United States Patent [19]

Frank

[11] **3,750,452**

[45] **Aug. 7, 1973**

[54] **COLLET CRIMPER**

[75] Inventor: **Irving Frank**, Euclid, Ohio

[73] Assignee: **The Weatherhead Company**, Cleveland, Ohio

[22] Filed: **Oct. 7, 1971**

[21] Appl. No.: **187,410**

[52] **U.S. Cl.** **72/402**, 29/237, 29/508

[51] **Int. Cl.** **B21d 41/00**

[58] **Field of Search** 72/402, 415; 29/237, 29/508, 517

[56] **References Cited**

UNITED STATES PATENTS

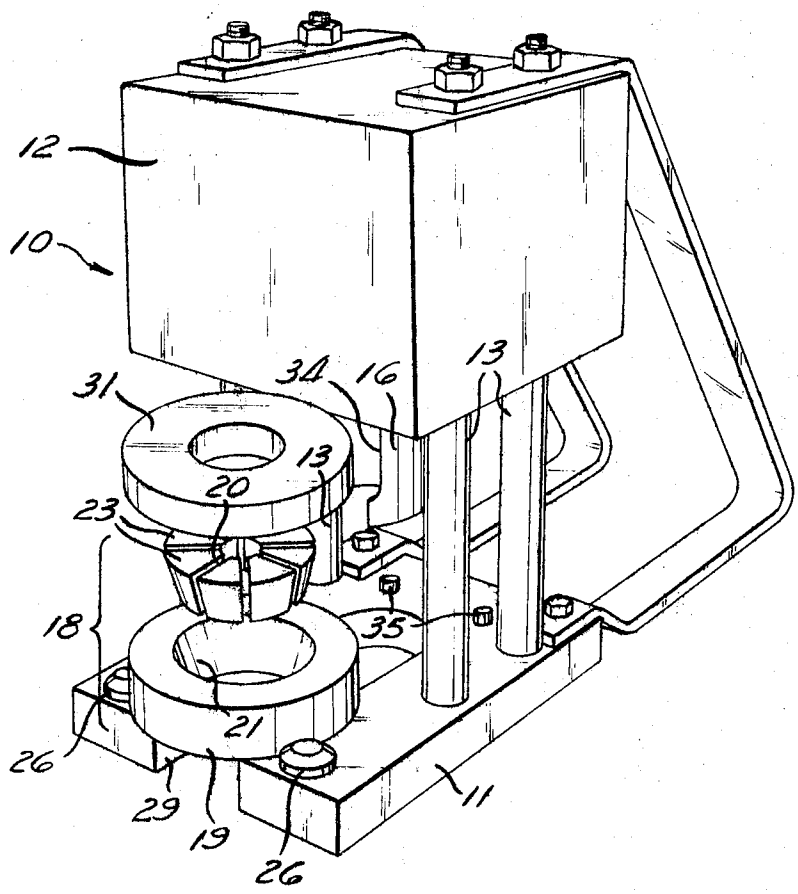
3,085,316	4/1963	Nelson	29/517
2,225,345	12/1940	Lamoreaux	29/517
3,455,140	7/1969	Galan et al.	72/402
3,228,228	1/1966	Myotte	72/402
3,048,212	8/1962	Morrison	29/237
2,978,263	4/1961	Walsh	29/508
2,815,217	12/1957	Fortunski	72/402
3,568,495	3/1971	Duffield	72/402

Primary Examiner—Charles W. Lanham
Assistant Examiner—Michael J. Keenan
Attorney—Harold F. McNenny, Richard H. Dickinson, Jr. et al.

[57] **ABSTRACT**

A collet crimping machine for permanently attaching fittings to hose assemblies including a crimping die assembly, having a die block and a multi-jawed collet, and resilient spacer means for angularly aligning the collet jaws in the die block while permitting the jaws to provisionally grip the fitting and allowing the jaws to be separated along a radial line for lateral passage of the fitting into and out of the collet. The machine is preferably arranged such that the collet is automatically biased in the die ring to the sleeve gripping position to minimize manual set-up operations.

10 Claims, 15 Drawing Figures



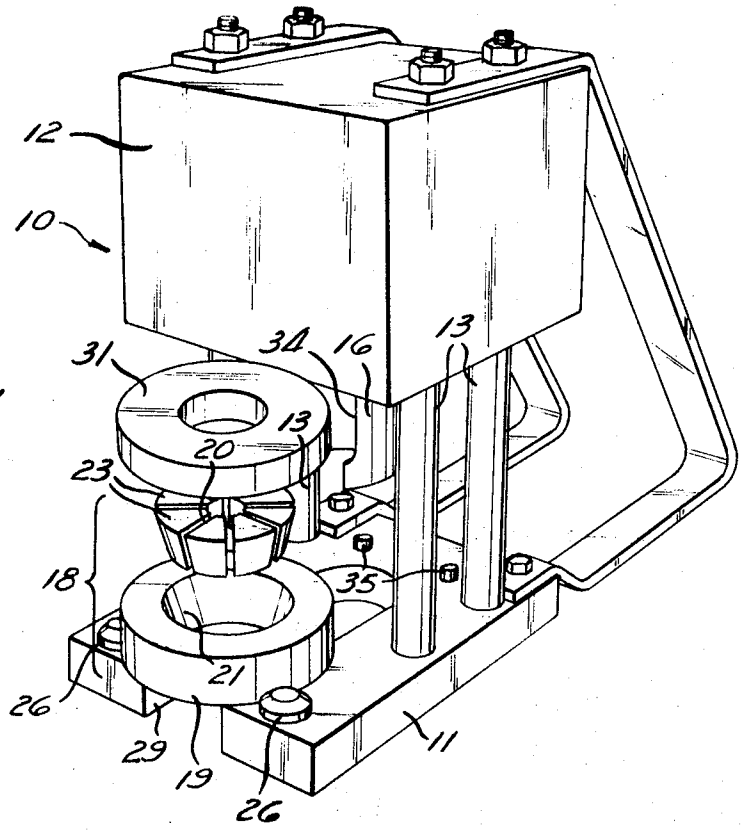


Fig. 1

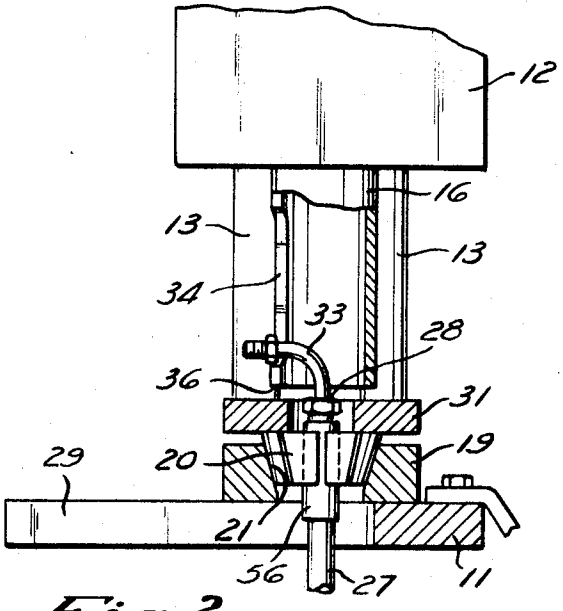


Fig. 2

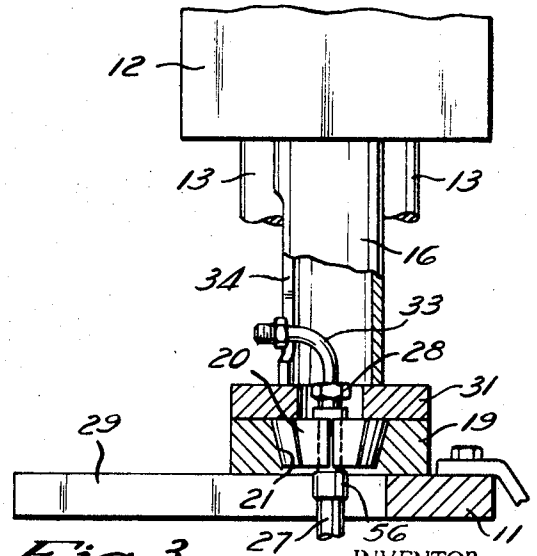


Fig. 3

INVENTOR.
IRVING FRANK

BY
McNENNY, FARRINGTON, PEARNE & GORDON

ATTORNEYS

Fig. 4

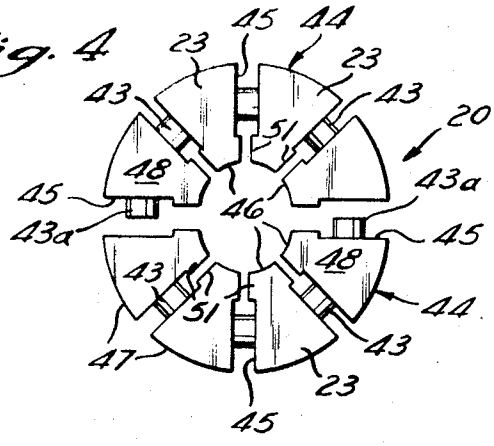


Fig. 5

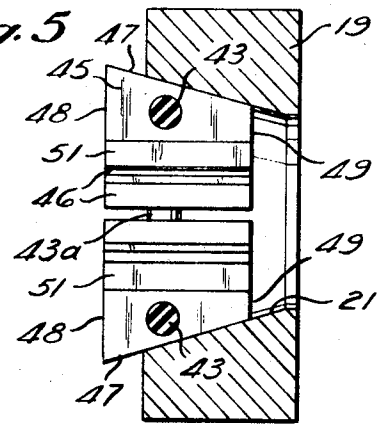
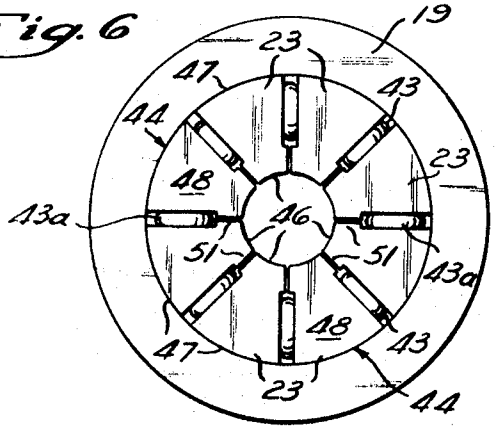


Fig. 6



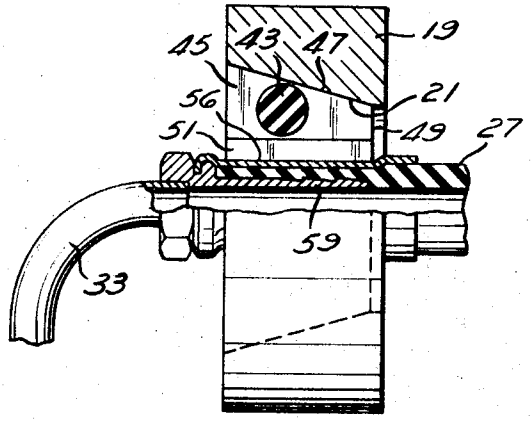
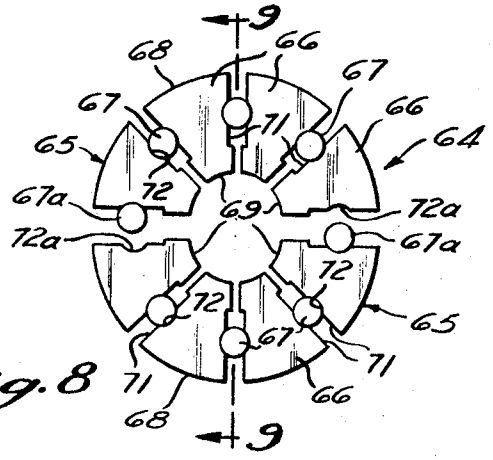


Fig. 7

Fig. 8



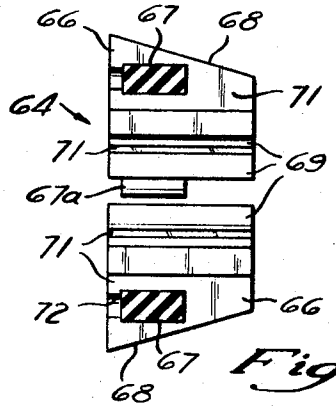


Fig. 9

INVENTOR.
IRVING FRANK
BY
McNENNY, FARRINGTON, PEARNE & GORDON
ATTORNEYS

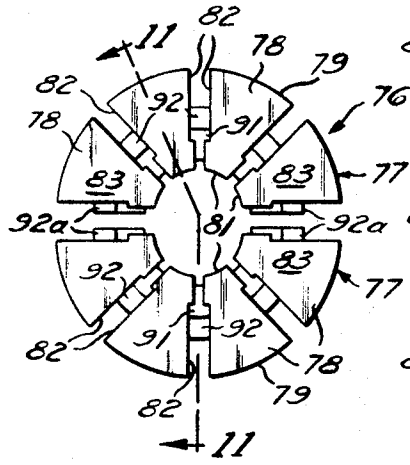


Fig. 10

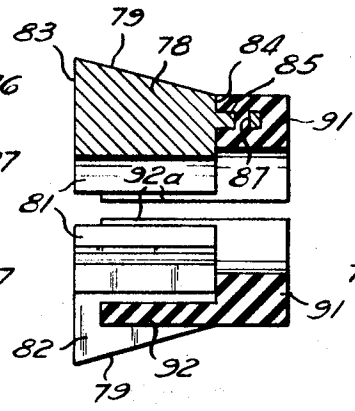


Fig. 11

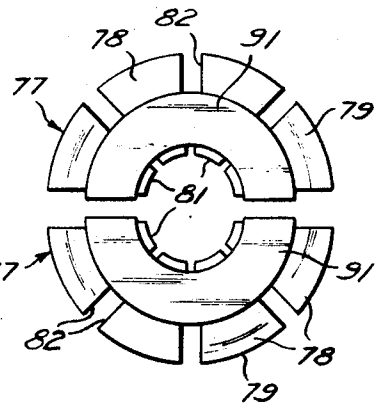


Fig. 12

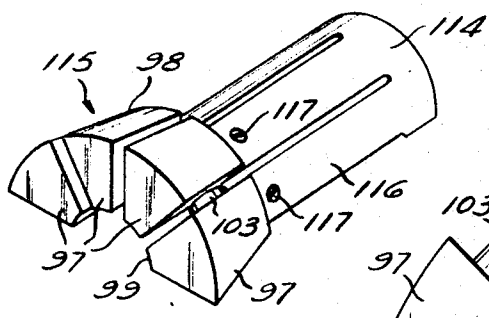


Fig. 15

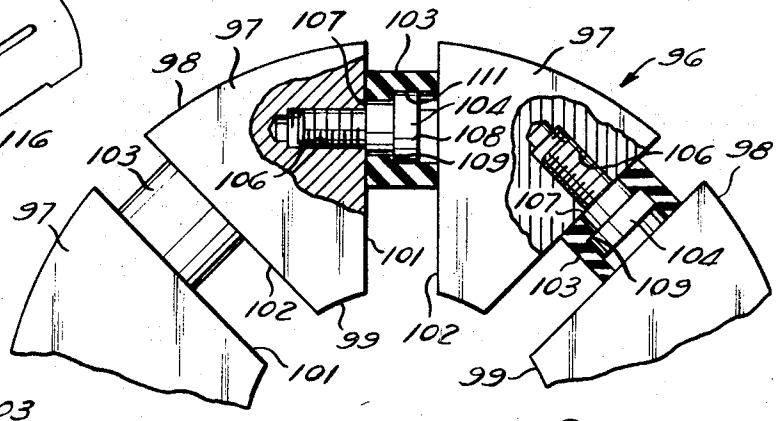


Fig. 13

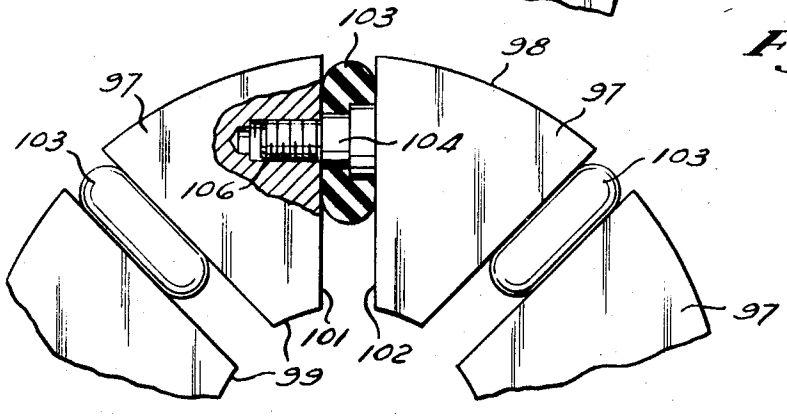


Fig. 14

INVENTOR.
IRVING FRANK
BY
McNENNY, FARRINGTON, PEARNE & GORDON
ATTORNEYS

COLLET CRIMPER

BACKGROUND OF THE INVENTION

This invention relates to devices for reducing the diameter or size of cylindrical or similarly shaped parts and, in particular, relates to improvements in such devices of the type in which the shaping tool comprises a contractible collet.

A principal application of a device embodying the present invention is the installation of tubular fitting assemblies on hose or tubing. According to a common practice in producing hose assemblies for moderate to high pressure service, a metal fitting or connector is permanently secured to a hose by plastically deforming or crimping an outer sleeve of the fitting around the hose end to cause the hose to be tightly held between the outer sleeve and a fitting nipple positioned inside the hose. The invention is directed to apparatus particularly suited for relatively low volume production such as for the makeup of replacement hoses in the field or at the point of use.

DESCRIPTION OF THE PRIOR ART

The present invention is adapted for use in the general type of machine disclosed in application of B. H. Pauly et.al., Ser. No. 798,972, filed Feb. 13, 1969, now abandoned, and assigned to the assignee of the present application. A machine of this type is provided with a fixed bed plate and a ram reciprocal towards and away from the bed. A die ring or socket and a segmented collet positioned in a tapered bore of the ring are axially compressed between the bed plate and ram. The segments or jaws of the collect are thereby cammed radially inward to constrict the collet bore around a fitting sleeve until the sleeve is permanently crimped onto a hose end.

The amount of diametral expansion and contraction available in a crimping collet may often be less than is required to permit free axial passage of certain fitting configurations. Accordingly, it has been proposed to split the collet assembly to form a pair of separable semicircular portions, for instance, into which a hose end assembly may be radially positioned. A problem often encountered in using prior split collets has been a necessity of establishing and maintaining the collet jaws in accurate angular alignment to prevent unsymmetrical or otherwise improper deformation of the sleeve. In certain arrangements, spacing between the collet halves in an expanded position allows the halves to assume or shift to positions where they are not diametrally opposed. Misaligned collet halves may produce defective parts which must often be scrapped.

SUMMARY OF THE INVENTION

The invention provides collet crimping apparatus wherein resilient spacer means allows the collet to be parted along at least one radial line for radially positioning a hose end therein and maintains a desired angular relationship between the collet segments at the expanded position and during travel to the contracted position to insure crimping uniformity. Preferably, according to the invention, the resilient spacer means is arranged to permit the collet jaws to provisionally grip the fitting sleeve when it is manually positioned in the collet and until the ram is actuated to crimp the sleeve.

In the preferred form the collet assembly comprises a plurality of rigid jaws and intervening elastic material

arranged such that, in a free or expanded state, the jaws normally form an enclosure slightly smaller than the precrimped sleeve diameter. This construction allows the individual jaws to be held in angular alignment while interference between the jaws and the sleeve permits the collet to provisionally grip the sleeve when the collet is in its expanded position. Ideally, the crimping apparatus is arranged so that the collet is biased towards the sleeve gripping position to automatically retain a fitting in a proper axial position without requiring extraneous manual movement or adjustment of the apparatus.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of a collet crimping apparatus showing the collet assembly in an axially exploded condition;

FIG. 2 is an elevatonal fragmented view, partially in cross section, of the collet crimping apparatus and a hose end assembly prior to crimping;

FIG. 3 is an elevational view similar to FIG. 2 illustrating the collet crimping apparatus in a crimping position;

FIG. 4 is an axial view of one embodiment of a crimping collet showing the halves of the oclet slightly separated;

FIG. 5 is a sectional view of the collet illustrated in FIG. 4 in an open position in a die ring;

FIG. 6 is an axial view of the collet of FIG. 4 in a fully contracted crimping positiion in the die block;

FIG. 7 is a cross-sectional view of the collet and die ring, corresponding to the position indicated in FIG. 6, illustrating a crimped hose end assembly therein;

FIG. 8 is an axial view of another embodiment of a collet assembly constructed in accordance with the present invention;

FIG. 9 is a cross-sectional view of the collet illustrated in FIG. 8 taken along the line 9-9 indicated therein;

FIG. 10 is an axial view of an additional embodiment of a collet assembly;

FIG. 11 is a sectonal view of the collet illustrated in FIG. 10 taken along the line 11—11 indicated therein;

FIG. 12 is an axial view of the collet assembly at an end opposite from that illustrated in FIG. 10;

FIG. 13 is an axial fragmentary view of still another embodiment of a collet assembly on a somewhat enlarged scale;

FIG. 14 illustrates the collet assembly of FIG. 13 in a radially contracted crimping position; and

FIG. 15 is a perspective view of a half portion of the collet assembly illustrated in FIG. 13.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawings, FIGS. 1 to 3 illustrate a collet crimping machine 10 similar in construction and operation to the collet crimper disclosed in the aforementioned application Ser. No. 798,972. The collet crimping machine 10 includes a frame bed plate 11, an upper frame housing 12, and a set of columns 13. A ram 16, driven by a hudraulic cylinder and piston (not shown) within the frame housing 12, reciprocates towards and away from the bed plate 11. The columns or tie rods 13 support the upper frame housing 12 on the bed plate 11 in tension against the compressive forces developed in the ram 16.

FIGS. 1 to 3 illustrate the mode of operation of the crimping machine 10 with a typical crimping die assembly 18. The die assembly 18 includes a die ring or block 19 and a cooperating collet assembly 20. The die ring, ideally is a unitary rigid annular member having a central tapered bore 21. The collet 20 includes a circular array of rigid segments or jaws 23 havihg outer tapered surfaces complementary to the surface of the tapered bore 21 of the die ring 19. Several embodiments of a collet assembly are described in ddtail hereinbelow along with their use with the crimping machine 10.

Initially, the die ring 19 is positioned against a pair of forward stops or lugs 26 screwed or otherwise fastened to the bed plate 11 so that the die ring 19 and collet 20 are not obstructed from above by the frame housing 12. A hose end assembly including a length of hose 27 and a crimp-type fitting 28, illustrated in FIGS. 2 and 3, may be positioned into the collet 20 by passing these members through a slot 29 in the bed plate 11 and through the die ring bore 21. The hose 27 may be positioned in the fitting 28 before or after the fitting is positioned in the collet 20. With the hose end assembly properly positioned in the collet 20, according to procedures discussed in detail below, and with a flat circular pressure ring 31 positioned on the collet 20, these elements may be pushed rearwardly until the die ring 19 abuts a pair of rear stop pins 35 fixed in the bed plate 11. At this point the elements assume the horizontal position illustrated in FIGS. 2 and 3 where the collet 20 and die ring 19 are axially centered under the ram 16.

The fitting 28 illustrated by way of example only in FIG. 2 and 3 includes a vent tube elbow portion 33 which extends radially beyond the body portion of the fitting 28. A slot 34 extends axially from a lower end 36 of the ram 16 to provide clearance for the elbow 33 of the fitting 28 when the collet 20 and die ring 19 are under the ram 16. The ram 16 is driven downwardly by the above mentioned cylinder and piston actuator in the housing 12 to bear against the pressure ring 31. The pressure ring 31 distributes the load of the ram 16 uniformly to each of the individual collet jaws 23, notably to the jaws immediately under the ram slot 34.

As the ram 16 is moved progressively towards the bed plate 11 the collet 20 is eventually moved from the position illustrated in FIG. 2 axially into the die ring bore 21 until it reaches the position illustrated in FIG. 3 where the pressure ring 31 abuts the bed plate 11. The die ring bore 21, due to its tapered or conical shape, cams the collet segments 23 radially inward as they are forced axially into the bore. The radially inward movement of the collet segments 23 causes the fitting 28 to be diametrally permanently compressed or crimped onto the hose 27.

FIGS. 4-7 illustrate the first embodiment of the collet assembly 20 in detail. The rigid jaws 23 may be formed of hardened steel, for instance, and preferably, are identical to one another. Resilient or elastic spacer means in the form of short cylindrical elastomeric rubber or rubberlike members 43 intervene between adjacent jaw segments 23. Each resilient spacer member 43 is secured to both adjacent jaws 23 by bonding with widely known heat and/or adhesive or molding techniques appropriate to the selected spacer material and the radial jaw surfaces, designated 45, on which it is bonded. As illustrated in FIG. 4, the collet assembly 20 is preferably formed as a pair of complementing substantially semicircular separable halves 44.

Each jaw 23 has the general form of a sector of a solid cone. The jaw segments 23, accordingly, may all be machined from a common circular blank. Ideally, the blank is machined with an axial circular cylindrical bore which eventually forms radially inner curved surfaces 46 of the jaws 23. Preferably, the outer surface of the blank is machined to form a straight taper conical surface, of 15° for instance, which eventually forms the radially outer conical surfaces 47 of the jaws 23.

The axial ends of the blank are machined perpendicular to its axis so that the end faces, designated 48 and 49, of the jaws 23 are perpendicular to the axis of the collet 20. Preferably after the circular blank has been bored, its outer surface tapered and its ends faced, it is cut into sectors by sawing or otherwise machining it along equally spaced radial lines. Each radial cut is stepped so that sufficient material is removed or relieved at the radially outward portions of the jaws 23 in the area of the radial faces 45 to accommodate the placement of the resilient spacers 43. The stepped radial cut maximizes the arcutae width of the inner curved surfaces 46 and forms inner circumferential projections 51 which prevent excessive deformation of the spacer members 43 by abutting against one another when the collet is contracted to an extreme position.

A resilient end spacer 43a, substantially identical to the intervening spacers 43, is secured to the outward radial face 45 of an end jaw 23 on each collet half 44. The resilient spacers 43 and 43a are dimensioned with respect to the jaws 23 such that with the collet halves 44 abutted and in a substantially free or uncontracted state, the inner surfaces 46 of the jaws 23 circumscribe a circle slightly smaller than the nominal precrimped outside diameter of an outer sleeve 56 of the fitting 28. The diametral interference between the jaws 23 and the fitting 28 may be between 0.005 inch and 0.010 inch, for example. FIG. 2 and 5 illustrate this first or open position of the collet assembly 20 wherein the resilient spacers 43 and 43*a* support the haws 23 in the die ring 19 at an axial position where the inner surfaces 46 of the jaws 23 provide the slight interference with the sleeve 56.

Preferably, the collet assembly 20 and die ring 19 are arranged with their axes extending in a substantially vertical direction as shown in FIGS. 1, 2, and 3. Gravitational force on the collet assembly 20 thereby biases the collet assembly 20 towards the position in the die block 19 where each end spacer 43a contacts the opposed radial jaw surface of the opposite collet half 44. When vertically supported in the tapered bore 21 of the die block 19, the collet assembly 20 allows only upward vertical movement of the fitting 28. The collet 20 firmly grips or locks against the outer surface of hte fitting sleeve 56 upon slight downward vertical movement of hte fitting 28 due to the camming action provided by the tapered die ring bore 21 to thereby limit downward vertical movement of the fitting.

A typical procedure for positioning the fitting 28 and hose 27 in proper axial registration in the collet assembly 20 may begin by slipping the fitting 28 and hose 27 through the tapered bore 21 of the die block 19 from beneath. Subsequently, at least one of the collet halves 44 may be moved radially in a plane above the die block 19 until the hose end radially enters the cavity formed by the jaws 23. The collet half or halves 44 may

then be lowered into the tapered bore 21. If the fitting 28 is too low in the collet assembly 20, once the collet halves 44 are seated in the bore 19, it may be manually pushed upwards into proper registration. If the fitting 28 is too high in the collet assembly 20 it may be manually lowered by pushing at least one of the collet halves 44 slightly upwards in the tapered bore 21 to release the self locking action of the collet 20. When properly registered in the collet 20, the fitting 28 will remain held in position while the ram 16 is energized.

FIGS. 3, 6, and 7 illustrate the fully crimped position of the collet assembly 20 in the die ring 19. At this positon the outer sleeve 56 of the fitting 28 is permAnently crimped or deformed radially inward in an axial zone s'ighJly longer than the length of the collet assembly 20. This crimping or radial deformation of the sleeve 56 locks the surrounded portion of the hose 27 against an inner nipple portion 59 of the fitting 28 to form a permanent assembly of these members.

Preferably, the radius of curvature of the inner surfaces 46 of the jaws 23 is selected so that at approximately the full crimping position they form segments of a common cylinder as illustrated in FIG. 6. The radial faces 45 of the jaws 23 have sufficient radial length to provide unrestricted radial expansion of the resilient spacer members 43 and 43*a* upon contracion of the collet as illustrated in FIG. 6 and 7. It may be appreciated that the resilient spacer members 43 and 43*a* maintain the collet jaws 23 uniformly spaced in an angular relationship to one another while the jaws provisionally grip the fitting 28 before the ram 16 is actuated to drive the collet. Further, the resilient spacer means or members 43 and 43*a* maintain this desired angular relationship thnoughout the axial travel of the colleJ 20 in the die ring 19. This insures thAt the fitting sleeve 56 will be uniformly and symmetrically crimped. Return of the collct assembly 20 upwards from the crimping position is assisted by the forces in the spacers 43 and 43*a* resisting compression.

ReferrIng now to FIGS. 8 and 9, there is illustrated another embodiment of a collet assembly 64 having the same general configuration as the collet assembly 20 illustrated in FIG. 1 through 7. The collet assembly 64 preferably includes a pair of complementing halves 65 each including a plurality of rigid jaws 66 and resilient spacer means in the form of cylindrical rubber or elastomeric members 67 intervening between adjacent jaws 66. Radially outer surfaces 68 of the jaws 66 are conical while the radially inner surfaces 69 are, preferably, cylindrical.

Radial faces 71 of each jaw 66 are provided with axially extending recesses 72 for reception therein of portions of the cylindrical spacer member 67. The receses 72 may be formed by drilling axial holes into a circular blank before sectioning the blank into separate jaws 66. Each resilient spacer 67 is secured to both of its adjacent jaws 66 by bonding portions of the spacer to the surfaces of the respectve recesses 72 with suitable heat and/or adhesive or molding techniques. Resilient spacers 67*a* are bonded to mating recesses opposite recesses 72a in jaws 66.

The collet assembly 64 may be used with the die ring 19 in substantially the same manner as the collet assembly 20 of the first described embodiment. Resilient end spacers 67*a*, substantially identical to the intervening spacers 67, cooperate with opposed recesses 72*a* in the opposite collet havles 65 to align the collet halves together to facilitate their placement into the tapered bore 21 of the die ring 19. The resilient spacers 67 and 67*a* are proportioned to normally hold the jaws 66 in an open position in the die bore 21 where the inner surface 69 provide a slight diametral interference with the fitting sleeve 56, as the above described collet assembly 20, to facilitate proper positioning of the fitting 28 therein.

FIGS. 10 to 12 illustrate another embodiment of a collet assembly 76 for use with the collet crimping machine 10. The arrangement of the collet crimping assembly 76 is similar to the collet assemblies 20 and 64 disclosed above and its use with the collet crimping apparatus, is substantially identical to that described above.

Again, the collet assembly 76, preferably, includes a sut of substantially semicircular halves 77. Each half 77, ideally, comprises a plurality of identical rigid jaw segments 78. As illustrated. the jaw segments 78 each have a major portion substantially identical to the jaws 23 of the first described collet assembly 20. More specifically, the jaws 78 each include a straight tapered conical outer peripheral surface 79, an inner cylindrical peripheral surface 81, radial faces 82 and a flat end face 83. At an end 84 opposite the end face 83, each jaw 78 is provided with an integral axially extending arcuate skirt portion 85. The skirt portion 85 is concentric with the axis of the collet 76 and extends across the arcuate width of its associated jaw 78. A radial hole 87 is drilled or otherwise formed in each skirt portion 85.

Resilinet elastomeric spacer means 91 is provided around the skirt portions 85 of adjacent jaws 78 to hold the jaws in position relative to one another. The resilient spacer means 91 of each collet half 77 is generally semi-cylindrical in the area surrounding the skirt portions 85 and includes integral axially extending fingers 92 between adjacent jaws 78. Preferably, the resilient spacer means 91, 92 is formed by molding it to shape. For example, the resilient spacer means 91, 92 may comprise a polyurethane elastomer cured in place with the jaws 78. Surfaces of the jaws 78 may be coated with a suitable primer to improve adhesion of the polyurethane material to the jaws. Additionally, the materail of the resilient spacer means 91, extends through the radial hole 87 of each jaw skirt 85 to mechanically hold the jaws together.

At the plane of separation of the collet halves 77, axially extending integrally molded resilient fingers 92*a* having apprximately half the width of the intervening fingers 92 are provided to maintain the halves in proper angular alignmnt when the halves are assembled in the die ring bore 21. The resilient spacer means 91, 92 and 92*a* is arranged to normally maintain the collet jaws 78 at a spacing where their inner surfaces 81 circumscribe a circle slightly smaller than the outer diameter of the fitting sleeve 56 when the collet assembly 76 rests in the die ring 19 before operation of the ram 16.

An additional embodiment of a collet assembly 96 is illustrated in FIGS. 13 through 15. The general form of the jaws, designated 97, of the collet assembly 96 is substantially the same as that of the above described collet assemblies 20, 64 and 76. Each jaw 97 is a sector of a straight tapered conical blank truncated by a plane perpendicular to its axis and cylindrically bored on its axis. Each rigid jaw 97 thus includes a radially outer tapered surface 98, a radially inner cylindrical surface 99, and a pair of radial faces 101 and 102.

Between the opposed radial faces **101** and **102** of adjacent jaws **97**, resilient spacer means in the form of a hollow cylindrical elastic pad **103** is retained by a shoulder screw **104**. Each shoulder screw **104** is threaded into a hole **106** in a jaw **97** through its radial face **101** until a shoulder **107** thereon locks against the radial face. A head portion **108** of the shoulder screw **104** cooperates with a radial shoulder surface **109** in a bore **111** of the pad **103** to mechanically fasten or retain the pad against the radial jaw surface **101**. The spacer pads **103** are dimensioned with respect to the jaws **97** such that the inner jaw surfaces **99** circumscribe a circle of a diameter slightly less than the uncrimped outer diameter of the fitting sleeve **56** when the circular collar assembly **96** rests in the tapered die ring bore **21**.

The individual jaws **97** are preferably mounted on a conventional semicylindrical spring base **114** to form semicircular collet halves **115**. Each spring base **114** includes axially extending radially deflectable spring fingers **116**. Each finger **116** is secured at its free end to a separate collet jaw **97** by a screw **117** or other fastening means in an axially extending skirt portion (not shown) of the jaw **97** similar to the skirt **85** of the collet jaws **78** illustrated in FIG. **11**. It will be understood tha there is an elastic spacer pad **103** associated with each jaw **97** so that two diametrally opposed spacers **103** are provided at the plane of separation between opposed collet halves **115**. FIG. **14** illustrates an extreme crimping position of the jaws **97** and the corresponding deformation of the elastic spacers **103** when the jaws are forced axially into the tapered die ring bore **21** until the head **108** of each shoulder screw **104** abuts the adjacent jaw **97**.

In each of the illustrated embodiments of the collet assemblies **20, 64, 77** and **96**, it may be appreciated that the associated resilient spacer means disposed between the collet jaws maintains the jaws in a desired angular relationship relative to one another when the particular collet assembly rests in the tapered die ring bore **21** at its open position. The resilient spacer means is further adapted to maintain this angular spacing between the jaws throughout movement of the collet assembly from the open or precrimping position axially to the full crimping position. The resilient spacer means also permits the collet assembly to be separated into halves so that a hose end assembly may be positioned radially into a pocket defined by the radial inner surfaces of the collet jaws.

Although preferred embodiments of this invention are illustrated, it is to be understood that various modifications and rearrangements of parts may be resorted to without departing from the scope of the invention disclosed and claimed herein. For example, it may be desirable or practical to arrange the collet assemblies so that they are not completely separable into halves or other fractions, but rather are separable along at least one radial line to permit radial positioning of a hose end therein.

What is claimed is:

1. A crimping die assembly for radially compressing a sleeve onto the exterior of a hose comprising a die block and a cooperating collet, said die block having a tapered bore therein, said collet including a plurality of rigid jaws positionable together in said bore in a circular array, said collet being axially movable between first and second positions in said bore, each of said jaws having a radially outer tapered surface complementary to the taper of said bore such that said jaws are cammed radially inward by said bore when said collet is moved from said first position to said second position, each of said jaws having a radially inner surface forming a section of a common collet bore when said collet is in said second position, each of said jaws being resiliently fixed to at least one adjacent jaw in a jaw assembly, at least two adjacent jaws being unattached to and separable from one another along a generally radial plane to permit a hose and a sleeve to be passed radially therebetween into and out of a pocket defined by said inner jaw surfaces, resilient spacer means locating said adjacent separable jaws in a predetermined angular relationship to one another at said first position and while said collet is moved from said first position to said second position.

2. A crimping die assembly as set forth in claim **1** wherein said resilient spacer means includes an elastomeric body secured to one of said jaws.

3. A crimping die assembly as set forth in claim **2** wherein at least one of said opposed jaws has a generally radial face associated with said radial plane and said elastomeric body is secured to such radial face, said resilient body being compressed between said opposed jaws when said collet is moved from said first position to said second position.

4. Apparatus for crimping a sleeve onto the exterior of a hose comprising a die block having a frustoconical throughbore with a generally even taper angle, a collet assembly axially movable in said bore between first and second positions, said collet including a plurality of circularly arranged rigid jaws, each of said jaws having a radially outer surface engageable with said bore and having a shape generally complementary to it, each of said jaws having a radially inner surface, said radially inner surfaces cooperating with one another to define a generally cylindrical die cavity when said collet is in said second position, said jaws each providing a pair of angularly spaced generally radial faces extending from its radially inner surface to its radially outer surface, at least a pair of jaws being separable along a radial plane to permit radial passage of a sleeve and hose therebetween to and from a pocket formed by the inner surfaces of said jaws, said collet including elastic spacer means adapted to maintain all of said jaws in a predetermined angular relationship with one another while said collet is seated in said bore, said jaws being cammed radially inward by the surface of said bore as said collet is moved axially from said first position to said second position, said elastic means including elastomeric material disposed between the radial faces of adjacent jaws, said material being resiliently compressed when said collet is moved to said second position, said jaws forming generally semicircular separable subassemblies, each of the jaws of a subassembly being resiliently fixed relative to one another.

5. Apparatus as set forth in claim **4** wherein said elastomeric material is bonded to said radial faces.

6. Apparatus as set forth in claim **4** wherein said elastomeric material is mechanically fastened to the radial faces of the jaws.

7. A method of crimping a sleeve on a hose comprising providing a multi-jaw circular collet assembly and co-operating die ring including resilient spacer means for maintaining the jaws in a desired angular position relative to one another in a sleeve gripping position in

the die ring, positioning a hose into a cylindrical portion of a sleeve, positioning the sleeve in the collet at a predetermined axial position relative to said jaws, temporarily maintaining said sleeve in said predetermined axial position by yieldably biasing said jaws towards the sleeve gripping position in said ring, and subsequently contracting said collet jaws from the sleeve gripping position by forcing them axially into said ring until the sleeve is permanently deformed about said hose end.

8. A method as set forth in claim **7** wherein said biasing is provided by disposing said collet assembly in said ring along a vertical axis such that gravity operates on the collet assembly to pull it into said gripping position.

9. A machine for permanently crimping a fitting on a hose comprising a bed, a ram reciprocal towards and away from the bed along a vertical direction, a die block disposed between the bed and ram, the die block including a tapered vertical bore therein, a radially contractible collet in the tapered bore and adapted to be moved axially by said ram between first and second positions in said bore, said collet includinG a plurality of circularly arranged rigid jaws, said jaws each including a radially inner surface collectively forming a central fitting receiving pocket, said inner jaw surfaces circumscribing a circle of a diameter slightly smaller than the nominal outer diameter of the fitting before crimping when said collet is in said first position, said bore camming said jaws radially inward to crimp a fitting therebetween onto a hose as said collet is moved from said first position to said second position, elastic spacer means for maintaining said jaws in a desired angular relationship relative to each other when said collet is in or between said positions, said elastic spacer means permitting gravitational force to move said collet towards said first position from an expanded position outside a zone defined by said first and second positions and points therebetween whereby said fitting is provisionally held in said collet prior to reciprocation of the ram.

10. A machine as set forth in claim **9** wherein, said elastic spacer means includes means to permit said jaws to be separated along a radial line when said collet is outside of said zone so that the fitting may be radially positioned in and removed from said receiving pocket.

* * * * *