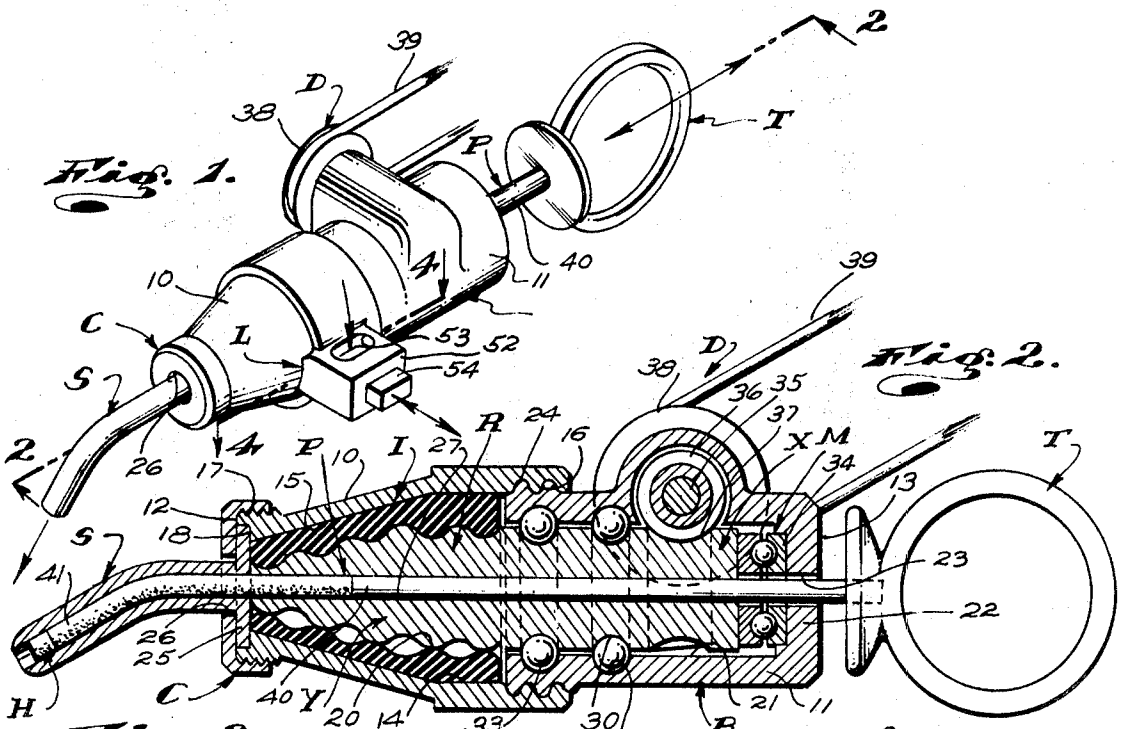
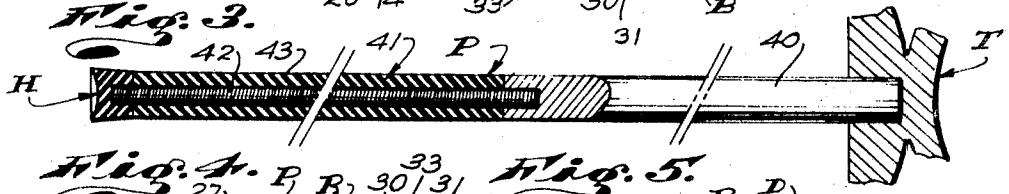
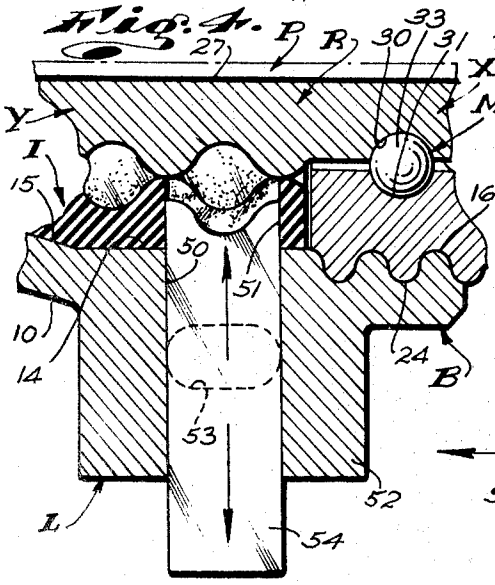
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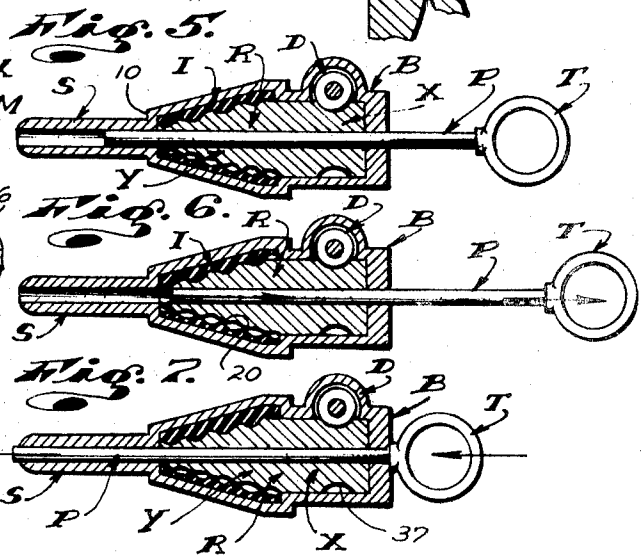
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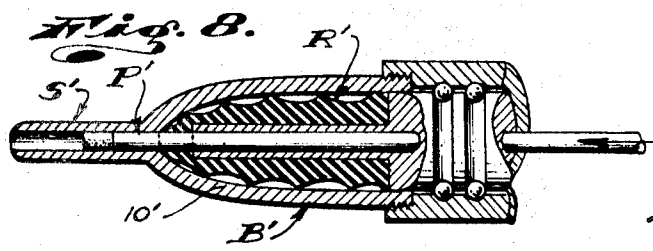
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3,611,573

AMALGAMATOR

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ABSTRACT OF THE DISCLOSURE

A manually engageable and manipulatable device for triturating dental amalgams which includes a pugmill with a helical rotor in a chamber with a central discharge opening at one end an a manually operable, axially shiftable valving and plunger member carried by the rotor to normally project into and close the opening to cause continuous mixing of the ingredients, shiftable from said opening to permit flow of ingredients into the opening and shiftable back into and through the opening to dispense the ingredients.

In the art of dentistry, amalgam of silver and mercury is employed to fill cavities in teeth. Since cavities in teeth are rather small and since the ingredients of filling amalgam are costly, such amalgams are mixed and provided in small quantities.

Mixing small quantities of particulate silver and liquid mercury, which materials have high indices of density and shear, to establish a plastic amalgam suitable for filling teeth is a difficult and time-consuming task, as the particles of silver and liquid mercury, in predetermined relative volumes, must be brought into uniform, intimate contact to establish a uniform mixture.

The process of mixing amalgams is called trituration and historically is performed manually by means of a mortar and pestle.

In the art of making and using amalgams for filling cavities in teeth, the particulate silver and mercury is triturated until a uniform plastic mass is established and is then deposited in a cavity and is condensed, by the application of pressure, to accelerate and to cause the amalgam to set and harden. That phase or time period during which the amalgam is plastic and capable of being worked is a rather short and transient period with the result that if the ingredients are triturated too long, the amalgam stiffens and sets up or hardens prematurely.

On the other hand, if the amalgam is not triturated enough, a poor or low grade amalgam, which sets up slowly and has a weak and grainy texture is produced.

The prior art, for many years, has recognized the need for a mechanical means for triturating the ingredients for dental amalgams so as to relieve the dentist of the time consuming and laborious task of triturating the ingredients of such amalgams with mortar and pestle and so that proper and effective trituration, with resulting uniform, high quality amalgams, can be assured.

The above recognized need has resulted in a multitude of amalgam triturating means, devices and mechanisms, each of which, while intended to gain the sought for end results, has been wanting in one or more ways, with the result that most have proved to be completely impractical and but a small number have proved to be of any use whatsoever. Those means and mechanisms provided the prior art have characteristically involved bench or usefulness, and which have been accepted by and utilized in the dental art, have been accepted and used with reservation and with an attitude that while they do not assure proper and satisfactory results, they relieve the dentist of the task of manually triturating amalgam and come sufficiently close to doing a proper job to make their use acceptable.

The principal problem to be overcome in providing mechanical means for triturating the ingredients for dental amalgams resides in the fact that extremely small volumes or quantities of materials must be worked upon under relatively close tolerances with respect to time. Further, the materials are such that when combined they set up and harden within a short period of time and with the result that if any appreciable traces of the combined materials are left in a mechanical device employed to triturate them, and are permitted to set and harden therein, manifold adverse effects result or are likely to result.

The triturating devices and mechanisms provided by the prior art have characteristically involved bench mounted mechanisms of considerable size and bulk and so they must be positioned and arranged at a location remote from the dental chair in which the patient is seated and with the result that the dentist must leave his patient to attend to the operation of the device or mechanism and must manually transport the amalgam from the machine to the patient.

An object of our invention is to provide a novel amalgam triturating and dispensing mechanism which is manually engageable and manipulatable whereby it can be advantageously used and operated by the dentist at the dental chair and so that the dentist need not leave the vicinity of said chair and his patient for the purpose of preparing an amalgam.

Another object of this invention is to provide a mechanism of the character referred to which is such that the amalgam triturated thereby can, in many instances, be advantageously discharged from the mechanism directly to the cavity to be filled, if desired, and need not be manually manipulated and transported to effect transfer from the mechanism to the cavity.

It is an object and feature of our invention to provide a mechanism of the character referred to which is such that it can be advantageously driven by the pneumatic or pulley type drive means commonly provided in connection with dental chairs and which are commonly employed to drive dental drills and the like.

An object and a feature of our invention is to provide a mechanism or instrument of the character referred to including a pugmill having an elongate helical rotor arranged within an elongate cylindrical chamber with front and rear ends, an inlet port with loading means communicating with the rear portion of the chamber, an outlet port in the front end of the chamber and valve means related to the outlet opening to shut off discharge from the mill whereby materials deposited therein are triturated.

Another object of our invention is to provide a mechanism or instrument which includes an elongate delivery tube communicating with the outlet opening and said valving means is in the nature of an axially shiftable cylindrical plug or plunger carried by the rotor and engageable in the outlet opening to close said opening, shiftable rearwardly in the rotor to open said outlet opening and to effect transfer of ingredients in the chamber into the tube and shiftable forwardly through the tube to discharge and dispense the ingredients from the tube.

Yet another object of the present invention is to provide an instrument of the character referred to wherein the rotor and/or the wall of the chamber is established of rubber or other soft resilient material whereby the ingredients deposited in the mill are effectively triturated when the outlet opening is closed.

Still further, it is an object to provide an instrument of the character referred to wherein the rotor, chamber and outlet opening are such that when the outlet opening

is open, the rotor effectively moves all materials deposited in the mill out of the chamber and about the rotor forwardly through the opening and into the tube.

Finally, it is an object of our invention to provide an instrument which is easy and economical to manufacture; which is easy and convenient to service and maintain, which is easy and convenient to use, and which is highly effective and dependable in operation.

The foregoing and other objects and features of our invention will be fully understood from the following detailed description of typical preferred forms and applications of the invention, throughout which description reference is made to the accompanying drawings, in which:

FIG. 1 is an isometric view of the dental amalgam mixing and dispensing instrument that we provide;

FIG. 2 is an enlarged detailed sectional view taken substantially as indicated by line 2—2 on FIG. 1;

FIG. 3 is a fragmentary view of a part of the structure provided;

FIG. 4 is enlarged detailed sectional view of a portion of our new instrument, taken substantially as indicated by line 4—4 on FIG. 1;

FIGS. 5, 6 and 7 are diagrammatic views showing parts of the construction in three different positions; and

FIG. 8 is a sectional view of a portion of another form of the invention.

Referring to the drawings, the construction that we provide includes generally, an elongate sectional body B, with front and rear sections **10** and **11** defining front and rear ends **12** and **13**, an elongate tubular dispensing stem S at the front end of the body and projecting forwardly therefrom, an elongate rotor R within and extending longitudinally of the body, bearing means M rotatably supporting the rotor in the body, drive means D to rotate the rotor relative to the body, an elongate axially shiftable plunger P extending longitudinally through the body, rotor and stem, a handle or thumb ring T on the stem and accessible at the rear end of the body, and loading means L carried by the body and adapted to facilitate introducing amalgam ingredients into the body.

The front section **10** of the body B is an elongate tubular part defining a cylindrical bore with a straight, cylindrical rear portion **14**, and a forwardly convergent, conical front portion **15**. The rear end of the section **10** is open and is internally threaded as at **16**. The front end of the section **10** is open and is externally threaded as at **17**. In the case illustrated, the front end of the section **10** is provided with a forwardly opening socket or recess **18** which occurs about the forward open end of the bore.

In the form of the invention shown in FIGS. 1 through 4 of the drawings, and as diagrammatically illustrated in FIGS. 5, 6 and 7, the front section **10** carries an insert I. The insert I is an elongate cylindrical part of rubber or other soft resilient material and is slidably engaged in the bore. The insert is characterized by a central longitudinally extending forwardly convergent, axially forwardly and rearwardly opening passage which is formed to define double threads **20**. The insert may be described and will hereinafter be described as a double internal screw stator.

The rear section **11** of the body B is a cylindrical part with a forwardly opening cylindrical bore **21** and a rear wall **22** closing the rear end of the bore and having a central opening **23** therein communicating with the bore. The forward end portion of the bore is externally threaded as at **24** and is threadedly engaged in the rear end of the front section **10**, as clearly illustrated in FIG. 2 of the drawings.

The stem S is an elongate tubular part open at its opposite ends. The stem can be straight or can, as illustrated, have its front end portion bent laterally as desired.

The rear end of the stem S is provided with a keeper flange **25** which is cooperatively engaged and seated in the recess **18** in the front end of the body section **10**.

The stem S is releasably retained in engagement with the body by means of a cup-like retainer C threadedly engaged on and about the front end portion of the section **10** of the body to overlie the flange **25** and having a central opening **26** through which the stem, forward of the flange, freely projects.

It is to be noted that the resilient double internal screw stator I is releasably held captive in the body section **10** between the flange **25** of the stem and the forward end of the rear section **11** of the body.

The rotor R is an elongate unitary part with a cylindrical rear portion X engageable in the bore **21** in the rear section **11** of the body and an externally threaded forward portion Y engageable in and extending longitudinally through the insert or stator I in the front section **10** of the body. The portion Y of the rotor has a single external thread and may be referred to as a single external screw rotor. The double internal screw stator I and the single external thread rotor, defined by the portion Y of the rotor R, cooperate to define a screw type mill means.

The rotor R is further characterized by a central forwardly and rearwardly opening cylindrical opening **27** concentric with and communicating with the open rear end of the stem S and with the opening **23** in the rear wall **22** of the body section **11**.

The bearing means M rotatably supports the rotor R in the body B and includes axially spaced pairs of annular opposing bearing races **30** and **31** in the bore **21** and about the rear portion X of the rotor R, rows of ball bearings **33** engaged in and extending between the races of each pair of races and an annular anti-friction thrust bearing **34** between the rear end of the rotor and the rear wall **22** of the body section **11**.

The drive means D is shown as including a drive shaft **35** rotatably carried by the section **11** of the body with its axis on a plane normal to the axis of the rotor, a worm gear **36** on the shaft and cooperatively engaging an annular series of gear teeth or ring gear **37** established in and about the exterior of the rotor and a sheave **38** on the shaft, at the exterior of the section **11** of the body, and with which the power transmission line **39** of the pulley drive means normally related to a dental chair can be engaged to effect rotation of the shaft and gear, and rotation of the rotor R relative to the body B and stator I.

In practice, the bearing means M and drive means D can vary widely in form and construction without departing from the spirit of the invention.

The plunger P is an elongate cylindrical member corresponding or slightly greater in longitudinal extent with the body B and stem S and corresponding in diametric extent with the opening **27** in the rotor and the interior or passage in the stem S.

In practice, if the stem S is straight, the plunger can be a unitary rigid member. If the stem S is bent or turned, as illustrated, the plunger must be flexible or must have a flexible section at its front end portion.

In FIGS. 2 and 3 of the drawings, the plunger is shown as having a rigid rear portion **40** and a flexible forward portion **41**. The forward portion **41** is shown as being established by a spring core **42**, the rear end of which is suitably fixed to the front end of the rear section and a jacket **43** about the core, which jacket can be established of a suitable plastic material.

The forward terminal end of the plunger is preferably provided with a longitudinally outwardly divergent head H with a concaved front face, which head serves to establish snug sealing and wiping engagement in the stem and to assure desired and effective transporting of materials deposited into the rear end of the stem longitudinally forwardly therethrough.

The thumb ring T at the rear end of the plunger P is a simple ring-like part fixed to the rear end of the plunger and is adapted to receive the thumb or the fingers of the operator of the construction to effect longitudinal shifting of the plunger.

The plunger P is normally slidably engaged in or through the opening 27 in the rotor R with its forward end portion engaged in and extending at least part way through the stem, as shown in FIG. 2 and as diagrammatically illustrated in FIG. 5.

It will be apparent that when the plunger is in the position referred to above, it effectively serves as a valving member and closes the forward or discharge end of the mill means established by the rotor and the stator and closes the rear or inlet end of the stem.

The plunger is shiftable to a second or rear position where its forward terminal end, or the head H at its forward end, is out of engagement in the stem and is within the rotor R, as illustrated in FIG. 6 of the drawings. When the plunger is in this second position, the forward discharge end of the mill means of the construction is open and/or the rear end of the stem is unplugged whereby amalgam materials within the mill portion of the construction can flow freely and be discharged by said mill means into the stem.

Finally, the plunger is shiftable to a third or forward position where it extends completely through the stem, as clearly illustrated in FIG. 7 of the drawings.

Upon shifting the plunger from its second rear position to its third, forward position, amalgam discharged by the mill means of the construction into the stem is moved forwardly through the stem and is dispensed or discharged from the forward open end of the stem.

Shifting of the plunger to and from its several above-noted positions, is effected by manual engagement of the thumb ring T at the rear end of the plunger.

The loading means L includes a radial port 50 in the side of the front section 10 of the body, at the rear portion thereof and a registering radial port 51 in the rear portion of the insert or stator I. The ports 50 and 51 establish communication between the exterior of the construction and the interior of the stator and are such that the ingredients for the amalgam to be made can be advantageous introduced into the rear portion of the mill means of the construction.

In the case illustrated the ports 50 and 51 are rectangular and the port 50 extends through a radially outwardly projecting protuberance 52 on the section 10. The protuberance normally projects horizontally outwardly from the section 10 and has a normally upwardly opening port 53, the lower end of which communicates with the port 50.

An elongate feed bar 54 is slidably engaged in the ports 50 and 51. The bar 54 is formed of rubber or the like. It corresponds in cross-section with the cross-section of the ports 50 and 51 and is slightly greater in longitudinal extent than the combined longitudinal extent of the bores 50 and 51.

The bar 54 has a manually engageable outer end portion that projects outwardly from the protuberance 52 and an inner end which is formed with portions of threads which correspond with the portions of the threads removed from the interior of the insert I when the port 51 is established in the insert or which are missing as a result of the establishment of the port 51 in the insert.

With the means L set forth above, it will be apparent that when the bar is in its in position, where the inner end of the bar is in the port 51, the lower end of the port 53 in the protuberance is closed by the bar and establishes a cavity into which measured quantities of materials to be triturated can be deposited.

Upon shifting the bar outward and from engagement over the lower end of the port 53, the materials deposited in the port 53 drop into the port 50.

Upon subsequent inward shifting of the bar, the materials are urged inwardly and into the mill portion of the construction.

Assuming the rotor R is being driven by the means D, the materials introduced into the mill means of the construction are engaged by the threads of the rotor and

are advanced forwardly thereby over and between the threads in the stator.

As a result of the above screw action, it will be apparent that the loading means does not require the noted feed bar and that if the ports 50 and 51 are disposed upwardly and the ingredients to be triturated are simply deposited into the ports, they will be picked up or engaged by the rotor threads and advanced forwardly in the construction and away from the ports 50 and 51 without physically urging the materials into the construction and without the possibility of the materials subsequently backing out into the said ports.

When the amalgam ingredients are deposited in the construction in the manner set forth above and the plunger P is in its normal or first position, the materials are screwed and advanced forwardly into the forward end portion of the insert or stator I. Upon reaching the forward end of the stator and upon continued rotation of the rotor, the ingredients are triturated within the construction by and between the threads of the rotor and stator.

As the ingredients are triturated, the consistency and plasticity changes, thereby changing the load on the drive means. By noting and observing the effect of the load on the drive means, it is possible to determine with considerable accuracy and consistency when the ingredients have been triturated to the desired extent and the desired amalgam is established.

While the materials are being triturated, the rubber resilient stator is such that it will effectively yield to the forces and pressures encountered and so that the construction will not rupture or load up in such a manner as to freeze or lock up.

When the desired amalgam is established in the above-noted manner, and while the rotor is still rotating, the plunger is manually urged to its second or rear position, opening the forward end of the mill means of the construction whereby the amalgam is discharged by the mill means forwardly and into the open rear end of the stem.

When the amalgam is thus deposited into the stem, the plunger is then manually urged forwardly to its forward or third position, urging the amalgam forwardly through the stem and discharging or dispensing it from the forward end of the stem.

In practice, the forward ends of the threads on the forwardly convergent rotor and in the stator terminate at and about the exterior of the plunger or terminate in close proximity to that point where their surfaces would intersect the surface of the opening 27 in the rotor. As a result of this relationship of parts, the construction is such that when the amalgam is being discharged from the milling means into the stem, all of the material is discharged from between the stator and rotor and the construction so effectively and completely discharges its contents that cleaning the mechanism of residue amalgam that might otherwise set up and foul the mechanism is not necessary.

Still further, the plunger, with the head H at its forward end, is such that it so effectively moves and displaces all amalgam deposited in the stem of the mill means that no residue amalgam is left in the stem and cleaning of that portion of the construction is not necessary, except for normal maintenance and servicing of the construction.

In practice, and since small quantities of materials are handled, the construction can be made extremely small, compact and such that it can be easily and conveniently manipulated by one hand and in such a manner that the amalgam can, if desired, be deposited directly from the stem, into the tooth cavity to be filled.

In practice, and as illustrated in FIG. 8 of the drawings, the rotor R' can be made of rubber or a rubber-like material. In such a case, the rotor must be provided with a tubular core, to support the rubber mass and through which the plunger P' can be engaged and operated.

The bore in the section 10' of the body B' is smooth and free of threads and the threads of the resilient rotor establish yielding wiping pressure engagement therewith.

The stem S' can, as illustrated, be formed integrally with the section 10'.

The section 11' and other elements, means and parts of this second form of the invention can be the same as corresponding elements, means and parts in the first form of the invention or mechanical equivalents thereof.

It will be readily seen that the construction provided is such that all elements and parts are rugged and durable in nature, are such that they are easy and economical to manufacture and that the construction is such that is can be easily and quickly assembled and disassembled for the purposes of cleaning and servicing.

Having described two typical preferred forms and applications of our invention, we do not wish to be restricted to the specific details herein set forth, but wish to reserve to ourselves any and all modifications and variations of our invention which may appear to those skilled in the art.

Having described our invention, we claim:

1. A dental amalgam triturator and dispenser comprising, an elongate screw type mill means including a tubular stator with front and rear ends, and and an elongate rotor with front and rear ends, an external helical thread and a central longitudinal opening, bearing means supporting the rotor in the stator for rotation relative thereto, drive means rotating the rotor relative to the stator, loading means at the rear end portion of the mill means to conduct amalgam ingredients into the mill means, an elongate tubular dispensing stem with front and rear ends arranged in fixed position relative to the stator with its rear end communicating with the front end of the stator and in axial alignment with the opening in the rotor, and an elongate plunger with front and rear ends slidably engaged in and through the opening in the rotor and in and through the stem, said plunger being shiftable from an intermediate normal position where it occurs in both the stem and rotor and closes the stem and the forward end of the mill means to a rear position where it occurs in the rotor only and the stem and forward end of the mill means are open and to a forward position where it extends through the stem and displaces amalgam deposited in the stem by the mill means through and from the front end of the stem.

2. A structure as set forth in claim 1 wherein the stator is resilient and has double internal helical threads with which the helical thread on the rotor slidably engages when the rotor is rotated.

3. A structure as set forth in claim 1 wherein the stem has a straight rear portion in axial alignment with the rotor and a front portion inclined relative to the axis of the rotor, and said plunger having a flexible portion to occur within the stem.

4. A structure as set forth in claim 1 wherein the stator is resilient and has double internal helical threads with which the helical thread on the rear slidably engages when the rotor is rotated, said stem having a straight rear portion in axial alignment with the rotor and a front portion inclined relative to the axis of the rotor, and said plunger having a flexible portion to occur within the stem.

5. A structure as set forth in claim 1 wherein said drive means includes a drive gear on and concentric with the rotor rearward of the loading means, a drive gear engaging the driven gear and a power shaft driving the drive gear and connected with a rotary power source.

6. A structure as set forth in claim 1 wherein the stator is resilient and has double internal helical threads with which the helical thread on the rotor slidably engages when the rotor is rotated, said drive means including a drive gear on and concentric with the rotor rearward of the loading means, a drive gear engaging the driven gear and a power shaft driving the drive gear and connected with a rotary power source.

7. A structure as set forth in claim 1 wherein the stator is resilient and has double internal helical threads with which the helical thread on the rotor slidably engages when the rotor is rotated, said stem having a straight rear portion in axial alignment with the rotor and a front portion inclined relative to the axis of the rotor, and said plunger having a flexible portion to occur within the stem, said drive means including a drive gear on and concentric with the rotor rearward of the loading means, a drive gear engaging the driven gear and a power shaft driving the drive gear and connected with a rotary power source.

8. A structure as set forth in claim 1 wherein the rotor is established of a resilient material and said thread establishes yielding pressure wiping engagement with the stator.

9. A structure as set forth in claim 8 wherein said stator is resilient and has double internal helical threads with which the helical thread on the rotor slidably engages when the rotor is rotated.

10. A structure as set forth in claim 9, said stem having a straight rear portion in axial alignment with the rotor and a front portion inclined relative to the axis of the rotor, and said plunger having a flexible portion to occur within the stem.

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