

Feb. 23, 1965

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3,170,648

AMALGAM PRODUCING MACHINE

Filed Aug. 27, 1962

2 Sheets-Sheet 1

FIG. 1.

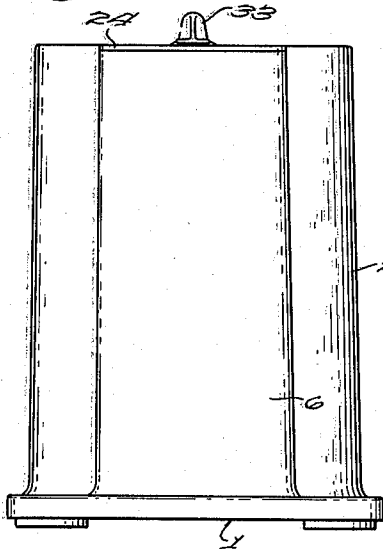


FIG. 2.

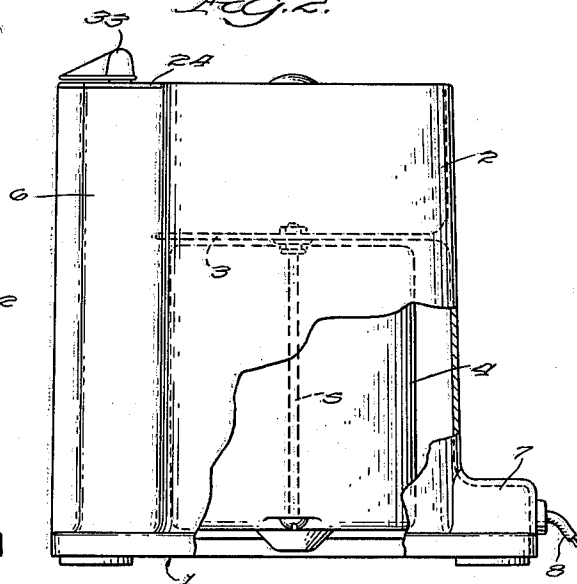


FIG. 3.

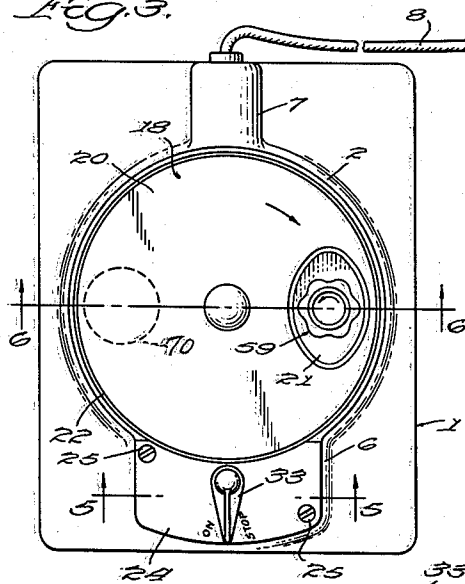


FIG. 11.

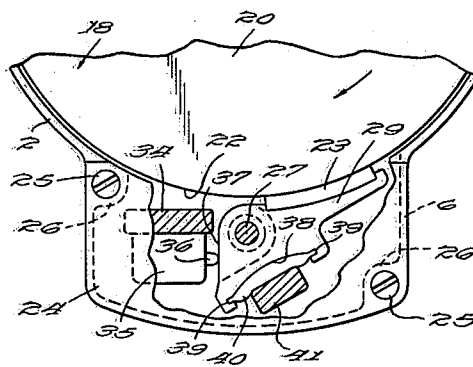
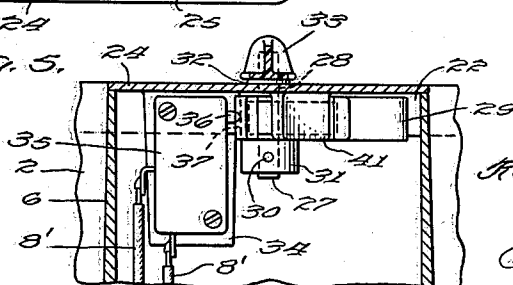


FIG. 4.

FIG. 5.



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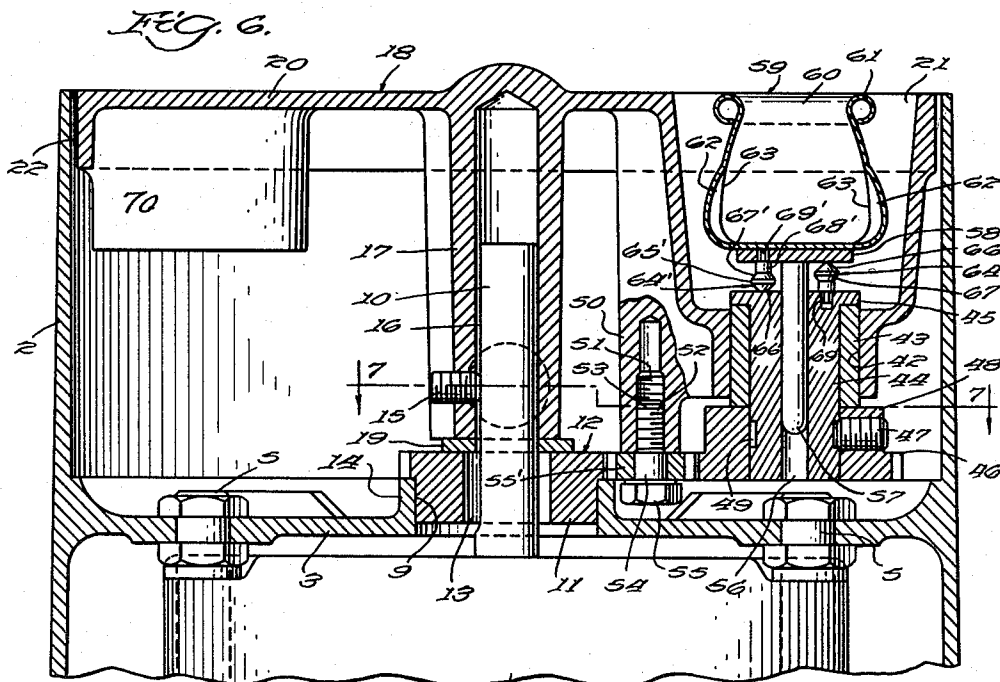
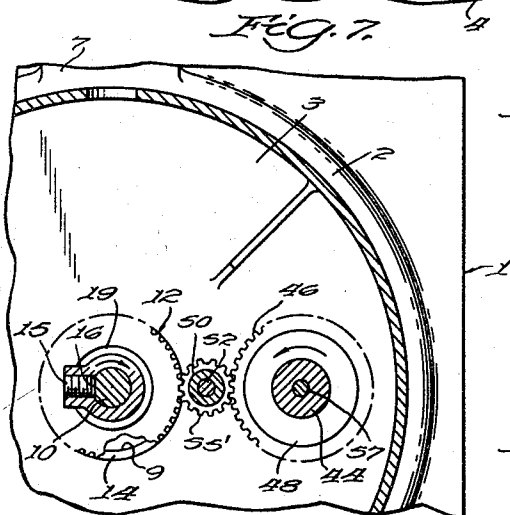
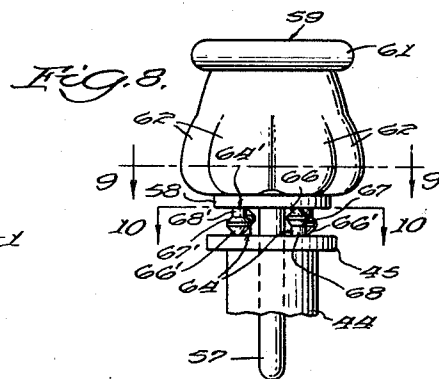
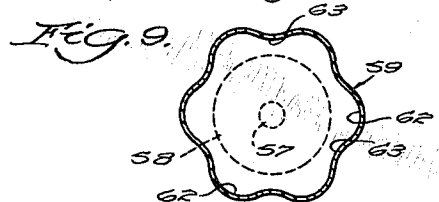
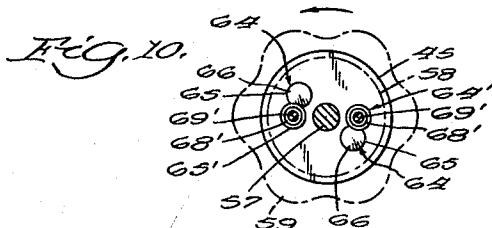
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AMALGAM PRODUCING MACHINE

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2 Sheets-Sheet 2



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AMALGAM PRODUCING MACHINE
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This invention relates to prosthetic dentistry and particularly to a device for accelerating the procedure necessary to amalgamate silver alloy and mercury into dental amalgam.

In making dental restorations of amalgam, the amalgam is first formed from a mixture of mercury and metal powder from which excess mercury, if any, has been removed. The compound is then kneaded or "mulled" for a short period to develop a softness sufficient to be readily formed as it is introduced into the tooth cavity. The amalgam hardens very quickly and the few seconds of time that are consumed in the mulling process, the more time the dentist has available to fill the cavity and form the outer surface of the restoration.

The procedure for the amalgamation of silver alloy powder and mercury involves placing predetermined proportions of the ingredients, i.e., alloy and mercury, into a receptacle, designed to abrade or triturate the alloy grain surfaces and to hold the mercury confined in such a way that it can mix with the alloy. Friction causes finely divided particles to rub off of the alloy grains which particles combine with the mercury. This combination produces a third material, Ag_2Hg_2 , sometimes known as Arbor Dianae, which has the property of a cement, or binder and which sets up and bonds the alloy grains together.

A common method of amalgamating silver alloy and mercury is by use of a mortar and pestle. The mortar surface is maintained rough by using a fine-grit emery cloth. Portions of alloy and mercury are measured into the mortar and the pestle is used to abrade the alloy and stir the ingredients to cause amalgamation. A rapid movement and light pressure is used. The time required to amalgamate by this means is about one minute. Considerable skill and practice is necessary to obtain uniform results.

Another common method is mechanical amalgamation by a machine imparting a reciprocatory motion. A capsule about $\frac{3}{4}$ " long and $\frac{1}{16}$ " in diameter in which the ingredients are placed is attached to an arm that reciprocates in the longitudinal line of the capsule about 3,000 times a minute in a path about $\frac{1}{2}$ " long. The rate of movement is thus 3,000 inches per minute. Trituration is usually accelerated by use of a pestle (an object comparable to an elongated ball bearing fitting loosely in the capsule). The time required to effect amalgamation with these machines averages about 15 seconds. The loading of the capsule, the fitting of the capsule into the holder, the removal of the capsule from the holder and the separation of the capsule to remove the ingredients requires additional time and considerable energy.

With this review of currently employed methods in mind, the principal object of the present invention is to provide a machine for amalgamating silver alloy and mercury more quickly and effectively than has yet been achieved.

Another object of the invention is to provide a machine of the above character in which the ingredients to be amalgamated are readily placed in the machine and as readily removed after having been converted into a usable quantity of plasticized amalgam.

A still further object of the invention is to provide a machine, of the above character, in which centrifugal force is employed to subject the ingredients, i.e., alloy

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and mercury, to a series of frictional movements sufficient to triturate the alloy and cause amalgamation.

Still another object of the invention is to provide a machine, of the above character, in which all the moving parts employed are rotating parts whereby the noise and annoyance of the vibration of prior art reciprocating mechanical amalgamators is eliminated.

With the foregoing objects in view, together with such additional objects and advantages as may subsequently appear, the invention resides in the parts and in the construction, combination and arrangement of parts described, by way of example, in the following specification of a presently preferred embodiment of the invention, reference being had to the accompanying drawings which form a part of said specification and in which drawings:

FIG. 1 is a front elevation of a machine embodying the invention,

FIG. 2 is a side elevational view as viewed from the right hand side of FIG. 1, portions of the casing of the machine being broken away to disclose interior construction details,

FIG. 3 is a top plan view having reference to FIG. 1,

FIG. 4 is an enlarged scale, fragmentary, top plan view with a portion of the control means supporting plate broken away to disclose interior construction,

FIG. 5 is a transverse sectional view of the control means portion of the machine taken on the line 5—5 of FIG. 3,

FIG. 6 is an enlarged scale, fragmentary, sectional view taken on the line 6—6 of FIG. 3 showing the operating means for the cup or container for the amalgam ingredients,

FIG. 7 is a fragmentary, sectional, top plan view taken on the line 7—7 of FIG. 6,

FIG. 8 is a side elevational view of the amalgam holding cup,

FIG. 9 is a transverse top plan, sectional view of the holding cup taken on the line 9—9 of FIG. 8,

FIG. 10 is a transverse section in top plan taken on the line 10—10 of FIG. 8 showing the interengagement of the cup driving and retaining clutch means, and

FIG. 11 is a fragmentary plan view, partly in section, of the centering means for the control devices.

Referring to the drawings, the illustrated embodiment of the machine comprises the unitary frame or case including a flat rectangular base 1 having a hollow, generally cylindrical casing portion 2 rising therefrom and defining an opening in said base; said casing portion supporting a transverse wall 3 to the under face of which a vertical axis electric motor 4 is secured by bolts 5, 5 extending through the motor frame and said transverse wall. The generally circular configuration of the wall constituting the casing 2 is interrupted at one side thereof by a hollow rib portion 6 of generally rectangular configuration as viewed in plan in which the control devices of the machine are housed as will presently be described in detail. Additionally, an upper surface portion of the base is provided with a hollow horizontally extending boss 7 into which an electric cord 8 extends en route to the control devices previously referred to and to the motor.

The transverse wall 3 at the center thereof is provided with an opening 9 disposed in the axial line of the motor shaft 10 which extends therethrough upwardly from the motor 4 to about the plane of the top casing 2 and tightly mounted in the opening 9 is the hub 11 of a stationary gear 12 having an opening 13 extending therethrough which is considerably larger than the motor shaft 10 and through which opening the motor shaft extends; the under face of said gear being engaged by a shoulder 14 at the upper end of the opening 9. Secured to the motor shaft

10 by a setscrew 15 engaging a flattened side 16 of said shaft is the hub 17 of a rotor member generally indicated by the numeral 18; the lower end of said hub engaging a thrust washer 19 on the upper face of the gear 12 to relieve the shaft and motor from the end thrust of the plate of the rotor.

The upper end of the rotor is disposed substantially in the plane of the upper end of the casing 2 and is provided with a top surface 20 lying in said plane but interrupted by a downwardly extending recess 21 of oval configuration as viewed in plan and disposed adjacent to the rim of the motor and to which recess further reference will be made. Adjacent the top surface 20, the rotor is provided with a peripheral braking surface 22 engageable by a brake shoe 23 which is disposed at the under side of a cover plate 24. The cover plate is secured to the upper open end of the casing rib portion 6 by screws 25, 25 engaging lugs 26, 26 extending laterally from the inner side surfaces of the side walls of said rib portion. A rock shaft 27 extends through and is journaled in a bore 28 extending through the cover plate 24 and below the cover plate, said rock shaft carries a rock lever 29 fixed thereto by a dowel pin 30 extending through the hub 31 of said rock lever and through the shaft 27. The upper surface of the cover plate 24 is provided with a boss 32 surrounding the bore 28 and secured to the upper end of the rock shaft and engaging said boss is a radially extending hand lever member 33. The rock lever 29 carries the brake shoe 23 and when the hand lever is moved in a counterclockwise direction as viewed in FIGS. 3 and 4, the brake shoe is moved against the rotor braking surface 22. At the side of the shaft 27 opposite the brake shoe 23, the cover plate 24 carries a depending bracket 34 on which is mounted a plunger actuated, normally open, snap switch 35 interposed in one of the leads 8' extending between the conductor cord 8 and the motor 4. The actuating plunger 36 of the switch 35 is positioned adjacent a camming surface 37 on the rock lever 29 which is so arranged that clockwise movement of the rock lever by the hand lever 33 will cause the rock lever to depress the plunger and effect closure of the switch and actuation of the motor and the rotor carried thereby. When manual effort tending to close the switch 35 is discontinued, the switch opening bias on the plunger 36 within the switch assists in returning the rock shaft to a neutral position in which the switch is open and the brake shoe is disengaged from the braking surface. Between the brake shoe carrying portion and the camming surface 37, the rock lever is provided with a relatively wide, shallow recess 38 having opposing notches 39, 39 at each end thereof. Filling said recess and secured thereby by engagement in the notches 39, 39 is a block 40 of resilient material such as sponge rubber which engages and is partially compressed by a member 41 depending from the cover 24 and facing said recess. This block of resilient material is so disposed as to normally resiliently maintain the control means comprising the rock shaft 27, the rock lever 29 and the hand lever 33 in said neutral position since said resilient material is subjected to the least degree of compression in that position.

The recess 21 in the rotor 18 has a depth of substantially half the distance from the top plane of the rotor to the upper surface of the transverse wall 3 and the bottom of said recess terminates in a bore 42 extending therethrough parallel to the rotor axis and a bushing 43 is secured in said bore with a press fit; said bushing extending beyond the opposite ends of said bore. Mounted for rotation in said bushing is a shaft 44 having a flange 45 engaging the upper end of said bushing, and at its lower end, the shaft 44 has a gear 46 fixed thereto by a setscrew 47 extending through the hub 48 of the gear and engaging the groove 49 in the shaft; the end of said hub engaging the lower end of the bushing 43 and cooperating with the flange 45 to hold the shaft 44 against endwise movement in the bushing. The lower portion of the rotor hub 17

is provided with a laterally extending boss 50 disposed in a line intersecting the axes of the gears 12 and 46 and extending upwardly from the under side of the boss 50 is a threaded bore 51 engaging the threaded portion 52 of a shoulder bolt 53 having a body portion 54 between the end of the boss 50 and the head 55 of said screw and on which body portion a pinion 55' is mounted for free rotation; said pinion meshing with the gears 12 and 46. It will be recalled that the gear 12 is fixed and so as the rotor 18 is rotated by the motor 4, for example, in a clockwise direction, the pinion 55' being rolled along the gear 12 will also rotate in a clockwise direction. Since the pinion is meshed with the gear 46 at a point diametrically opposite its engagement with the stationary gear 12, it will impart counterclockwise rotation to the gear 46 while that gear is carried clockwise in an orbit about the gear 12 by the rotor 18.

The shaft 44 has an axial bore 56 extending there-through serving as a socket means for a pin 57 carrying a disk-like head 58 at the upper end thereof and the upper surface of said head is fixed to the bottom of an amalgam holding cup 59 disposed in axial alignment with the axis of the pin 57. The cup is preferably formed of thin sheet metal with the side walls thereof sloping slightly inwardly to an open end 60 bounded by a rolled rim portion 61 and the lower portion of the side wall is expanded into a series of shallow, rounded pockets 62 defined by circumferentially spaced, inwardly projecting, rounded ridges 63 extending from the bottom of the cup to the upper limit of said expanded portion.

The top surface of the flange end 45 of the shaft 44 carries a pair of vertically upwardly extending pins 64, 64 disposed diametrically opposite to each other at equal distances from the axis of the shaft 44; each of said pins terminating in a head 65 comprising a conical top surface 66 and a frusto-conical bottom surface 67 extending to the body portion 68 of the pin and said body portion terminates in a reduced diameter end portion 69 having a drive fit with a complementary hole in the flange 45. The bottom surface of the cup supporting head 58 carries a corresponding pair of identical pins 64', 64' similarly radially disposed and depending from said head; the corresponding surfaces being similarly numbered with the addition of the exponent "' . These pairs of pins are adapted to interengage and, in effect, to form a readily engageable and disengageable jaw clutch means capable of rotating and retaining the cup in position when the machine is operating as will be explained. Additionally, the rotor 18 is provided with a mass 70 diametrically opposite the cup means which serves as a counterbalance therefor.

In use, the amalgam may be formed by placing the mercury and metal powder in the required proportions and amounts therefor in the cup and the machine actuated for a period of about four seconds at full motor speed, it being noted that the motor and rotor speed is approximately three thousand r.p.m. and that the motor reaches that speed in less than about two seconds. The device is stopped abruptly by the brake means and the cup is lifted out of the machine. When the cup is inverted, the amalgamated ingredients will fall freely from the cup.

It is particularly to be noted that the radius of the orbit about which the cup is moved bodily is much greater than the radius of the interior of the cup. Actually, the radial dimension of the orbital path of the most remote pocket portion of the cup measured from the axis of the rotor is about four times the radius of the interior of the cup measured from the axis about which the cup itself rotates to the deepest portion of any one of the pockets, wherefore, since the gears 12 and 46 are of equal size, the centrifugal force deriving from the orbital movement of the cup as measured at the inner surface of the cup which is most remote from the axis of the rotor will be approximately sixteen times the centrifugal force deriving

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from the rotation of the cup about its own axis. As the cup is moved in its orbit by the rotor, centrifugal force is constantly tending to move the amalgam ingredients as a mass, regardless of the extent to which they are amalgamated, into the pocket of the cup which is farthest from the axis of rotation of the rotor. Since the cup is being rotated about its own axis in a direction opposite the direction of rotation of the rotor, the pockets thereof thus are constantly trying to move the mass of ingredients to a position closer to the axis of rotation in opposition to the centrifugal force acting on said mass and when the pocket surface against which the mass is forced by the centrifugal force reaches an angle at which the centrifugal force can overcome the retention of the mass by that pocket surface, the mass is flung by the centrifugal force to the then outermost portion of the interior surface of the cup with sufficient force to substantially deform it from whatever form it occupied in the pocket from which it was thus forcibly moved. To some extent, the point at which the mass will thus flow or be flung depends on the plasticity of the mass—the plasticity increasing as the working or “mulling” proceeds within the time employed for amalgamation as above specified.

It will be appreciated that under the high rate of rotation employed, each individual grain of the alloy powder will be independently subjected to centrifugal force of sufficient magnitude to cause the grains which are inwardly from the inner surface of the cup to try to displace those grains which are at the cup surface. At the same time, the irregular contour of the inner surface of the cup and the movement of the amalgam mass as it tries to remain at the radially outermost portion of the cup interior continues to change the relative positions of the alloy grains with respect to the axis of rotation of the rotor, whereupon, those grains which have been inwardly displaced, are caused to try to work back to the cup surface. The result is that the alloy grains are caused to abrade the surfaces of each other in an action which is comparable to a brisk rubbing without crushing with quicker and more complete trituration of the amalgam.

The ideal action for production of dental amalgam is one which does not require the use of a pestle so that crushing of the alloy grains is avoided with the attendant danger of over amalgamation or the production of more binder than is necessary. The action of the device of this invention achieves this desirable result in a very few seconds and as a consequence, the amalgam is in better condition for use in less time than by other processes and accordingly, many seconds of very valuable time are available to the dentist in installing the restoration. Moreover, since no pestle is employed, there is no danger of crushing the alloy grains.

The machine of the present invention is also excellent for mulling amalgam from which mercury has been expressed. Generally, amalgams of silver alloy and mercury formed by the mortar and pestle method or other mere mixing routines must be squeezed to lower the mercury ratio by expressing surplus mercury. When this is done, the mixture is dry and less cohesive unless the mixture is mulled to develop additional binder from the mercury that is still free to unite with finely divided particles of alloy. By reason of the accelerated action of this apparatus, amalgams wherein the mercury has been reduced to less than 50% by weight can be rendered plastic and workable by mulling in the amalgamating cup for a very short time. This is important because the mercury content of the filling should be as low as possible, yet the amalgam must be plastic enough for good adaptation to the cavity. Thus, amalgams which have been squeezed out to the point where they cannot be made plastic by other means can be plasticized in this machine.

This invention is also useful for mulling pellets of amalgams which have been made by the pressure method of amalgamation. This method produces a pellet of

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amalgam having a predetermined mercury proportion but which, generally, is not sufficiently plastic for easy insertion in a cavity. This desirable plasticity is easily achieved by placing the pellet into the cup and operating the machine about 3 to 4 seconds.

Amalgam working devices using a rotary movement have been proposed before. However, in all cases so far as known, the rotation of the rotor and of the ingredient carrying container is in the same direction. The action thus generated is complementary and produces little trituration. The differential for achieving trituration is far greater and more efficient when the rotation of the ingredient carrying container rotates in the opposite direction from that of the rotor. Moreover, by not having to remove a capsule from a machine, open it, and remove the amalgam, several seconds of critically important time are made available to the dentist by the always open cup of the present invention.

Another use of the machine is the quick and efficient mixing of the so-called porcelain types of restoration materials by generally following the preliminary steps employed for preparing such materials in vibratory or reciprocatory amalgamators. The ingredients are placed in a small flexible bag of rubber or like material and the bag and contents is then placed in the cup of the machine which is then run for a few seconds. The tumbling of the bag and contents under the stress of the applied centrifugal force will effect a kneading action resulting in the quick preparation of the material ready for use upon opening the bag.

It should be noted that the frusto-conical surfaces 67 and 67' of the pins 64 and 64' interengage under the spinning action of the shaft 44 and thus tend to hold the cup against upward movement while causing it to be rotated by the rotation of the shaft 44 and that at the same time the sloping surfaces allow the cup to be readily lifted out of the recess 21, the oval shape of the recess 21 affording room for the fingers of the user to reach into the recess and grasp the cup. Also, the conical ends of the pins 64 and 64' insure that when the cup is replaced in the driving shaft 44, there will be no failure of engagement of the pins since, if the pins should contact each other endwise, these conical surfaces will cause relative rotary displacement sufficient to insure that the conical ends of the pins will engage, respectively, the end of the shaft 45 and the under face of the cup supporting head 58.

There is a great deal of variation and little agreement as to the proper terms to employ to describe the formation of dental amalgam. Some authorities refer to the process as “achieving” amalgam or amalgamation. Others seem to prefer such terms as “producing,” “creating” or “forming” in the same sense. With this variation in terms in mind, the word “producing” has been chosen for use in this application and it will be understood to be synonymous in its scope of means with any word or words used to describe the process of mixing silver alloy powder and mercury to produce a dental restoration material.

While in the foregoing specification there has been disclosed a presently preferred embodiment of the invention, the invention is not to be deemed to be limited to the precise details of construction thereof thus disclosed by way of example, and it will be understood that the invention includes as well all such changes and modifications in the parts and in the construction, combination and arrangement of parts as shall come within the purview of the appended claims.

I claim:

1. In a machine for producing dental amalgam having sufficient plasticity for installing in a tooth cavity, a frame structure, a rotor mounted on said frame structure for rotation about a vertical axis, power means operatively connected to said rotor to effect rotation thereof about said vertical axis, an amalgam material retaining cup

mounted on said rotor for rotation in an orbital path generated about a vertical axis laterally spaced from the axis of rotation of said rotor, devices carried by said frame structure and said rotor operative, as an incident to rotation of said rotor about its said vertical axis, to impart simultaneous rotation of said cup about said laterally spaced axis but in the direction opposite to the direction of rotation of said rotor and means formed integrally with the internal surface of said cup operative in response to the combined effect of rotation of said cup about its own axis and in said orbital path to cause amalgam forming ingredients separately introduced into said cup to be combined into a pellet.

2. An amalgam producing machine as claimed in claim 1 in which said material retaining cup is disposed concentrically with respect to said laterally spaced axis and includes a body portion surmounted by an open top portion of lesser internal diameter than the internal diameter of said body portion, and in which said means on the internal surface of said body portion of said cup constitutes a series of inwardly facing pockets defined by a series of ribs spaced circumferentially about the inner surface of the cup and of lesser radial distance from the axis of rotation of said cup than the surfaces of said pockets.

3. An amalgam producing machine as claimed in claim 1 in which said material retaining cup is detachably mounted on said rotor.

4. An amalgam producing machine as claimed in claim 1 in which said power means comprises an electric motor mounted on said frame structure, and in which a vertical shaft driven by said motor extends upwardly beyond the motor and carries said rotor for rotation therewith.

5. An amalgam producing machine as claimed in claim 1 in which said frame carries a manually operable switch for controlling said motor and manually operated brake means for stopping said motor and said rotor.

6. An amalgam producing machine as claimed in claim 1 in which said devices for rotating said material retaining cup include a stationary gear carried by said frame structure and disposed in coaxial relation to the axis of rotation of said rotor, a pinion rotatably mounted on said rotor and meshing with said stationary gear, and a gear meshing with said pinion and rotatable about said laterally spaced axis and operably connected to said material retaining cup to rotate said cup when said rotor is rotated.

7. An amalgam producing machine as claimed in claim 5 in which said switch and said brake means are operably engaged by a manually oscillatable lever means carried by said frame structure and are so disposed relative to said lever means that when said switch is closed, the brake means is disengaged and when the brake means is rendered operative, said switch is open.

8. An amalgam producing machine as claimed in claim 6 in which said gear rotatable about said laterally spaced axis is mounted for rotation on said rotor and carries socket and clutch means detachably engageable with complementary components of said material retaining cup and effective both to rotate said cup and to hold said cup on said rotor while being rotated by said rotatable gear.

9. An amalgam producing machine as claimed in claim 7 in which said rotor is provided with a peripheral brake engaging surface and in which said manually oscillatable lever means includes a brake shoe positioned to engage said peripheral surface of said rotor.

10. An amalgam producing machine as claimed in claim 7 in which said manually operable lever means includes resilient means normally operative to position said manually oscillatable lever means in an intermediate, neutral position.

11. In an amalgam producing machine, a cup for reception of the amalgam ingredients; said cup having a body portion and a constantly open end for reception and removal of the amalgam; said end being of lesser diameter than said body portion and said body portion having an interior surface of irregular configuration radially of the axial line of said open end, cup actuating means on which said cup is detachably mountable and including elements detachably engaging complementary elements on said cup effective to retain and impart actuation to said cup, devices operating said cup actuating means effective to impart rotation to said cup about an axial line at least substantially parallel to the axial line of said open end of said cup, and other means for simultaneously moving said cup in an orbit about an axial line substantially parallel to the axis of rotation of said cup; said orbit having a radial dimension greater than the greatest radial dimension of the interior of said body portion of said cup.

12. An amalgam producing machine as claimed in claim 11 in which said other means causes said cup to move in said orbit in a direction of rotation which is opposite the direction of rotation of said cup by said actuating means.

13. In a machine for producing dental restoration material having sufficient plasticity for installing in a tooth cavity, a frame structure, a rotor mounted on said frame structure for rotation about a vertical axis, power means operatively connected to said rotor to effect rotation thereof about said vertical axis, means for receiving and retaining the restoration material ingredients comprising a material retaining cup mounted on said rotor for rotation about a vertical axis laterally spaced from the axis of rotation of said rotor, devices carried by said frame structure and said rotor operative, as an incident to rotation of said rotor about its said vertical axis, to impart simultaneous rotation of said cup about said laterally spaced axis but in the direction opposite to the direction of rotation of said rotor, and means on the inner surface of said cup and rotatable in unison therewith forming radially inwardly projecting ribs effective, incident to rotation with said cup about its own axis and movement of said cup about the axis of said rotor, to effect both an intermixing of restoration material ingredients contained in said cup and a mulling action on the intermixed ingredients with resultant formation of the restoration material ready for installation in a tooth cavity.

14. An amalgam producing machine as claimed in claim 13 in which said material retaining cup is detachably mounted on said rotor.

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