United States Patent [19]

Whitledge et al.

[11] **3,849,858**

[45] **Nov. 26, 1974**

[54] **SWAGING APPARATUS**

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[73] Assignee: **Samuel Moore & Company,** Mantua, Ohio

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[52] **U.S. Cl.** ..... **29/200 B,** 29/200 D, 29/237

[51] **Int. Cl.** **B23p 19/00,** B23p 19/04

[58] **Field of Search** ..... 29/200 B, 200 D, 200 R, 29/237, 208 D

[56] **References Cited**

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3,348,292	10/1967	Turner et al.	29/237
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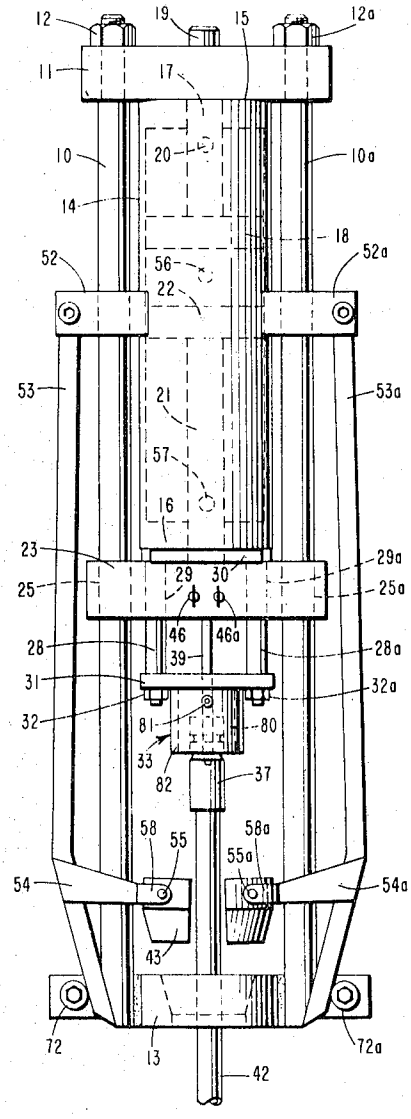
Primary Examiner—Thomas H. Eager

Attorney, Agent, or Firm—Clelle W. Upchurch

[57] **ABSTRACT**

A hydraulically actuated swaging apparatus having a means for pushing an assembly of a fitting on a hose end in a die and press the fitting on the hose is provided with a mandrel carried by the pushing means which is inserted in the assembly during swaging to prevent deformation of the wall of the hose into the bore through the hose and with means for removing the mandrel from the swaged assembly.

10 Claims, 11 Drawing Figures



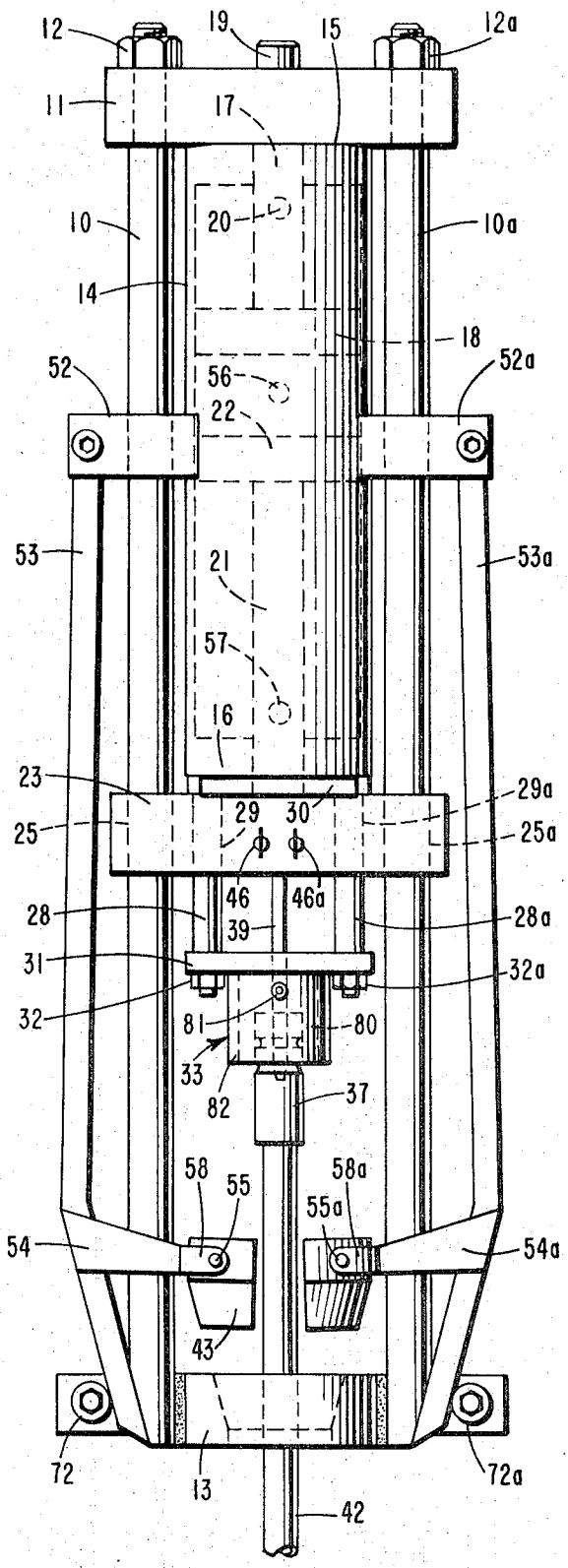

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FIG. 1

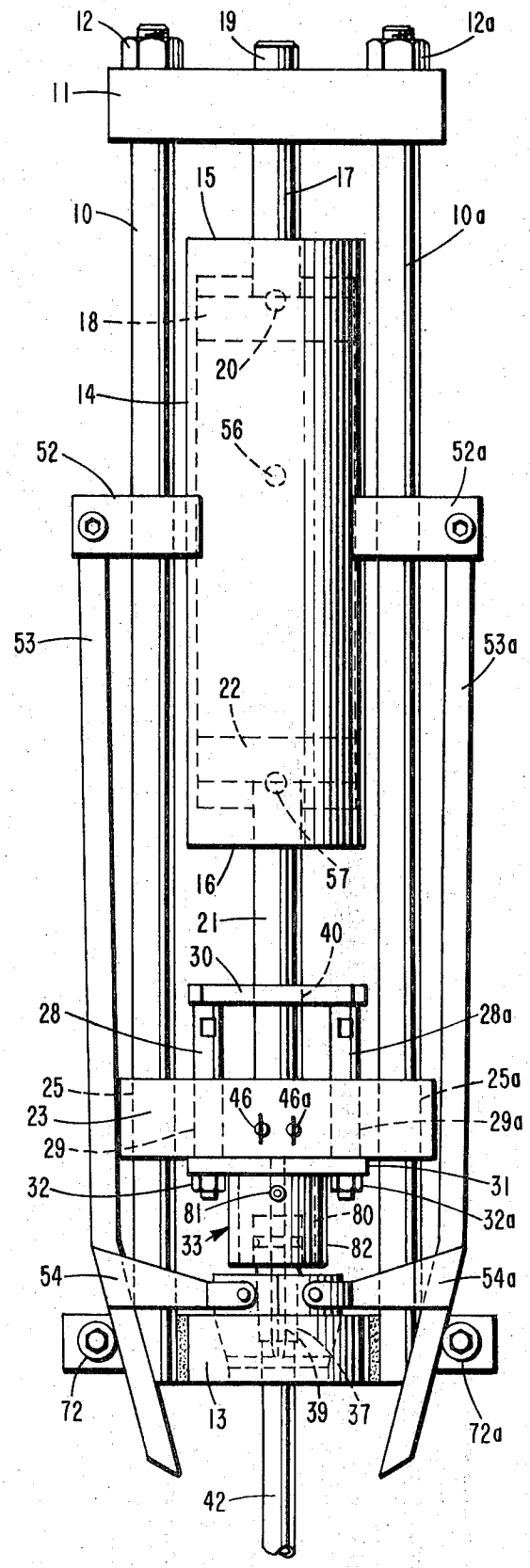
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FIG. 2

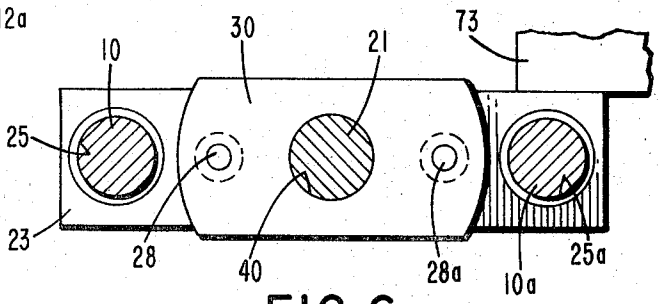
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FIG. 6

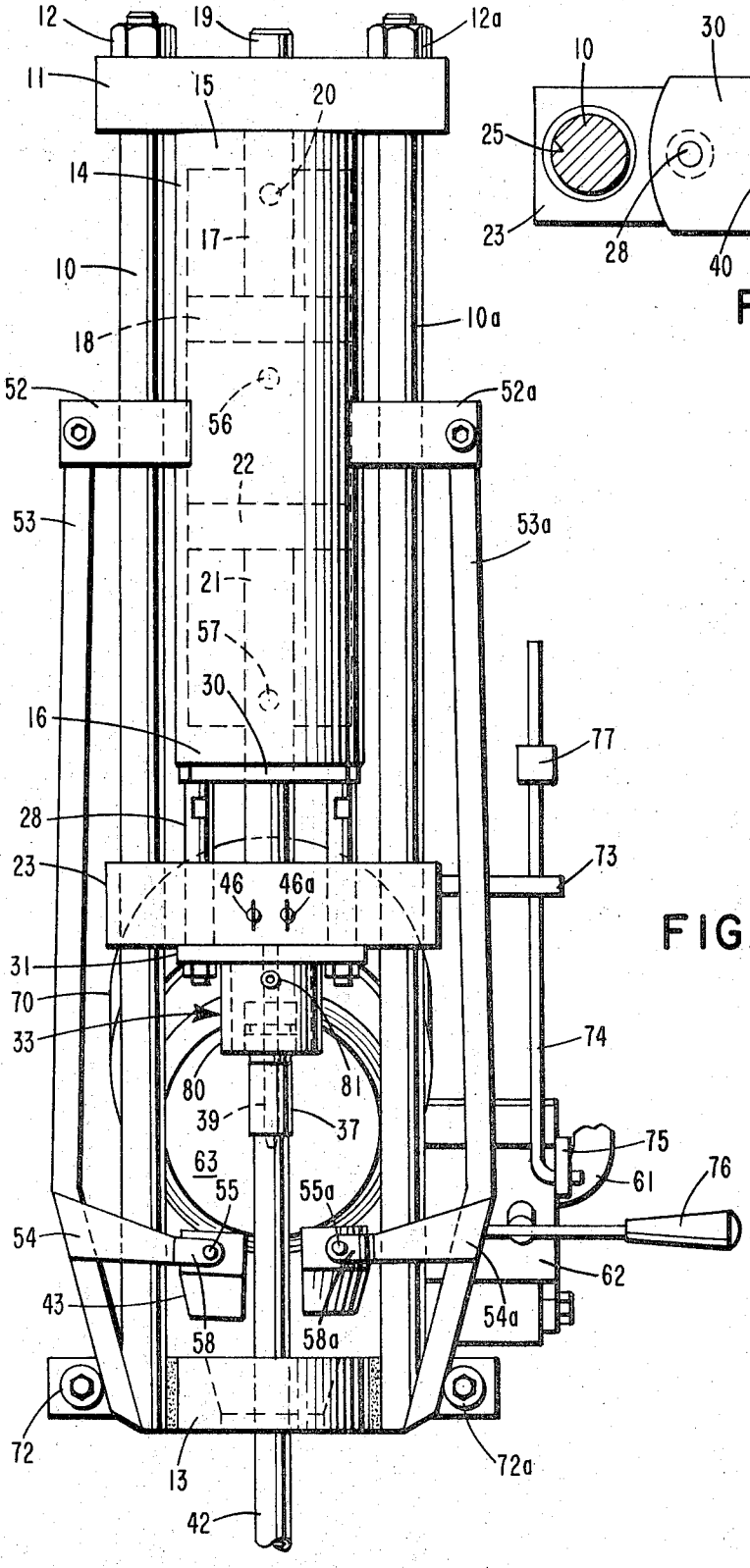
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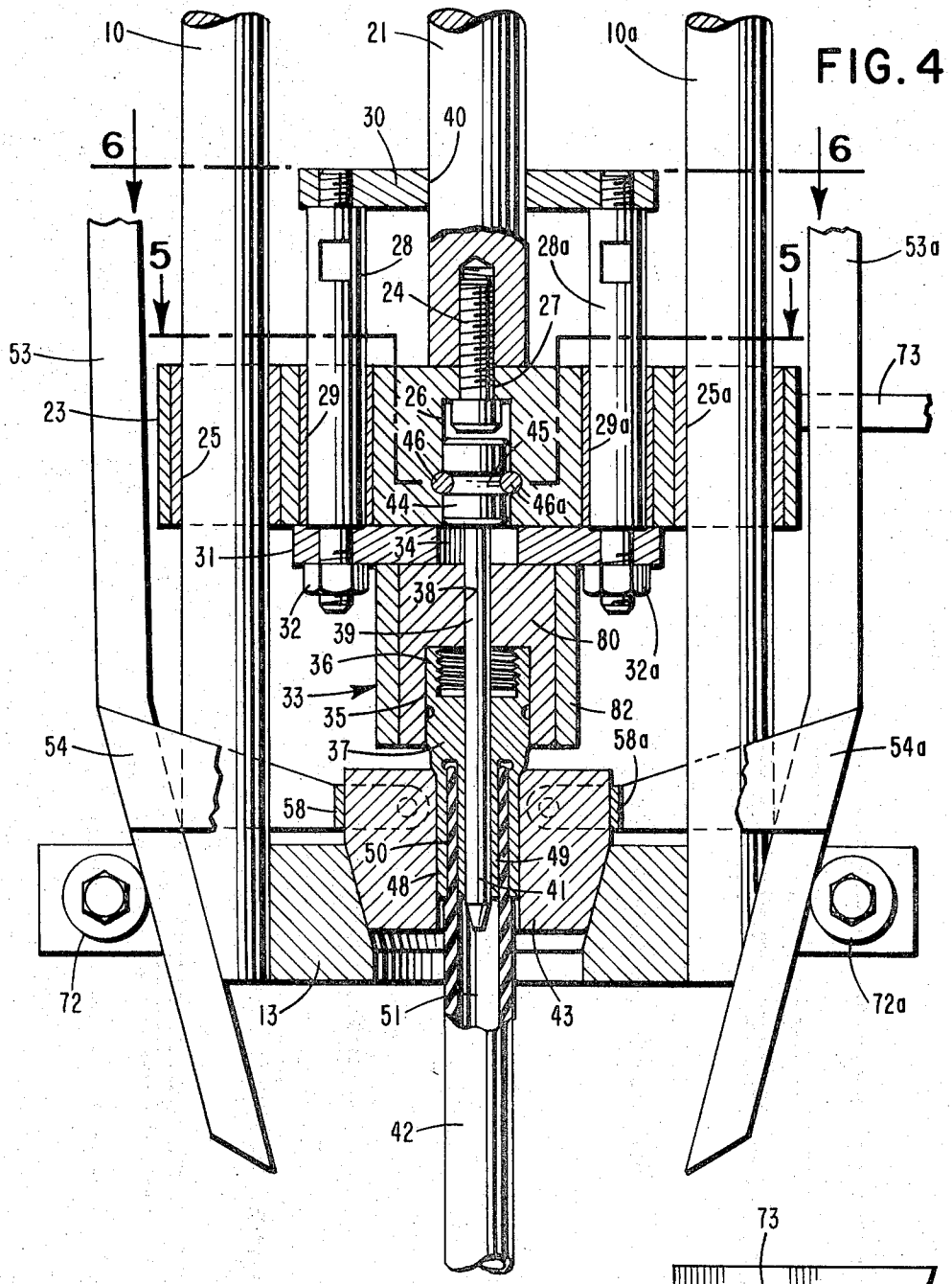
FIG. 3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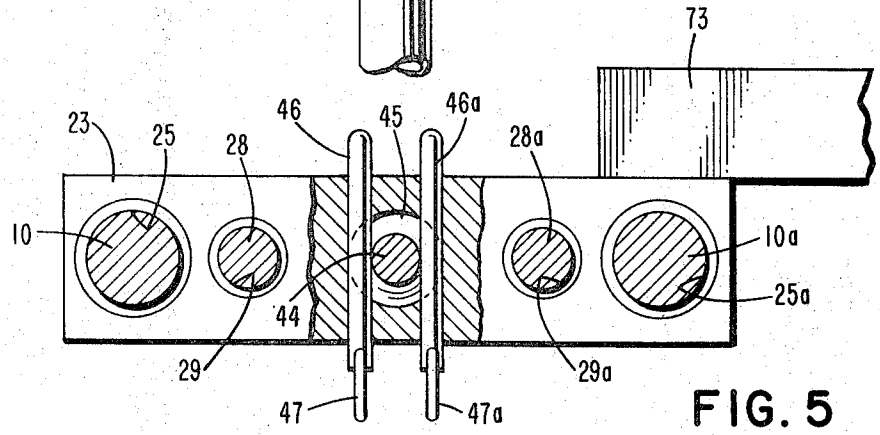
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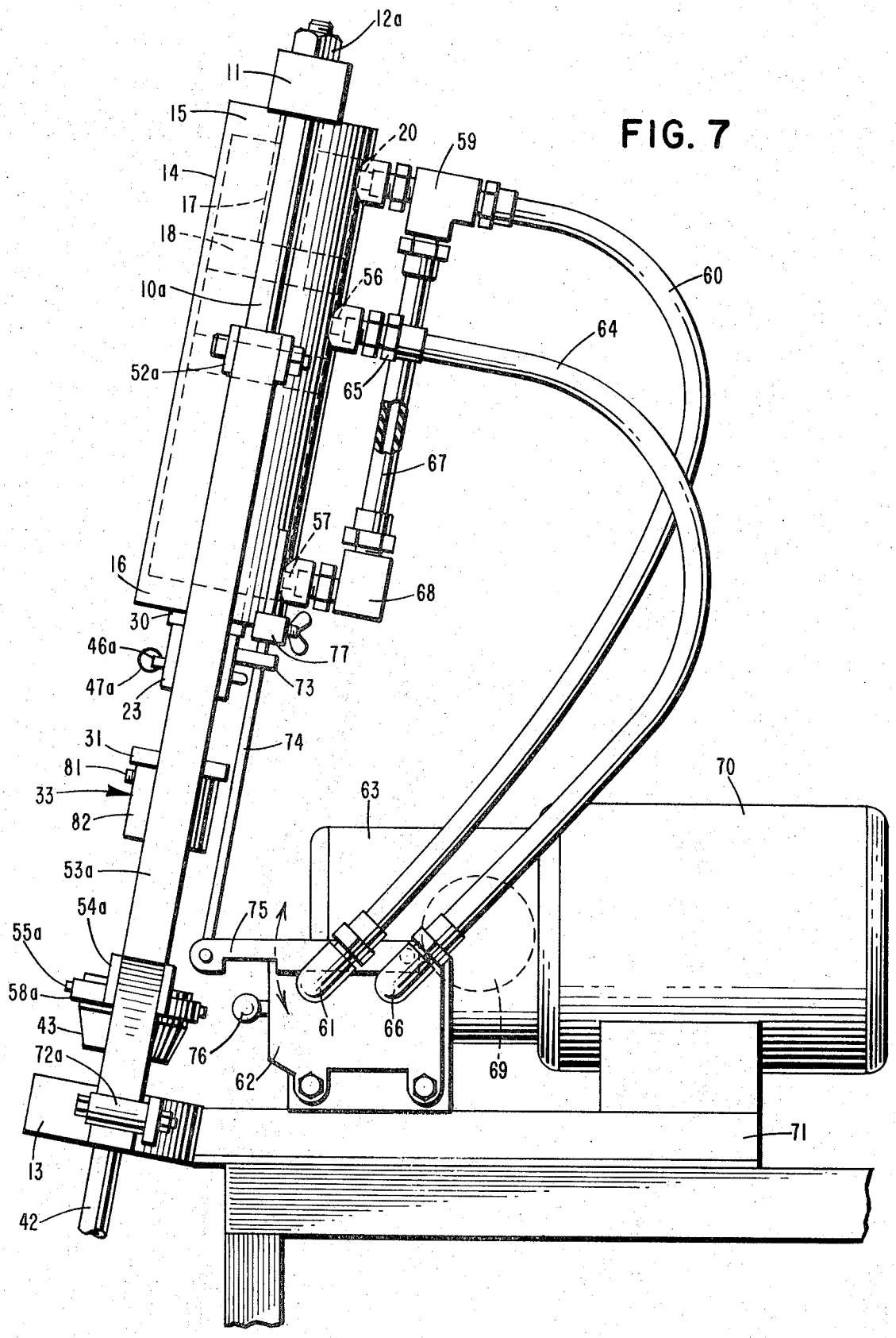
FIG. 4

FIG. 5

FIG. 7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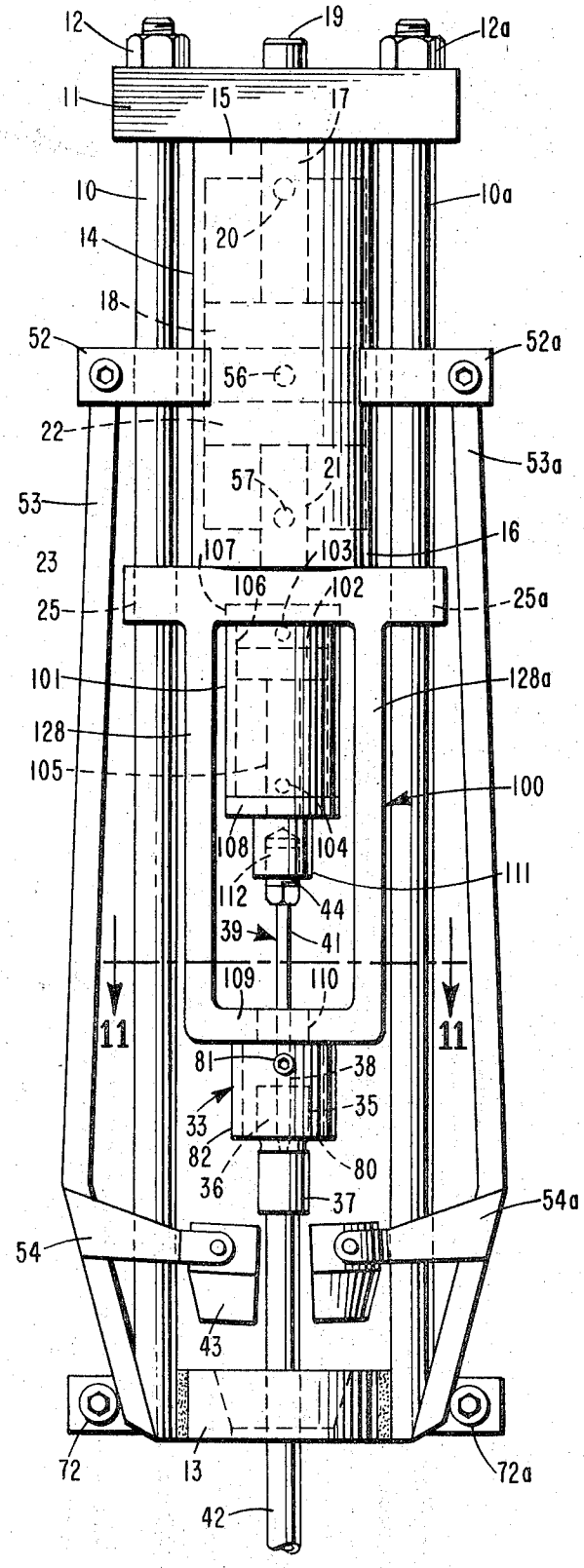
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FIG. 8

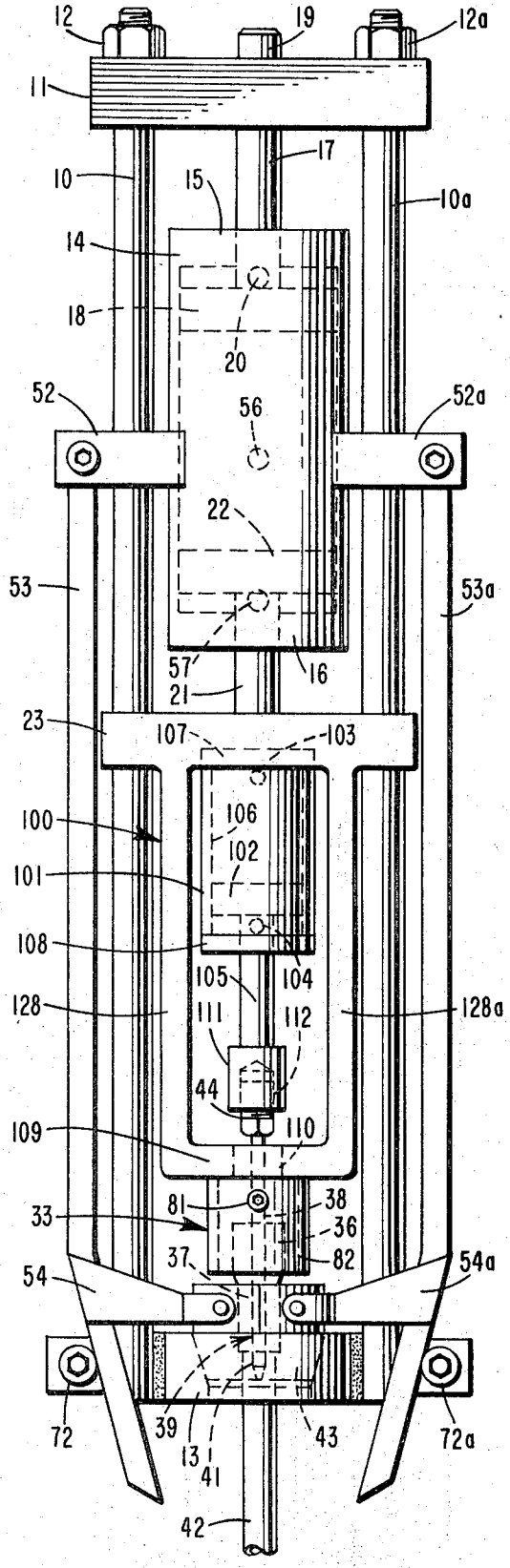
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FIG. 9

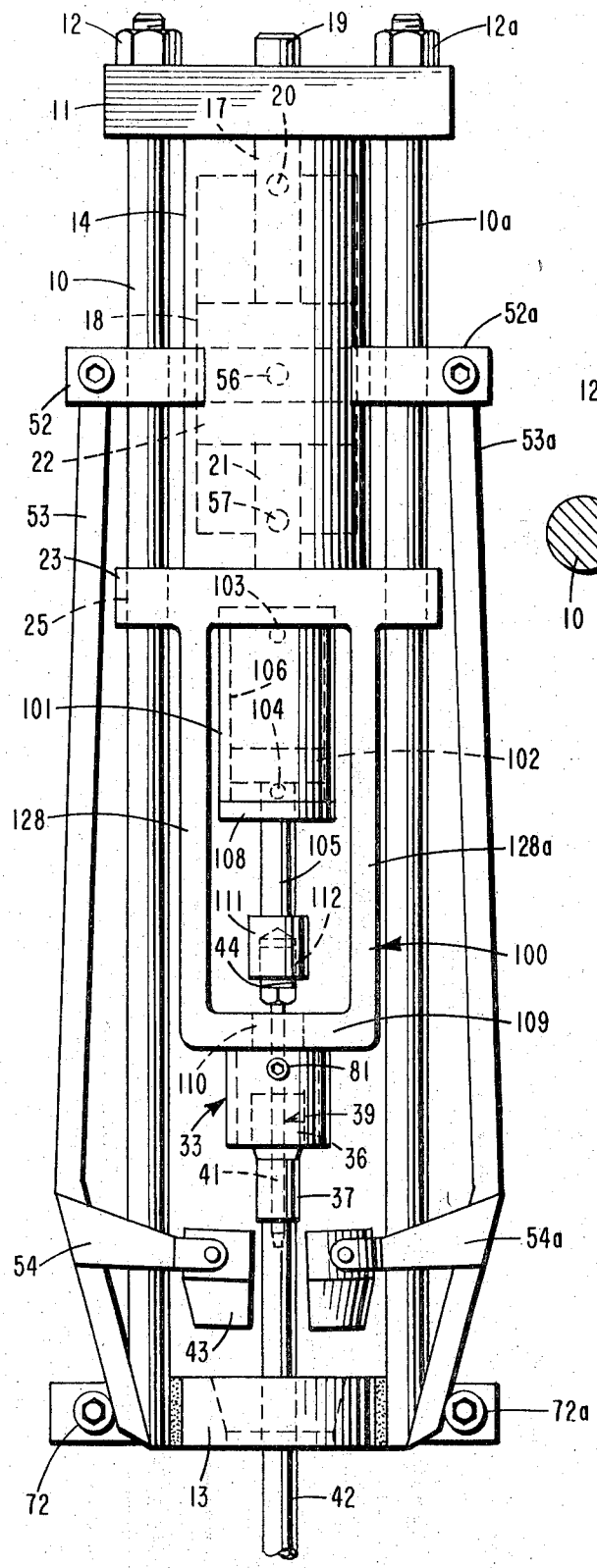
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FIG. 10

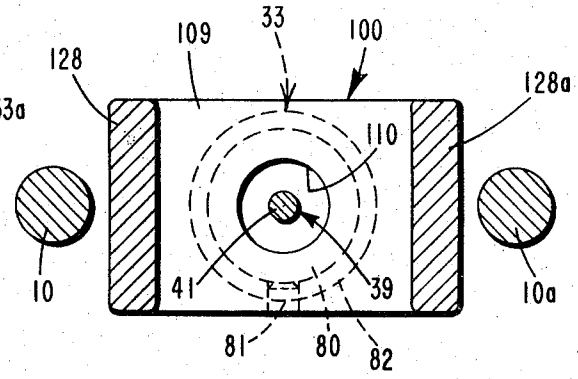
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FIG. 11

SWAGING APPARATUS

This invention relates generally to apparatus for securing a fitting or coupling to the end of a hose or tube and more particularly to an improved hydraulic swaging apparatus.

A hydraulically actuated apparatus for swaging a fitting on the end of a hose is disclosed in the Whitledge U.S. Pat. No. 3,706,123 granted Dec. 19, 1972. The disclosed apparatus has hydraulically actuated pistons which move a pusher element alternately to and from a swaging die to press a fitting and hose end assembly in a die cavity and thereby compress or swage the fitting on the hose. Such an apparatus has been found to be advantageous for swaging most fittings about a hose end and has met with commercial success. However, it has been found that in swaging fittings which require the application of a substantial amount of force the fitting and enclosed hose wall may be deformed inwardly with a reduction of the internal diameter of the hose and reduced passageway for fluid flow.

It is therefore an object of this invention to provide an improved hydraulically actuated swaging apparatus. Another object of the invention is to provide an apparatus adapted to swage a fitting on a hose end under substantial pressure without significant reduction of the passageway through the hose. A more specific object of the invention is to adapt a hydraulically actuated swaging apparatus similar to that described in U.S. Pat. No. 3,706,123 to secure a fitting or coupling to the end of a hose or tube even at high pressures without significant distortion of the fitting or hose wall into the bore or fluid passageway therethrough.

Other objects will become apparent from the following description with reference to the accompanying drawing wherein

FIG. **1** is a front elevation of one embodiment of a hydraulically actuated swaging apparatus provided by the invention, with the fluid pressure source removed, which illustrates the apparatus with a hose and fitting assembly prior to swaging;

FIG. **2** is a front elevation of the embodiment of FIG. **1**, also with the fluid pressure source removed, which illustrates the apparatus with the fitting and hose assembly seated in the swaging die after swaging;

FIG. **3** is a front elevation of the embodiment of FIGS. **1** and **2** including a fluid pressure source which illustrates the apparatus after the swaged assembly is withdrawn from the swaging die but still holding the coupling;

FIG. **4** is a fragmentary partial section of the embodiment of FIGS. **1** and **2** illustrating the position of the apparatus as the fitting and hose end are pressed in the die to secure the fitting to the hose end;

FIG. **5** is a partial section taken along the line **5—5** of FIG. **4**;

FIG. **6** is a partial section taken along the line **6—6** of FIG. **4**;

FIG. **7** is a side elevation of the embodiment of FIGS. **1** through **6** illustrating the embodiment of a fluid pressure source shown in FIG. **3** and described and illustrated in U.S. Pat. No. 3,706,123;

FIG. **8** is a front elevation of a second embodiment of the invention with its parts positioned prior to swaging;

FIG. **9** is a front elevation of the embodiment of FIG. **8** with its parts in swaging position;

FIG. **10** is a front elevation of the embodiment of FIG. **8** after swaging; and

FIG. **11** is a section taken along the line **11—11** of FIG. **8.**

The foregoing objects and others are accomplished in accordance with this invention, generally speaking, by providing an apparatus having a swaging die and a means actuatable by fluid pressure for pressing a fitting and hose end in the die about a mandrel until the external surface of the assembly has the configuration of the die cavity and the fitting and hose are secured together without significant indentation of the fitting into the fluid passageway of the hose. More specifically, the invention provides an apparatus having a swaging die, a support for the die, a piston rod carrying a pusher and mandrel assembly adapted to press a fitting and hose end assembly in a swaging die and a cylinder provided with means for the fluid pressure to pass alternately into and out of the cylinder to move the pusher and fitting assembly to and from the swaging die. The invention provides a pusher and mandrel assembly which may be installed on apparatus of the type described in U.S. Pat. 3,706,123 to be used for swaging under substantial pressures.

Referring now to the drawing, the illustrated embodiment of the apparatus has a frame composed of longitudinally disposed laterally spaced rods **10** and **10***a*, an end cross-bar **11** and a die supporting base **13** bridging opposite ends of rods **10** and **10***a*. Cross-bar **11** is secured to threaded ends of rods **10** and **10***a* by nuts **12** and **12***a* and die base **13** is secured by welding to the opposite ends of rods **10** and **10***a*. A cylindrical housing **14** has ends **15** and **16** and encloses a cylinder chamber adapted to hold fluid under pressure. A first piston rod **17** has a first piston **18** bolted or otherwise secured to an end thereof inside the cylinder chamber and is secured at the opposite end to cross-bar **11** by a socket head cap screw **19.** The peripheral edge of piston **18** forms a slidable substantially fluid impervious seal with the surrounding inner surface of housing **14.** A fluid impervious seal is provided by an O-ring about piston rod **17** where it is slidably disposed in an opening through end **15.** An aperture **20** through housing **14** permits flow of fluid under pressure into and out of the cylinder chamber between piston **18** and end **15.** The diameter of the inner portion of end plate **15** is less than the internal diameter of housing **14** to provide a boss with an annular space thereabout for flow of fluid through aperture **20** when piston **18** is disposed against end **15.**

A second piston rod **21** has a piston **22** secured by a nut (not shown) to a threaded end thereof inside the cylinder chamber. Piston rod **21** is slidably disposed through an opening in end **16** which may be sealed against loss of fluid from the chamber by an O-ring or other suitable sealing means.

A second cross-bar **23** is secured to the end of piston rod **21** by bolt **24** (FIG. **4**) and is slidably mounted on rods **10** and **10***a* for longitudinal movement between end **16** of housing **14** and die base **13.** Rods **10** and **10***a* are disposed through bores **25** and **25***a* in cross-bar **23.** A centrally disposed bore **26** in cross-bar **23** (FIG. **4**) communicates with a counter-bore **27** through which bolt **24** extends.

A pair of bolts **28** and **28***a* are slidably disposed in bores **29** and **29***a* through cross-bar **23** between rods **10** and **10***a* and piston rod **21.** A first laterally extending plate **30** is threadably secured in face to face relation-

ship with one side of cross-bar **23** to ends of bolts **28** and **28***a* and a second plate **31** is fastened by nuts **32** and **32***a* to the ends of bolts **28** and **28***a* in similar face to face relationship on the opposite side of cross-bar **23.** As best illustrated in FIG. **4,** plates **30** and **31** are secured to the ends of bolts **28** and **28***a* against movement relative to each other but cross-bar **23** can move longitudinally over bolts **28** and **28***a* between plates **30** and **31.** Piston rod **21** is slidably disposed through bore **40** in plate **30.**

A pusher element **33** is composed of a sleeve **82** welded or otherwise secured to plate **31** between nuts **32** and **32***a* and a holder **80** is held in the sleeve **82** by a set screw **81.** A bore **34** through plate **31** has its longitudinal axis aligned with the longitudinal axis of bore **26.** A bore or cavity **35** in holder **80** is aligned with bore **34** and is dimensioned to enclose and loosely engage a coupling end **36** of a fitting **37.** A counter-bore **38** communicates between bores **34** and **35.** By providing the holder **80** as separate pieces, holders adapted for use with different sized fittings can be interchanged with each other by simply loosening set screw **81.**

A mandrel **39** has an elongated cylindrical body portion or arbor **41** (FIG. **4**) which is of sufficient length to extend through bores **34** and **38** and through the length of fitting **37** as the pusher element **33** presses metal fitting **37** and the end of a hose **42** into die **43** into the position shown in FIGS. **2** and **4.** The elongated body portion **41** is integral with an enlarged head portion **44** (FIG. **4**) disposed in bore **26** of crossbar **23.** An annular groove **45** is provided in head portion **44.** Pins **46** and **46***a* extend through openings through the wall of cross-bar **23** about bore **26** and through annular groove **45** on opposite sides of head portion **44** to removably secure the mandrel **39** in cavity **26** against relative longitudinal movement. Rings **47** and **47***a* (FIG. **5**) may be pivotally secured to the ends of pins **46** and **46***a* to facilitate insertion of pins **46** and **46***a* through groove **45.**

As illustrated in FIG. **4,** fitting **37** may have concentric walls **48** and **49** with an annular space **50** therebetween adapted to receive the end of a hose **42.** When the fitting **37** is swaged as shown in FIG. **4,** the hose wall in space **50** is compressed between walls **48** and **49** to rigidly secure fitting **37** to the end of a hose **42.** The body portion **41** of mandrel **39** is disposed in the passageway **51** through hose **42** and prevents significant inward distortion or collapse of wall **49.**

Brackets **52** and **52***a* are welded to housing **14** and are slidably disposed on rods **10** and **10***a*. Lift arms **53** and **53***a* are bolted or otherwise pivotally secured at one end to brackets **52** and **52***a*, respectively, and are bent at their opposite ends inwardly towards each other at an angle which is substantially equal to that of the adjacent bevelled surfaces of the ends of rods **10** and **10***a*.

Brackets **54** and **54***a* are welded to lift arms **53** and **53***a*. Die support frames **58** and **58***a* are welded to the opposite ends of brackets **54** and **54***a*. A plurality of peripherally spaced fixed pins **55** and **55***a* and one detent pin are carried by frames **58** and **58***a* to removably secure the segments of die **43** to the frames **58** and **58***a*. The bevelled ends of rods **10** and **10***a* are inclined about 15° from perpendicular.

Any suitable source of fluid under pressure may be used to actuate pistons **18** and **22** and the cylinder formed by housing **14** and ends **15** and **16.** It may be, for example, the one described and illustrated in U.S. Pat. No. 3,706,123, the entire disclosure of the said patent being incorporated herein by reference. The structure of the fluid actuating system is not included in FIGS. **1, 2** and **4** through **6** for the sake of simplicity. The preferred embodiment of the apparatus including the fluid actuating system is illustrated in FIGS. **3** and **7.**

Referring now to FIG. **7,** a suitable T-type fitting **59** secures one end of a hose **60** to housing **14** through aperture **20** and a fitting **61** secures the opposite end of hose **60** to a hydraulic valve **62** connected to a pump **69** and a reservoir **63** of hydraulic fluid. A hose **64** is connected to aperture **56** in housing **14** by a suitable fitting **65** and to hydraulic valve **62** at its opposite end by a fitting **66.** A longitudinally extending hose **67** is connected at one end to T-fitting **59** and at the other end to aperture **57** in housing **14** by a suitable fitting **68.** Pump **69** is driven by motor **70.** The internal diameters of hose **67** and of fitting **68** are sufficiently smaller than the opening through aperture **20** to require a greater pressure for passage of fluid through **67** and **68** than is required for fluid flow through the opening of aperture **20.** An angle iron support member **71** may be provided for securing the apparatus to a bench **90** or the like (FIG. **7**). Support **71** is secured to die base **13.** The swaging apparatus may be inclined backwardly at an oblique angle as illustrated in FIG. **7.** Adjustable members **72** and **72**a guide lift bars **53** and **53**a along the inclined surfaces of rods **10** and **10**a (FIGS. **3** and **7**).

A bracket **73** is welded to cross-bar **23** and extends outwardly therefrom beyond lift arm **53**a, as shown in FIGS. **3** and **7.** A lift rod **74** is attached at its lower end to latch handle **75** and passes through a hole drilled near the end of bracket **73.** Valve handle **76** opens and closes hydraulic valve **62.** The position of collar **77** on lift rod **74** can be used to determine the length of the stroke of piston rod **21** but the length of the stroke should always be sufficient to extract the mandrel **39** from the swaged fitting.

To operate the apparatus illustrated in FIGS. **1** through **7,** cylindrical housing **14** is brought to the position illustrated in FIGS. **1** and **7** with plate **30** disposed against end wall **16** and with cross-bar **23** against plate **30.** Fitting **37** on an end of a hose **42** with the hose wall in space **50** is inserted in cavity **35** of pusher **33.** With pump **69** being driven by motor **70,** valve handle **76** is positioned to open valve **62** for flow of fluid under pressure from pump **69** through hose **64** and aperture **56** between pistons **18** and **22.** Fluid above piston **18** is displaced through hose **60** to reservoir **63** and the cylindrical housing **14** moves longitudinally from cross-bar **11** towards die base **13** until it rests on piston **18.** Since a greater fluid pressure is required for passage of fluid through aperture **57** than through aperture **20** fluid is forced through aperture **20** instead of through aperture **57** as fluid enters through aperture **56.** The distance between piston **22** and end wall **16** remains substantially constant. Consequently, cylindrical housing **14,** piston rod **21,** lift arms **53** and **53***a*, plates **30** and **31,** cross-bar **23** and pusher **33** move longitudinally as a unit. As the bent ends of lift arms **53** and **53***a* are guided below die base **13,** the die segments are seated in the cavity in die base **13** to form die **43.**

Continued pumping of fluid between pistons **18** and **22** moves piston **22** longitudinally forcing fluid out

through aperture **57** until piston rod **21**, cross-bar **23**, plates **30** and **31** and pusher **33** have reached the position shown in FIG. **2** and the fitting **37** has been pressed in the cavity of die **43**. It is to be noted that the elongated body or arbor **41** of mandrel **39** is disposed in the bore through fitting **37** as shown in FIG. **4** and has prevented inward distortion of wall **49**.

At this point in the cycle, fitting **37** is tightly swaged about mandrel **39**. To remove the swaged fitting **37** from the die **43**, valve handle **76** is moved to adjust valve **62** for flow of fluid through hose **60** and because there is less resistance to flow through aperture **20** than through aperture **57**, fluid flows through aperture **20** into the cylinder above piston **18** and leaves the cylinder through aperture **56** back to reservoir **63**. This moves the cylindrical housing **14** until end **15** strikes cross-bar **11** as shown in FIG. **3**. As piston rod **21** and cross-bar **23** move away from die **43** to the position illustrated in FIG. **3**, the tightly swaged fitting on mandrel **39** prevents relative movement between plate **30** and cross-bar **23** so piston **21**, cross-bar **23**, pusher **33** and plates **30** and **31** move as a unit to the position shown in FIG. **3**. At this point fitting **37** has been removed from die **43**. The segments of die **43** are moved upwardly by lift arms **53** and **53***a* and are separated as the bent ends of the lift arms are guided over the inclined surfaces of rods **10** and **10***a*. However, fitting **37** is held firmly in cavity **35** by mandrel **39** until the position shown in FIG. **3** is reached.

After cylindrical housing **14** strikes cross-bar **11**, continued pumping of fluid will cause flow through aperture **57** into the cylinder chamber. This causes piston **22** and piston rod **21** to move towards cross-bar **11** but plate **30** is prevented from further movement because it is against end **16** of housing **14**. This further movement of piston rod **21** lifts cross-bar **23** over bolts **28** and **28***a* towards plate **30**. Plate **31** cannot move relative to plate **30** so pusher **33** is held against longitudinal movement while cross-bar **23** and mandrel **39** move with piston rod **21** until cross-bar **23** strikes plate **30**. This movement pulls mandrel **39** from fitting **37** which can now be removed from cavity **35**. The apparatus is now positioned as illustrated in FIG. **1** ready for insertion of another fitting and hose assembly into cavity **35**.

The embodiment of the apparatus illustrated in FIGS. **8** through **11** is a modification of the one illustrated in FIGS. **1** through **7** and uses a second hydraulic cylinder and piston for inserting the mandrel into the fitting and hose assembly prior to swaging and for extracting the mandrel from the swaged assembly.

A U-shaped member **100** has laterally spaced vertical bars **128** and **128***a* welded or otherwise secured at one end to cross-bar **23** and integral at the other ends with base **109**. A cylindrical housing **101** is secured at one end to cross-bar **23** and is disposed in the space between the vertical bars **128** and **128***a*. A piston rod **105** is carried by piston **102** disposed in chamber **106** of cylindrical housing **101**. End walls **107** and **108** close housing **101** to form chamber **106**. Ports **103** and **104** through housing **101** are located on housing **101** to be above and below piston **102**, respectively, throughout the stroke of piston rod **105**.

Pusher element **33** is welded or otherwise secured to base **109** of U-shaped member **100**. Opening **110** through base **109** is aligned with bore **38** through holder **80**. Holder **80** is held in sleeve **82** by set screw **81**. Counter-bore **35** of greater diameter than bore **38** provides a cavity for frictionally engaging coupling end **36** of a fitting **37** disposed therein.

Piston rod **105** extends through an opening through end **108** of housing **101** and carries mandrel holder **111** welded or otherwise secured thereto. A fluid tight seal is provided around piston rod **105** in the opening through the end wall **108** of housing **101**.

A bore **112** in mandrel holder **111** is threaded and the head **44** of mandrel **39** is threadably secured therein. Arbor **41** of mandrel **39** extends through opening **110**, bore **38** and into counter-bore **35**.

The relative positions of the apparatus prior to swaging are shown in FIG. **8**. At this point cross-bar **23** is disposed against bottom wall **16** of cylindrical housing **14** and piston **22** is disposed in spaced relationship with respect to bottom wall **16**. End **15** of housing **14** is disposed against top bar **11**. Piston **102** is disposed in spaced relationship with end **108** of cylindrical housing **101**. Arbor **41** at this point protrudes downwardly from pusher **33** into the bore in fitting **37**. Fitting **37** is positioned above the split segments of die **43**.

Suitable hoses (not shown) are attached to ports **103** and **104** and to a source of fluid under pressure. The hydraulic system used to actuate piston **102** may combine any conventional hydraulic valve and fluid reservoir adapted to direct fluid under pressure alternately through ports **103** and **104** to move piston **102** longitudinally in chamber **106**. The source of fluid under pressure for actuation of piston **102** may be the same as that used to actuate pistons **18** and **22** or a separate system. The hydraulic system is not illustrated in FIGS. **8** through **11** since it is conventional.

In operating the apparatus of FIGS. **8** through **11**, a fitting **37** and hose **42** assembly are inserted in cavity **35** of pusher **33** as described above with respect to FIGS. **1** through **7**. Cross-bar **23** is disposed against end wall **16** of cylindrical housing **14** and the various other parts of the apparatus are positioned as shown in FIG. **8**. Fluid under pressure is then introduced through port **103** and fluid below piston **102** returns through port **104** to the fluid reservoir. Piston **102** moves longitudinally in chamber **106** with piston rod **105** and mandrel holder **111** moving to the position near base **109** of U-shaped member **100** shown in FIG. **9**. However, at this point in the operation, U-shaped member **100** has not moved from its position shown in FIG. **8**. The movement of piston **102** moves arbor **41** through the bore of fitting **37**.

Pistons **18** and **22** are now actuated as described above with respect to the operation of the embodiment illustrated in FIGS. **1** through **7**. Longitudinal movement of piston **22** and piston rod **21** towards die base **13** closes the die segments to seat die **43** in die base **13** and moves cross-bar **23** towards die base **13** into the position shown in FIG. **9**. Member **100** is carried by cross-bar **23** with piston rod **105** in its extended position until the fitting **37** is seated in the die cavity as shown in FIG. **9**.

Pistons **18** and **22** are now actuated as described above with respect to FIGS. **1** through **7** to withdraw the swaged fitting **37** and hose end from the die cavity. Cross-bar **23** is withdrawn until it strikes end **16** of cylindrical housing **14** as shown in FIG. **10**. U-shaped member **100** is carried along by cross-bar **23** until it reaches the position as shown in FIG. **10** with piston rod **105** still in its extended position.

Mandrel **39** is extracted from the swaged fitting and hose end by introducing fluid under pressure through port **104.** Piston **102** now moves longitudinally in chamber **106** to the position shown in FIG. **8** as fluid is displaced from chamber **106** through port **103.** Piston rod **102** carries holder **111** and mandrel **39** with it while pusher **33** remains in the position shown in FIG. **10** until mandrel **39** has been removed from the base of the swaged fitting and has reached the position shown in FIG. **8.**

The bars **128** and **128***a* of U-shaped member **100** are disposed inwardly from rods **10** and **10***a* as shown in FIG. **11.** In still another embodiment of the invention, the base of U-shaped member **100** is a cross-bar of approximately the same length as cross-bar **23** and has bores therethrough which permit it to slide longitudinally over rods **10** and **10***a* as it moves with cross-bar **23.** The ends of bars **128** and **128***a* may be welded or otherwise secured to cross-bar **23** and to the cross-bar substituted for base **109.**

It is believed to be apparent from the foregoing that the apparatus provides improvements over the apparatus described in the aforesaid patent which accomplish the objects of the invention. The swaged fitting on the hose end is prevented by the mandrel from obstructing the hose passageway. The mandrel is inserted and removed from the swaged fitting assembly as the apparatus passes through the swaging cycle.

Although the invention has been described in detail for the purpose of illustration, it is to be understood that such detail is solely for that purpose and that variations can be made therein by those skilled in the art without departing from the spirit and scope of the invention except as it may be limited by the claims.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. In an apparatus for swaging a fitting on the end of a hose, said fitting having a coupling end and an end having substantially concentric walls for insertion of a hose end therebetween, said apparatus comprising a die having a cavity therein, a pair of spaced rods disposed in a plane substantially parallel to the axis of the die cavity, means for supporting the die bridging a pair of ends of the rods and fixed thereto, a first cross-bar bridging the opposite ends of the rods and fixed thereto, a cylindrical housing having first and second end walls enclosing a cylindrical chamber, an opening through each end wall, a first piston rod fixed at one end to the said cross-bar and slidably disposed through the opening in the first end wall in fluid impervious relationships therewith, a piston carried by the said piston rod in the chamber, a second piston rod slidably disposed through the openings in said second end in fluid impervious relationship therewith, and carrying a second piston in said chamber, bracket means slidably mounting said housing on said rods, a second cross-bar slidably mounted on said rods and fixed to said piston outside said chamber, and means for introducing fluid under pressure into said chamber to actuate said second piston and said cylindrical housing longitudinally with respect to said first piston, an improved means for supporting and swaging said fitting on said hose end comprising a first plate member disposed on one side of said second cross-bar and a second plate member disposed on the opposite side of the cross-bar and lying in a plane substantially parallel to the first plate and to the longitudinal axis of the second cross-bar, means for slidably securing the plates to the cross-bar and for securing the plates together against relative movement, a pusher element fixed to said second plate having a cavity therein for enclosing the coupling end of the fitting, a cavity in said cross-bar having a common longitudinal axis with the cavity in the second cross-bar, a bore through the second plate and a bore through the pusher element having a longitudinal axis aligned with those of the cavities in the cross-bar and pusher element and communicating therewith, and a mandrel having a head position secured in the said cavity of the cross-bar and an elongated body which extends through said bores and the cavity in the pusher element and adapted to extend into the fitting and support the said concentric walls while the fitting is pressed in the die cavity by the pusher element.

2. The apparatus of claim **1** wherein said die is divided longitudinally into segments which join to form a die cavity when inserted in the die supporting member and said segments are carried by means fixed to said bracket means.

3. The apparatus of claim **1** wherein said plates are bolted together in spaced relationship, said head portion of the mandrel has an annular groove and a pair of pins disposed through openings in the cross-bar and through arcuate portions of the groove secure the mandrel against longitudinal movement relative to the second cross-bar.

4. The apparatus of claim **3** wherein a counterbore communicates with the cavity in the second cross-bar and the second cross-bar is bolted to an end of the second piston rod.

5. In an apparatus for swaging a fitting on an end of a hose comprising means for pressing a fitting and hose end assembly into a swaging die, the improvement which comprises a mandrel carried by said means and adapted to support the inner wall of the hose as the fitting is pressed thereagainst in the swaging die.

6. In an apparatus for swaging a fitting on an end of a hose, said apparatus comprising a swaging die and means for pressing a fitting and hose end assembly in the die, said means comprising a pusher element having a cavity therein which is adapted to hold a said assembly and a mandrel disposed longitudinally through the cavity and adapted to be inserted in said hose, and means for moving said pusher element towards said die and press the assembly therein about the mandrel.

7. A swaging apparatus comprising a die, means for holding a fitting and hose assembly, means for inserting a mandrel through the base of the fitting, means for pressing the assembly in a die to swage the fitting on the hose, means for removing the pressed assembly and mandrel as a unit from the die and means for removing the mandrel from the swaged assembly.

8. The apparatus of claim **7** wherein the means for removing the mandrel from the swaged assembly comprises a housing enclosing a cylinder, a piston in the cylinder, means for hydraulically actuating the piston, a piston rod fixed to the piston, and a mandrel fixed to the piston rod.

9. In an apparatus for swaging a fitting on the end of a hose, said fitting having a coupling end and an end adapted for insertion of a hose end therein, said apparatus comprising a die having a cavity therein, a pair of spaced rods disposed in a plane substantially parallel to the axis of the die cavity, means for supporting the die

bridging a pair of ends of the rods and fixed thereto, a first cross-bar bridging the opposite ends of the rods and fixed thereto, a first cylindrical housing having first and second end walls enclosing a cylindrical chamber, an opening through each end wall, a first piston rod fixed at one end to the said cross-bar and slidably disposed through the opening in the first end wall in fluid impervious relationships therewith, a piston carried by the said piston rod in the chamber, a second piston rod slidably disposed through the openings in said second end in fluid impervious relationship therewith, and carrying a second piston in said chamber, bracket means slidably mounting said housing on said rods, a second crossbar slidably mounted on said rods and fixed to said piston outside said chamber, and means for introducing fluid under pressure into said chamber to actuate said second piston and said cylindrical housing longitudinally with respect to said first piston, an improved means for supporting and swaging said fitting on said hose end comprising a third cross-bar spaced longitudinally towards the die from the second crossbar, means for securing the second and third cross-bars for longitudinal movement together, a pusher element fixed to the third cross-bar and facing said die, said pusher element having a cavity for holding a fitting therein, a bore through the third cross-bar, a bore in the pusher element aligned with and communicating with the bore through the cross-bar, a counterbore in the pusher having axis common with the axis of the bore in the pusher element and communicating therewith, a second cylindrical housing carried by the second cross-bar and having a cylindrical chamber therein, a piston disposed for longitudinal movement in the chamber and carrying a third piston which extends outside of the second cylindrical housing, a mandrel carried by said third piston and projecting through the bore in the third cross-bar, the bore in the pusher element and into the counterbore of the pusher element, and means for moving the said third piston longitudinally.

10. The apparatus of claim **9** wherein the third piston rod carries a mandrel holder and the mandrel is removably secured in the said mandrel holder.

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