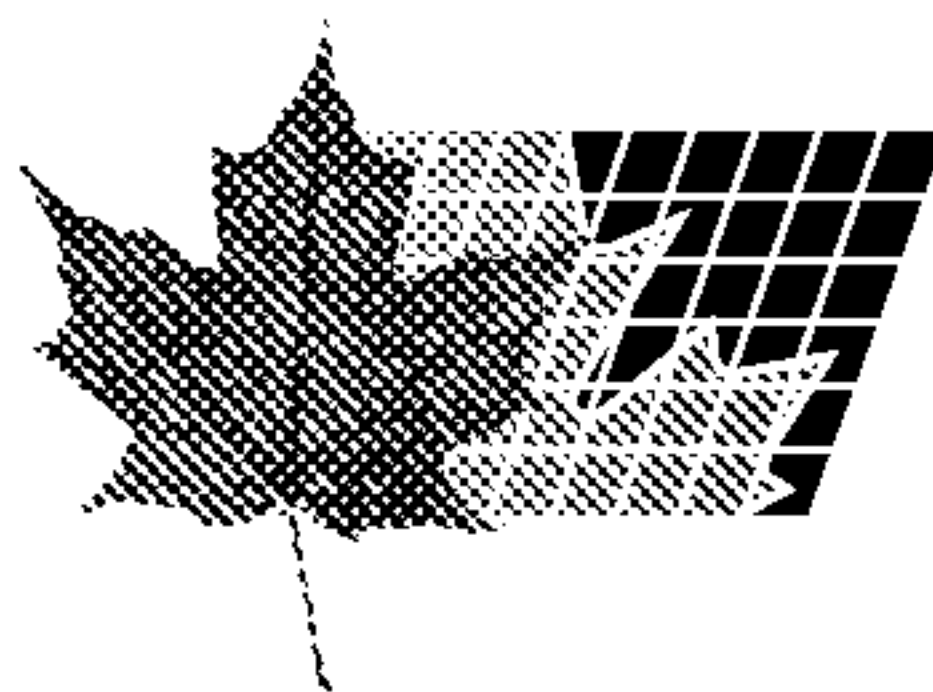




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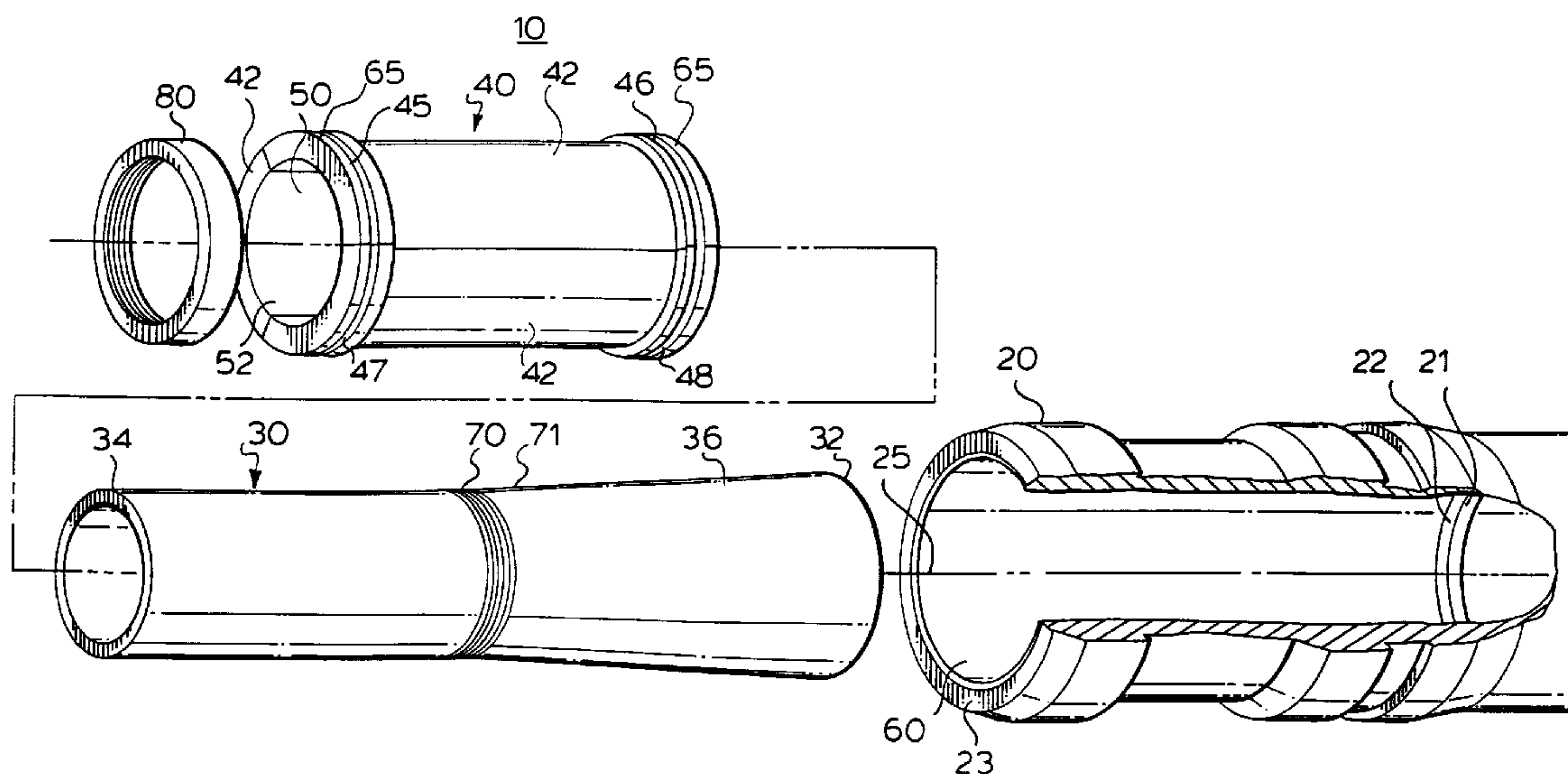
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(54) **APPAREIL D'ALIGNEMENT AXIAL A L'INTERIEUR D'UN
RACCORD D'EXTREMITÉ DE CANAL DE COMBUSTIBLE**

(54) **APPARATUS FOR AXIAL ALIGNMENT WITHIN A FUEL
CHANNEL END FITTING**



(57) An apparatus for axial alignment within a fuel channel end fitting of a nuclear reactor is taught. The apparatus includes a tapered shaft supporting a mating expanding collet arrangement which binds with the inner surface of the fuel channel and holds the shaft in axial alignment within the end fitting. The apparatus allows precise alignment of reworking tools with the surface to be reworked.



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APPARATUS FOR AXIAL ALIGNMENT WITHIN A
FUEL CHANNEL END FITTING

Abstract of the Invention

An apparatus for axial alignment within a fuel channel end fitting of a nuclear reactor is taught. The apparatus includes a tapered shaft supporting a mating expanding collet arrangement which binds with the inner surface of the fuel channel and holds the shaft in axial alignment within the end fitting. The apparatus allows precise alignment of reworking tools with the surface to be reworked.

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APPARATUS FOR AXIAL ALIGNMENT WITHIN A FUEL CHANNEL END FITTING

Field of the Invention

The present invention is directed to an apparatus for use in a nuclear reactor and, in particular, an apparatus for axial alignment within a fuel channel end fitting of a nuclear reactor.

Background of the Invention

The fuel channel end fitting of a nuclear reactor is the communication port between the fuel channel and the outside. Over time, the movement of equipment and fuel bundles within and around the end fitting causes the end fitting to wear resulting in deviations in the end fitting dimensions. The end fitting must be reworked, especially at the sealing surfaces, to maintain its integrity and to ensure proper sealing of the fuel channels. Reworking processes such as milling or lapping must be carried out to precise dimensions. For example, the E-face seal of the end fitting creates a metal to metal seal with the fuel channel closure. Lapping of this seal is occasionally required to maintain the integrity of the seal. The lapping process must be carefully controlled to ensure that the seal is lapped to be exactly concentric relative to the axis of the end fitting. Further, the seal must be lapped

evenly over its entire surface. Previously, reworking processes were carried out using manually operated tools positioned within the end fitting in axial alignment with the end fitting. Axial alignment was accomplished by means of manual measurements and trial and error. Understandably, the accuracy of the alignment was not always perfect and this sometimes led to irreparable damage of the end fitting. To avoid damage to the end fitting during reworking, it is necessary that any apparatus used in association with the end fitting is initially aligned with the axis of the end fitting and that this initial alignment is maintained during any reworking operation.

Summary of the Invention

In accordance with a broad aspect of the present invention, there is provided an apparatus for axial alignment within a fuel channel end fitting of a nuclear reactor, the apparatus comprising:

a shaft comprising an inward end for insertion into the fuel channel and a smaller outboard end opposite the inward end, the inward end comprising a predetermined taper, the taper being positioned to taper toward the outboard end of the shaft; and,

a mating expanding collet arrangement comprising a plurality of collet segments supported on the taper and arranged concentrically about the shaft, each collet segment adapted to move radially outwardly from the shaft when the taper is inserted into the collet;

wherein when the inward end of the shaft is inserted into the fuel channel, the collet arrangement is forced radially outwardly to bind with the inner surface of the fuel channel such that the shaft is in axial alignment within the fuel channel end fitting.

In accordance with a further aspect of the present invention, there is provided an apparatus for supporting a lapping tool in position relative to the axis of a fuel channel end fitting of a nuclear reactor, the apparatus comprising:

a shaft comprising an inward end for insertion into the fuel channel and a smaller outboard end opposite the inward end, the inward end comprising a predetermined taper, the taper being

positioned to taper toward the outboard end and a threaded portion, adjacent the taper;

a mating expanding collet arrangement comprising a plurality of collet segments supported on the taper and arranged concentrically about the shaft, each collet segment adapted to move radially outwardly from the shaft when the taper is inserted into the collet;

a collet nut threadingly engaged on the threaded portion of the shaft and moveable along the shaft to act against the collet segments and insert the taper into the collet arrangement; and,

wherein the shaft is adapted to carry the lapping tool; and,

wherein when the inward end of the shaft is inserted into the fuel channel, the collet nut is advanced along the shaft to force the collet arrangement radially outwardly to bind with the inner surface of the fuel channel such that lapping tool is in position relative to the axis of the fuel channel end fitting.

Brief Description of the Drawings

For a better understanding of the present invention reference is made by way of example to the following diagrammatic drawings, in which:

Figure 1 is an exploded perspective view of the apparatus of the present invention aligned to enter a fuel channel end fitting; and,

Figure 2 is a cross section elevational view through an end fitting having the lapping tool of the present invention disposed therein.

Detailed Description of the Preferred Embodiment

Referring to Fig. 1, there is shown the apparatus 10 of the present invention aligned for entry into a fuel channel end fitting 20 the remote end of which enters the fuel pressure channel (not shown). An exemplary end fitting contains a number of surfaces which require reworking throughout the life of the structure. Three such surfaces are the radial seal 21 of the seal ring, the flat face seal 22 of the seal ring

and the E-face seal 23. Various tools are used for the reworking of these surfaces. Alignment of the reworking tool with the central axis, indicated at 25, of the end fitting 20 allows precise reworking of the concentric sealing surfaces 21, 22 and 23. The apparatus 10 of the present invention allows precise axial alignment of a tool within a fuel channel end fitting.

Fig. 1 shows the apparatus 10 exploded into its component parts. The apparatus comprises a tapered shaft 30 and a mating expanding collet 40. Shaft 30 has an inward end 32 for insertion into the end fitting 20 and a smaller outboard end 34 opposite the end 32. End 32 of the shaft 30 is positioned to taper toward the outboard end 34 of the shaft 30. The taper 36 is made to mate with a collet arrangement 40. As is known in the art, the collet arrangement 40 comprises a plurality of collet segments 42 which are arranged concentrically about the shaft 30 and are adapted to move radially outwardly when the taper 36 is inserted into collet 40.

Apparatus 10 of the present invention maintains axial alignment within the fuel channel 20 in a well known manner, readily understood by those skilled in the art. When the inward end 32 of the shaft 30 is inserted into the fuel channel end fitting 20, the collet arrangement 40 is forced radially outwardly along the taper 36 to bind with the inner surface 60 of the end fitting 20. This forces the shaft 30 of the apparatus 10 into axial alignment with the end fitting 20.

The collet arrangement 40 is comprised of a plurality of collet segments 42. The number of segments 42 required for the function of the apparatus is three or more. In the most simplified and therefor most preferred apparatus, the number of segments 42 is three, as shown in Fig. 1. The collet segments 42 may be maintained on the shaft 30 by any suitable means. For example, as shown in Fig. 1, by a pair of O-rings 45, 46 resting in a pair of grooves 47, 48 encircling the collet arrangement 40.

The inner surface 50 of each collet segment 42 is adapted to move smoothly over the taper 36. Preferably, the inner surface 50 of each collet segment 42 is adapted to have contacting surfaces 52 only at the ends to reduce the frictional forces and thereby allow enhanced

movement of the segments 42 over the taper surface 36. This feature is best seen in cross section as shown in Fig. 2.

Referring again to Fig. 1, the outer surface of the collet segments 42 are adapted to bind with the inner surface 60 of the end fitting 20. To provide stability of the shaft 30 along its length when in axial alignment within the end fitting 20, it is understood that each segment 42 must bind with the inner surface 60 at more than one point. Debris within the end fitting may come between the binding surface and the inner surface of the end fitting and cause improper binding. To avoid improper binding, the entire outer surface of each segment 42 preferably does not bind with the inner surface 60 of the end fitting 20 but rather, each segment 42 binds simultaneously at at least two binding surfaces 65 along its outer surface. In the most preferred embodiment, the two binding surfaces 65 are positioned at opposite ends of each segment 42 as shown. This arrangement of binding surfaces 65 is shown in Fig. 1 also having the O-ring grooves 47, 48 extending thereacross. Binding surfaces 65 are preferably comprised of a curved face having a radius in agreement with that of the inner surface 60 of the end fitting 20 to allow the apparatus 10 to be more securely bound.

The taper 36 may be inserted into the collet 40 by any suitable means. In a preferred embodiment, a threaded portion 70 is worked onto the shaft 30 adjacent the taper 36 to threadingly engage a collet nut 80. As best seen in Fig. 2, an end portion 82 of each segment 42 extends over the threaded portion 70. Collet nut 80 is tightened along the threaded portion 70 into contact with the segments 42. Further tightening of the nut 80 forces the taper 36 to be inserted into the collet 40 causing the collet 40 to expand radially outwardly from the shaft 30 until the binding surfaces 65 of the segments 42 bind with the inner surface 60 of the end fitting 20. The collet nut 80 acts to lock the collet arrangement 40 in the radially extended position until the nut 80 is loosened to remove the force exerted by the nut 80. The nut 80 may be adapted to be in direct engagement with the collet segments 42. As shown in Fig. 2, in a preferred embodiment a flange 84 extends from the nut 80 toward the segments 42. A mating flange 86 extends out from each of the collet segments 42 toward the nut and is engaged by the nut

flange 84. The flanges 84, 86 provide that any movement by the nut 80 along the threaded portion 70 is directly translated to the collet segments 42.

The apparatus 10 as described hereinabove allows axial alignment of the shaft 30 of the apparatus 10 within the end fitting 20. The shaft 30 of the apparatus 10 may be adapted to support a tool and thereby convey axial alignment to the tool. The various tools may be positioned in appropriate places on the apparatus to allow work on the end fitting to be carried out. In an exemplary embodiment, as shown in Fig. 2, the shaft 30 is adapted to support a set of lapping tools 90, 92 positioned to refinish the radial seal 21 and/or the flat face seal 22 of the end fitting 20. In this embodiment, the shaft 30 is hollowed along the length of its axis (shown coaxial with the axis 25 of the end fitting 20) to accommodate a lap arbor 95 extending beyond each end 32, 34 of the shaft 30. The lapping tools 90, 92 are supported by the arbor 95 adjacent the inward end 32 of the shaft 30. An operator (not shown) is able to control the lapping tools 90, 92 by appropriate means such as a handle 97 attached to the arbor 95 adjacent the outboard end 34 of the shaft 30. To rework the sealing surfaces 21, 22, the end of the shaft 30 supporting the lapping tools 90, 92 is placed in the end fitting 20 and is adjusted into axial alignment within the end fitting 20 by means of tightening the collet nut 80 to force the collet segments 42 into binding engagement with the inner surface 60 of the end fitting 20. This axially aligns the lap arbor 95 with the end fitting and positions the lapping tools 90, 92 orthogonal to the axis 25 of the end fitting 20. To begin the lapping procedure, the tools 90, 92 are advanced by the arbor 95 to be in contact with the seal to be reworked. It is to be understood that other tool arrangements may be used with the aligning apparatus of the present invention. For example, lapping tools may be positioned on the outer end of the shaft to rework the E-face 23 seal of the end fitting.

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

1. An apparatus for axial alignment within a fuel channel end fitting of a nuclear reactor, the apparatus comprising:

a shaft comprising an inward end for insertion into the fuel channel and a smaller outboard end opposite the inward end, the inward end comprising a predetermined taper, the taper being positioned to taper toward the outboard end of the shaft; and,

a mating expanding collet arrangement comprising a plurality of collet segments supported on the taper and arranged concentrically about the shaft, each collet segment adapted to move radially outwardly from the shaft when the taper is inserted into the collet;

wherein when the inward end of the shaft is inserted into the fuel channel, the collet arrangement is forced radially outwardly to bind with the inner surface of the fuel channel such that the shaft is in axial alignment within the fuel channel end fitting.

2. The apparatus as defined in claim 1 wherein the taper is inserted into the collet arrangement by the force of a collet nut threadingly engaged on the shaft and acting against the collet segments.

3. The apparatus as defined in claim 2 wherein the collet nut is in engagement with the collet segments.

4. The apparatus as defined in claim 1 wherein the collet arrangement comprises three collet segments.

5. The apparatus as defined in claim 1 wherein the shaft is adapted to carry a tool.

6. The apparatus as defined in claim 5 wherein the tool is a lapping tool.

7. An apparatus for supporting a lapping tool in position relative to the axis of a fuel channel end fitting of a nuclear reactor, the apparatus comprising:

a shaft comprising an inward end for insertion into the fuel channel and a smaller outboard end opposite the inward end, the inward end comprising a predetermined taper, the taper being positioned to taper toward the outboard end and a threaded portion, adjacent the taper;

a mating expanding collet arrangement comprising a plurality of collet segments supported on the taper and arranged concentrically about the shaft, each collet segment adapted to move radially outwardly from the shaft when the taper is inserted into the collet;

a collet nut threadingly engaged on the threaded portion of the shaft and moveable along the shaft to act against the collet segments and insert the taper into the collet arrangement; and,

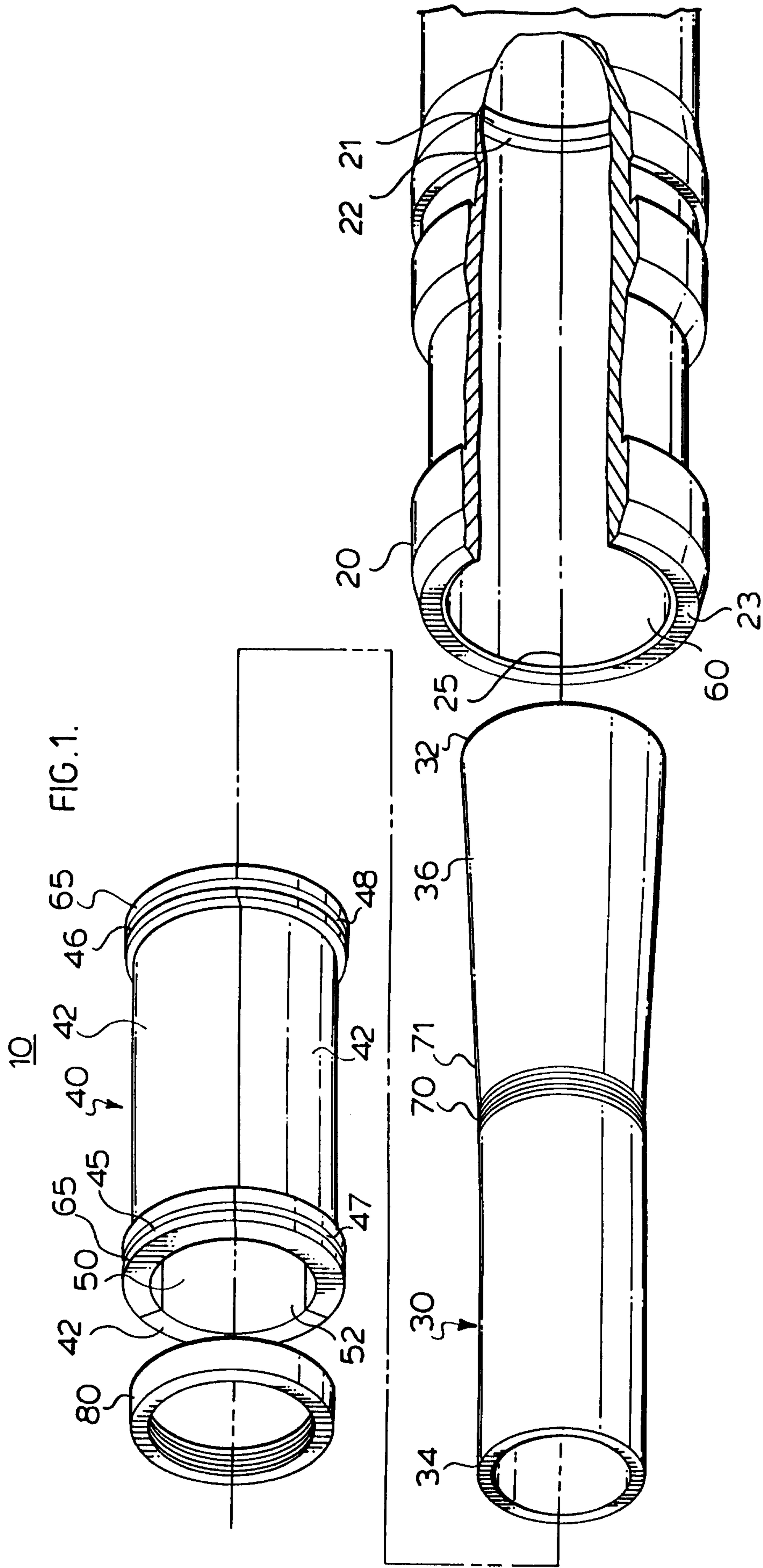
wherein the shaft is adapted to carry the lapping tool; and,

wherein when the inward end of the shaft is inserted into the fuel channel, the collet nut is advanced along the shaft to force the collet arrangement radially outwardly to bind with the inner surface of the fuel channel such that lapping tool is in position relative to the axis of the fuel channel end fitting.

8. The apparatus as defined in claim 7 wherein the inward end of the shaft is adapted to carry the lapping tool and the shaft is hollowed along its axis to accommodate a lap arbor for controlling the lapping tool.

9. The apparatus as defined in claim 7 wherein the collet arrangement is adapted to bind with the inner surface of the fuel channel at at least two binding surfaces.

10. The apparatus as defined in claim 9 wherein the collet arrangement is maintained on the shaft by a pair of O-rings encircling the collet arrangement.



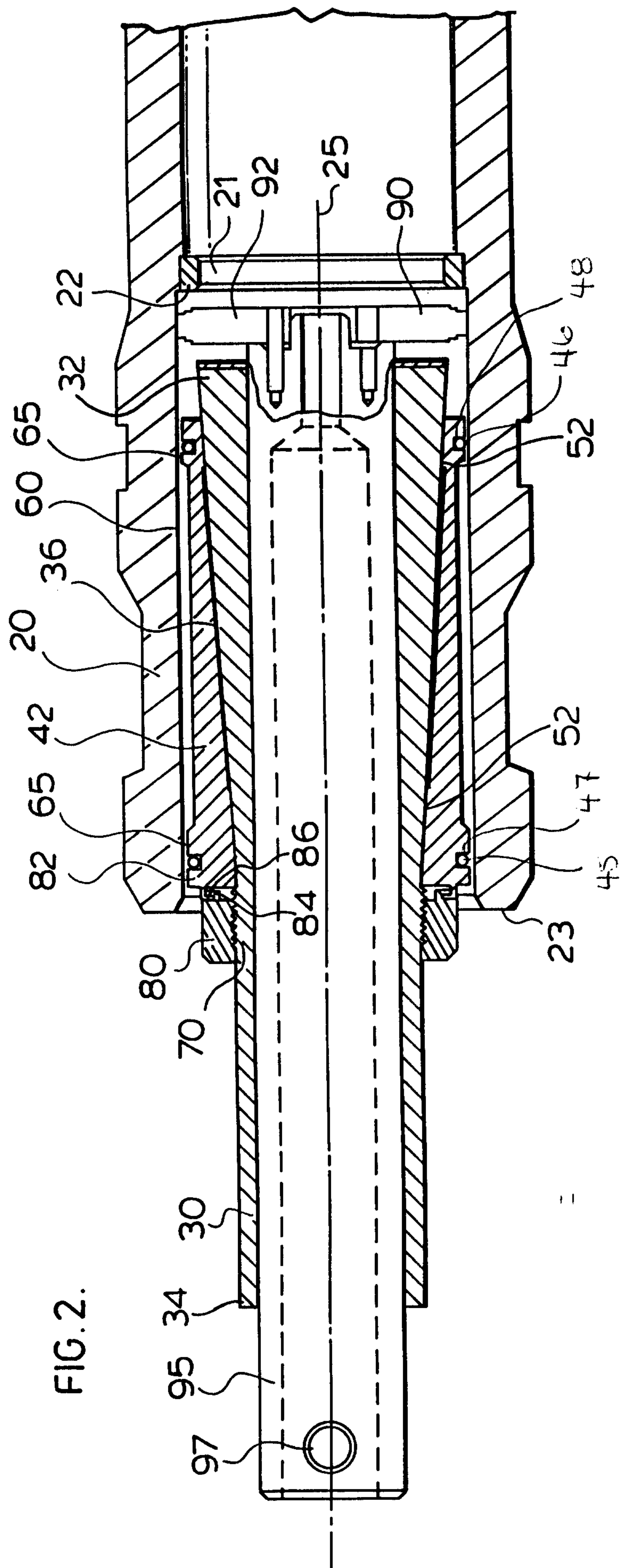


FIG. 2.

