

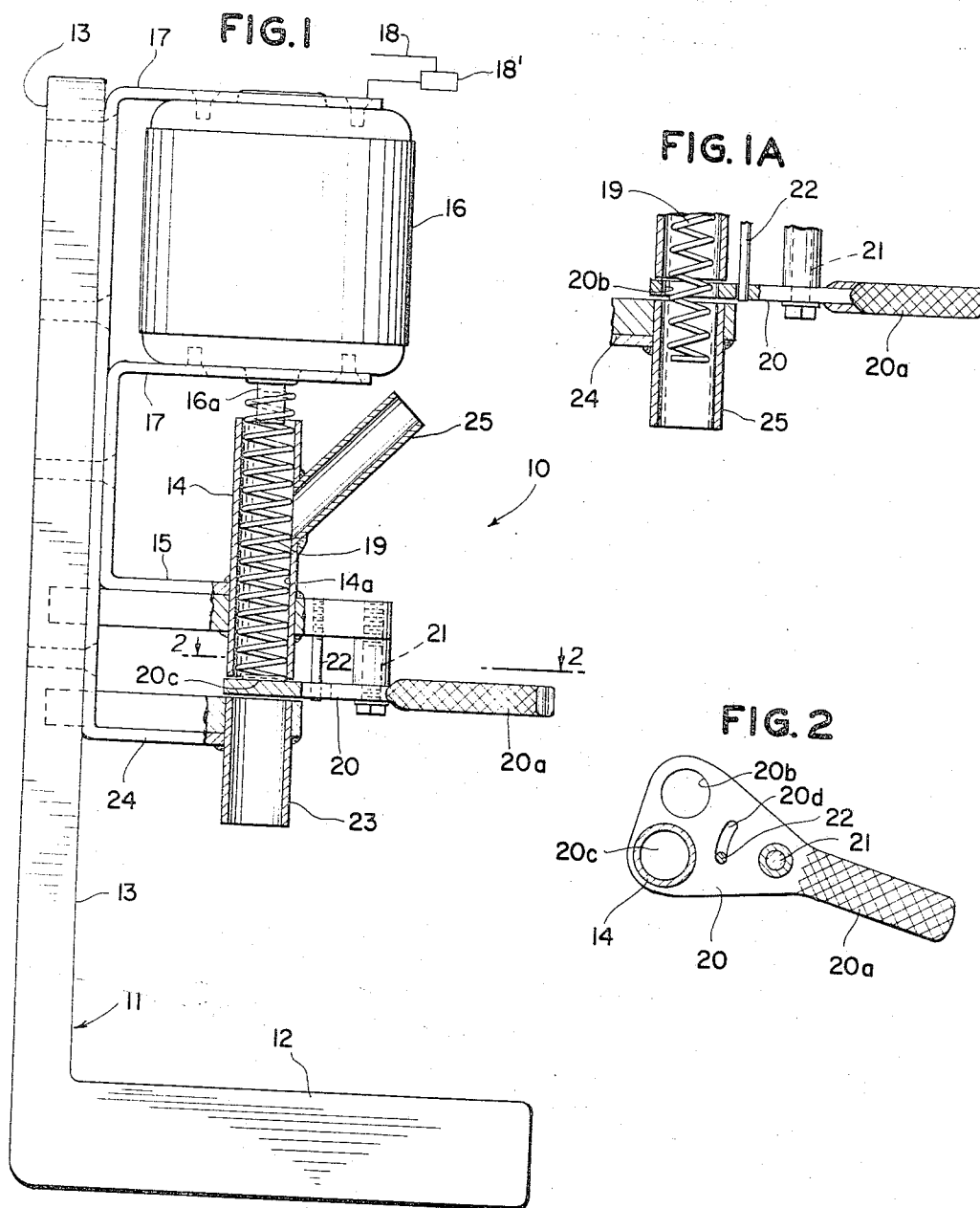
Aug. 15, 1967

R. P. SPINELLO

3,336,009

INSTRUMENT FOR MIXING DENTAL MATERIALS AND THE LIKE

Filed Aug. 20, 1965



INVENTOR.  
*Ronald P. Spinello*  
 BY  
*McGregor & Eisenman*  
 ATTORNEYS.

1

3,336,009

## INSTRUMENT FOR MIXING DENTAL MATERIALS AND THE LIKE

Ronald P. Spinello, Westbury, N.Y., assignor to The Dentists' Supply Company of New York, York, Pa., a corporation of New York

Filed Aug. 20, 1965, Ser. No. 481,263

8 Claims. (Cl. 259—8)

### ABSTRACT OF THE DISCLOSURE

A mixing device for triturating dental materials such as amalgams and in which a yieldable helical spring rotates in a chamber to cause continuous mixing movement of the ingredients and also discharge the same by such rotating spring to render the device substantially self-cleaning.

Mixing small quantities of materials having high densities or shear characteristics such, for example, as dental amalgams, is difficult. Historically, and to a large extent today, it is done manually with a mortice and pestle. The operation is not only time-consuming but it is relatively critical because, in the case of amalgams, the particles of silver and the liquid mercury must be brought into intimate contact in a uniform mixture as part of the process called trituration. The material has only a transient phase in which it is suitably pliant to be condensed in a tooth cavity to form an effective filling. On the other hand if it is not thoroughly triturated, a low quality filling also results even though hardening has not set in prior to the condensing operation.

The combination of relatively long periods for manual mixing and possible low-quality results have given rise to various attempts to mechanize the operation.

The character of the material and the small amounts which are normally mixed at one time has not yielded to an effective, economical solution. A typical mechanical aid evolves the use of a small container or capsule into which the materials are placed and thereafter agitated until trituration occurs. The difficulty of loading of the capsules, the noise and time of the agitation, and the difficulty of removing the amalgam from the capsules represent some of the objections to this approach to mechanization.

Accordingly, it is an object of the present invention to provide an improved mixing instrument particularly adapted for triturating metal particles and mercury.

A further object of the invention is to provide an instrument for triturating dental amalgam which greatly simplifies the loading and unloading process and which is self-cleaning.

Still another object of the invention is to provide an improved mixing instrument which is capable of accommodating extremely small quantities of material and which is capable of carrying out mixing processes such as trituration in minimum time with minimum attendant noise.

In accordance with the present invention, metered quantities of basic materials are deposited in a mixing chamber, preferably in the form of a small, vertically disposed cylindrical cavity. A mixing rotor is disposed in the cavity in the form of a helically wound wire element coupled to a drive motor for rotary motion. The drive is preferably arranged so that the rotor is driven in a predetermined direction in relation to the pitch of the helix, viz so that the material engaged by the helix is driven downward. The helical rotor is preferably under slight axial compression within the chamber against a base, which can take the form of a valve plate movable to release the completed mixture.

2

In operation, assuming a dental amalgam is being triturated, metallic particles and mercury are deposited in the chamber and the rotor is driven to cause the mixture to be mulled within the chamber until trituration occurs. The mixture at the walls of the chamber is driven downward toward the base and the material in the center is squeezed upward until it is again caught in the downward flow. The rapid flow and attendant reversals of direction result in intimate coaction of the materials. When the load on the rotor is heavy, the helical rotor is automatically compressed upwardly to lighten the load and maintain good mixing speed. Upon completion of the mixing cycle, a valve is then opened and the amalgam is released from the instrument, preferably under the combined effects of gravity and the thrust of the rotating helical rotor, which also scavenges the walls of the chamber of all residue material. After the material is discharged the valve is closed, first compressing the extended helical rotor which, in one preferred arrangement of the invention can be made to drive itself backward into the chamber to its previous compression state to rest on the base or valve plate under compression awaiting the next load.

Other objects and features of the present invention will be apparent from the following description of one preferred embodiment thereof taken in conjunction with the accompanying drawings in which:

FIGURE 1 is a view in side elevation and partly broken away in vertical section of a mixing instrument particularly adapted for amalgam trituration;

FIGURE 1A is a fragmentary view in vertical section of a portion of the instrument of FIGURE 1; and

FIGURE 2 is a view in horizontal section taken on the line 2—2 of FIGURE 1, looking in the direction of the arrows and showing the design and operation of the base valve.

Referring to the drawing, the invention is illustrated as embodied in a mixing instrument 10, particularly designed for the trituration of amalgams in a dental office. The instrument 10 includes a supporting frame 11 having a base 12 adapted to rest on a table, for example, and a vertical support 13 carried thereby. A mixing chamber 14, preferably taking the form of a housing having a vertically arranged cylindrical mixing cavity 14a is supported by the frame by means of a fixed bracket arm 15 secured to the vertical member 13.

An electrical drive motor 16 is also fixed to the support member 13 by a mounting bracket 17 with its output drive shaft 16a disposed above the mixing chamber 14a in coaxial alignment therewith. The motor 16 is adapted to be energized from a suitable electrical source 18 through an electrical switch control 18', both schematically illustrated in the drawing for purposes of simplicity. Secured to the rotor or drive shaft 16a to turn therewith is a rotary mixing element 19 in the form of a helically wound spring element. The lower end of the helical mixing element 19 bears against a valve plate 20, which normally covers the lower end of the mixing chamber 14a. The plate valve 20 is mounted for pivotal movement on a vertical shaft 21 carried by the bracket arm 15 so that it can be swung horizontally by means of its forwardly extending handle 20a. The valve plate 20 includes a circular opening 20b of approximately the same diameter as the mixing chamber 14a and, disposed to one side thereof, a bearing surface 20c. In its closed position the bearing surface 20c is disposed beneath the mixing element 19 and covers the bottom opening of the vertical chamber 14a. In its open position the valve plate is swung to dispose the discharge opening 20b beneath the chamber 14a, allowing the contents thereof to be discharged as will be more fully described below. A limit stop pin 22 working in an arcuate slot 20d

formed in the valve plate 20 positions the valve plate in its full-open and full-closed positions. If desired, a ball detent, toggle or other limit stop arrangement can be used.

Disposed beneath the valve plate 20 and coaxially aligned with the mixing chamber 14a is a discharge nozzle 23 carried by the frame 11 through a bracket arm 24. The discharge nozzle 23 can be arranged to discharge mixed amalgam into a suitable carrying dish or cup (not shown) or it can be arranged to discharge directly into a dental instrument such, for example, as that disclosed in the applicant's copending application, Ser. No. 437,806 filed Mar. 8, 1965, and now abandoned and entitled, "Amalgam Conveyor and Method of Condensing Amalgam."

Materials to be mixed or triturated such, for example, as mercury and silver particles, are introduced into the mixing chamber 14a through an inlet chute 25. In the case of an amalgam triturating instrument, the input can take the form of a metering dispenser capable of accommodating liquid mercury and metal particles either in loose form or in compressed pellet form.

In operation, it will be assumed that metered charges of mercury and silver particles or filings have been introduced into the chamber 14a through the inlet chute 25 falling under the force of gravity to the bottom of the chamber resting on the bearing plate 20c of the valve plate 20 and filling the chamber to a point below the inlet chute 25. The motor 16 having previously been turned on by means of a switch 18, causes the helical rotor member 19 to be rotated at relatively high speed in a counterclockwise direction as viewed downwardly from the top of the chamber 14a. This motion assists in the movement of raw materials to the bottom of the chamber as well as carrying out the mixing cycle described below. It will be observed that the pitch of the helical member 19 is positive so that as it is turned in a clockwise direction, as viewed from the top, it will tend to drive material within its influence downwardly. Stated otherwise, the pitch is such that were it disposed in a solid medium, it would tend to back out of the medium in the manner of a screw.

The initial reaction of the member 19 against the mass of material to be mixed will therefore tend to compress the spring upwardly against its natural spring force and the combined agitation of the whirling spring driving downwardly under its spring force will mull or triturate the materials within the chamber. The action is such that materials proximate the walls of the chamber will be driven downward to be urged toward the center and squeezed upwardly from the base plate, and thence radially outwardly into the down flow in a rapid succession of reversals of direction and intimate commingling of the components of the mix results.

In one preferred unit formed in accordance with the invention particularly adapted for effecting trituration of a useful quantity of dental amalgam composed of silver particles and mercury, a cylindrical mixing chamber of .250 inch was used with a helical rotor or spring having an outside diameter of .218 inch wound at a pitch of ten turns per inch using stainless steel wire of .032 inch diameter. A nominal drive speed of 3600 r.p.m. was used and the helical spring was compressed approximately eight percent by the base or valve plate 20. It should be noted that the helical member operates in a close proximity to the walls of the chamber, and that in motion it sweeps or eclipses the entire surface area of the chamber while maintaining an open central core.

The time to complete the trituration of one charge of amalgam was about five seconds. During this time the helical spring element initially backed off the base of the valve plate and re-established contact at the conclusion of the mixing cycle. The slight change in tone of the low level sound emitted from the unit as the

element made contact with the base 20 was an effective indicator of completion of the cycle.

At the completion of the mixing cycle, but before the drive motor 16 is de-energized the valve plate 20 is swung into its open position i.e. with the opening 20b disposed beneath the chamber 14a and the amalgam is discharged by the conveyor action of the rotating spring element into whatever receptacle or instrument might be disposed in receiving position. The rotation of the element coupled with gravity scavenges loose material from the walls of the unit. It will be understood, therefore, that the helical rotor or spring element serves as a conveyor both at the time of top loading (if used) and at the time of discharge.

The plate valve is then swung to its closed position with the edge of the hole 20b in the valve plate engaging the lower coils of the rotating helical element causing it by virtue of its pitch in relation to the direction of rotation, to back up into the mixing chamber 14a and rest on top of the valve plate 20 above the bearing surface 20c ready for the next charge.

While a relatively wide range of pitch angles and spring constants can be used for the helical mixing element 19, it is in general preferred that the spring force be such that the member is able, while rotating in the mass of material being mixed, to work its way down to the valve plate when mixing is completed so that there are no pockets or cavities between the fixed walls of the chamber and the rotor which are reached. It will be understood, however, that under certain conditions the rotor spring need not back off the valve plate during the mixing operation. The ability, however, of the rotor to compress in action serves as an automatic means for relieving extraordinary stresses on the system and for maintaining effective mixing speeds at all times.

It will also be understood that the mixing apparatus can take various other forms and arrangements within the scope of the present invention. Thus, for example, the laterally swinging valve plate 20 can be replaced by a vertically movable plug element adapted to be inserted into the discharge nozzle 23, compressing the spring rotor 19 as desired. Such arrangement has the advantage of affording variable compression on the spring rotor 19 for use in mixing other materials which might require greater or less downward pressure. It is also possible to load the materials to be mixed through the bottom rather than through the inlet chute 25 or other top loading means. In the case of bottom loading it is not necessary that the motor be energized at the time of introducing the charge into the mixing chamber as is preferred in the case of an upper inlet such as the chute 25 where the action on the helical rotor assists in thrusting the charge, particularly granular matter, to the bottom of the chamber to set up conditions for thorough mixing. Automatic timing can be used for particularly critical operations which can be coordinated with other operations. Other variations and arrangements will suggest themselves to those skilled in the art. The invention should not, therefore, be regarded as limited except as defined in the following claims.

I claim:

1. Apparatus for mixing dental amalgam comprising a substantially cylindrical chamber having inlet means to receive amalgam ingredients to be mixed and said chamber having a discharge opening adjacent one end thereof, closure means normally extending across said opening to close it, a helical resilient member substantially complementary to the inner surface of said chamber and rotatable therein about the axis thereof, the interior of said helical member defining a substantially cylindrical central opening extending axially thereof and said member also extending between said inlet means and said closure means, and power means connected to said helical member to rotate it as aforesaid to effect mulling of amalgam ingredients within said chamber.

2. Apparatus for mixing dental amalgam comprising a substantially cylindrical chamber having inlet means to receive amalgam ingredients to be mixed and one end of said chamber comprising a discharge opening, closure means normally extending across said opening to close it, a helical resilient spring substantially complementary to the inner surface of said chamber and rotatable therein about the axis thereof, said spring extending between said inlet means and said closure means and being sufficiently long to be compressed axially a limited amount when one end thereof is in engagement with said closure and said one end slidably moving relative to said closure when said spring is rotated, thereby effectively engaging material in contact with said closure means, and power means connected to said helical member to rotate it as aforesaid to effect mulling of amalgam ingredients within said chamber.

3. Apparatus for mixing dental amalgam comprising a substantially cylindrical chamber having inlet means to receive amalgam ingredients to be mixed and one end of said chamber comprising a discharge opening, a closure member movable substantially transversely in opposite directions relative to the axis of said chamber to open and close said discharge opening, a helical resilient member substantially complementary to the inner surface of said chamber and rotatable therein, said resilient member also extending between said inlet and outlet means and being sufficiently long to project into said discharge opening when said closure has been moved to open position, thereby to induce self-cleaning of said discharge opening when mixed amalgam is discharged therethrough, and power means connected to said helical member to rotate it as aforesaid to effect mulling of amalgam ingredients within said chamber.

4. The apparatus according to claim 3 in which said closure is of sufficient area to include a hole complementary in size to the diameter of said chamber and registerable therewith when said closure is positioned to open said discharge opening and said closure also including a solid portion equal to the diameter of said chamber and positionable across the same to maintain said discharge opening closed.

5. The apparatus according to claim 4 further including a pivot for said closure parallel to the axis thereof and spaced laterally therefrom, and handle means on said closure extending outwardly from said chamber and operable manually to move said closure between open and closed positions.

6. The apparatus according to claim 3 in which said power means is arranged to rotate said resilient helical member in a direction relative to its pitch so that when said plate-like closure is moved from open to closed position, said resilient member will engage an edge on said closure and effect compression of said resilient member from the extended position thereof sufficiently to engage the inner surface of said closure and enable it to move laterally past the resilient member to fully closed position.

7. Apparatus for mixing dental amalgam comprising a substantially cylindrical chamber having inlet means to receive amalgam ingredients to be mixed and one end of said chamber comprising a discharge opening, a closure member extending transversely across said chamber adjacent said discharge opening to form a bottom in said chamber and said inlet means intersecting a wall of said chamber intermediately of the ends thereof, a helical resilient member substantially complementary to the inner surface of said chamber and rotatable therein about the axis thereof, said helical member extending at least between said inlet means and closure means and intersecting the incoming amalgam ingredients when entering said chamber through said inlet means, and power means connected to said helical member to rotate it as aforesaid to effect mulling of amalgam ingredients within said chamber.

8. The apparatus according to claim 7 in which said helical member is a spring closely conforming to the interior of said chamber and at least lightly engaging the walls thereof and said power means being connected to the upper end of said spring and arranged to rotate it in a direction relative to its pitch to engage and force the amalgam material toward said discharge opening, the central core space of said spring comprising means in which amalgam material may pass in the opposite direction to that by which it is moved by said spring, thereby effecting efficient mulling of said amalgam.

#### References Cited

##### UNITED STATES PATENTS

|           |         |                    |         |
|-----------|---------|--------------------|---------|
| 882,781   | 6/1906  | Smith.             |         |
| 1,249,403 | 12/1917 | Howard et al.      | 259—7   |
| 2,641,412 | 6/1953  | Byberg             | 259—8 X |
| 2,791,404 | 5/1957  | Kelley et al.      | 259—9   |
| 2,884,963 | 5/1959  | Erndt              | 259—8 X |
| 3,063,813 | 11/1962 | Yeinbrenner et al. | 259—7 X |
| 3,224,740 | 12/1965 | Kuehn et al.       | 259—8   |

##### FOREIGN PATENTS

|         |        |                |
|---------|--------|----------------|
| 448,553 | 6/1936 | Great Britain. |
|---------|--------|----------------|

WILLIAM I. PRICE, *Primary Examiner*.

WALTER A. SCHEEL, *Examiner*.

J. M. BELL, *Assistant Examiner*.