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STRUT - NODE JOINT CONJUGATES FOR THE ASSEMBLY OF SEMI-PERMANENT OR REUSABLE TRUSS STRUCTURES

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ABSTRACT

INTRODUCTION

When strut and node components are used for truss construction an assembly problem occurs if a strut must be fitted between nodes whose separation distance is either closer or farther than the design intended. This condition is the result of normal dimensional variations that occur in any manufacturing process. In such circumstances two actions would permit continued assembly:

1. Change the effective strut length.
2. Move the nodes.

Assuming continued assembly is the most attractive alternative, attention is focused on accomplishing these actions as part of the assembly process.

DISCUSSION

Existing strut-node systems solve the assembly problem in a variety of ways. Manufacturing accuracy and material elasticity minimize the problem, especially for small manually assembled truss structures where necessary forces and reactions can be applied by hand. Large and (or) rigid structures require mechanisms to assist in accomplishing one of the two necessary actions. A common method depends on lateral forces applied to "ramp" the strut axis into position between nodes [ref. 3]. When sufficient lateral force is difficult to apply or react, a variable length strut can be used to fit between nodes or apply axial force. This approach permits a choice of several mechanisms that can transmit force and energy to actuate axial displacement. Such systems are available commercially [ref 1]. Others have been designed for special applications [references 2 thru 6].

Dimensional integrity is a necessary requirement of a truss in most applications. Variable length struts are usually preloaded at the joints against a reference length in an attempt to maintain the desired dimension. As a byproduct they can pull the nodes together or push them apart but most cannot do both.

DEFINITIONS

Double action shall be taken to mean the ability of a variable length strut to fit between nodes spaced either too close together (push) or too far apart (pull) and preload against a reference length in both cases [references 2 & 5].

Single action provides the same capability if nodes are too close together or too far apart but not both [ref 1,3,4 & 6].

DESCRIPTION

Three concepts have been pursued to a point where "Invention Disclosures" were submitted to the LaRC Patent Office:

1. SIMPLIFIED DOUBLE ACTION MECHANISM TO PRELOAD STRUT AND NODE JOINTS IN THE ROBOTIC ASSEMBLY OF TRUSS STRUCTURES (Figure 1).

   Objective - preload mechanism for strut-node truss joints that:

   a) allows parametric variation over a wide range of envelope configurations, preload forces, and preload displacements,
   b) provides for double action (both push and pull) from a single drive interface to facilitate automated assembly,
   c) has simple easily manufactured cylindrically shaped components to reduce production costs,
   d) is compatible with currently available knob-end and pocket-scar joint conjugates.

2. SLOTTED NODE & T-BAR JOINT FOR ASSEMBLY OF TRUSS STRUCTURES submitted with M. D. Rhodes (Figure 2).

   Objective - node and conjugate strut ends that:

   a) are compact having a high packaged density for shipping,
   b) will work with double or single action push/pull mechanisms,
   c) allow each attachment site to be approached from two sides,
   d) guide an approaching strut end toward capture of the node,
   e) locate strut axis on node center when the preload is applied,
   f) prevent rotation about any axis.

3. SIMPLIFIED DOUBLE ACTION TRUSS STRUT JOINT (Figure 3).

   Objective - double action strut ends that:

   a) are simple to use and inexpensive to manufacture,
   b) can be used in architectual and structural applications,
   c) will extend to allow automated assembly possibilities.

REFERENCES

[1] Meroform M 12:
Trade name of MERO - Raumstruktur GmbH & Co.
Wurzberg, West Germany.

[2] Gralewski, M.
"Development of Joint Connector Model and Associated End Effector Concept for Automated Assembly of Large Space Truss Structures", Contract No. NAS1-17536, Doc. No. 36120-114, Astro Aerospace, Carpenteria CA 93013-2993, 2/29/88

[3] Final Report, " ... same as title above ... ", Response to AS&M RFP 18235-39-092887, Honeybee Robotics, New York NY 10002, 1988

[4] Everman, M. R.
"Final Report on the ASMI End Effector", AECR88336/429, Able Engineering Company, Goleta CA 93116-0588, 3/11/88

[5] Stout, D. A.
"Joint Connector Concept", D-300-01-001, Jewett Automation, 2/8/88

[6] Wesselski, C. J.
"Space Station Lock Joint", Div/Off ES22, Johnson Space Center, Houston TX

[7] Rhodes, M. D., Will, R. W., Wise, M. A.
"A Telerobotic System for Automated Assembly of Large Space Structures", NASA Technical Memorandum 101518, LaRC, Hampton VA 23665, 3/89

Double Action
Preload Mechanism:

TURNBUCKLE

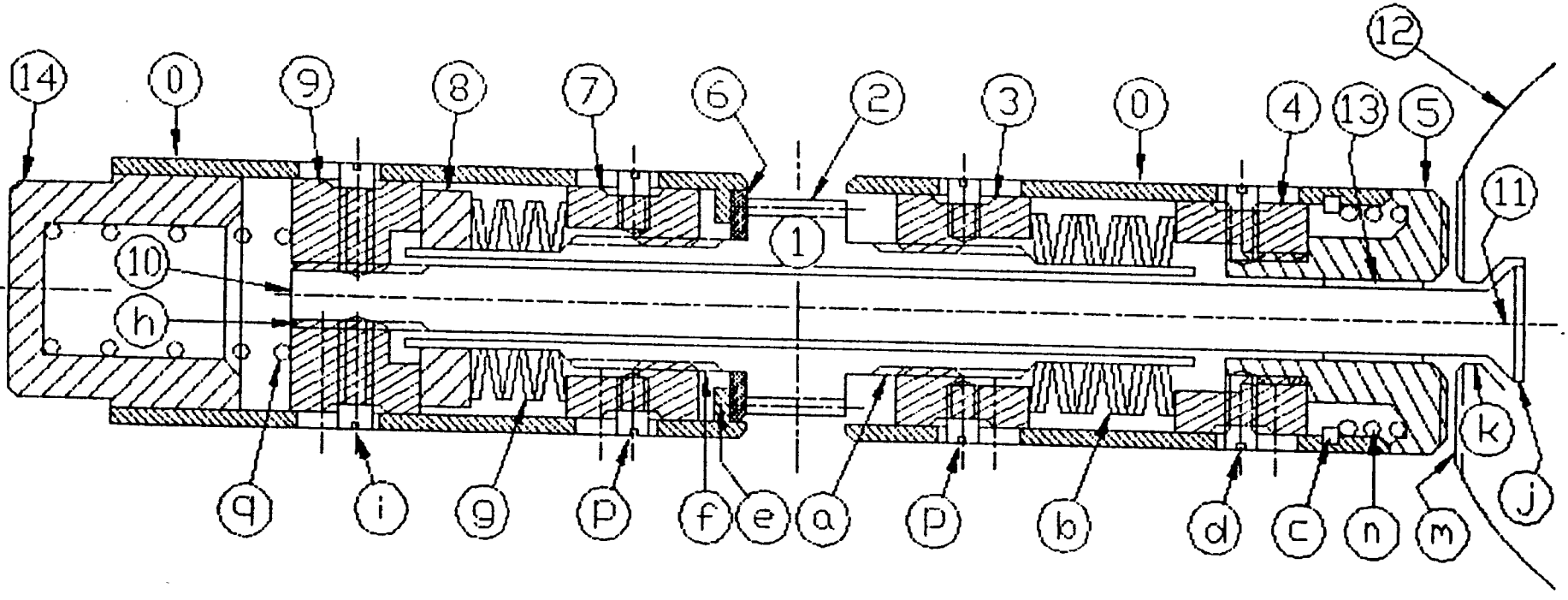

Figure 1

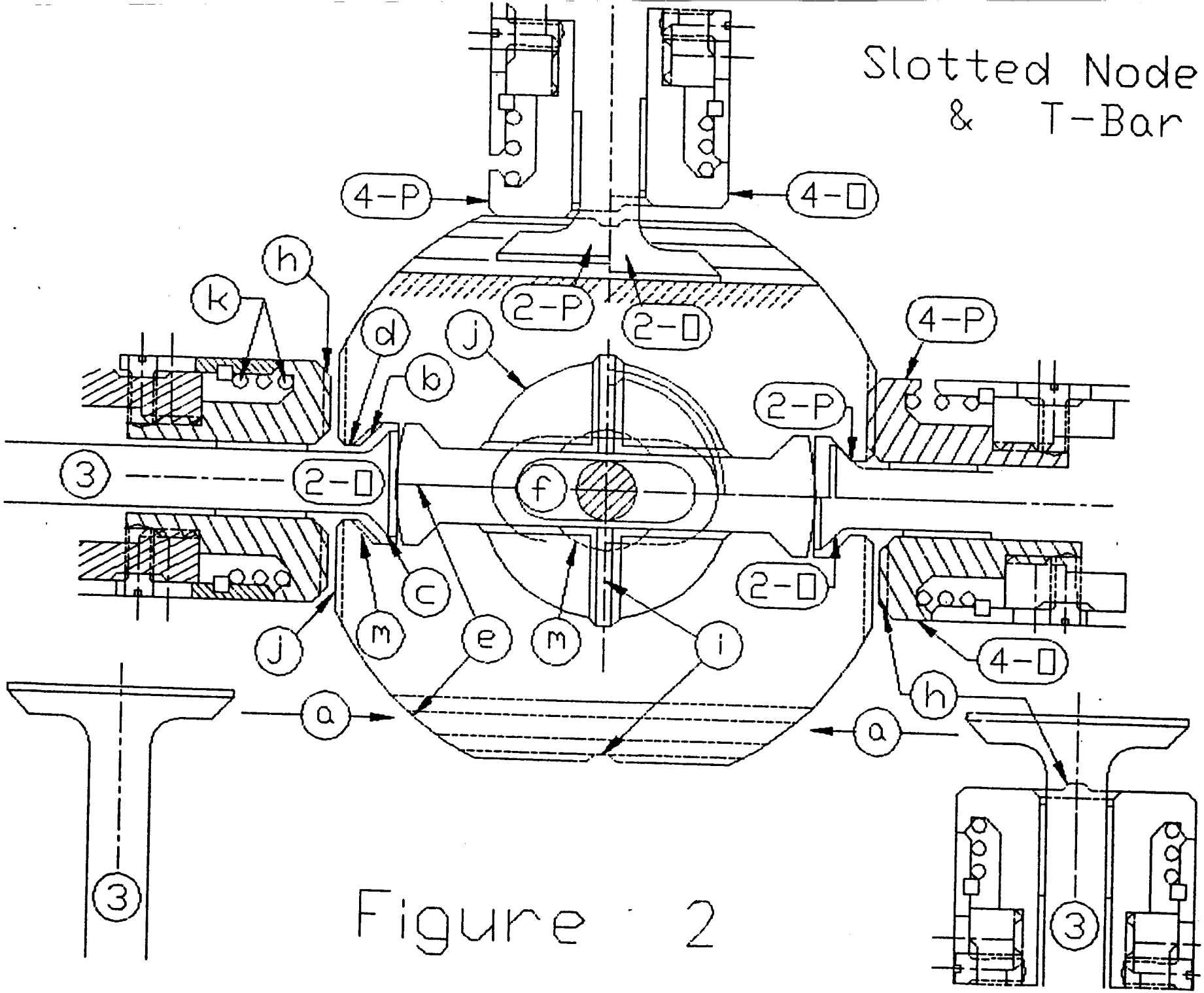

Figure 2

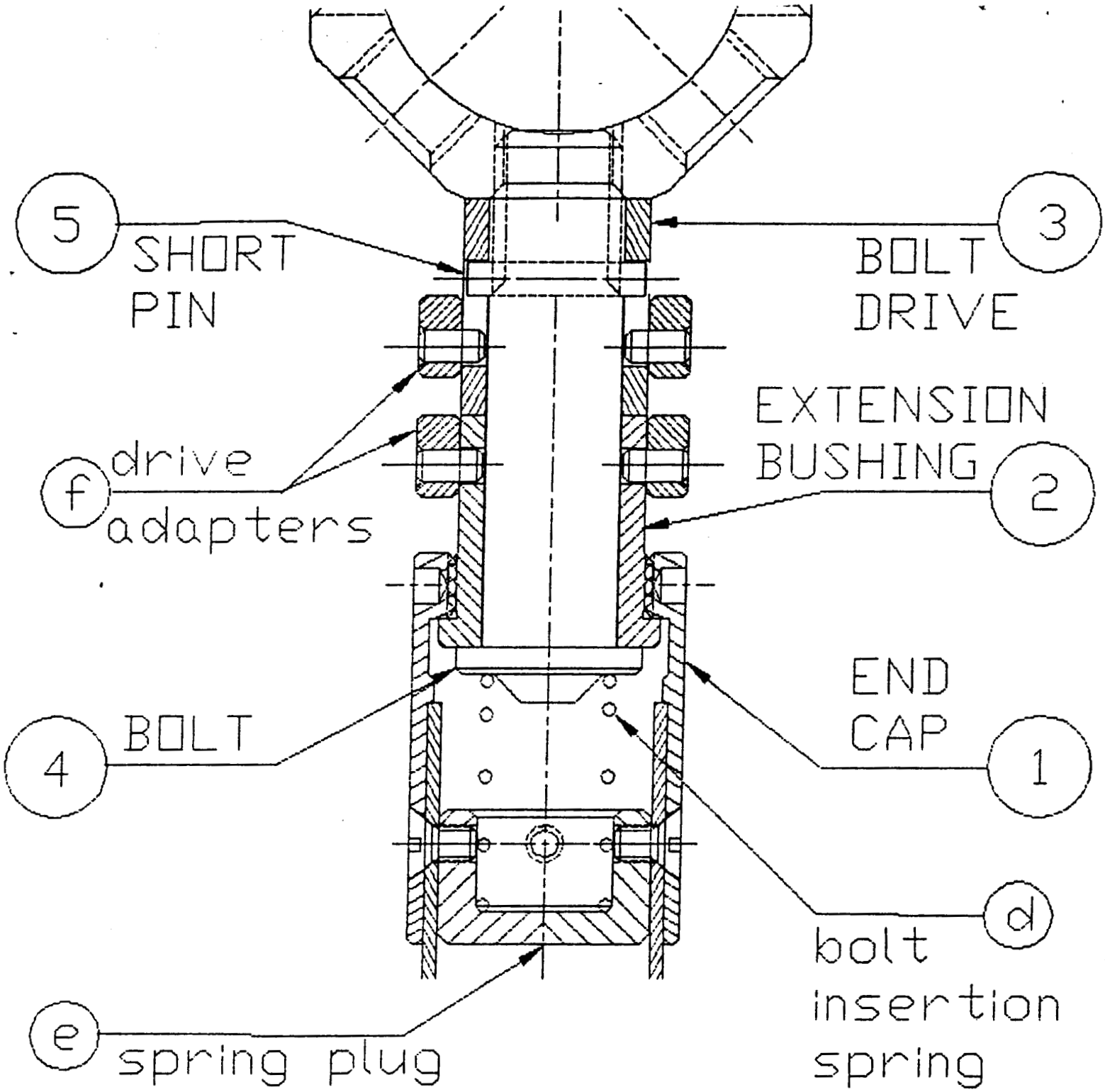

figure 3 - with Adaptive Collars