United States Patent [19]

Fischer

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[54] **UNIVERSALLY JOINTED CHILLING TOOL**

[75] Inventor: **Christopher L. Fischer,** Sunnyvale, Calif.

[73] Assignee: **Raychem Corporation,** Menlo Park, Calif.

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[52] **U.S. Cl.** ..... **294/19 R,** 294/100, 294/115

[51] **Int. Cl.** **A47f 13/06**

[58] **Field of Search** ..... 294/1 R, 19 R, 20, 21, 22, 294/100, 115, 116

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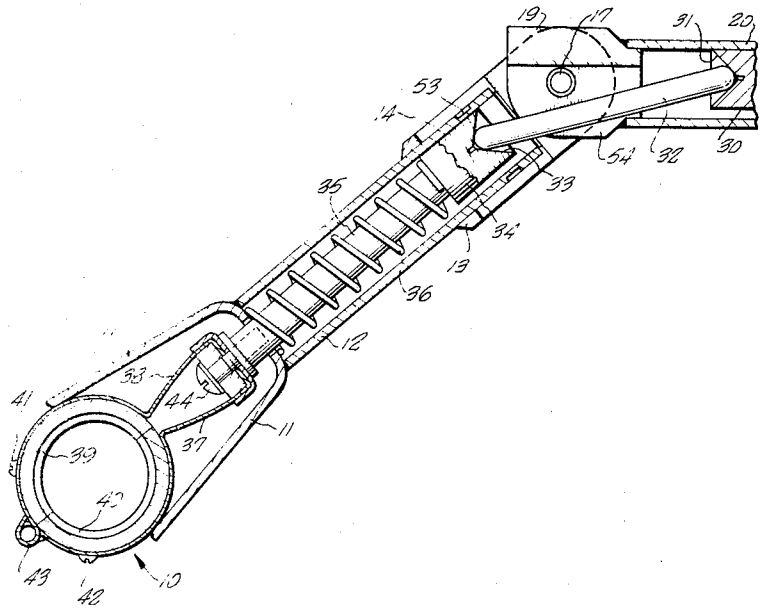
Primary Examiner—Evon C. Blunk
Assistant Examiner—Johnny D. Cherry
Attorney, Agent, or Firm—Lyon & Lyon

[57] **ABSTRACT**

A hand tool having a plurality of part-holding jaws which are operated from a remote handle through a shaft having a universal joint therein. The tool is capable of being used to hold a part in its jaws while that part is immersed in a very low temperature fluid such as liquid nitrogen. After the part has been thus chilled, the tool is capable of physically holding the chilled part while the part is moved to a different environment while maintaining the part in a chilled condition. The universal joint permits free rotational movement of the jaws with respect to the handle and also permits angular movement in the shaft of the tool. Tightening means are provided which permit holding the angular and rotational position of the jaws in a fixed position with respect to the handle.

9 Claims, 8 Drawing Figures



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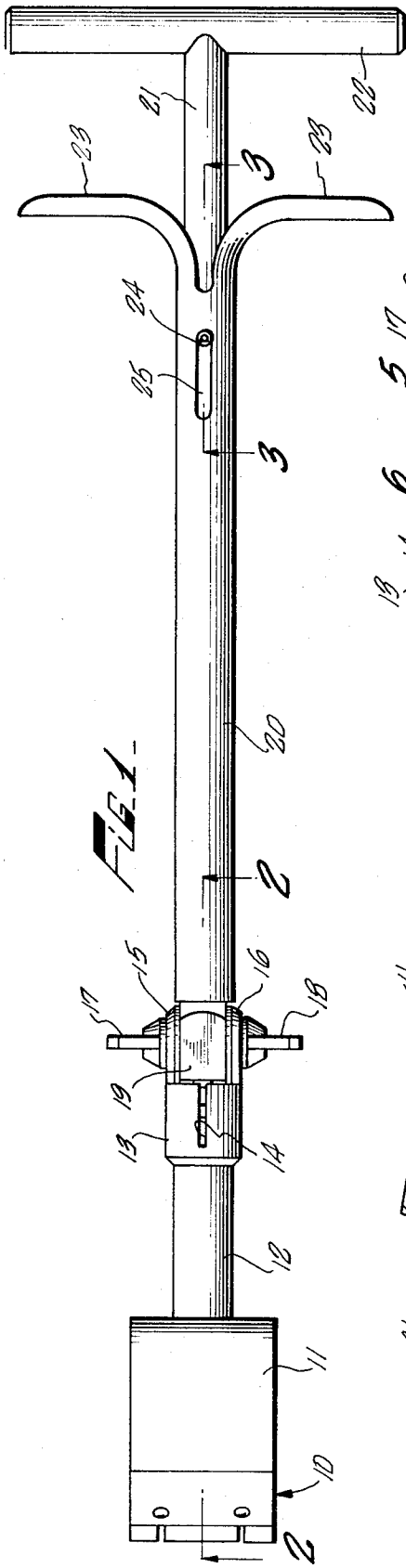

FIG. 1

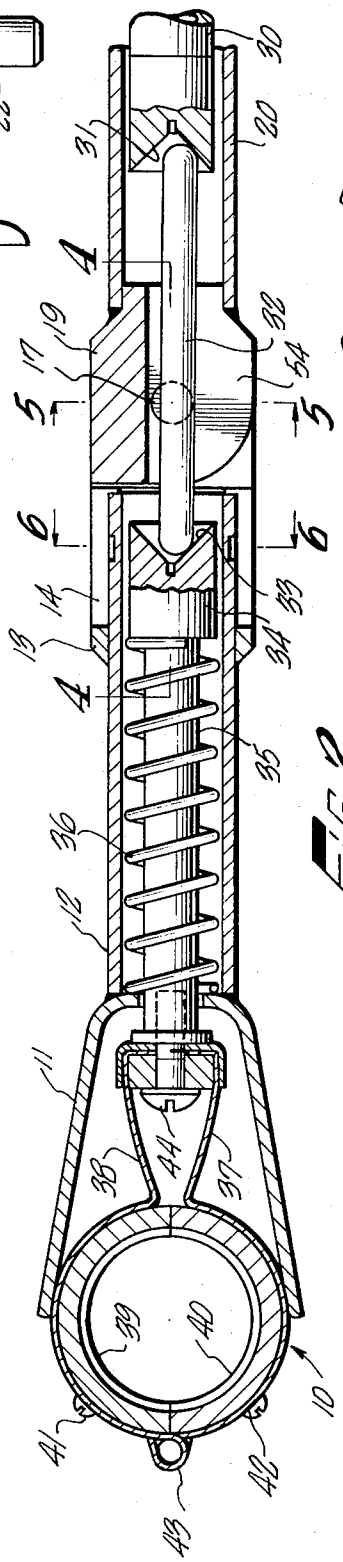

FIG. 2

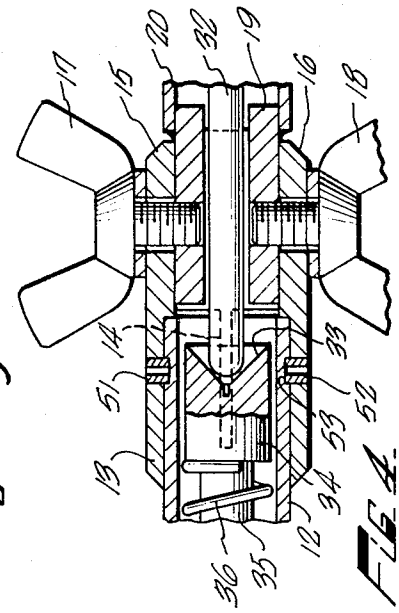

FIG. 4

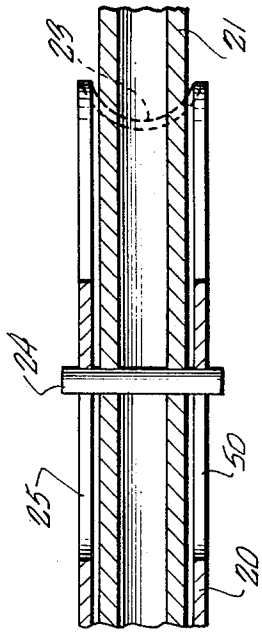

FIG. 3

INVENTOR
CHRISTOPHER L. FISCHER

BY

Lyon Lyon
ATTORNEYS.

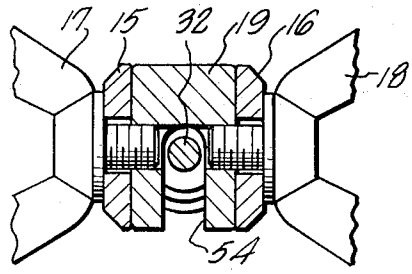

FIG. 5

FIG. 7

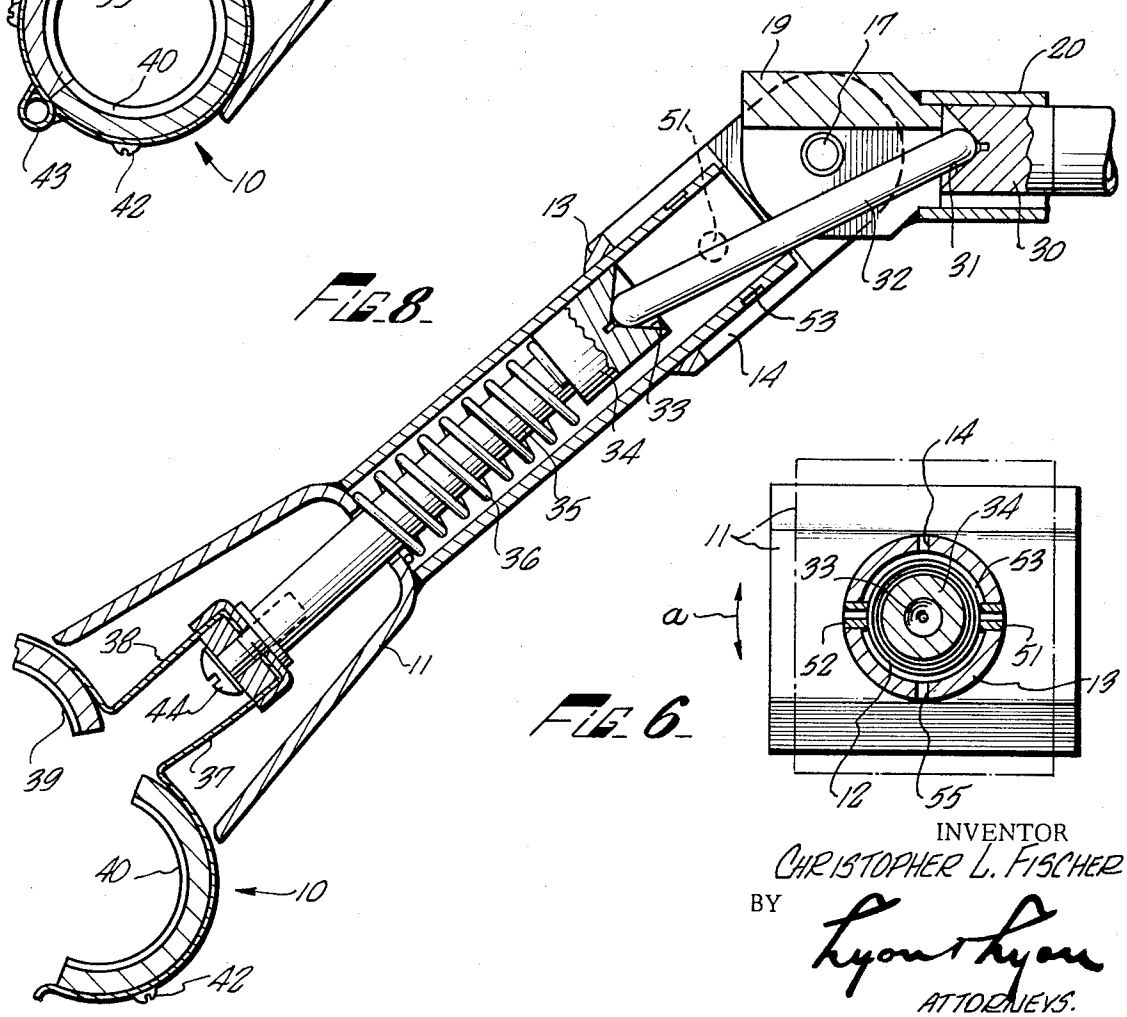

FIG. 8

FIG. 6

INVENTOR
CHRISTOPHER L. FISCHER
BY
Lyon & Lyon
ATTORNEYS.

UNIVERSALLY JOINTED CHILLING TOOL

BACKGROUND OF THE INVENTION

The field of the invention is hand tools and more particularly those hand tools which have jaws for holding parts and wherein the jaws are operated by the movement of a remote handle. Even more particularly the invention relates to hand tools of the above-described type which are jointed at a position between the handle and the jaws. Still further, the invention relates to hand tools whose jaws are operable under cryogenic conditions.

A recently developed type of hydraulic couplings requires that the coupling be held at a very low temperature before it is inserted over the end of a length of hydraulic tubing. Such couplings are of the type which when cooled to a very low temperature may be expanded and will maintain their expanded configuration as long as they are kept at a sufficiently low temperature. When later permitted to warm, they shrink toward the direction of their original shape. In operation, such couplings are commonly chilled by immersion in liquid nitrogen and then expanded and kept in an expanded state. One means for expanding these couplings comprises forcing the coupling over a mandrel which has an outside diameter slightly larger than the inside diameter of the coupling. The expanded coupling is maintained in the liquid nitrogen until ready for use. The chilled coupling is then transferred from the liquid nitrogen and placed over a hydraulic line. After it has been thus placed, it is allowed to warm and shrink to form a very secure joint. It is thus important that these couplings be maintained at a very low temperature during the time which they are transferred from the cooling medium to their final position.

Initial attempts to develop such a tool led to a scissors-like device having a handle at one end and part-holding jaws at the other end. Hydraulic couplings of the type described above are often cylindrical. When the tool was used for a cylindrical coupling, the jaws were typically two halves of a hollow cylinder which had been longitudinally split. In use, the jaws and the part held between them were dipped in the cooling medium and then transferred from that medium to the hydraulic line to be sealed. The surrounding split cylinders of the jaws helped to maintain the low temperature of the coupling so that it would not shrink in size before being placed in its final position.

The scissors-type hand tool had several substantial shortcomings. First, it was necessary for the operator to keep continued pressure on the handles so that the chilled part would not fall out of the jaws. Since it was often necessary to place the part in a relatively inaccessible position, it was often difficult to maintain this pressure. The result was that parts would occasionally fall from the jaws. At the very cold temperatures the part is in a weakened condition and is readily damaged by dropping. Furthermore, if the hydraulic parts to be joined were in a particularly inaccessible position, it was often difficult to maneuver the coupling into the proper orientation.

A greatly improved hand tool was recently developed which utilized a hollow shaft having a control rod which cooperated with a pair of jaws which were held by a spring in a closed position unless the handle of the tool was depressed. In this way, it was far less likely for the parts to fall from the tool while they were being transferred from the cooling medium and being placed over the hydraulic line. This tool, however, did not permit the rotational or angular movement of the jaws with respect to the handle. In many instances the hydraulic lines are in highly inaccessible positions and this inability to move the jaws in an angular or rotational direction made it impossible to apply these cryogenic couplings. Such highly inaccessible locations often exist in aircraft where these cryogenic couplings have found wide acceptance.

SUMMARY OF THE INVENTION

It is an object of this present invention to provide a tool having part-holding jaws which are operated from a remote handle through a shaft, such shaft permitting angular movement at a point between the handle and the jaws.

It is another object of the present invention to provide a tool which permits rotational movement of the jaws with respect to the handle.

It is yet another object of the present invention to provide a hand operated holding tool which permits both rotational and angular movement between its handle and its jaws.

It is still a further object of the present invention to provide a hand tool which is capable of rotational and angular movement between its handle and its jaws and which further may be tightened in a desired angular and rotational position.

These and other objects of the present invention are provided by a tool having a first hollow shaft means which surrounds a first central rod which contacts jaw means which are capable of holding the coupling or other part to be cooled or otherwise treated. The relative movement of the first central rod with respect to the first hollow shaft means opens and closes the jaw means. A second hollow shaft means is hingedly connected to the first hollow shaft and a second central rod is located within the second hollow shaft. This second central rod is operably connected to the first central rod through a thrust pin and is connected at its other end to a handle or other device which is capable of moving the central rod in an axial direction with respect to the second hollow shaft. The first and second hollow shaft means are interconnected by hinge means which permit the angular movement of the first hollow shaft means with respect to the second hollow shaft means.

The first hollow shaft means may include a surrounding collar means at the location adjacent the hinge means. This collar means permits the rotational movement of the first shaft with respect to the collar means and thus permits the rotational movement of the first shaft with respect to the second hollow shaft means.

In order to facilitate the manipulation of the coupling or other part held by the jaws, tightening means may be provided which rigidly affix the resulting universal joint in a desired position. Preferred tightening means include the combination of a pair of slits in the collar means which slits are aligned in the direction parallel to the axis of the collar. Extensions may be affixed to the collar and adapted to surround the second hollow shaft means. Means are then provided to urge these collar extensions inwardly resulting in reducing the inside diameter of the collar and holding the first hollow shaft in a fixed rotational position. Furthermore, the inward movement of the collar extensions causes them

to abut against the second shaft means and affixes it in a desired angular relationship with respect to the first hollow shaft.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a front view of the tool of the present invention.

FIG. 2 is a view taken along line 2—2 of FIG. 1.

FIG. 3 is a view taken along line 3—3 of FIG. 1.

FIG. 4 is a view taken along line 4—4 of FIG. 2.

FIG. 5 is a view taken along line 5—5 of FIG. 2.

FIG. 6 is a view taken along line 6—6 of FIG. 2.

FIG. 7 is an enlarged side view partly in cross section of the tool of FIG. 1 shown in an angularly displaced position.

FIG. 8 is an enlarged side view partly in cross section of the tool of FIG. 1 showing the tool in an angularly displaced position and further showing the jaws in an open position.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Turning now to FIG. 1, one embodiment of the tool of the present invention is shown in front view. Jaw means 10 are shown at the bottom of FIG. 1 and contact a pair of extension arms indicated in FIG. 1 by the reference character 11. The opening and closing of jaw means 10 is described below. These extension arms 11 are rigidly affixed to a first hollow shaft 12. Shaft 12 is rotatably held in collar 13. Collar 13 has a pair of slits, one of which is indicated by the refernece character 14 in FIG. 1. Collar 13 also has a pair of collar extensions 15 and 16. The inward movement of collar extensions 15 and 16 causes collar 13 to bind against hollow shaft 12 thereby tightening the collar 13 around the shaft. This tightening is carried out by wing screws 17 and 18 which are threaded into an extension 19 of the second hollow shaft 20. The details of this tightening action are described more fully below and are shown more clearly in FIG. 4.

The second hollow shaft 20 contains a second central rod 21 to which a handle 22 is affixed. A grip 23 is integrally formed from the upper portion of shaft 20 and cooperates with handle 22 to enable the user to force central rod 21 downwardly with respect to shaft 20. The upward extent of the axial movement of rod 21 with respect to shaft 20 is limited by retaining pin 24 which extends into slot 25 located in shaft 20.

Turning now to FIG. 2, the details of the hinging mechanism are shown more clearly in cross-sectional view. A socket member 50 having an integral socket 31 is attached to second central rod 21 and thus socket 31 is axially movable with respect to hollow shaft 20. A thrust pin 32 has one end in socket 31 and its lower end in socket 33 which is an integral part of socket member 34. Socket member 34 is likewise rigidly affixed to a first central rod 35 which is located in the interior of first hollow shaft 12. A spring 36 urges socket member 34 upwardly in shaft 12 which holds the jaw means 10 in a closed position.

First central rod 35 is held to jaw means 10 by screw 44. Jaw means 10 comprises a pair of elastic arms 37 and 38 which are attached to part contacting members 39 and 40 by means of screws 41 and 42. A passageway 43 is located in the lower portion of elastic arms 37 and 38 and permits the locking of the jaw means 10 in a closed position by insertion of a pin, not shown, through passageway 43.

Turning now to FIG. 3, the means for limiting the vertical movement of rod 21 are more clearly shown. Retaining pin 24 is rigidly inserted through rod 21 and extends outwardly through slot 25 and a corresponding slot 50 located in the opposite side of shaft 20. When no pressure is exerted between handle 22 and grip 23, the retaining pin 24 is forced against the upper ends of slots 25 and 50 in the position shown in FIG. 3. Although the downward movement of rod 21 may be similarly limited, this downward movement may instead be limited by contact of socket member 30 with the extension 19 of the second hollow shaft.

Turning now to FIG. 4, the means for fixing the tool in a desired position is shown. Wing screws 17 and 18 are threaded into holes in the second hollow shaft extension 19. It may be readily seen that the tightening of nuts 17 and 18 forces the collar extensions 15 and 16 against the shaft extension 19 preventing movement between the collar extensions and the shaft extensions. The rotational movement between collar 13 and the first hollow shaft 12 is prevented by this same tightening step. This results from the inward movement of the upper part of collar 13 against the upper part of shaft 12. This movement is permitted by slit 14 (shown in phantom lines in FIG. 4) and slit 55 (shown in FIG. 6). A pair of pins 51 and 52 extend through collar 13 into an annular groove 53 located near the upper end of hollow shaft 12. In this way, even when wing screws 17 and 18 are loosened, the hollow shaft 12 will be held in collar 13, although it will be permitted to freely rotate therein.

Turning now to FIG. 5, further details of the tightening action which holds the desired angular position between the hollow shafts are shown. Collar extensions 15 and 16 are forced against the second hollow shaft extension 19 by the tightening of nuts 17 and 18. A slotted opening 54 is provided in shaft extension 19. Opening 54 is wider than thrust pin 32 and allows for the outward movement of thrust pin 32, thereby permitting increased angular movement between the first and second shafts.

Turning now to FIG. 6, further details are shown as to the means used to hold shaft 12 in collar 13. Pins 51 and 52 extend through collar 13 and into annular grooves 53 in shaft 12. An upper view of the extension arms 11 is shown and the rotational movement of arms 11 is indicated by arrow "*a*." Thus, arms 11 may be rotated into the position shown in FIG. 6 by the phantom lines. A top view of slit 14 is shown as is a corresponding slit 55.

Turning now to FIG. 7, the angular movement in the handle of the tool is more clearly shown. The second hollow shaft 20 is attached to its extension 19 which has a slotted opening 54. Thrust pin 32 is smaller than slotted opening 54 and moves outwardly through it as shaft 12 is moved angularly with respect to shaft 20. Thrust pin 32 is held by sockets 31 and 33 and transmits the axial movement from rod 21 to rod 35. It is evident that this axial movement is transmitted even though shaft 12 is at an angle to shaft 20. The extent of this axial movement is limited and must be less than 90° and preferably less than 45°. In practice, an angle of 30° has been found sufficient to permit the tool to be used to install couplings in inaccessible locations.

It can also be seen in FIG. 7 that extension arms **11**, attached to shaft **12**, serve to hold the jaw means **10** in a closed position. Arms **11** contact elastic arms **37** and **38** which are attached to part contacting members **39** and **40**.

The opening of jaw means **10** is shown most clearly in FIG. **8**. There, socket member **30** has been axially depressed with respect to shaft **20** and has forced thrust pin **32** downwardly thereby causing the downward movement of socket member **34** and first central rod **35**. This causes the contact between extension arms **11** and elastic arms **37** and **38** to change, and the elastic nature of arms **37** and **38** tends to open the part-contacting members **39** and **40**. When the handle is released, spring **36** forces socket member **34** and attached rod **35** inwardly with respect to shaft **12** and returns the jaw means to a closed position.

In operation, the location of hydraulic members to be connected is studied and the tool is tightened in a position which permits the most ready access of the jaw means to the hydraulic parts to be connected. The jaws of the tool are lowered into the liquid nitrogen and allowed to cool. The jaws are then opened to pick up one of the cooled, expanded parts. The tool and its retained part are then removed and the retained part is inserted over the appropriate hydraulic line. The part may then either by held by the tool while the part warms and shrinks or if the coupling is in a stable position, the tool may be immediately removed to facilitate warming of the part.

The choice of materials for part-contacting members **39** and **40** is an important feature of the present invention. In the past, felt has been used in an attempt to retain cooling fluid within its fibers after the tool has been removed from the cooling fluid. The use of felt has created some problems caused by the retention of moisture by the felt. This retained moisture causes the felt to harden and reduce its ability to retain the part. Furthermore, the felt was difficult to secure to the elastic arms. It has been found preferable to use a metal for the part-contacting members. The metal should be one which has a high heat capacity, that is, the product of its specific heat times its mass should be high. In this way, it is capable of transferring heat to the part and thus helping to maintain its temperature. It has been found that copper is a particularly effective metal for use as part contacting members. Other useful metals include aluminum and beryllium.

While it is desirable that the cooling fluid, such as liquid nitrogen, be maintained at a location close to the hydraulic fitting to be joined, in some instances this is not possible. In such instances it may be desirable to supply a stream of coolant against the part while it is being transferred from the cooling fluid to the hydraulic fitting. This may be carried out through the use of a Dewar flask or other appropriately insulated container which is equipped with a flexible conduit which is attached to the tool. The outlet of the flexible conduit should be located so that the cooling fluid passes against either the part contacting members or the retained part itself. The flexible conduit is preferably a spiral metallic conduit which will remain flexible at very low temperatures. The Dewar flask should have a pressure relief valve in order to avoid excessive pressure inside the flask. The gas pressure may be used to move the liquid coolant through the conduit to the part. A hand-operated valve in the flask may be closed to force the fluid through the conduit.

While materials of construction of the tool are not critical, it has been found that metals, and particularly facecentered cubic metals, are particularly effective since they are embrittled to a lesser extent than body-centered cubic metals. Stainless steel has been found to be an effective metal for the structural parts. The spring clip should have sufficient strength to hold the jaw means in an open position and further should maintain its flexibility at very low temperatures. It has been found that beryllium-copper is effective for these purposes. The tool shown in the drawings is capable of opening and closing with a 30° angled bend at its joint.

While the present invention has been discussed as a hand tool, it, of course, need not be operated by hand. The upper shaft could be electrically, hydraulically, or otherwise motivated. Furthermore, while the tool of the present invention is particularly useful for the cooling of parts to a very low temperature, its use is not so limited. It can also be used to hold parts while they are heated or otherwise dipped in various chemicals. Also, while the tool shown in the drawings has a pair of jaws, it can also be made with three, four, or more jaws, it being only necessary that the jaws be operated by the axial movement of a shaft. Still further, the tool of the present invention may be provided with a second or more similar joints along its shaft to further increase its maneuverability. Thus, the present embodiments of this invention are to be considered in all respects as illustrative and not restrictive, the scope of the invention being indicated by the appended claims, rather than by the foregoing description, and all changes which come within the meaning and range of the equivalency of the claims therefor are intended to be embraced therein.

What is claimed is:

1. A device for angularly directing translational force which comprises:

a first hollow shaft;

a first central rod located within said first hollow shaft;

a second hollow shaft connected at one end to said first hollow shaft;

a second central rod located within said second hollow shaft and being operably connected at one end to said first central rod through a thrust pin and, at the junction of said first and second hollow shaft;

hinge means for controllably permitting change of the angular relationship of said first and second hollow shaft and for controllably permitting rotation of said first hollow shaft about its longitudinal axis, said hinge means including tightening means which, in operation, simultaneously maintain the angular relation of said first and second hollow shafts, one to the other, and prevent rotation of said first hollow shaft about its longitudinal axis.

2. The device of claim **1** wherein said hinge means comprise a slit collar for receiving one end of one of said hollow shafts and two arms extending from said slit collar toward the other of said hollow shafts, an end of said other shaft being received therebetween, and wherein actuation of said tightening means urges said arms toward one another and against the hollow shaft received therebetween to fix the angular relation of said shafts one with the other, said actuation simultaneously compressing said slit collar about the shaft re-

ceived therein to prevent its rotation about its longitudinal axis.

3. A tool according to claim 2 having jaw means operable in response to translational movement of said first and second rods and thrust pin upon actuation of a remote handle, arms extending from the second end of said first hollow shaft distant from said hinge means embracing said jaw means when the latter are in a closed position, said jaw means being disengageable from the constraint of said arms upon actuation of the handle to prevent opening thereof.

4. The device of claim 2 wherein said thrust pin is connected to said first and second central rods through ball and socket joints.

5. A tool according to claim 1 having jaw means operable in response to translational movement of said first and second rods and thrust pin upon actuation of a remote handle, arms extending from the second end of said first hollow shaft distant from said hinge means embracing said jaw means when the latter are in a closed position, said jaw means being disengageable from the constraint of said arms upon actuation of the handle to prevent opening thereof.

6. The device of claim 1 wherein said thrust pin is connected to said first and second central rods through ball and socket joints.

7. A tool for angularly directing translational force which comprises:

a first hollow shaft;

a first central rod located within said first hollow shaft;

a second hollow shaft connected at one end to said first hollow shaft;

a second central rod located within said second hollow shaft and being operably connected at one end to said first central rod through a thrust pin and, at the junction of said first and second hollow shaft,

hinge means for controllably permitting change of the angular relationship of said first and second hollow shaft and for controllably permitting rotation of said first hollow shaft about its longitudinal axis, and

jaw means operable in response to translational movement of said first and second rods and thrust pins upon actuation of a remote handle, arms extending from the second end of said first hollow shaft distant from said hinge means embracing said jaw means when the latter are in a closed position, said jaw means being disengageable from the constraint of said arms upon actuation of the handle to prevent opening thereof.

8. The tool of claim 7 wherein said thrust pin is connected to said first and second central rods through ball and socket joints.

9. A device for angularly directing translational force which comprises:

a first hollow shaft;

a first central rod located within said first hollow shaft;

a second hollow shaft connected at one end to said first hollow shaft;

a second central rod located within said second hollow shaft and being operably connected at one end to said first central rod through a thrust pin, such thrust pin being connected to said first and second central rods through ball and socket joints and, at the junction of said first and second hollow shaft,

hinge means for controllably permitting change of the angular relationship of said first and second hollow shaft and for controllably permitting rotation of said first hollow shaft about its longitudinal axis.

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