United States Patent [19]

Pogonowski

[11] **3,877,282**

[45] **Apr. 15, 1975**

[54] **SWAGING TOOL FOR JOINING TWO TELESCOPIC PIPE ENDS**

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[73] Assignee: **Texaco Inc.,** New York, N.Y.

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[21] Appl. No.: **401,776**

Related U.S. Application Data

[62] Division of Ser. No. 247,584, April 26, 1972, Pat. No. 3,795,035.

[52] **U.S. Cl.** **72/393;** 72/392

[51] **Int. Cl.** **B21d 41/02**

[58] **Field of Search** ..... 72/393, 392, 370; 269/48.1; 29/200 B, 208 D, 517, 523, 200 P; 61/46.5

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Primary Examiner—C. W. Lanham
Assistant Examiner—James R. Duzan
Attorney, Agent, or Firm—T. H. Whaley; C. G. Ries

[57] **ABSTRACT**

At least two methods for swaging one vertical smaller tubular member internally of a larger tubular member are disclosed. One device for practicing the method comprises a cylindrical swage block for loosely fitting in the large tubular member and resting on the upper edge of the inner smaller tubular member. A plurality (preferably six) pistons and cylinders are suspended from the swage block a precise distance below the upper edge and actuatable radially from the longitudinal axis of the smaller tubular member for deforming the upper edge portion thereof against the larger tubular member for providing more working space internally of the tubular members. A modification comprises a plurality as seven axially spaced apart, parallel layers of swaging pistons and cylinders suspended from the swage block.

Other new devices utilizing the multiple piston and cylinder swage are a mechanisms for cold-work connecting two telescopic pipe ends together, and a mechanism for making a new pile with anchor knobs for increased load carrying capacity and pull-out resistance.

3 Claims, 13 Drawing Figures

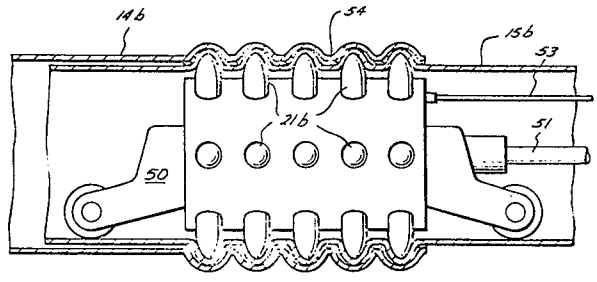


Fig. 1

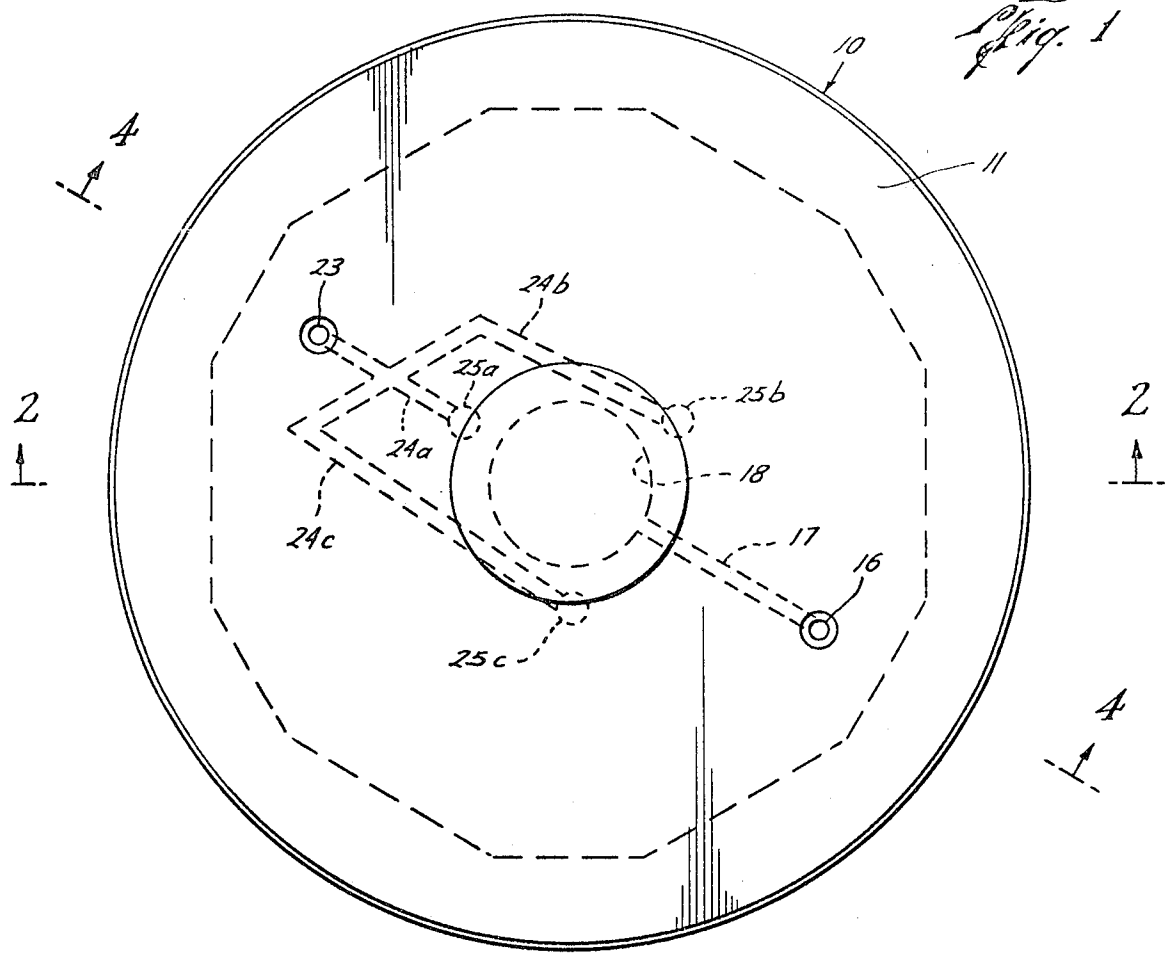

10
11
4
4
2
2
23
24b
25a
25b
24a
18
24c
17
16
25c

Fig. 2

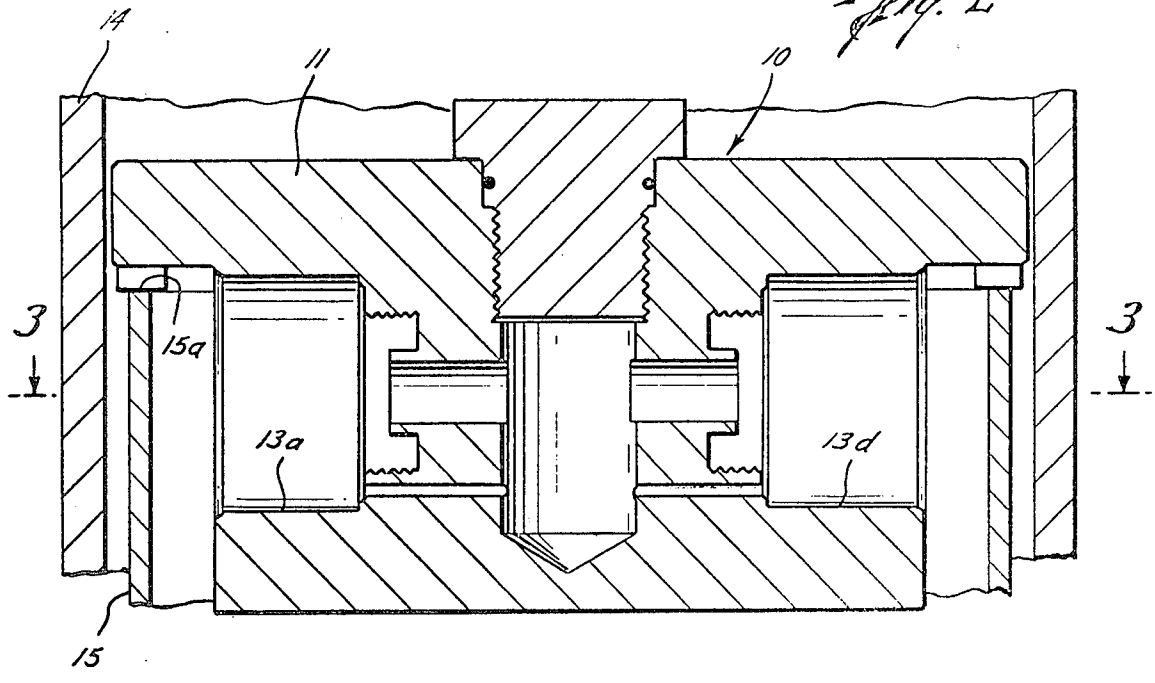

14
11
10
3
3
15a
13a
13d
15

Fig. 3

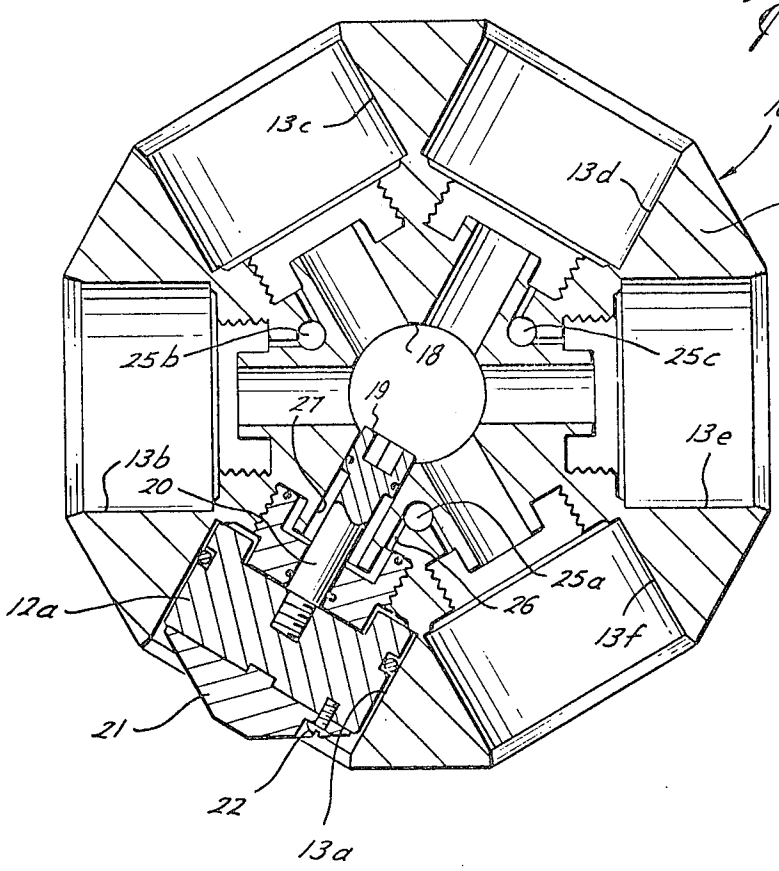
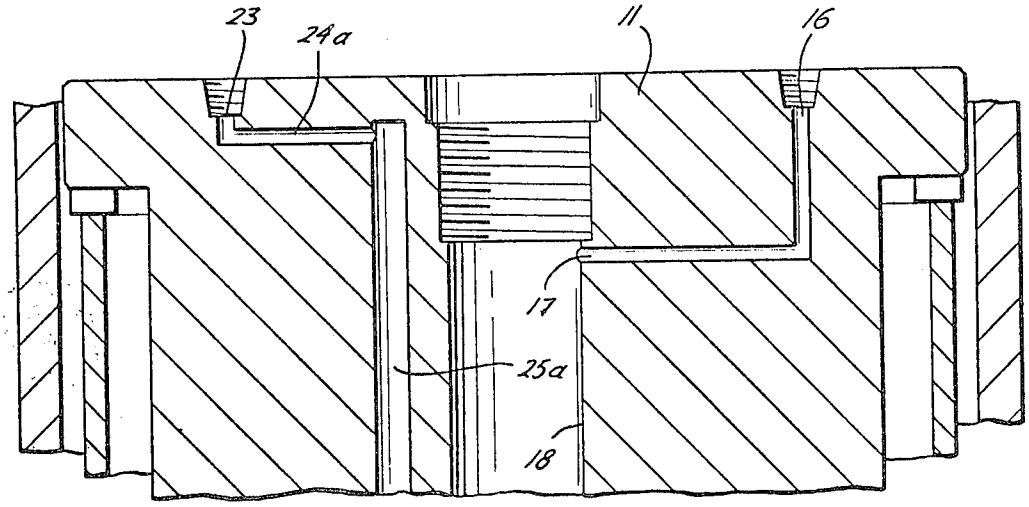

13c
10
13d
11
25b
18
25c
27
19
13e
13b
20
25a
12a
26
13f
21
22
13a

Fig. 4


23
24a
11
16
17
25a
18

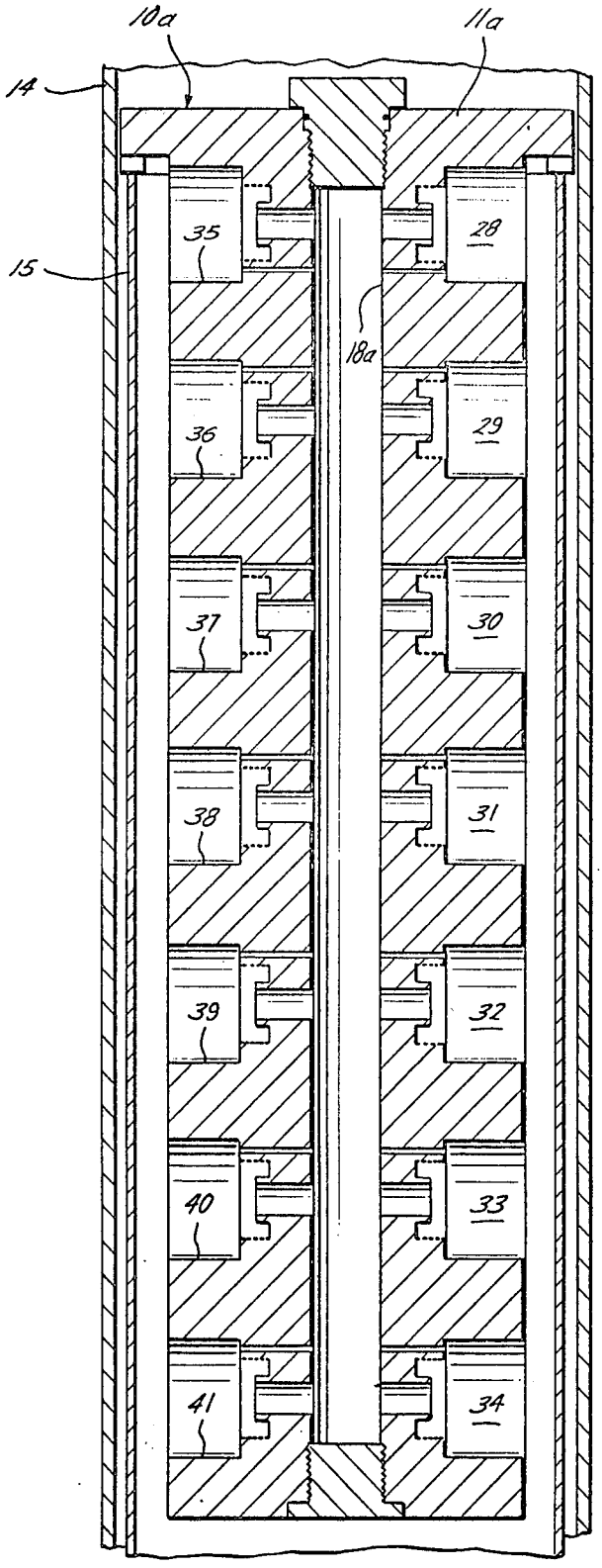


Fig. 5

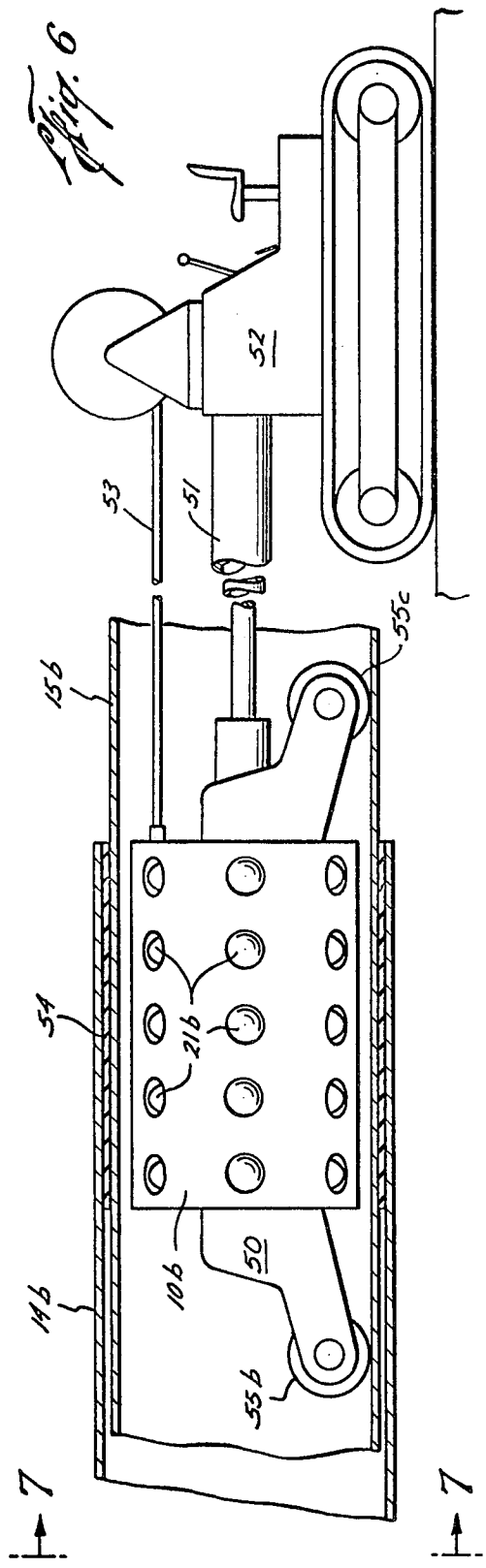


Fig. 6

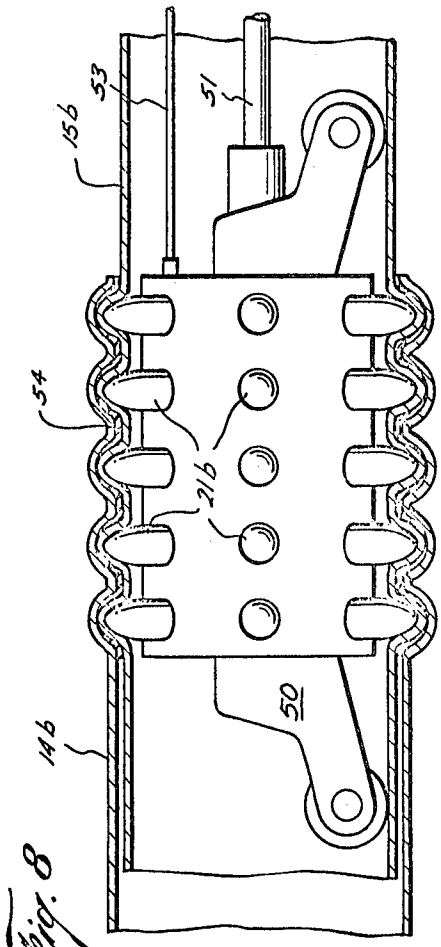


Fig. 8

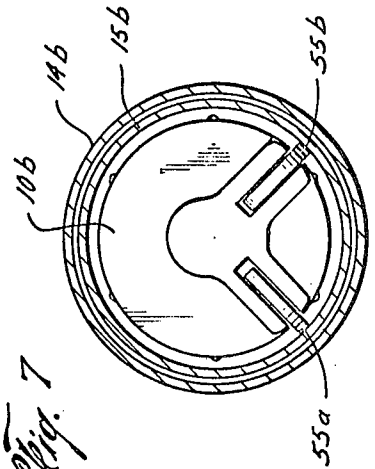


Fig. 7

Fig. 12

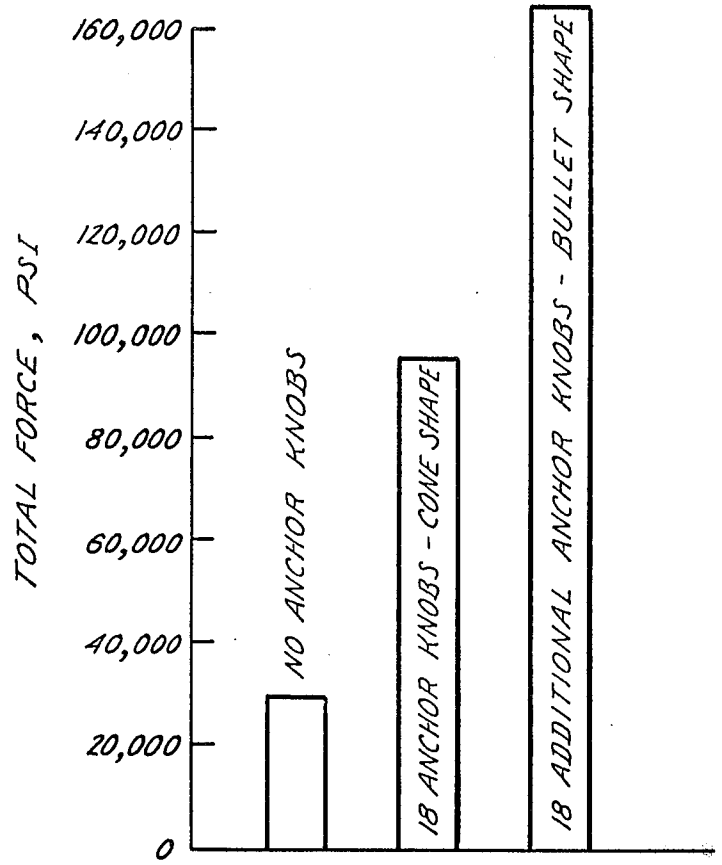

TOTAL FORCE, PSI
160,000
140,000
120,000
100,000
80,000
60,000
40,000
20,000
0
NO ANCHOR KNOBS
18 ANCHOR KNOBS - CONE SHAPE
18 ADDITIONAL ANCHOR KNOBS - BULLET SHAPE

Fig. 8A

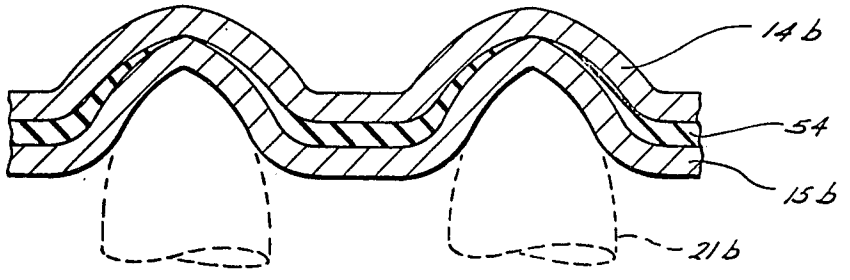

14b
54
15b
21b

Fig. 9

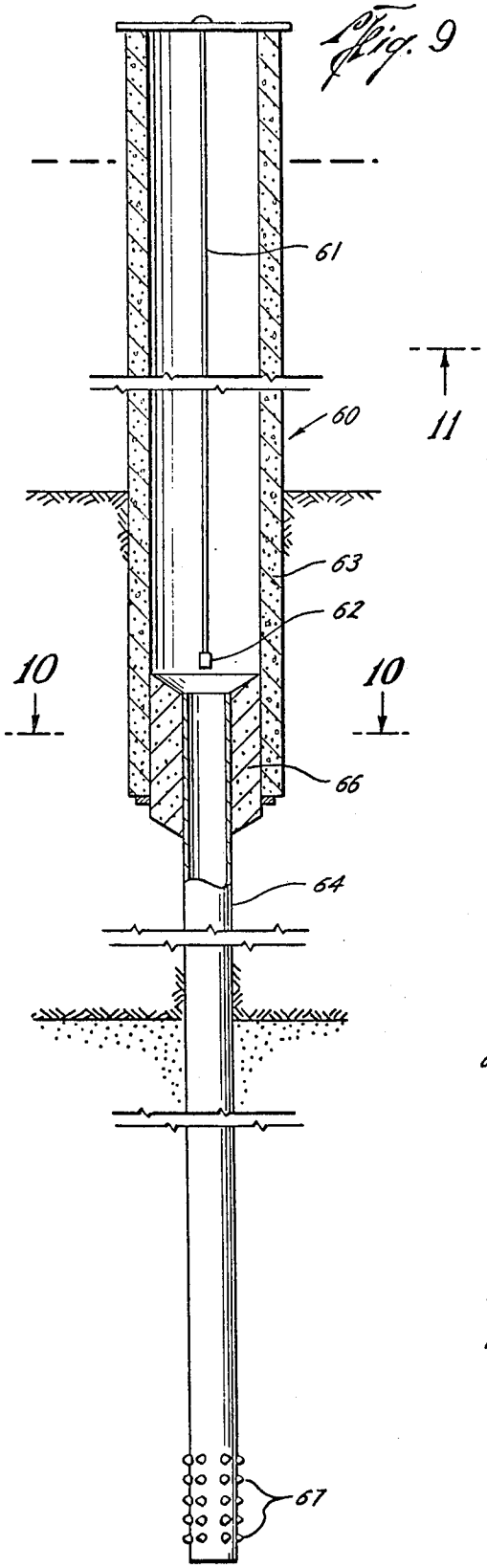
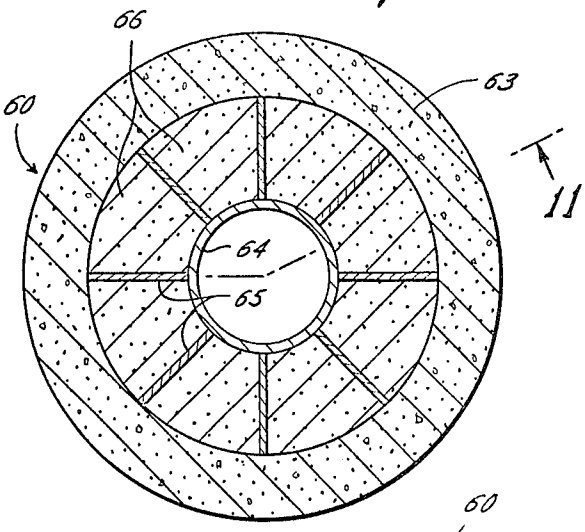


Fig. 10



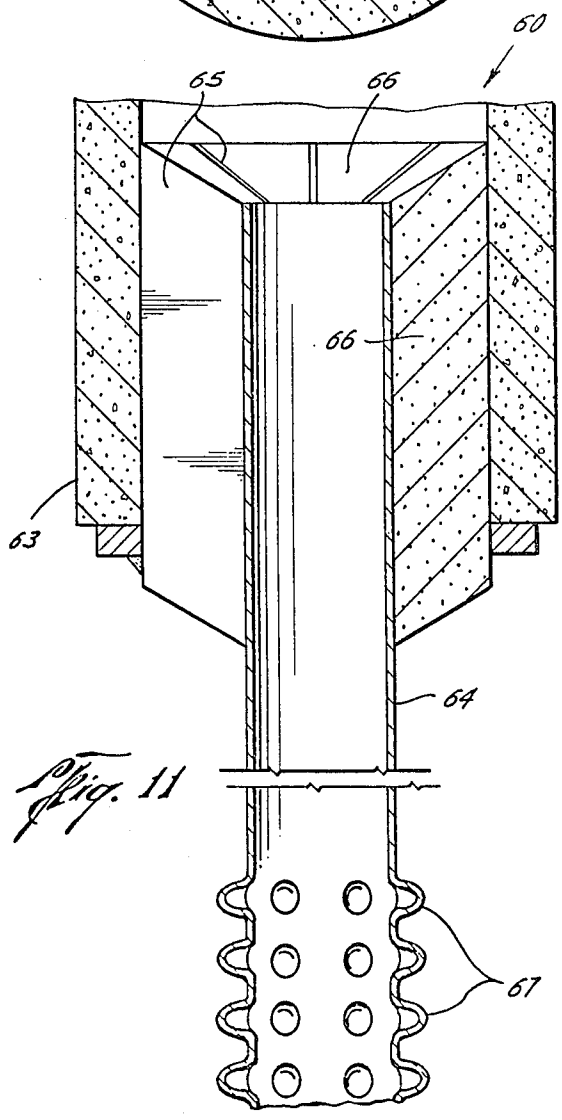


Fig. 11

SWAGING TOOL FOR JOINING TWO TELESCOPIC PIPE ENDS

This is a division, of application Ser. No. 247,584, filed Apr. 26, 1972, now U.S. Pat. No. 3,795,035.

BACKGROUND OF THE INVENTION

In the swage joining of two oil well casings by hydraulic expanding devices, a permanent deformation often results in two overlapping casings, depending on the type of joint formed. Where six hydraulic swaging rams are utilized in joining a smaller upper end of one casing to a larger bottom end of an upper casing, as by dimpling as illustrated in my U.S. Pat. No. 3,555,831, the free upper edge of the smaller inner casing end often distorts into a hexagonal shape with six straight sides spaced from the wall of the larger upper casing. These straight sides accordingly leave less working space in the casings for drill bits, drill stems, etc., for example.

OBJECTS OF THE INVENTION

Accordingly, it is a primary object of this invention to provide at least one method for eliminating protuberances internally of tubular joints for producing more operating space therein.

Another primary object of this invention is to provide at least two embodiments for carrying out or practicing the disclosed method.

Another object of this invention is to provide a device for swaging or deforming one tubular member inside of another which is easy to operate, is of simple configuration, is economical to build and assemble, and is of greater efficiency for providing more working space internally of the tubular members.

Another object of this invention is to provide a method for joining two horizontal telescopic pipe ends together.

A further object of this invention is to provide a swaging mechanism for carrying out the method of joining two horizontal pipes together.

A still further object of this invention is to provide an insert for water immersed pipes for preventing cracking thereof.

Another object of this invention is to provide a method and mechanism for increasing the load capacity and pull-out resistance of piling driven in the ground.

Other objects and various advantages of the disclosed method and devices for swaging one tubular member inside another tubular member will be apparent from the following detailed description, together with accompanying drawings, submitted for purposes of illustration only and not intended to define the scope of the invention, reference being had for that purpose to the subjoined claims.

BRIEF DESCRIPTION OF THE DRAWINGS

The drawings diagrammatically illustrate by way of example, not by way of limitation, two forms or mechanisms for carrying out the method of the invention wherein like reference numerals have been employed to indicate similar parts in the several views in which:

FIG. **1** is a schematic plan view of one embodiment of the new tubular swaging device;

FIG. **2** is a section at **2—2** on FIG. **1**;

FIG. **3** is a section at **3—3** on FIG. **2**;

FIG. **4** is a schematic section at **4—4** on FIG. **1**;

FIG. **5** is a vertical sectional view of another modification of the embodiment of FIG. **1**;

FIG. **6** is a schematic sectional view of another modified swaging device for joining two tubes gogether illustrating the deforming tips in retracted position, and;

FIG. **7** is a section at **7—7** on FIG. **6**,

FIG. **8** is a section of the truck and swage of FIG. **6** with the deforming tips illustrated in extended position for swaging the two tubes together;

FIG. **8***a* is a detailed sectional view of the depressions of FIG. **8**;

FIG. **9** is a schematic sectional view of a composite steel-concrete pile immersed in freezing water with an insert therein;

FIG. **10** is a section at **10—10** on FIG. **9**;

FIG. **11** is a section at **11—11** on FIG. **10**; and

FIG. **12** is a graph illustrating the increased load carrying capacity and pull-out resistance added to the pile by the anchor knobs.

DESCRIPTION OF THE INVENTION

The invention disclosed herein, the scope of which being defined in the appended claims, is not limited in its application to the details of construction and arrangement of parts shown and described for carrying out the disclosed method, since the invention is capable of other embodiments for carrying out other methods and of being practiced or carried out in various other ways. Also, it is to be understood that the phraseology or terminology employed herein is for the purpose of description and not of limitation. Further, many modifications and variations of the invention as hereinbefore set forth will occur to those skilled in the art. Therefore, all such modifications and variations which are within the spirit and scope of the invention herein are included and only such limitations should be imposed as are indicated in the appended claims.

DESCRIPTION OF THE METHODS

This invention comprises a few methods for eliminating the shelf formed on the inner surface of a well casing larger end by a non-round upper end portion of a well casing smaller end secured therein comprising the steps of,

1. swaging the non-round portions of the upper edge of the inner well casing outwardly firmly against the larger well casing inner surface, and

2. simultaneously swaging the non-round portions spaced below the upper edge of the smaller well casing firmly against the larger well casing inner surface.

A second method comprises,

1. positioning a plurality of pistons and cylinders in a horizontal plane and a precise distance below the upper edge of the smaller well casing, and

2. deforming the upper edge of the well casing smaller end firmly against the well casing larger end surface by simultaneous actuation of at least two pistons and cylinders 180° directly opposite from each other for providing more operating room internally of the well casings.

Another method for deforming a smaller end of a first pipe internally of a larger end of a second pipe comprises,

1. positioning a plurality of pistons and cylinders in several planes, each plane being normal to the longitudinal axis of the first pipe at a precise distance from the first pipe smaller end, and

2. deforming the first pipe smaller end against the second pipe larger end by actuation of all pistons and cylinders outwardly in a radial direction opposite from each other for providing more operating room internally of the pipes.

DESCRIPTION OF THE DEFORMING DEVICES

Two embodiments are disclosed in FIGS. **1 – 4** and FIG. **5**, respectively, for practicing or carrying out the above methods of the invention.

FIG. **1**, a plan view of a swage **10**, illustrates hydraulic oil lines for supplying pressure fluid to swaging actuators disclosed hereinafter.

FIG. **2**, a schematic sectional view taken at **2—2** on FIG. **1** of one of the swaging devices **10** for carrying out at least one of the methods of the invention comprises a cylindrical swage block **11** supporting a deforming means **12**, such as a plurality of pistons and cylinders, pistons **12***a*, **12***d* and their respective cylinders **13***a*, **13***d* being illustrated in this figure.

As illustrated in FIG. **2**, the cylindrical swage block **11** is small enough to loosely fit internally of the enlarged lower end of a tube, as a well casing **14**, and large enough to rest on the upper deformed edge **15***a* of the upper end of a second well casing **15**. While the latter casing is secured to the upper well casing **14** a little below the illustrated section of FIG. **2**, the upper deformed edge **15***a* has straight portions which extend inwardly from the inner wall or are spaced from the inner wall of the casing **14** to accordingly form a shelf on which all items being lowered in the well tend to hang up on.

FIG. **3**, a sectional view at **3—3** on FIG. **2**, with parts in section illustrates a swage comprising six pistons and cylinders for swedging or deforming into the cylindrical casing wall **14**, FIG. **2**, any section of the cylindrical casing wall **15** spaced from the wall of casing **14**, as straight sections particularly. In FIG. **3**, cylinders **13***b* to **13***f* are illustrated with their pistons **12***b* to **12***f* removed for clarity of disclosure, as well as cylinders **13***a* and **13***d* on FIG. **2**. These straight sections occur when an inner casing or tube is attached to an outer casing or tube by riveting or swaging as by the forming of dimples through the walls of both tubes, as shown in my above-mentioned U.S. Pat. No. 3,555,831. When an inner tube or casing is thus secured, the result is sometimes inward flaring or warping of the upper free edge of the inner casing. Thus when equally spaced dimples are utilized, the upper edge **15***a* of casing **15** forms a rough hexagon in plan view and accordingly six pistons and cylinders are required to reshape the hexagon back into its original cylindrical shape. If eight dimples are utilized as illustrated in inventor's above identified patent, to secure an inner casing upper end to an outer casing lower end, then an octagon shaped free upper edge is formed immediately above the dimples on the inner casing upper end.

FIG. **4**, a sectional view at **4—4** on FIG. **1**, illustrates more details of the supply and return hydraulic ducts for the pistons and cylinders shown in FIG. **3**. Piston and cylinder, **12***a*, **13***a*, respectively, are typical. Actuating fluid under high pressure from a high pressure source (not shown) on top of the cylinder block **11**, FIGS. **1** and **4**, is supplied through passages **16** and **17** to a central reservoir **18**. The high pressure fluid from central reservoir **18** passes to cylinder **13***a*, FIG. **3**, for example, and behind piston **12***a* through ducts (not shown) and also directly to the inner end **19** of piston rod **20** for actuating piston **12***a* radially outwardly.

Piston **12***a*, FIG. **3**, has a case-hardened deforming or coldworking tip **21** secured thereto with screws **22** for swaging or deforming inner casing **15**, FIG. **2**, against casing **14**. End **19**, FIG. **3**, of the piston rod **20** is enlarged to form a return stroke piston. The return stroke of piston **12***a* is accomplished by depressurizing conduits **16** and **17**, FIG. **4**, and pressurizing conduits **23**, **24***a*, and **25***a* leading to conduit **26**, FIG. **3**, and to small cylinder **17** to actuate return stroke piston **19** radially inwardly to the position illustrated. Three vertical ducts **25***a*, **25***b*, and **25***c* are utilized, each duct supplying piston-return-movement-pressure fluid for a pair of pistons. With inward return movement of piston **19**, reverse flow occurs in reservoir **18**, FIG. **4**, and conduits **17** and **16**. Pistons **12***b* - **12***f*, FIG. **3**, are actuated similarly and simultaneously with piston **12***a* in their respective cylinders to deform the casing edge **15***a*, FIG. **2**, against outer casing **14**.

MODIFICATION I

FIG. **5** illustrates schematically, in a vertical section, another embodiment for practicing the aforementioned method of the invention. This swage **10***a* comprises a swage block **11***a* supporting seven rows of pistons **28 – 34**, each row being similar to the row of the first modification of FIG. **3**, with six equally spaced pistons in each row operable in their respective seven rows of cylinders **28 – 41**. Similarly, reservoir **18***a* supplies high pressure fluid to the pistons for actuating all pistons for deforming inner casing **15** against outer casing **14**. Likewise, this swage includes return stroke pistons and their accompanying pressure conduits similar to those of the first embodiment for retracting the pistons within the swage after the swaging or deforming operation.

The swage of each of the above disclosed embodiments have either a self-contained unit mounted thereon including a pump and reservoir of hydraulic fluid with control cables running up the swage support wire, or they have long pressure hoses extending up the swage support wire to the pumps and reservoirs.

MODIFICATION II

A method is disclosed for sealing together two telescopic pipe ends comprising the steps of,

1. positioning a sheet of elastic material or cementing the material which requires an undisturbed curing period, i.e., 2 hours, between the two telescopic pipe ends,

2. deforming a circular first row of dimples through both pipes in a plane normal to the pipe longitudinal axis, and

3. deforming a plurality of rows of dimples simultaneously and parallel to the first row of dimples for forming an efficient, quick, and high strength pipe joint.

FIGS. **6**, **7**, and **8** disclose a swage cold working pipe connector for practicing one of the methods described above for permanently connecting or sealing two telescopic horizontal pipes together, as for cargo pipe lines, particularly, in addition to air cargo lines (air in the pipe being the vehicle), oil lines, gas lines, and water lines.

FIG. **6** is a schematic view, with parts in section, of a swaging mechanism **10***b* for joining together two horizontal external and internal pipe ends, **14***b* and **15***b*, re-

spectively. Here, the truck **50** supporting the swage **10*b*** centrally of the pipes is rolled internally of the pipes by expanding of telescopic arm **51** from a hydraulic actuator as tractor **52** having hydraulic fluid hose **53.**

FIG. **7,** a sectional view at 7—7 on FIG. **6,** illustrates centering wheels **55*a*, 55*b*,** and **55*c*** for supporting truck **50** for longitudinal movement internally of the pipes.

FIG. **8,** a sectional view at **8**—**8** on FIG. **7,** illustrates the case-hardened tips **21*b*** of the pistons (not shown) of the swage **10*b*** being extended for deforming and dimpling the pipe ends **14*a*** and **15*b***. The actuating mechanism comprising the pistons for operating in cylinders of this modified swage **10*b*** are very similar to those illustrated in FIG. **3** of swage **10.** All dimples or deformations are swaged beyond the yield point to prevent springback.

FIG. **8A** illustrates the flow of the elastic material between the two telescopic pipes in the area of the dimples through the walls of the two pipes.

FIG. **6** illustrates the sealing swage **10*b*** for sealing the two horizontal (or vertical like well casing) pipes together comprising a swage block **11*b*** having five parallel rows of six pistons and cylinders each for forming five rows of dimples or depressions in the two joining ends of the horizontal cargo pipes. While the outer and inner pipes, **14*b*** and **15*b***, respectively, are shown as alternating slightly smaller and larger diameter pipes, they may all be formed alike with one enlarged end each to slide over the smaller end, if so required and desired for providing constant inside diameter for laminar flow. An annular lining **54** of rubber-like material, such as but not limited to silicon rubber having a working temperature resistance range of −130°F. to +500°F. circumscribes the inner end **15*b*** prior to swaging or cold working in the dimples.

This swage **10*b*** is used to form rows of continuous dimples almost touching each other. To accomplish this extraordinary seal, the swage is actuated by first moving outwardly all pistons from their respective hydraulic cylinders to form with their case-hardened tips parallel rows of six evenly spaced deep dimples 60° apart around the internal peripheral pipe surface. The pistons are retracted, the telescopic rod **51** and when using a sleeve gasket or lining **54,** the swedge **10*b*** are rotated 12° about the longitudinal axis of the rod, and the pistons are actuated outwardly again to form a second set of dimples adjacent to the first. This process is repeated by the swage four times after the initial actuation to provide another set of six dimples spaced radially by 12°. This radial spacing may be decreased to 6° with nine additional actuations by the swage, the greater the pipe diameter, the greater the number of swage operations is preferred.

Quick field connections may be made on an oil or gas line with the above swage deformations for providing a very good fluid-tight seal or joint without time taking, slow, expensive welding.

Use of the insulating fluid-tight gasket **54** provides a pipe line cathodic corrosive protection system. This cold working process generates less tendency and susceptibility of the pile to galvantic corrosion than does the welding process, as the latter process results in uninterrupted electrical conductivity throughout the length of the pipe line, thereby enhancing the corrosion damage and increasing the cost of preventative measures. Accordingly a more economical and faster pipe connection results, particularly in areas inaccessible to welding.

Particularly, this cold-working pipe connection provides quick field assembly in a hostile environment. Further, a constant internal diameter pipeline may be constructed without field welding using prefabrication, prepositioned seal, and cold working by the hydraulic swage.

MODIFICATION III

FIG. **9,** a schematic sectional view of a water immersed composite concrete and steel pile **60** with the new insert **61** protruding therein deeper than the freezing depth of the water around and inside the pile for preventing cracking due to the water freezing internally of the pile. Insert **61** is a long flexible, soft, and resilient element. It is formed of a soft plastic material as silicon foam rubber, for example. While the cylindrical shape filled with air is preferred, it may also comprise instead, a multiplicity of interconnected spheres, if so desired and required.

Insert **61** is weighted at the bottom with a suitable inert weight **62,** such as but not limited to the resistant mineral barite, it also may be concrete. Thus the insert would be squeezed and contracted as the water freezes internally of the pile and cracking thereof is obviated for the full length of formation of the resultant ice block in the pile.

MODIFICATION IV

A new method for increasing the load carrying capacity and pull-out resistance of a hollow pile comprises the steps of,

1. driving a pile having a malleable steel lower end portion into the ground to the desired and required depth, and

2. forming protrusions or anchor bumps outwardly on the pile external surface.

A method step intermediate the above steps (1) and (2) may include:

1*a*. evacuating any earth inside the pile.

Also, in greater detail, the second step may comprise swaging recesses outwardly from internally of the pile to form the anchor bumps on the pile external surface.

FIGS. **10** and **11** disclose at least one new pile for carrying out or practicing the above method. This pile **60,** which has greatly increased load capacity and pull-out resistance, is disclosed in FIG. **10,** a section at **10**—**10** on FIG. **9** and in FIG. **11,** a section at **11**—**11** on FIG. **10.**

This composite pile **60** comprises a 54 inch outside diameter concrete pipe portion **63** joined to a 3 foot outside diameter metal pipe portion **64,** the latter pipe portion having metal gussets **65** joined to the former pipe portion with grout **66.**

The lower end of the metal pipe portion **64** has deformations or anchor bumps **67** formed therein by a swage like **10*b***, FIGS. **6 8,** to protrude outwardly a distance of at least the thickness of the pile wall after the pile is driven in the marsh, tundra, lake, or ocean bottom, for example.

These anchor bumps **67** greatly increase the load carrying capacity and pull-out resistance of the pile **60** as evidenced by the graph of FIG. **12** from inventor's report "Test of Skin Friction With and Without Swaging — Comparison of Smooth Pipe vs. Anchor Pattern by Hydraulic Swage". Here the test specimen had a 7 inch

ID, 7⅞ inch OD, and 9 inch length imbedded to a depth of 7 inches in a container of lead having an 11 inch ID, 11½ inch OD, and a 10 inch height.

Accordingly, from FIG. **12**, with a total force required to pull out the smooth test pile being less than 30,000 pounds and a total force required to pull out the test pile with **36** indentations being greater than 160,000 pounds, the increase in pull-out resistance was over **5** times greater with the disclosed anchor bumps.

Thus an efficient, high strength, elongated pile is disclosed having increased load carrying capacity and pull-out resistance which is especially critical in sandy soils.

Accordingly, it will be seen that the disclosed methods and swages for practicing the methods for producing more working space internally of two interconnected tubes for connecting two telescopic pipes together, and for increasing the load carrying capability and pull-out resistance of piles operate in a manner which meets each of the objects set forth hereinbefore by the use of various combinations of the disclosed multiple piston and cylinder swage.

While a few methods of the invention and two swages for carrying out the methods have been disclosed, it will be evident that various other methods and modifications are possible in the arrangement and construction of the disclosed methods and swages without departing from the scope of the invention and it is accordingly desired to comprehend within the purview of this invention such modifications as may be considered to fall within the scope of the appended claims.

I claim:

1. A swage for sealing together two telescopic pipe ends having a longitudinal axis comprising,

a. roller supported swage block means in the telescopic pipe ends,

b. a plurality of rows of pistons operable in cylinders, each row having a plurality of pistons mounted for movement in a radial direction from said pipe longitudinal axis,

c. telescopic arm means for moving said roller supported swage block means longitudinally in the pipes and rotatably about the pipe longitudinal axis,

d. means for actuating said pistons in said cylinders for forming depressions in the two pipes, and

e. said piston actuating means being responsive to said telescopic arm means for forming parallel rows of depressions through the pipe ends around the internal periphery of the pipes to seal the pipe ends together.

2. A swage as recited in claim **1** wherein,

a. an annulus of elastic material comprises an axially elongated annular solid sheet, and

b. said axially elongated annular solid sheet being positioned between the telescopic pipe ends for being deformed with the telescopic pipe ends over a length of at least over four axial rows of pipe depressions.

3. A swage for sealing together two horizontal telescopic pipe ends having a longitudinal axis comprising,

a. a hexagonal swage block centrally supported on rollers internally of the two pipes,

b. a plurality of rows of pistons operable in cylinders, a piston mounted in each side of the hexagonal swage block for movement in a radial direction from said longitudinal axis of the pipes,

c. a tractor having telescopic arm means for positioning said roller supported hexagonal swage block centrally in the pipes,

d. said telescopic arm means being rotatable for positioning said roller supported hexagonal swage block at various positions around the internal periphery of the pipes, and

e. hydraulic means for actuating said pistons in said cylinders for forming parallel rows of depressions through the pipe ends around the internal periphery of the pipes to seal the ends together.

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