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Ferguson

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[54] **PROCESS AND APPARATUS FOR UNIVERSAL JOINT DISASSEMBLY AND ASSEMBLY**

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[52] **U.S. Cl.** ..... **29/251,** 29/256, 29/200 H, 29/434

[51] **Int. Cl.** **B23p 19/02**

[58] **Field of Search**...29/434, 242, 244, 256, 239, 29/426, 258, 264, 251, 200 R, 200 B, 200 D, 200 H, 212R; 269/9, 10, 172, 75, 77, 84, 85, 104, 111, 155, 156; 100/199, 193, 206; 59/7, 9; 72/454, 455

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[57] **ABSTRACT**

An adjustable press with vibratile characteristics and a symmetrical frame structure locates a compression means along the longitudinal axis of each of a plurality of symmetrical bearing sleeves and resilient lock rings. The sleeves are positioned with a press fit in a support therefor in a U-joint casing and, in operative position, held in place by the lock rings.

The press is operated to apply vibration as well as a shearing force to each of such resilient lock rings to separate each of such sleeves from the U-joint casing. The press also supports a symmetrically located second compression means for moving and locating longitudinally spaced apart bearing sleeves in longitudinally spaced apart supports therefor with a press fit.

4 Claims, 10 Drawing Figures

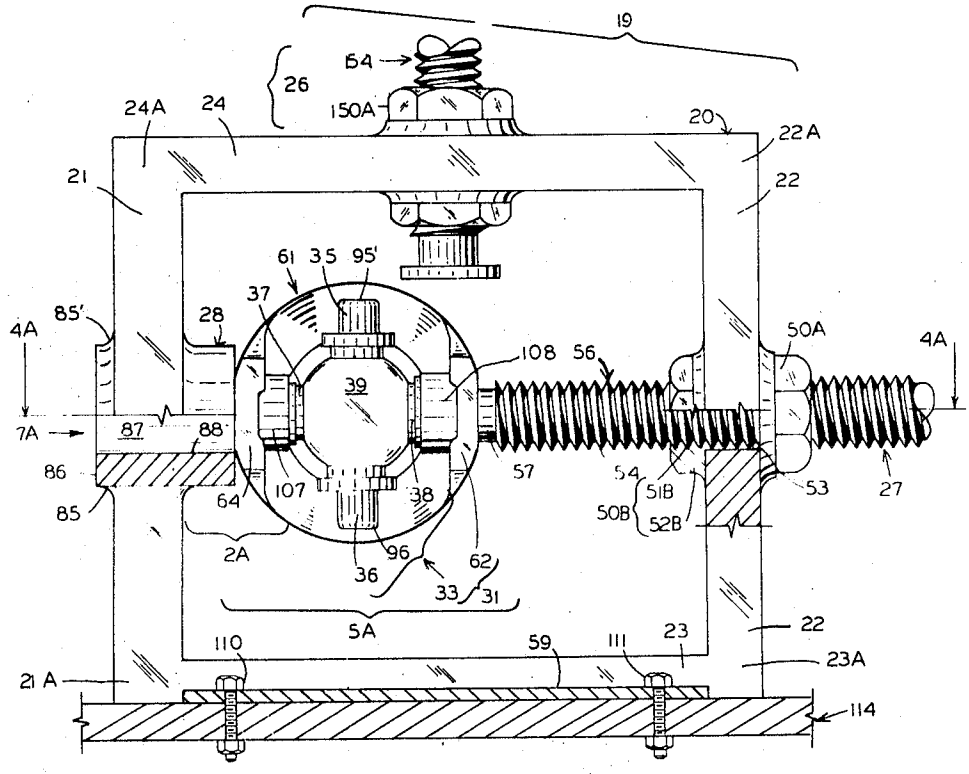

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FIG. 1

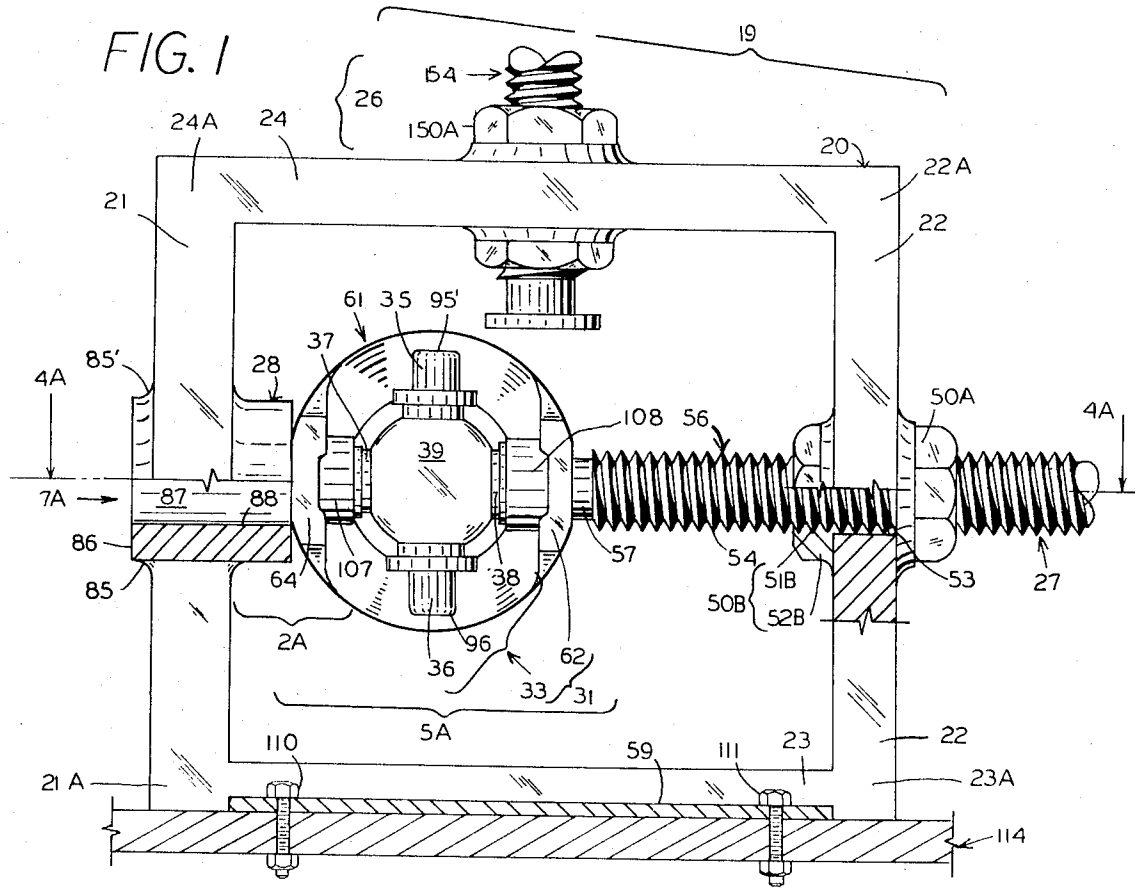

FIG. 2

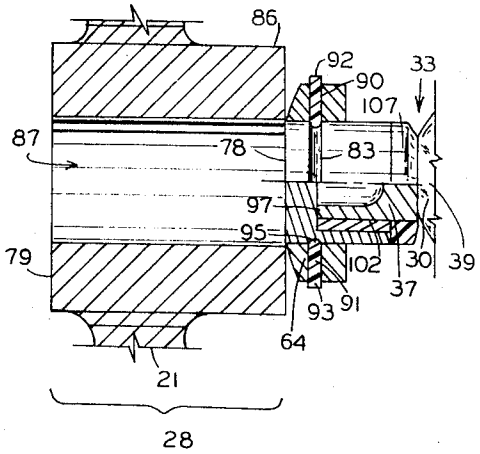

FIG. 3

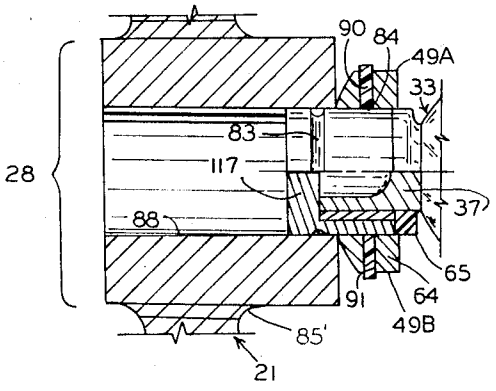

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FIG. 4

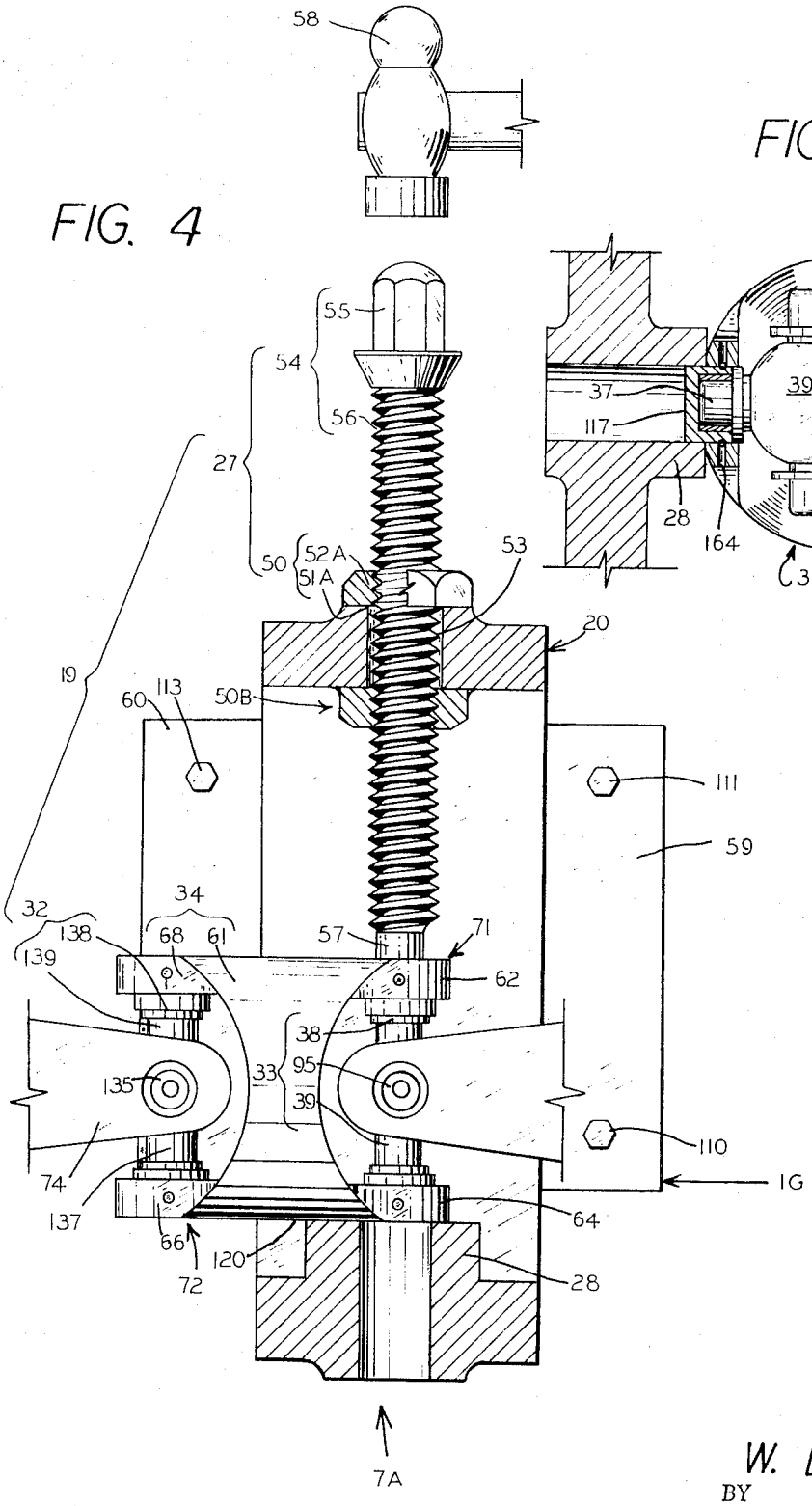

FIG. 5

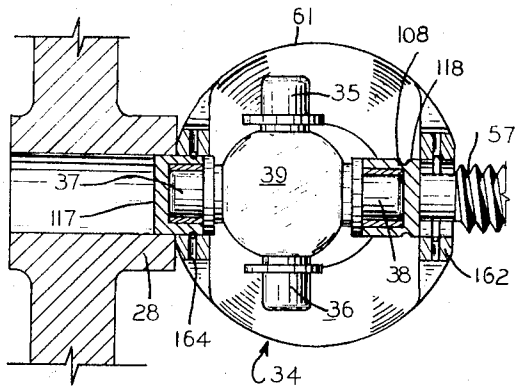

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FIG. 6

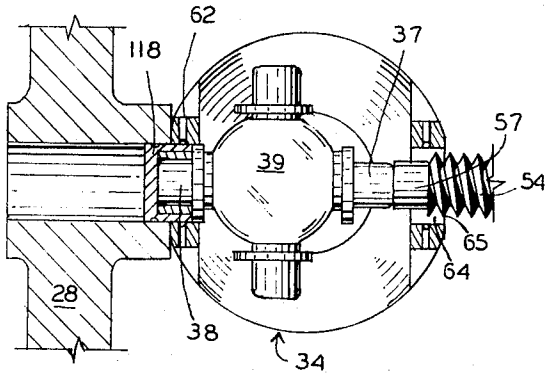

FIG. 7

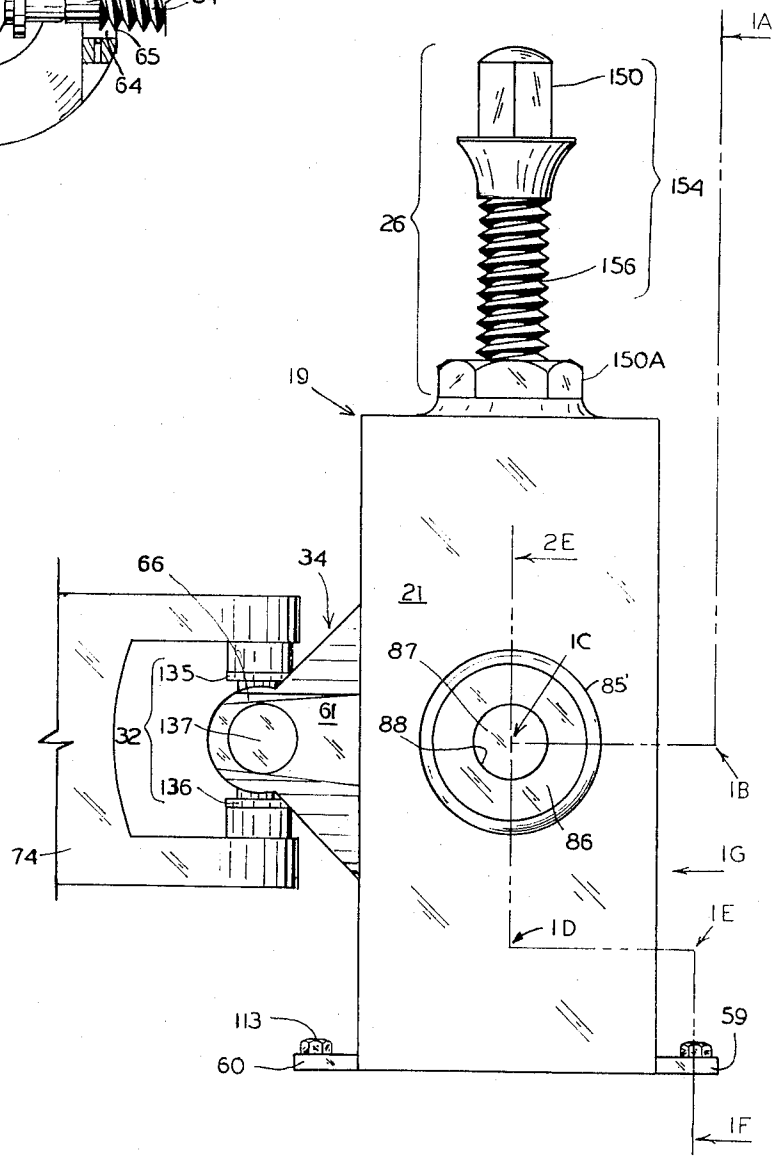

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FIG. 8

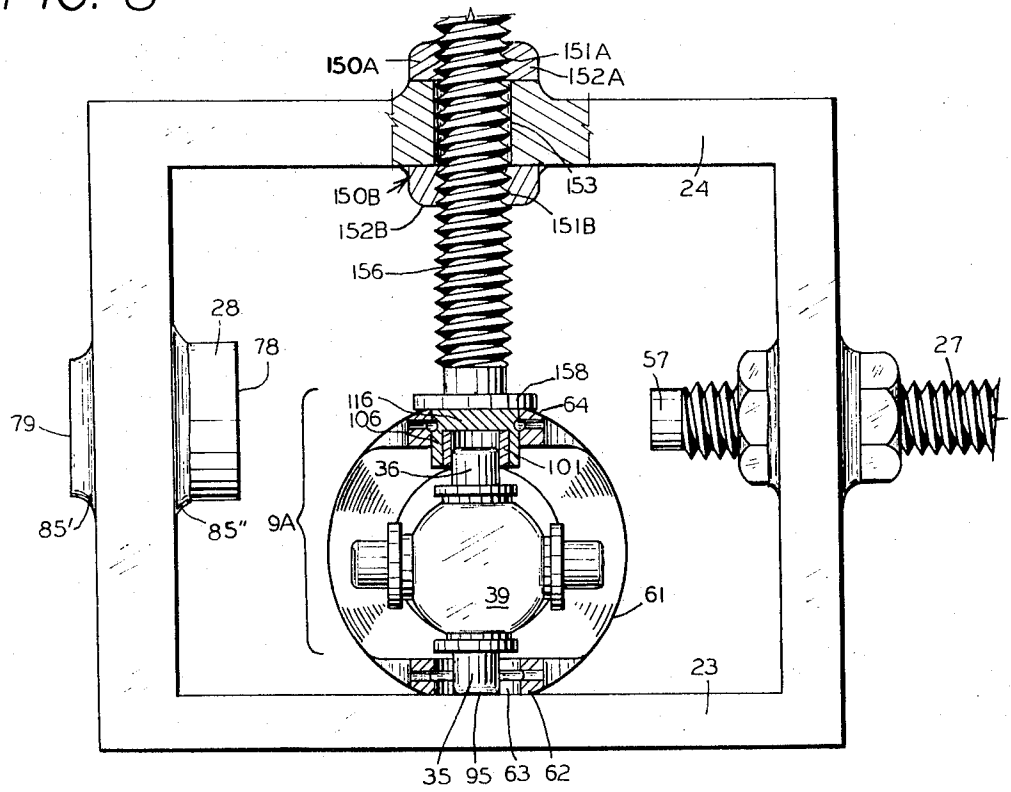


FIG. 9

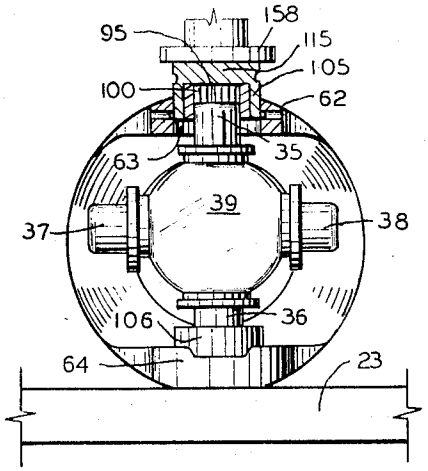
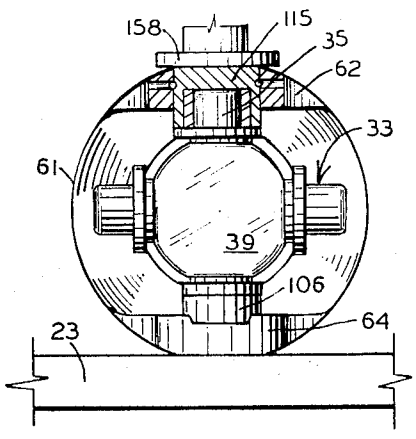


FIG. 10



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PROCESS AND APPARATUS FOR UNIVERSAL JOINT DISASSEMBLY AND ASSEMBLY

BACKGROUND OF THE INVENTION

1. Field of the Invention

The field of art to which this invention pertains is metal-working and more particularly assembling and disassembling apparatus, with a central screw and work engaging arms along or parallel to the screw.

2. The prior Art

Universal joints or U-joints for automotive use are constructed to withstand substantial torque stresses and are, accordingly, so highly resistant to disassembly that it is conventional to replace the entire U-joint unit when one portion thereof, usually one bearing, becomes sufficiently worn to create undesirable vibration when in operation.

The elastic lock rings located between the U-joint casing and the bearing sleeves therein are particularly designed for permanent location of the bearing sleeve or cap in its position in the U-joint casing. Attempts to press or beat out the U-joint cross are resisted by such resilient lock rings and are unsuccessful. Notwithstanding the cost of such U-joint units and the necessity for their replacement no reliable rapid economical apparatus or process for disassembly and assembly of automotive U-joints has been available.

It is an object of this invention to provide a reliable economical and rapid method and apparatus for disassembly and assembly of automotive U-joints.

SUMMARY OF THE INVENTION

A sturdy rigid frame extending in one plane and structurally symmetrical about a second plane at right angles thereto is provided with a first press means and an anvil means with a common longitudinal axis located along the intersection of the first and second plane. The anvil has an orifice therethrough larger than the head of the bearing cap to be removed from the U-joint and the press means has a smaller diameter drive head than the bearing sleeve whereby the press drive head can pass through the hole in the U-joint casing holding the bearing cap and vibrate the locking joint therebetween as well as drive the U-joint cross arm bearing sleeve out of the hole provided therefor in the U-joint casing.

The frame is also provided with a second press having a head larger than the bearing sleeve to be replaced in a U-joint casing, whereby to press the bearing sleeve no deeper than the surface of the casing into which it is desired to locate such bearing sleeve; such second press is located with its longitudinal axis along the intersection of a third plane perpendicular to said one and said second planes and the frame structure is symmetrical about such third plane.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a front and partly sectional view of the apparatus **19** along the irregular section 1A–1B–1C–1D–1E–1F of FIG. 7 as seen along direction of arrow 1G of FIGS. 4 and 7 in an early stage of disassembly of a U-joint **31** thereby.

FIG. 2 is an enlarged sectional view of Zone 2A of FIG. 1 along vertical section 2E–1D of FIG. 7.

FIG. 3 is an enlarged sectional view of elements in Zone 2A of FIG. 1 along section 2E–1D of FIG. 7 in a stage of disassembly a U-joint **31** by apparatus **19** which stage of disassembly follows the stage shown in FIGS. 1 and 2.

FIG. 4 is a broken away and sectional view of the apparatus **19** of FIG. 1 as seen from above with the portion of frame **20** of apparatus **19** above plane 4A—4A removed and the U-joint **31** in the position thereof or disassembly as in FIG. 1.

FIG. 5 is a sectional view in Zone 5A of FIG. 1 along section 2E–1D of FIG. 7 in a stage of disassembly of U-joint unit **31** by apparatus **19** which stage is subsequent to that stage shown in FIG. 3.

FIG. 6 is a sectional view in Zone 5A of FIG. 1 along section 2E–1D of FIG. 7 in a stage of disassembly of U-joint unit **31** by apparatus **19** which stage is subsequent to that shown in FIG. 5.

FIG. 7 is an end view along direction of arrow 7A of FIGS. 1 and 4 of the apparatus **19**.

FIG. 8 is a front view of apparatus **19** along the direction of arrow 1–G of FIGS. 4 and 7 and a partly broken away U-joint **31** during an initial stage in the assembly thereof by apparatus **19**, the U-joint yoke being shown in section along vertital plane 2E–1D of FIG. 7.

FIGS. 9 and 10 are, respectively, showings of the structure in Zone 9A of FIG. 8 during successive stages of assembly of a U-joint **31** by the apparatus **19** following the stage shown in FIG. 8.

FIGS. 1 and 4–10 are drawn to scale.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The apparatus **19** comprises a sturdy rectangular frame **20**, a first top vertical reassembly bolt unit **26** and a second, side, horizontal disassembly bolt unit **27** and a disassembly anvil **28** in operative combination.

The frame **20** (the dimensions of which are given in Table I herebelow) is rectangular and comprises a left vertical member **21**, a right vertical member **22**, a bottom horizontal member **23**, and a top horizontal member **24** in cooperative combination, the frame being composed of a first side frame member, a second side frame member extending at right angles to the first side frame member and firmly joined thereto, a third side frame member joined to said second side frame member at a distance from said first frame side member and parallel to said first frame side member, a fourth frame side member joined to said first frame side member and to said third side member, said fourth frame side member being parallel to the second side member and having the same tensile strength as said second frame side member. Each of the members **21, 22, 23** and **24** is a sturdy straight solid steel member of rectangular cross section. The members **21–24** are firmly joined at their ends as **21A, 22A 23A** and **24A** to form a resilient yet sturdy structure of great tensile strength. The frame member **22** with the press means attached thereto forms an integral vibrating unit with the remainder of frame **20**.

The apparatus **19** is arranged to be operated to disassemble a U-joint as **31** and also to reassemble a U-joint, as when after the parts thereof may have been repaired and/or replaced.

The U-joint **31** comprises a rear cross **32**, a front cross **33** and a casing **34** in operative connection.

The casing **34** is a rigid longitudinally extending member with a front yoke **71**, a rear yoke **72** each firmly attached to and extending outwardly from a central rigid ring **61**. The crosses **31** and **32** are rotatably

yet firmly supported in the yokes 71 and 72, respectively.

The front cross 33 comprises, in operative combination, a top vertical cylindrical arm 35, a bottom cylindrical arm 36, a left cylindrical arm 37 and a right cylindrical arm 38 and a body 39 all firmly connected together, with their bearings.

The top and bottom arms 35 and 36 are sturdy solid cylinders and coaxial with each other and firmly joined to the body 39; the left and right arms 37 and 38 are also rigid solid cylinders identical in size and shape to arms 35 and 36 and firmly attached to the body 39. Arms 37 and 38 are coaxial with each other and at right angles to axis of arms 35 and 36. The axis of arms 35 and 36 is co-planar with the axis of arms 37 and 38, (the "axis" being the central longitudinal axis).

The base as 30 of each arm as 37 is firmly fixed to the periphery of the rigid body portion 39; body portion 39 is a thick sturdy short flat cylinder to which the arms 35, 36, 37, and 38 are firmly connected.

Each arm has a free or outer end, as end 95' on arm 35, end 96 on arm 36, end 97 on arm 37, and end 98 on arm 38, that is bevelled or tapered in the direction away from the body 39.

The rear cross 32 is composed of a body 139 and arms as 135, 137 and 138 identical to the body 39, and arms 35, 37 and 38 respectively, and arm 136. Each of the arms of each of the crosses 32 and 33 such as the left arm 37 of the front cross 32 is provided with a bearing sleeve as 107; i.e., a bearing sleeve 105 on arm 35, a bearing sleeve 106 on arm 36 and a bearing sleeve 108 on arm 38 are identical in size and shape and material to bearing sleeve 107 on arm 37. Each arm of each corss as 35, 36, 37 and 38 on cross 32 has a set of roller bearings, as set 100 on arm 35, set 101 on arm 36, set 102 on arm 37 (and set 103 not shown on arm 38), adjacent thereto.

Each of the roller bearings 100, 101, 102 and 103 is located within a bearing sleeve therefor as 105, 106, 107 and 108 (for each of arms 35, 36, 37 and 38) respectively. Each sleeve of the unit 31 as 107, has a rigid circular cap as 117 on sleeve 107 (and cap 118 on sleeve 108, cap 115 on sleeve 105, cap 116 on sleeve 106) which cap is firmly fixed to the periphery of such sleeve.

Each of the bearing sleeves and its cap is firmly located in a hole therefor in the casing 34 of U-joint 31.

The U-joint casing 34 comprises a front left lug 64, a front right lug 62, a rear left lug 66 and a rear right lug 68. The front right lug 62 has therein a hole 63 therein, the front left lug 64 has therein a hole 65. Holes 63 and 65 are coaxial and form a press fit with the bearing sleeve caps 108 and 107, respectively; these relationships of the two arms on the front cross are exemplary of the relationship of the holes in the lugs for each of the other roller bearings and arms of U-joint 31. Thus, the rear right lug 66 has a rear lug hole 67 and the rear left lug has therein a rear left bottom hole 69 which engage the bearings for the arms as 137 and 138 of the rear cross 32.

The front right lug 62 and the front left lug 64 are both joined at their rear to the front end of a rigid sturdy hollow ring 61 at the front of that ring 61; the front right lug 62 and the front left lug 64 form a front yoke 71. The rear right lug 68 and the rear left lug 66 are joined at their front ends to the rear end of the ring 61 and form the rear yoke 72. A drive shaft (not shown) is, in the conventional manner, operatively yet removably connected to a rigid drive shaft yoke 74 which yoke supports one set of opposing arms—one of which is 135—attached to the rear cross 32 as shown in FIG. 4.

Such drive shaft is usually removed from at least one end of the unit 31 prior to the assembly and disassembly operations herein described using the apparatus 19. Also, the method and procedure for release of arms 37 and 38 from the arms 62 and 64 of yoke 71, which method and procedure are shown in some detail in the FIGS. 1–7 is the same as the method of release and procedure for release of the arms on the rear cross 32 from the yokes, as 72 and 74, to which the arms of such other cross is attached as well as the method and procedure for release of arms 35 and 36 of cross 33 to the yoke to which such arms are attached.

The yoke which is attached to the portion of the drive shaft to which the cross arms 35 and 36 may be attached prior to the disassembly of joint 31 from such yoke are not shown in the figures herein for purpose of clarity of the figures as the method of release of arms 37 and 38 from the arms 62 and 64 of yoke 71 is the same method of release as the method of release of other arms as 35 and 36 of U-joint 31 from the arms of such other yoke, not shown.

Each cylindrical sleeve as 107 on the front and rear cross of unit 31 has an annular externally open locking groove as 83 uniform in size all along its perimeter: each cylindrical hole for support and location of a bearing sleeve, as hole 65, in each lug, as 64, has an internally open annular groove as 84 of uniform size all along its perimeter. In the usual operative position of each sleeve (as 107) and the lug therefore (as 64) supporting each such bearing sleeve the grooves 83 and 84 match to form a hollow toroidal chamber or annular hollow ring of a uniform circular cross-section. Cylindrical channels 90 and 91 each extend in diameterically opposite directions radially from the internally open groove 84 through the body of each lug, as 64, of each yoke on the frame 34 of the unit 31. An elastic tough resilient water and grease insoluble plastic with a high melting point, or thermosetting, is injected into one of the channels as 91 and fills it and the toroidal chamber (or ring) and the channel as 90: this results in a solid annular lock ring mass 95 in the annular space formed by the grooves as 83 and 84 as well as filling of each of the channels as 90 and 91 with such plastic resilient material, as nylon 66, which masses are continuous with lock ring 95; a nipple, as 92 and 93, extends from and is continuous with each of the cylindrical masses of plastic in channels 90 and 91. During the normal operation of the U-joint 31, each of the lock rings on each arm of each cross, as lock ring 95 on sleeve 107 of arm 37 of cross 33 resists usual displacement of the bearing sleeve, as 107, the yoke lug, as 64, adjacent thereto due to operational stresses applied thereto.

The side disassembly unit 27 comprises, in operative combination, threaded journals 50A and 50B, a bolt 54 and an anvil 28. The journal 50A has an internally threaded portion 51A and an outer sleeve 52A which sleeve is firmly fixed at its inner side (left as shown in FIG. 1) by welding to the outer (right as shown in FIG. 1) surface of the right vertical frame arm 22 at the circumference of a cylindrical hole 53 in and passing horixontally through arm 22. The journal 50B has an internally threaded portion 51B and an outer sleeve

52B and is firmly fixed at its outer (right, as shown in FIG. 1) side by welding to the inner (or left as shown in FIG. 1) surface of the right vertical frame arm 22 at the circumference of the cylindrical hole 53. The threaded portions 51A and 51B and cylindrical hole 53 are coaxial. Hole 53 has a greater diameter than the maximum diameter of the threads of the bolt 54. The bolt 54 is formed of steel and is sturdy and comprises a head hexagonal portion 55, a rigid threaded staff 56, and a cylindrical drive end 57. The staff 56 is helically threaded and those threads on staff 56 match the threads in threaded portions 51A and 51B of journals 50A and 50B and is coaxial therewith; the thread of staff 56 is greased and smoothly rotatably fits the threaded portions 51A and 51B of journals 50A and 50B.

The drive end 57 is a solid cylinder continuous and integral with and coaxial with the staff 56 and has a smaller diameter than the diameter of the bearing sleeve as 107 and 108 on the U-joint the unit 19 is used to disassemble.

The anvil 28 comprises a rigid cylindrical tube or pipe: it has a rigid cylindrical wall 86 of uniform thickness along all of its perimeter and along all of its length from its inner edge 78 to its outer edge 79. Wall 86 has a cylindrical inner wall surface 88. The inner cylindrical surface 88 is smooth and bounds a cylindrical anvil interior space 87. The diameter of the surface 88 is slighly; i.e., 0.01 inch to 0.20 inch larger, than the diameter of the bearing sleeves as 105–108 with which the apparatus 19 is used, and is definitely smaller (i.e., from one-eighth inch to one-half inch) than the width of the yoke lug (49A to 49B) from which the bearing sleeve, as 107, is to be removed.

The wall 86 is coaxial with the bolt 54.

The arm 21 is provided with a hole therein and the anvil 28 fills that hole and the exterior of the anvil wall 86 is firmly attached, as by welding at 85, 85' and 85'' to arm 21. Rigid base plates 59 and 60 are attached firmly to the bottom of arm 23; bolts as 110, 111, 112 and 113 serve to hold the frame 20 to a work table as 114 for support of the apparatus 19 during its use as herein described.

The top reassembly bolt unit 26 comprises, in operative combination, threaded journals 150A and 150B and a bolt 154. The journal 150A has an internally threaded portion 151A and an outer sleeve 152A which is firmly fixed at its bottom, as by welding, to the upper surface of the top horizontal frame arm 24 at the circumference of a cylindrical hole 153; hole 153 passes through the frame arm 24. The journal 150B has an internally threaded portion 151B and an outer sleeve 152B and is firmly fixed at its outer surface, as by welding, to the bottom surface of top frame arm 24 around at the circumference of the cylindrical hole 153. The threaded portions 151A and 151B and cylindrical hole 153 are coaxial. Hole 153 has a greater diameter than the maximim diameter of the threads of the bolt 154. The bolt 154 is formed of steel and is sturdy and comprises a rear hexagonal portion 155, a rigid threaded staff 156, bottom end 157 and a face plate 158. The staff 156 is helically threaded and those threads on staff 156 match the threads in the threaded portions of sleeves 151A and 151B of journals 150A and 150B.

The face plate 158 is a rigid circular plate with its lower end coaxial with the extending perpendicular to the staff 156 and is firmly fixed thereto. The bottom of plate 158 is flat, wider than the threaded portion of staff 156 and wider than the diameter of the bearing sleeves as 105, 106, 107 and 108 of the U-joint, as 31, that the unit 26 is used to assemble.

To set up the press for operation of disassembling a joint as 31, the frame 20 is firmly secured to a bench or work table 114 using a plurality of the mounting holes and screws, as 110–113 in plates 59 and 60.

The drive shaft and U-joint 31 are removed from the vehicle and the U-joint is positioned on the bench inside frame 20. A flexible wire or cord 120 is passed around the arm 24, under ring 61 and around staff 156 above plate 158: wire 120 is used to help support the U-joint 31 while the height of the U-joint is adjusted by rotating the head 155 and threaded shaft 156 in threaded journals 150A and 150B.

The axis of a pair of cylindrical arms, as 37 and 38, on one cross, as 33, of the U-joint 31 is brought into line with, i.e., into coaxial alignment with, the axis of staff 56 of bolt 54 and the axis of the cylindrical surface 88 in anvil 28 and the external surface of a yoke lug, as 64, of the U-joint frame 34 is brought into contact with the center edge 78 of the tube or wall 86 of anvil 28. The axis of the cross arm, as 37, which arm is then adjacent to the anvil 28 is coaxial therewith. The drive end 57 of the bolt 54 is then brought into contact with the cap 118 of the sleeve 108: then bolt 54 is forced leftwards (as in FIG. 1) while applied directly along the direction of the longitudinal axis of coaxial staff 56, arms 37 and 38, and surface 88. Bolt 54 is so forced by a 10 inch long open end wrench applied to the bolt head hexagonal portion 55, to the limit of hand pressure—about 100 pounds—there is then some very slight visible bending of the arm 23 but the sleeves 107 and 108 do not move relative to the lugs 64 and 62, respectively.

While maintaining such stress on the bolt 54 and bearing sleeve head 118, the head 55 of bolt 54 is then rapped sharply with a one pound hammer 58 directly along the direction of the longitudinal axis of the staff 56 and axis of arms 37 and 38. There is a metallic clanking sound (at least two octaves higher than middle C) immediately followed by a sharp "crack" sound indicating shear of the lock rings, as 95, and, after such cracking sound, the sleeve 107, which is coaxial with the cylindrical surface 88 of anvil 28 and of smaller diameter than the diameter of the hole 87 in anvil 28, comes to rest at a position displaced (leftward as shown in FIGS. 1–3) relative to the arm 21 than the width of the groove 83: this movement does not occur unless the lug is firmly and directly against the hard face 78 of the anvil 28. The high frequency and amplitude of the vibration of the arm 22 resulting from the rap of the one pound hammer relative to the fixed position of the lugs as 62 and 64 of yoke 71 of frame 34 of the U-joint 31 shears the nylon lock ring as 95 on each of the ring-like chambers between the bearing sleeve, as 107, and the yoke lug as 64 adjacent to such ring 95, and between the bearing sleeve as 108 and the yoke lug, as 62, adjacent to the corresponding ring between such sleeve and lug. Such a hammer blow directly on the cap 118 does not cause such shearing and increased pressure of bolt 54 on cap 118 alone does not cause shearing of the lock rings as 95.

Thereafter with head 57 in contact with the bearing sleeve cap 118 the bolt 54 is further turned until the

bearing sleeve cap is moved until the body 39 of the cross 31 contacts the right side of lug 64 as shown in FIG. 5; the bolt 54 is then loosened (to right in FIG. 1) and the U-joint casing 34 removed from apparatus 19.

If the cap and sleeve thus moved outward of the lug 64 theretofore held against the anvil 28 is not then freed from the lug 64, a small chisel may be placed in the groove 83 and tapped lightly, whereupon the sleeve 107 and its cap 117 and bearing 102 are removed from arm 37. Arm 37, is by this procedure (as shown in FIG. 5) positioned at a radially or laterally displaced position from its normal operating position shown in FIG. 1 and arm 38 is moved centrally.

With cap 117 and sleeve 107 removed, casing 34 of joint 31 is rotated 180° about the longitudinal axis of ring 61. The axis of arms 37 and 38 is again brought into alignment with the axis of staff 56 and surface 88 and the external surface of lug 62 (opposite to the one, 64, theretofore so located) is brought into contact with the center edge 78 of the tube or wall 86 of anvil 28. The axis of the arm 38, which arm is then adjacent to anvil 28, is coaxial therewith.

The drive end 57 of the bolt 54 which drive end has a lesser diameter than the diameter of cylindrical surface 88 in lug 64, is then brought into contact with the lateral end of arm 37 and turned clockwise (as seen from right to left in FIG. 1). This presses the arm 37 and the bearing sleeve 108 and cap 118 directly along the direction of the longitudinal axis of the staff 56 and axis of cylindrical arms 37 and 38 and cylindrical anvil wall 86 and moves the cross 33 leftward until, as shown in FIG. 6, the right edge of lug 62 is contacted thereby and bearing sleeve 108 and cap 118 extend substantially, i.e., over one-fourth inch, beyond the lateral edge of lug 62 as shown in FIG. 6. If the cap and sleeve are not then freed from the lug 62 a small chisel may be placed in the groove for the locking ring, which groove is, like 83, located in the sleeve 108 (corresponding to the sleeve 107 for arm 37): light tapping against such chisel in such groove removes the sleeve 108, cap 118 and bearings from the arm 38. Then arms 37 and 38 are readily manipulated to pass through the groves 162 and 164 in the lugs 62 and 64 and separate the cross 33 and the casing 34.

To set up the press for operation of assembling a joint as 31, the frame 20 is firmly secured to a bench or work table 114 using a plurality of the mounting holes and screws as 110–113 in plates 59 and 60.

The drive shaft and U-joint 31 are removed from the vehicle and the U-joint is positioned on the bench inside the press frame 20 and the bottom edge of a yoke lug, as 64, of the U-joint casing 34 is brought into contact with the flat top of arm 23 of frame 20 with the axis of the cross arm, as 35, adjacent to the arm 23 perpendicular to the top surface thereof. The arms 35 and 37 of cross as 33 are manipulated through grooves 162 and 164 and located with arms 35 and 36 vertical in the center of holes 63 and 65 of lugs 62 and 64, respectively. The end 95 of arm 35 then rests on the top of frame arm 23.

The interior surface of sleeve 106 is coated with a thick (one-sixteenth inch) layer of grease. A set of roller bearings, 101, is located on the interior surface of the sleeve, 106, with its cap, 116. The thick coating of grease serves to hold the bearings against the interior surface of the sleeve 116.

The axis of the pair of cylindrical arms, 35 and 36, on the cross 33 of the U-joint 31 is brought into line with; i.e., into coaxial alignment with, the axis of staff 156 of bolt 154.

The sleeve 106, with the set of roller bearings 101 therein, is then placed over the slightly but definitely bevelled end 96 of the arm 36 and pressed thereover by hand a short distance, and into the hole 65 in lug 64.

The bolt 154 is then turned so that the plate 158 on the bolt 154 is then brought into contact with the cap 116 of the sleeve 106. Plate 158 is then tightened against cap 116 by turning bolt 154 clockwise (as seen from above) by a 10 inch (between jaws) long open end wrench applied to the bolt head hexagonal portion 155. This tightening is effected by hand pressure of about 30 pounds and drives cap 116 directly along the direction of the longitudinal axis of the staff 156 and axis of arms 35 and 36 without canting, said first and third frame side members being substantially unchanged dimensionally by tensile stress applied thereto by said second press means, until the plate 158 comes to rest against the top of the lug 64 and the top of the cap 116 is flush with the top of lug 64, as shown in FIG. 8.

In this position the end 95 of arm 35 is in same plane as the outer surface of lug 62.

The bolt 154 is then loosened and moved upwardly about one inch to allow movement of unit 31 and manipulation of the sleeve 105 between unit 31 and the bolt 154, following which casing 34 of joint 31 is rotated 180° about the longitudinal axis of ring 61 and the outer face of lug 64 located on the top surface of arm 23.

The fit of the sleeve 106 in hole 65 of lug 64 holds the sleeve 106 and the set of roller bearings 101 and the arm 36 coaxial and with their common axis vertical and arm 35 substantially coaxial with the cylindrical hole 63 in lug 62. The axis of arms 35 and 36 is again brought into alignment with the (central longitudinal) axis of staff 156.

The interior surface of the sleeve 105 is coated with a thick (one-sixteenth inch) layer of grease. A set of roller bearings 100 is located against the interior surface of the sleeve 105 below its cap 115: the thick layer of grease serves to hold the bearings against the interior surface of sleeve 115.

The sleeve 105, with the set of bearings 100 therein, is then placed within hole 63 and over the slightly but definitely bevelled end 95′ of the arm 35 and pressed thereover by hand a short distance—about one-fourth inch.

The plate 158 at the end of threaded staff 156 is then brought into contact with the top surface of cap 115 as shown in FIG. 9 by rotating the bolt 154 and the bolt 154 is tightened against cap 115 (by turning bolt 154 clockwise as seen from above) by a wrench applied to bolt head 155 by hand pressure: this action of plate 158 serves to directly drive cap 115 and sleeve 105 and the arms 36 and 35 directly along the direction of the longitudinal axis of the staff 156 and the axis of arms 35 and 36 without canting until the plate 158 comes to rest against the top of lug 62 and the top of cap 115 is flush with the top of lug 62, as shown in FIG. 10.

After such assembly of the cross, fresh plastic may be injected into the channel 90 (or 91) of each lug as 64 (and 62) and a new lock ring seal as 95 created in each toroidal chamber therefor.

When steel lock rings are used on bearing sleeves to position them relative to lugs as **62,** application of the plate **158** by bolt **154** or drive end **57** to the caps of such bearing sleeves frees metal lock rings thereon for removal by lock ring pliers: after separate removal of each of such steel lock rings, the drive end **57** is applied to the bearing sleeves and caps(as for **107, 108, 117** and **118** on arms **37** and **38** as above described in relation to FIGS. **1–6**)for removal of such sleeves and caps from such arms except for the rapping with the hammer.

To replace new U-joint with steel lock rings located external of the lugs as **62** and **64,** the yoke as **71** is placed with one outer surface of one lug, as **62,** against lower arm **23** of frame **20** and a cross as **33** is located as is shown in FIG. **8** with its arms in holes **63** and **65** of lugs **62** and **64.** A cap as **116** is then placed on one upper arm as **36** in FIG. **8,** following which the yoke **71** and cross **33** are rotated 180° and another bearing sleeve, as **105** and its cap, as **115,** is added to arm **35** as above described in relation to FIG. **9.** Thereafter both bearing sleeves as **105** and **106** and caps as **115** and **116** on their arms as **35** and **36** are compressed by plate **158** against arm **35** and lock rings are replaced one at a time on the bearing sleeves; following replacement of the lock rings the pressure by plate **158** on the caps is released.

TABLE I

DIMENSIONS OF APPARATUS 19

	Inches
Height — Bottom of 23 to top of 24 in FIG. 1	8
Length — Left of 21 to right of 22 in FIG. 1	9 ½
Width — Left to right of arm 21 in FIG. 7	3 ¼
Thickness of arm 21 as shown in FIG. 1	1 ⅛
Thickness of arms 22,23,24 as shown in FIG. 1	¾
Screw 54 length; top of 55 to bottom of 57 as in FIG. 4	8
Screw 154 length; top of 155 to top of 158 as in FIG. 4	8
Screw 54 and 154 — Outside diameter in FIG. 4	1
Height of casing 34 left end of 64 in FIG. 1 to right end of 62	3 ⅝
Lug 64 — Width top to bottom as in FIG. 1	1 ⅝
Lug 64 — Thickness left to right as in FIG. 1	5/16
Sleeve 117 length left to right as in FIG. 2	⅞
Sleeve 117 width top to bottom as in FIG. 2	1 ⅛
Sleeve 117 — Width of groove 95 left to right as in FIG. 2	⅛

While the apparatus and process herein are disclosed for freeing bearing sleeves from their supports in U-joints in which such sleeves are held by nylon lock rings it is within the scope of this invention that the apparatus and process are adapted for use to treat similar sleeve-like structures located in similar supports therefor and held by locking elements of equivalent characteristics such as but not limited to axles, stub shaft and trip arms.

I claim:

1. An adjustable press with vibratile characteristics comprising

a. a sturdy rigid resilient frame composed of a first side frame member, a second side frame member extending at right angles to the first side frame member and firmly joined thereto, a third side frame member joined to said second side frame member at a distance from said first frame side member and parallel to first said frame side member, a fourth frame side member joined to said first frame side member and to said third side member, said frame having a width, a depth and a height, the lengths of the first and third members extending along the height of the frame, the lengths of the second and fourth members extending across the width of the frame, the depth of the frame being perpendicular to said lengths, said side members being sturdy;

b. said sturdy frame extending in one plane and structurally symmetrical about a second plane at right angles thereto, a first press means movably yet firmly attached to the first side frame member of said frame and an anvil means attached to the opposite third side frame member of said frame, the anvil having an orifice therein, the press means being movable along a longitudinal axis located along the intersection of said first and second planes, said axis passing through the opening of said orifice, said first press means comprising a rigid compression member which is extended towards said anvil on one side of said frame and has a solid head thereon which extends beyond said frame in the opposite direction;

c. the first said frame member having a thickness extending along the width of the frame, and a depth, the thickness of the first frame member being less than the depth of said first member; the depth of the first member being less than its length;

d. said fourth frame side member being parallel to the second side member and having the same tensile strength as said second frame side member and said second and fourth frame members being equispaced from said longitudinal axis, said first side member being parallel to the third side member and being bendable symmetrically about said second plane and along said longitudinal axis; and

e. said first press means comprises a rigid solid threaded staff with a solid head and which staff is threadedly engaged on two sides thereof with said first side frame member and, with said first side frame member, forming a vibrating structure with an audible vibration frequency, said anvil being located on said third frame side member.

2. Apparatus as in claim **1** wherein said frame members are metal and the first side frame member vibrates with a frequency at least two octaves above middle C along said longitudinal axis.

3. Apparatus as in claim **1** wherein a second press means is movably yet firmly attached to said second frame means for movement along an axis which lies at the intersection of a third plane perpendicular to said first plane and to said second plane and said first and third frame side members being substantially unchanged dimensionally by tensile stress applied thereto by said second press means.

4. Apparatus as in claim **3** wherein there is a hole in the anvil and a hole in the first member and each are substantially the same size and distance from the second frame member.

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