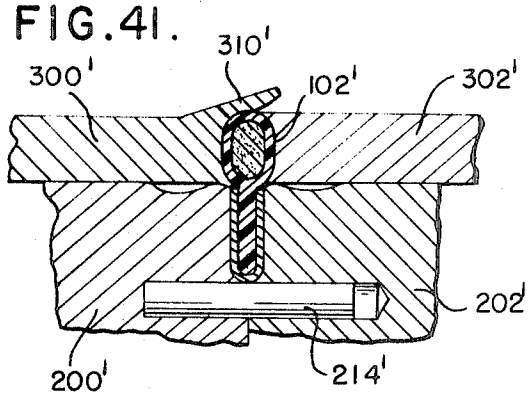

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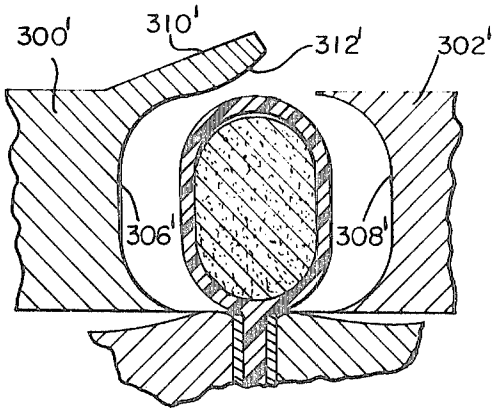

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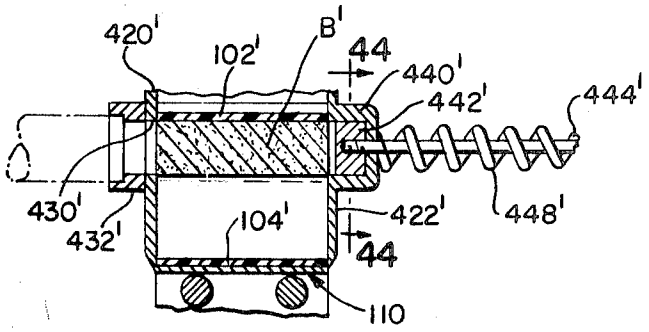
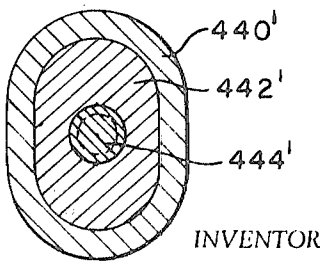


FIG. 44.



INVENTOR
DONALD G. SMITH

BY Sherman and Mattare

ATTORNEYS

AMALGAM CARTRIDGE AND METHOD OF MAKING SAME AND METHOD AND APPARATUS FOR DISPENSING AMALGAM FROM A CARTRIDGE

BACKGROUND OF THE INVENTION

When filling cavities in a tooth, it is necessary for a dentist or his assistant to manually mix the necessary ingredients so as to provide conventional dental amalgam. The usual ingredients comprise an amalgam powder and mercury which are separately stored and then mixed by hand when it is desired to fill a cavity in a tooth.

Manual mixing of the ingredients to form the amalgam material is time consuming, and furthermore the exact amounts of the ingredients employed in the amalgam mixture are generally not accurately determined so that the quality of the amalgam mixture is not uniform.

It is accordingly desirable to provide an amalgam cartridge wherein the necessary ingredients can be stored in a single cartridge in exact desired proportions to one another, and furthermore wherein the ingredients of the final amalgam mixture can be mixed while in the cartridge prior to dispensing same.

It is furthermore desirable to provide a mixing and dispensing apparatus wherein proper mixing of the ingredients within the cartridge can be carried out substantially automatically, and furthermore wherein the apparatus includes means for efficiently and effectively dispensing amalgam from the apparatus to a suitable instrument. Such an apparatus will obtain optimum results and the time and effort involved in preparation of the amalgam mixture can be substantially reduced.

SUMMARY OF THE INVENTION

The amalgam cartridge of the present invention comprises a closed flexible body means defining a pair of separate chambers which have amalgam powder and mercury respectively therewithin. The body means defines passage means for providing communication between said chambers, and closure means normally closes off such passage means to prevent communication between the chambers. The closure means can take two different forms according to he present invention. In one form, the closure means comprises a relatively rigid member disposed in surrounding relationship to one of the tubular portions of the cartridge, this relatively rigid closure means compressing or pinching off the passage means between the two chambers to prevent communication therebetween. In a second form of the invention, the closure means comprises an integral frangible membrane which can be ruptured when a portion of the cartridge is compressed so as to provide communication between the two chambers of the cartridge.

An amalgam cartridge according to the present invention serves to store the ingredients in exact proportion to one another and enables the ingredients to be readily mixed while still within the cartridge, whereupon the mixed body of material can be ejected from the cartridge to a suitable dental instrument.

The mixing and dispensing apparatus of the present invention includes a pair of compression members which are adapted to squeeze a portion of an associated amalgam cartridge according to the present invention therebetween to force the contents within the cartridge into contact with one another. Alignment means is provided for properly aligning the cartridge with the compression means.

The apparatus also includes a mixer means comprising a pair of opposed mixing members which are oscillated by a power operated means, the mixing members engaging the exterior of a portion of the cartridge to cause proper mixing of the ingredients within the cartridge.

The apparatus also includes a reshaping means in the form of a pair of reshaping members which are movable into engagement with a portion of the cartridge to form the mixed body of material within the cartridge into a desired configuration. Operating means is provided for the reshaping means and is mounted for swinging movement into operative relationship with the reshaping means.

A cutter means is mounted for swinging movement with respect to the remaining components and includes a pair of spaced cutter members for engaging and cutting off opposite ends of a cartridge within the apparatus. The cutter means includes means for interlocking the cutter means with the operating means for the reshaping means when the cutter means and the operating means are disposed adjacent one another.

Ejection means is carried by the cutter means and is adapted to eject the mixed body of material within an associated cartridge from the cartridge after the ends thereof have been cut off, means being provided for properly aligning the ejection means with the cartridge supported by the apparatus.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an elevation partly cut away and partly in section illustrating an extrusion employed in making the body means of a cartridge according to the present invention;

FIG. 2 is a sectional view taken substantially along line 2—2 of FIG. 1, looking in the direction of the arrows;

FIG. 3 is an elevation partly broken away of a relatively rigid member which forms a closure means in one form of the invention;

FIG. 4 is a sectional view taken substantially along line 4—4 of FIG. 3, looking in the direction of the arrows;

FIG. 5 is a sectional view illustrating the manner in which aligning holes are formed in the closure means in this form of the invention;

FIG. 6 is a top perspective view illustrating a completed closure means according to one form of the invention;

FIG. 7 is a sectional view illustrating a closure means of FIG. 6 is a suitable fixture for opening up the closure means;

FIG. 8 is a top perspective view illustrating the closure means of FIG. 6 is operative position relative to a portion of the extrusion shown in FIGS. 1 and 2;

FIG. 9 is a top perspective view of a modified form of body means according to the present invention;

FIG. 10 is a sectional view taken substantially along line 10—10 of FIG. 9, looking in the direction of the arrows;

FIG. 11 is a top view illustrating the manner in which one end of the body means shown in FIG. 8 is sealed;

FIG. 12 is a sectional view taken substantially along line 12—12 of FIG. 11, looking in the direction of the arrows;

FIG. 13 is a view illustrating the manner in which the chambers within the body means are filled with amalgam powder and mercury;

FIG. 14 illustrates the manner in which the opposite end of the body means is sealed to form a completely closed body means;

FIG. 15 is a top perspective view illustrating a completed amalgam cartridge according to one form of the invention;

FIG. 16 is a sectional view illustrating the mixing and dispensing apparatus of the invention with the mixer means pivoted to inoperative position;

FIG. 17 is a sectional view similar to FIG. 16 and illustrating the mixer means moved into its operative mixing position;

FIG. 18 is a top view of the structure shown in FIG. 17;

FIG. 19 is a front view of the lower portion of the structure shown in FIG. 18, with certain parts broken away and in section for the purpose of illustration;

FIG. 20 is a sectional view taken substantially along line 20—20 of FIG. 19, looking in the direction of the arrows;

FIG. 21 is a sectional view taken substantially along line 21—21 of FIG. 19, looking in the direction of the arrows;

FIG. 22 is a top perspective view illustrating a portion of the structure shown in FIG. 19;

FIG. 23 is a sectional view taken substantially along line 23—23 of FIG. 18, looking in the direction of the arrows;

FIG. 24 is a sectional view of a portion of the structure shown in FIG. 23 illustrating the mixer means in one operative position;

FIG. 25 is a view similar to FIG. 24 illustrating the mixer means in another operative position;

FIG. 26 is a view similar to FIG. 25 illustrating the mixer means in still another operative position;

FIG. 27 is a sectional view through the apparatus illustrating the operating means for the reshaping means in its lower operative position;

FIG. 28 is a sectional view taken substantially along line 28—28 of FIG. 27, looking in the direction of the arrows;

FIG. 29 is a sectional view on an enlarged scale taken substantially along line 29—29 of FIG. 28,

FIG. 30 is a sectional view taken substantially along line 30—30 of FIG. 29, looking in the direction of the arrows;

FIG. 31 is a sectional view illustrating the reshaping means in a first operative position;

FIG. 32 is a sectional view similar to FIG. 31 illustrating the reshaping means in a further operative position;

FIG. 33 is a view similar to FIG. 32 illustrating the reshaping means in still another operative position;

FIG. 34 is an enlarged sectional view illustrating the reshaping means in yet another operative position;

FIG. 35 is an elevation illustrating the cutter means in its lowered position;

FIG. 36 is a sectional view on an enlarged scale taken substantially along line 36—36 of FIG. 35, looking in the direction of the arrows;

FIG. 37 is a sectional view taken substantially along line 37—37 of FIG. 35, looking in the direction of the arrows;

FIG. 38 is a sectional view similar to FIG. 37 illustrating the components in a different operative position;

FIG. 39 is a top perspective view illustrating a modified cartridge according to the present invention;

FIG. 40 is a sectional view illustrating the manner in which the reshaping means is modified to cooperate with the cartridge shown in FIG. 39;

FIG. 41 is a sectional view illustrating the manner in which the reshaping means engages the cartridge shown in FIG. 39;

FIG. 42 is a sectional view on an enlarged scale illustrating the reshaping means in a further operative position;

FIG. 43 is a sectional view illustrating the ejection means employed with the form of cartridge shown in FIG. 39; and

FIG. 44 is a sectional view on an enlarged scale taken substantially along line 44—44 of FIG. 43, looking in the direction of the arrows.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to the drawings wherein like reference characters designate corresponding parts throughout the several views, a first form of amalgam cartridge according to the present invention is made by extruding an integral flexible body means indicated generally by reference numeral **100** as seen in FIGS. **1** and **2**, this body means being formed of a suitable plastic material which is adapted to be heat sealed. The extruded body means includes a pair of tubular portions **102** and **104**, tubular portion **102** being of greater cross-sectional dimension than tubular portion **104**. These tubular portions are interconnected by integral separate web portions **106** which define a passage means **108** therebetween, this passage means providing communication between the chambers defined within each of the tubular portions **102** and **104**. Extrusion **100** is cut along the phantom lines C illustrated in FIG. **1**, whereby the extrusion is divided into discrete lengths each of which is suitable for forming a single amalgam cartridge.

Referring now to FIG. **3**, a relatively rigid tubular member **110** may also be extruded and may be formed of a suitable deformable metallic substance, such as spring steel or hard plastic and the like. This relatively rigid member is also adapted to be cut into discrete lengths along the cut lines indicated by reference characters C' to provide individual rigid members for cooperation with individual lengths of the body means as hereinafter described.

As seen in FIG. **4**, a rigid member **110** is of substantially cylindrical cross-sectional configuration, the inner diameter thereof being substantially equal to the outer diameter of tubular portion **104** of the body means. A cutting member **114** is employed for cutting an elongated slot **116** through the wall of member **110**, whereby member **110** is split longitudinally thereof so as to be of resilient construction for a purpose hereinafter described.

Referring now to FIG. **5** of the drawings, a jig is illustrated for forming suitable aligning holes in member **110**. The jig includes a base member **120** supporting a block **122** thereon. A gauge member **124** is secured in a suitable slot in block **122** and is fixed in place by a screw **126**. Gauge member **124** extends through the aforementioned slot **116** in member **110** for retaining member **110** in the operative position illustrated in FIG. **5**.

Gauge member **124** is provided with a pair of spaced holes **128** formed therethrough, one of such holes being visible in FIG. **5**. Base member **120** is also provided with a pair of spaced holes **130** formed therethrough, these latter holes being aligned vertically below holes **128**. A pair of drill bits **134** aligned with holes **128** and **130** are then brought vertically downwardly as indicated by the arrow in FIG. **5** so as to drill two pairs of diametrically opposite holes **136** through the walls of member **110** at longitudinally spaced portions thereof. The two holes **136** at one side of member **110** can be seen clearly in FIG. **6**, it being understood that another pair of holes **136** are provided in diametrically opposite portions of member **110**. Holes **136** serve as aligning means for properly aligning the cartridge with respect to the associated apparatus as hereinafter described.

Referring now to FIG. **7**, a further jig is illustrated for facilitating insertion of tubular portion **104** of the body means within member **110** which serves as a closure means for the completed cartridge. This jig includes a base portion **140** having a block **142** supported thereon, a pair of threaded members **144** being threaded through suitable holes in block **142** and including inner cylindrical shank portions **146** which fit within the holes **136** formed at one side of member **110**.

The jig also includes a further block **150** having a pair of threaded members **152** supported therein, members **152** including substantially cylindrical shank portions which fit within the holes **136** formed at the opposite side of closure member **110**. A lever portion **154** is secured to the lower portion of block **150** and is separate from base means **140** whereby downward movement of lever portion **154** tilts block **150** to the position shown on full lines of FIG. **7**, thereby opening up closure member **110** and spreading the slot **116** in the upper part thereof whereby the body means may be moved into the operative position illustrated in phantom lines in this figure so that tubular portion **104** of the body means is received within closure member **110**.

After the body means has been inserted into operative position with respect to rigid member **110**, the assembled components can be removed from the jig to provide the arrangement shown in FIG. **8**. As shown in this figure, relatively rigid closure member **110** is disposed in surrounding relationship to tubular portion **104** of the body means, and the opposite free edges of member **110** defining slot **116** engage the outer surfaces of web portions **106** of the body means in a resilient manner so as to clamp these web portions together, thereby closing off the passage means defined between the web portions.

Referring now to FIGS. **11** and **12**, a pair of generally T-shaped heating elements **160** are provided which are connected by suitable electrical cables **162** with a source of electrical current. These heating elements are positioned so as to clamp one end of the structure shown in FIG. **8** therebetween as shown in FIG. **12**, whereupon heat is applied by the heating elements, and one end of the amalgam cartridge is heat sealed to provided a flattened heat sealed area **166** as seen in FIGS. **13–15**.

Referring now to FIG. 13, the chambers define within tubular portions 102 and 104 are next filled with amalgam powder and mercury respectively. The cartridge structure, which is now sealed at one end thereof, is disposed in a vertical position. A first nozzle 170 is aligned with the upper open end of the chamber within tubular portion 104 and is adapted to dispense mercury downwardly into such chamber. A similar nozzle 172 is aligned with the upper open end of the chamber defined within tubular portion 102 and is adapted to dispense amalgam powder downwardly within such chamber. The amalgam powder is dispensed into its associated chamber under vacuum conditions, and a vacuum chamber is indicated by reference numeral 174 to facilitate this step in the manufacture of the amalgam cartridge. The mercury and the amalgam powder may each fill substantially three quarters of the associated chambers, whereby sufficient excess space is provided in the chambers to enable the subsequent mixing and ejection steps to be carried out as hereinafter described.

After filling the two chambers within the body means with mercury and amalgam powder respectively, heating elements 160 are applied to the opposite end of the amalgam cartridge as shown in FIG. 14 in a manner similar to that previously described so as to heat seal the opposite end of the cartridge, thereby providing a flattened heat sealed area 168 at the opposite end of the cartridge as seen in FIG. 15. In the finished form of the cartridge as seen in FIG. 15, both ends of the cartridge are sealed, and closure member 110 tightly clamps the web portions of the body means together so as to prevent communication between the two separate chambers defined within the body means.

Referring now to FIGS. 9 and 10 of the drawings, a modified form of amalgam cartridge according to the present invention is illustrated. The body means of this form of the invention is similar in many respects to that previously described, and similar parts have been given the same reference numerals primed. This form of the invention is provided with an integral frangible membrane 180 extending between the web portions 106'. This membrane is of substantially less thickness than the remaining wall portions of the body means whereby, when compression is applied to the body means, the membrane is adapted to rupture and provide communication between the two chambers defined within the tubular portions 102' and 104' respectively. Accordingly, membrane 180 serves as the closure means in this form of the invention.

Since a separate relatively rigid closure member is eliminated in this form of the invention, suitable aligning holes are provided in the form of recessed portions or grooves 184 formed in the outer wall of tubular portion 104'. These aligning holes serve the same purpose as the holes 136 disclosed in connection with the previously described modification for a purpose hereinafter described.

The body means as shown in FIGS. 9 and 10 is adapted to be heat sealed at opposite ends thereof and filled in the same manner as described in connection with the previous embodiment of the invention.

As seen most clearly in FIGS. 19–22 inclusive of the drawings, a compression means for compressing a portion of a cartridge therebetween includes a pair of compression members 200 and 202 which are mounted for sliding movement on a base means 204, members 200 and 202 being movable toward and away from one another. A first guide pin 210 is secured to member 200 and extends slidable within a cavity 212 formed in member 202 as seen most clearly in FIG. 20. A second guide pin 214 is secured to member 202 and extends slidably within a cavity 216 formed in member 200. These two guide pins 212 and 214 also serve as alignment means for aligning an associated amalgam cartridge vertically within the apparatus. As seen most clearly in FIG. 19, the bottom of closure member 110 of a cartridge is supported on the upper surfaces of the guide pins when the cartridge is mounted within the apparatus to properly position the cartridge in a vertical direction.

A first pair of cylindrical vertical pins 220 are supported in the face of compression member 200, and a second pair of similar spaced vertical pins 220 are supported in the face of compression member 202. These vertical pins extend outwardly beyond the faces of the associated compression members and are adapted to extend within the alignment holes 136 provided in closure member 110 as seen most clearly in FIG. 20 as to properly align the cartridge in a horizontal direction with respect to the apparatus.

The compression members 200 and 202 are disposed in spaced-apart relationship as shown in FIGS. 19 and 20, and means for selectively moving the compression members towards one another comprises a jack screw 224 having a pair of oppositely threaded portions which are threaded within correspondingly threaded holes provided in the two compression members 200 and 202. An operating handle 226 is connected with jack screw 224, this operating handle being disposed within a cutout 228 formed in compression member 202 as seen in FIG. 21.

When the operating handle is moved from the full line position shown in FIG. 21 downwardly into the phantom line position, jack screw 224 is rotated in such a direction as to move compression members 200 and 202 together into the full line position shown in FIG. 23 wherein closure member 110 has been flattened, thereby collapsing tubular portion 104 of the cartridge and forcing the mercury from the lower chamber in the cartridge upwardly through the passage means defined between the web portions of the body means into the chamber within upper tubular portion 102 of the body means thereby causing the mercury and amalgam powder to come into contact with one another. The compression means is retained in the full line position shown in FIG. 23 until the mixed body of material within the cartridge is ejected therefrom, whereupon the compression members may be moved apart and the cartridge removed from the apparatus to prepare the apparatus for a subsequent cycle of operation with a new cartridge.

Referring now to FIGS. 16–18 inclusive, the mixer means of the mixing and dispensing apparatus includes an upwardly extending support portion 240 formed integral with base means 204. A timer 242 is mounted on support portion 240. An integral abutment portion 244 extends laterally from he upper part of support portion 240 and serves to limit pivotal movement of the mixer housing hereinafter described in one direction. A laterally extending projection 246 is also formed integral with the upper part of the support portion 240, and an adjusting screw 248 is threaded through a suitable threaded hole provided in projection 246.

A pivot pin 250 is carried by the upper end of support portion 240 and is interconnected with a pair of ears 254 extending from a mixer housing 256 whereby the mixer housing is mounted for pivotal movement about the axis of pin 250. An operating handle 258 is formed integral with housing 256 and extends laterally therefrom, whereby the mixer housing can be readily pivoted from the interoperative position shown in FIG. 16 into the operative mixing position shown in FIGS. 17 and 18.

An electric drive motor 260 is mounted within housing 256, and an operating microswitch 262 for motor 260 includes a contact portion 264 adapted to engage adjusting screw 248 whereby the switch is automatically closed when the mixer housing is swung into the operative position shown in FIG. 17. Switch 262 is connected in a suitable electric circuit along with timer 242 whereby, upon closure of switch 262, the mixer will be automatically operated for a predetermined length of time whereupon the circuit will be deenergized so as to stop the motor. In a typical example, the mixer motor will be actuated for a period of approximately 30 seconds.

Drive motor 260 is connected with an output shaft 270 which, in turn, is interconnected with an eccentric crankshaft 272. This eccentric crankshaft is pivotally interconnected with a link 274 which, in turn, is connected to a pivot pin 276 pivotally interconnected with a further line 280. Link 280 extends downwardly through a suitable slot provided in the lower wall of mixer housing 256 and is pivotally connected by a pivot pin 282 with a pair of mixing members 284 which are

adapted to be oscillated about the axis of pivot pin 282 during operation of the apparatus.

As seen most clearly in FIG. 23, each of mixer members 284 includes an inner surface 286 adapted to engage the outer surface of the upper tubular portion 102 of a cartridge within the apparatus, the chamber defined within tubular portion 102 having both amalgam powder and mercury disposed therewithin at this point in the operation of the apparatus. Each of mixer members 284 has a length substantially equal to the length of tubular portion 102 of an associated cartridge so as to effectively engage this portion of the cartridge throughout its length to thoroughly mix the contents therewithin.

The lower tapered ends of each of mixer members 284 are adapted to slide along depressions 288 of generally arcuate cross-sectional configuration formed in the top of compression members 200 and 202. The upper surfaces 290 of the mixer members are of curved configuration for engaging the undersurface of mixer housing 256 to assist in producing the desired oscillatory movement of the mixer members during operation.

Referring now to FIGS. 24–26 inclusive, the sequence of operation of the mixer members during the mixing cycle of the apparatus is illustrated. As shown in FIG. 24, link 280 is in its lowermost position and mixer members 284 have been moved downwardly and away from one another so as to flatten tubular portion 102 of the cartridge.

Referring now to FIG. 25, link 280 has been moved upwardly and mixer members 284 are in an intermediate position wherein they are squeezing tubular portion 102 of the cartridge. Referring now to FIG. 26, link 280 has now moved into its uppermost position wherein mixer members 284 have moved inwardly toward one another to further squeeze tubular portion 102 of the cartridge.

It is apparent that as link 280 moves upwardly and downwardly during operation of the mixer means, mixer members 284 will successively move through the positions shown in FIGS. 24–26 inclusive, to alternately flatten and squeeze the tubular portion 102 of the cartridge thereby deforming this tubular portion and causing the amalgam powder and mercury therewithin to be intimately mixed with one another in an automatic manner.

After the completion of the mixing cycle and motor 260 is deenergized, the mixer means is swung outwardly to its inoperative position as shown in FIG. 16, abutment member 244 limiting pivotal movement of the mixer means in his direction.

Reshaping means is provided for engaging tubular portion 102 of the cartridge so as to reshape deformed tubular portion 102 of the cartridge into a perfectly round cross-sectional configuration and further to constrict and compress the cartridge so as to reshaping the diameter of the body of mixed material within the cartridge and thereby facilitate ready ejection of such body of material at a later step in the operation of the apparatus.

The reshaping as seen in FIG. 23 includes a pair of reshaping members 300 and 302 slidably supported on the upper surface of compression members 200 and 202 respectively, a cover 304 supported by the base means being disposed in overlying relationship to reshaping members 300 and 302. As seen most clearly in FIG. 34, reshaping members 300 and 302 have arcuate ends 306 and 308 respectively, adapted to engage tubular portion 102 of the associated cartridge. Each of these arcuate ends 306 and 308 defines a portion of a cylindrical surface. Reshaping member 300 includes a laterally extending lip 310 having an upwardly sloping undersurface 312. This upwardly sloping undersurface is adapted to engage the upper part of tubular portion 102 which may be deformed vertically upwardly from its initial position, surface 312 serving to press tubular portion 110 in a downward direction into the path of arcuate end 308 of the other reshaping member, the two reshaping members advancing simultaneously toward the cartridge. As the two reshaping members move toward one another as seen in FIG. 31, undersurface 312 of lip 310 initially engages tubular portion 102 of the cartridge.

The reshaping members then move further toward one another as shown in FIG. 32 and subsequently move into the final operative position shown in FIG. 33 wherein the arcuate ends of the two reshaping members snugly embrace tubular portion 102 of the cartridge and reshape this portion of the cartridge into a perfectly round cross-sectional configuration. The body of mixed material within the cartridge is constricted and compressed so that subsequent movement of the reshaping members away from one another as shown in FIG. 34 leaves a small space S within the cartridge since the body of material assumes a cross-sectional configuration slightly less than that of portion 102 of the cartridge thereby facilitating the subsequent removal of the body of material.

Reshaping members 300 and 302 are provided with holes 320 and 322 in the upper surfaces thereof respectively for receiving drive pins hereinafter described for moving the reshaping members toward and away from one another. Cover 304 is provided with holes 324 and 326 to provide access to elongated holes 320 and 322 respectively.

Referring now to FIGS. 27–30 inclusive, operating means for the reshaping means includes and elongated cover plate 340 of generally inverted U-shaped cross-sectional configuration as seen in FIG. 29, this cover plate having a pair of ears 342 rigidly secured to opposite sides thereof, these ears being connected by pin means 344 to compression member 200 for pivotal movement with respect thereto.

As seen most clearly in FIG. 28, a pair of pinions 350 and 352 are rotatably supported by cover plate 340, these two pinions being connected with a pair of disclike members 354 and 356 which have pins 358 and 360 respectively, connected thereto in depending relationship therefrom, these pins being received within the holes in the upper surfaces of the reshaping members whereby these pins serve as drive pins for moving the reshaping members toward and away from one another dependent upon the direction of turning of the pinions connected with the disc members carrying the drive pins.

An elongated toothed rack member 364 is slidably supported by over plate 340 and is guided in its movement with respect thereto by a guide member 366 secured to the cover plate. A tension spring 368 is connected between one end of rack member 364 and pin 370 secured to the cover plate for normally biasing the rack member in one direction so as to move pins 358 and 360 into the operative position shown in FIG. 28 wherein the pins are adapted to engage the holes in the reshaping member when the reshaping members are in their retracted spaced position.

A pair of spaced ears 374 are provided at the outer end of cover plate 340, and a pin 376 pivotally connects ears 374 with a handle 378. As seen in FIG. 27, handle 378 includes a depending curved portion 380 having a tip 382 adapted to be received within a cavity in one side of compression member 202. A lip 386 is defined by compression member 202 adjacent cavity 384, and portion 380 is adapted to be engaged under this lip.

The upper surface of the handle includes a sloping surface 390 adjacent a stepped slot 392 which is seen most clearly in FIG. 36, surface 390 and stepped slot 392 serving a purpose hereinafter described.

A cable 394 is connected at one end 396 thereof with rack member 364, the opposite end of the cable being interconnected with a threaded member 398 received within a suitable threaded portion in the handle 378 for adjusting the position of cable 394 and 364.

When it is desired to operate the reshaping means, handle 378 on cover plate 340 is grasped and swung downwardly until the cover plate is disposed in overlying relationship to cover 304 and drive pins 358 and 360 are received within holes 320 and 322 of the reshaping members 300 and 302 respectively. Cover plate 340 engages an integral upwardly extending projection 400 provided on cover 304.

After cover plate 340 engages projection 400, handle 378 continues to move downwardly, whereupon tip 382 enters cavity 384 and portion 380 of the handle engages lip 386 on compression member 202 to hold the cover plate 340 firmly in place.

Further continued smooth and uninterrupted motion of handle 378 causes rack member 364 to move longitudinally within the cover plate which, in turn, causes rotation of disc members 354 and 356, thereby causing drive pins 358 and 360 to move the associated reshaping members toward one another. The reshaping members are thereupon carried into the final operative position shown in FIG. 27. This position corresponds to the operative position shown in FIG. 33 of the drawings.

Cutter means is provided for cutting off opposite ends of the cartridge, this cutter means including an elongated member 410 having a pair of spaced ears 412 at one end thereof, these spaced ears being connected by pin means 414 with cover plate 340, whereby member 410 is independently pivotally mounted on the cover plate. A knob 416 is provided at the outer end of member 410 to facilitate swinging movement thereof.

As seen most clearly in FIG. 37, a pair of cutting members 420 and 422 are secured to and extend downwardly from opposite sides of member 410. These two cutter members have sharpened cutting edges 424 and 426 respectively formed thereon for engaging and cutting off opposite ends of a cartridge supported within the apparatus.

A hole 430 is formed through cutter member 420, and a counterbored filling boss 432 is aligned with hole 430, this filling boss being adapted to cooperate with a member 436 of a dental instrument or the like which is adapted to receive the completed mixed body of dental amalgam.

Cutter member 422 has an enlarged portion 440 extending from the side thereof, portion 440 being hollow and receiving an ejection plunger 442 slidably mounted therewithin. A rod 444 is connected with plunger 442, a knob 446 being secured to the outer end of rod 444. A compression spring is disposed in surrounding relationship to rod 444 and normally biases knob 446 along with rod 444 and plunger 442 into the operative position shown in FIG. 37.

After the ends of the cartridge have been cut off and the components are disposed in the relationship shown in FIG. 37, knob 446 is moved to the left as seen in the drawings so as to move the plunger 442 into the operative position shown in FIG. 38 wherein he body of dental amalgam indicated by reference character B has been moved out of the cartridge and into portion 436 of a dental instrument or the like.

As seen most clearly in FIG. 27, a member 450 extends in depending relationship from the underside of member 410, member 450 having a rounded ball 452 disposed at the lower end thereof. As member 410 swings downwardly, the ends of the cartridge are cut off while the cartridge is still being firmly held in place by compression members 200 and 202 as well as reshaping members 300 and 302. Upon downward movement of member 410, ball 452 engages surface 390 formed on the upper part of handle 378 which causes handle 378 to pivot in a counterclockwise direction whereupon portion 380 of the handle moves outwardly of cavity 384 into the full line position as shown in FIG. 35. This movement of handle 378 causes reshaping plates 300 and 302 to move away from one another under the influence of spring 368 which urges rack 364 to the left as seen in FIG. 28, but only after the ends of the cartridge have been cut off. Accordingly, tubular portion 102 of the cartridge is released by the reshaping members.

As member 410 swings still further in a downward direction, ball 452 enters into the aforementioned slot 392 provided in handle 378, thereby locking member 410 in its downward operative position as shown in FIG. 35 wherein it is interconnected with handle 378 of the operating means for the reshaping means.

With the components in this operative position, the ejection means is operated to eject the body of finished amalgam from the cartridge into a suitable instrument or the like. Ball 452 serves to lock the cutting means 410 in proper operative relationship with respect to the remaining components of the apparatus so that the ejection means is accurately aligned with tubular portion 102 of the cartridge within the apparatus.

After the body of material has been ejected from the cartridge, handle 378 is depressed so as to release locking ball 452 from slot 392. Member 410 can then be swung upwardly and cover plate 342 may also be swung upwardly to again move these components into an elevated position as shown, for example, in FIG. 23.

Operating handle 226 is then operated to release the compression members whereupon the cartridge can be removed from the apparatus. Any residue of material in the apparatus can then be blown out, and the mixing and dispensing apparatus is ready for reuse.

Referring now to FIG. 39 of the drawings, a modified form of cartridge C' according to the present invention is illustrated. This form of cartridge is substantially identical to that previously described, with the exception that the tubular portions of this form of cartridge are of elongated cross-sectional configuration rather than being of substantially cylindrical cross-sectional configuration in accordance with the teaching of the previously disclosed embodiments.

FIGS. 40, 41 and 42 illustrate the manner in which the apparatus previously disclosed is modified in order to cooperate with a cartridge C'. Since the apparatus is substantially the same as previously described, similar parts have been given the same reference numerals primed. The only difference in the reshaping means of the apparatus is the fact that surfaces 306' and 308' of reshaping members 300' and 302' respectively are of elongated cross-sectional configurations so as to be complementary to the elongated cross-sectional configuration of tubular portion 102' of the modified cartridge.

As shown in FIGS. 43 and 44, the ejection means of the apparatus employed with a cartridge C' is modified such that the cross-sectional configuration of hole 430' as well as the bore formed through filling boss 432' is complementary to the cross-sectional configuration of the finished body of material B'. Additionally, ejection plunger 442' is of elongated cross-sectional configuration as seen in FIG. 44 so as to be complementary to the shape of the interior of tubular portion 102' of the cartridge.

As this invention may be embodied in several forms without departing from the spirit or essential characteristics thereof, the present embodiment is therefore illustrative and not restrictive, since the scope of the invention is defined by the appended claims rather than by the description preceding them, and all changes that fall within the metes and bounds of the claims or that form their functional as well as conjointly cooperative equivalents, are therefore intended to be embraced by those claims.

What is claimed is:

1. An amalgam cartridge comprising a closed flexible body means defining a pair of separate chambers for containing an amalgam powder and mercury respectively, said body means defining passage means for providing communication between said chambers, closure means normally closing off said passage means to prevent communication between said chambers, said closure means being deformable to selectively permit communication between said chambers through said passage means, and said cartridge including aligning means thereon for engagement with cooperating alignment means on an associated mixing and dispensing apparatus for aligning the cartridge with respect to said associated mixing and dispensing apparatus.

2. A cartridge as defined in claim 1 wherein said body means comprises an integral plastic extrusion.

3. A cartridge as defined in claim 1 wherein said body means comprises a pair of tubular portions connected with one another by a pair of separate web portions, said web portions defining said passage means therebetween.

4. A cartridge as defined in claim 3 wherein each of said tubular portions is of substantially cylindrical cross-sectional configuration.

5. A cartridge as defined in claim 3 wherein each of said tubular portions has an elongated transverse cross-sectional configuration.

6. A cartridge as defined in claim 3 wherein said closure means comprises a relatively rigid member engaging said web portions.

7. A cartridge as defined in claim 6 wherein said relatively rigid member is of generally tubular construction and is split longitudinally thereof.

8. A cartridge as defined in claim 7 wherein said relatively rigid member is disposed in partially surrounding relationship to one of said tubular portions of the body means.

9. A cartridge as defined in claim 6 wherein said relatively rigid member has holes formed therein for aligning the cartridge with an associated mixing and dispensing apparatus.

10. A cartridge as defined in claim 1 wherein said closure means comprises a frangible membrance formed integral with said body means and disposed in spanning relationship to said passage means.

11. The method of making an amalgam cartridge comprising forming a flexible body means defining a pair of chambers and a passage means for providing communication between the chambers, providing means to close off said passage means to prevent communication between said chambers including forming a relatively rigid member engageable with said body means between said chambers to close said passage means, filling one of said chambers with an amalgam powder and filling the other of said chambers with mercury and sealing said chambers.

12. The method as defined in claim 11 wherein said flexible body means is formed by extruding an integral member including a pair of tubular portions connected by separate web portions defining passage means therebetween.

13. The method as defined in claim 11 wherein the step for providing means for closing off such passage means includes making said relatively rigid member tubular, and splitting said tubular member longitudinally thereof.

14. The method as defined in claim 13 including the step of forming aligning holes in said relatively rigid tubular member.

15. The method as defined in claim 14 including the steps of forming said flexible body means by extruding an integral member including a pair of tubular portions connected by separate web portions defining a passage means therebetween, and placing one of said tubular portions within said longitudinally split tubular member with opposite free edges of said tubular member engaging opposite sides of said web portions to close off the space therebetween.

16. The method as defined in claim 11 wherein said flexible body means is formed by extruding an integral member including a pair of tubular portions connected by separate web portions defining passage means therebetween, and forming aligning holes in one of said tubular portions.

17. The method as defined in claim 11 wherein said other chamber is filled with mercury under vacuum conditions.

18. The method as defined in claim 11 wherein said body means is formed of a plastic material and said chambers are sealed by heat sealing said plastic body means.

19. An amalgam cartridge comprising a closed flexible body means defining a pair of separate chambers for containing an amalgam powder and mercury respectively, said body means including a connecting portion between the chambers and defining passage means for providing communication between said chambers, and closure means comprising a relatively rigid member engaging said connecting portion normally closing off said passage means to prevent communication between said chambers, said closure means being deformable to selectively permit communication between said chambers through said passage means.

20. The method of making an amalgam cartridge comprising forming a flexible body means defining a pair of chamber means therein for containing an amalgam powder and mercury, respectively, providing passage means in said body means for establishing communication between said chambers, providing means to lose off said passage means to prevent communication between said chambers, said closure means being deformable to selectively permit communication between said chambers through said passage means, providing aligning means on said cartridge for engagement with cooperating alignment means on an associated mixing and dispensing apparatus for aligning the cartridge with respect to said associated mixing and dispensing apparatus, filling one of said chambers with an amalgam powder and filling the other of said chambers with mercury and sealing said chambers.

21. The method as defined in claim 20 wherein the means for closing off said passage means is provided by forming a frangible membrance integral with said body means and in spanning relationship to said passage means.

22. An amalgam cartridge mixing and dispensing apparatus comprising compression means for compressing a portion of a cartridge therebetween, mixer means for intimately mixing materials within a cartridge with one another, reshaping means to engage a portion of a cartridge and forming a mixed body of material therewithin to a desired configuration, cutter means for cutting off a portion of a cartridge and ejection means for ejecting a mixed body of material from a cartridge.

23. Apparatus as defined in claim 22 wherein said compression means includes a pair of compression members mounted for relative movement toward and away from one another and means for selectively moving said pair of compression members with respect to one another.

24. Apparatus as defined in claim 22 including alignment means supported by said compression means for engaging an associated cartridge to properly align the cartridge with respect to the compression means.

25. Apparatus as defined in claim 24 wherein said alignment means includes vertically extending means for aligning an associated cartridge horizontally with respect to the compression means.

26. Apparatus as defined in claim 24 wherein said alignment means includes horizontally extending means for aligning an associated cartridge vertically with respect to the compression means.

27. Apparatus as defined in claim 22 wherein said mixer is movably mounted for movement into and out of operative mixing position.

28. Apparatus as defined in claim 22 wherein said mixer means includes a pair of oppositely disposed mixing members movable with respect to one another.

29. Apparatus as defined in claim 28 wherein said mixing members are pivotally mounted.

30. Apparatus as defined in claim 29 including a drive motor operatively connected with said mixing members for oscillating said mixing members during operation of the mixer means.

31. Apparatus as defined in claim 30 wherein said drive motor is operatively connected with said mixing members by an eccentric drive connection.

32. Apparatus as defined in claim 22 wherein said reshaping means includes a pair of reshaping members mounted for movement with respect to one another.

33. Apparatus as defined in claim 32 wherein said reshaping members includes arcuate end portions for engaging a part of a cartridge.

34. Apparatus as defined in claim 33 wherein one of said reshaping members includes a laterally extending lip extending from the associated arcuate end portion.

35. Apparatus as defined in claim 32 wherein said laterally extending lip includes an upwardly sloping undersurface.

36. Apparatus as defined in claim 32 including operating means for operating said reshaping means, said operating means being mounted for swinging movement with respect to said reshaping means.

37. Apparatus as defined in claim 36 wherein said operating means includes a movably mounted handle.

38. Apparatus as defined in claim 37 wherein one of said compression members has a cavity formed therein and defines a lip adjacent said cavity, said handle of the operating means including a portion for engaging said lip.

39. Apparatus as defined in claim 36 wherein said operating means includes a pair of pins, each of said reshaping members having a hole formed therein for receiving one of said pins.

40. Apparatus as defined in claim 39 wherein said operating means for the reshaping means includes a pinion operatively connected with each of said pins, a toothed rack member engaging said pinions, said rack member being resiliently biased in one direction, said rack member being operatively connected with a handle pivotally carried by said operating means.

41. Apparatus as defined in claim 22 wherein said cutter means is mounted for swinging movement with respect to the remaining components of the apparatus.

42. Apparatus as defined in claim 41 wherein said cutter means includes a pair of spaced cutter members for engaging opposite ends of a cartridge.

43. Apparatus as defined in claim 42 wherein at least one of said cutter members has a hole formed therethrough and a boss formed thereon for facilitating filling and associated dental instrument.

44. Apparatus as defined in claim 41 including operating means for operating said reshaping means, said cutter means and said operating means including interlocking means for interlocking the operating means and the cutter means when the cutter means and operating means are disposed adjacent one another.

45. Apparatus as defined in claim 22 wherein said ejection means is carried by said cutter means.

46. Apparatus as defined in claim 45 wherein said ejection means includes a plunger mounted for movement with respect to said cutter means.

47. Apparatus as defined in claim 46 wherein said plunger is resiliently biased in a direction away from said cutter means.

48. The method of mixing and dispensing amalgam from a cartridge having a pair of separate chambers containing amalgam powder and mercury respectively comprising forcing the mercury and amalgam powder together within the cartridge, intimately mixing the amalgam powder and the mercury with one another, reshaping the mixed body of material within the cartridge to a desired configuration, cutting off both ends of the cartridge and then ejecting the mixed body of material from the cartridge.