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TEMPERATURE-COMPENSATED CLAMP SEAL

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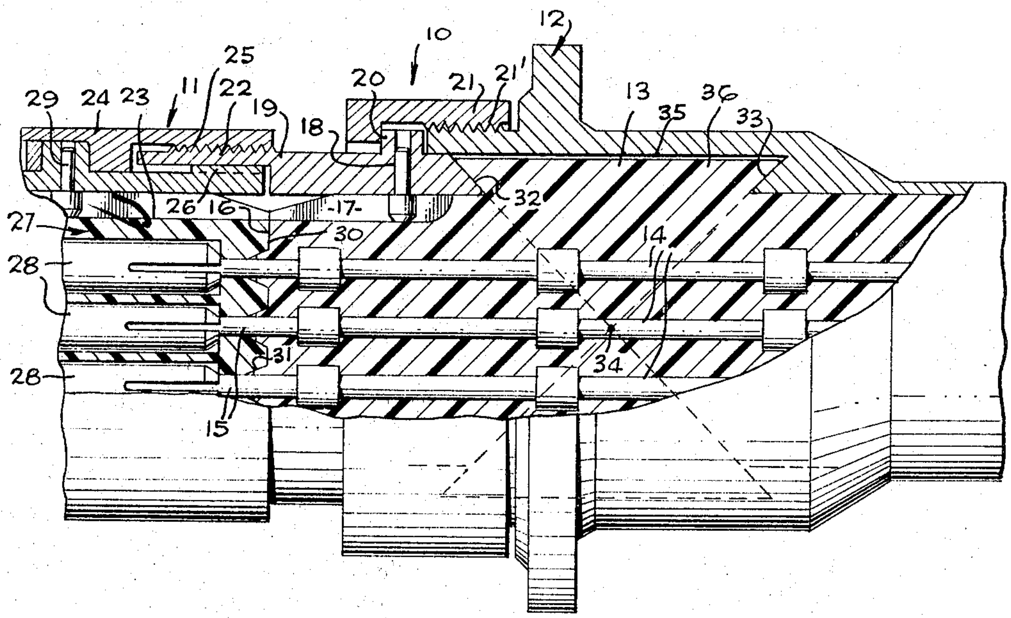

Fig. 1

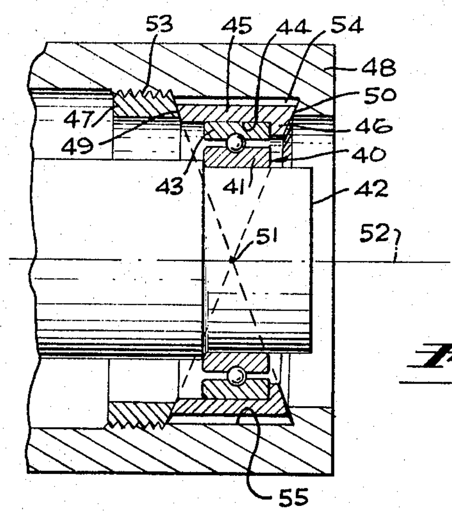

Fig. 2

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TEMPERATURE-COMPENSATED CLAMP SEAL

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This invention relates generally to temperature compensation of interfitting bodies, and more particularly has to do with preventing undesirable variation of clamping force transmission between interfitting members when subjected to temperature change, the members having different temperature coefficients of expansion.

When coaxial members having different temperature coefficients are clamped together at an axially tapering interface, the clamping force transmission will in general vary with temperature. This may be considered to result from the fact that the radial components of the clamping force are directly affected by unequal growth or shrinkage of the clamped members. In addition, axial components of the clamping force may be affected in like manner. Serious problems can arise as for example where the interface is used as a fluid seal, leakage of the seal developing when the clamping force transmissions drops below the fluid pressure acting at the seal, in response to temperature change. Accordingly, a need exists for a mechanism characterized in that relative thermal expansion and contraction of members clamped together at a tapered interface will not result in appreciable variation of the clamping force transmission at the interface.

The present invention meets this need, and may be considered as solving the referred to problem, through the provision of a novel clamp assembly broadly comprised of substantially coaxial members clamped together at first and second coaxial interfaces having apices proximate the same location, typically on the member common axis. Typically, the interfaces are re-entrant and taper axially oppositely with equal angularity. Thus, when an outer tubular member is made to comprise metal such as steel and an inner member to comprise hardened plastic such as molded tetrafluoroethylene, temperature variation will not appreciably affect the clamping force transmission at the re-entrant interfaces.

Additional objects of the invention include the provision of a novel electrical connector incorporating the invention, as well as a novel bearing incorporating the invention.

These and other objects and advantages of the invention, as well as the details of an illustrative embodiment, will be more fully understood from the following detailed description of the drawings, in which:

FIG. 1 is a cross section through an electrical connector incorporating the inveniton; and

FIG. 2 is a cross section through a bearing assembly incorporating the invention.

Referring first to FIG. 1, the novel electrical connector is shown to include a receptacle means generally designated at **10** and a plug means generally designated at **11** as being electrically and mechanically connected with the receptacle means.

The receptacle means is shown to include a tubular housing **12** containing an insert member **13**, which in turn contains a multiplicity of pins **14** the terminals of which project at **15** from the end face **16** of the insert. Typically, the insert may be formed of the hardened thermosetting plastic material such as molded tetrafluoroethylene. The circular cross section insert is longitudinally or axially grooved at **17** for the reception of the head of a key **18** the remainder of which is carried by a tubular retainer **19** which is received over the terminal end of

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the insert. The retainer is externally and circularly flanged at **20** to carry a nut member **21** which has threaded connection to the receptacle **12** at **21'**.

The projected skirt portion **22** of the retainer **19** fits concentrically between plug members **23** and **24**, the latter having thread connection with the skirt portion at the location **25**. The inner member **23** is typically keyed to the skirt portion at the location **26** to accommodate relative axial sliding therebetween but resisting turning. This circumstance prevents turning of the socket insert **27** relative to the pin insert **13**, whereby the multiple sockets **28** carried by the insert **27** may maintain registration with the pin terminals **15** during connection and disconnection of the plug and receptacle. Such connection is facilitated by turning of the outer plug member **24** on the skirt portion **22** of the retainer **19**. It will also be noted that the socket insert **27** is keyed at **29** to the plug member **23**. When the plug and receptacle are completely connected as illustrated, the face **16** of the receptacle insert **13** and the face **30** of the plug or skirt insert **27** have frusto-conical interengagement at the locations **31** about the pin terminals **15**, thereby to form a sealing relationship sealing off access of fluid to the pin terminals.

Such access of fluid to the space about the receptacle or pin insert **13** is prevented in the first instance by the seal effected by the temperature compensated clamp assembly which will now be described, this assembly being an important feature of the invention. The assembly may be considered to comprise substantially coaxial members such as members **19**, **12** and **13**, which are clamped together at first and second substantially frusto-conical interfaces, as for example are designated at **32** and **33**. These interfaces are characterized as having apices falling proximate the same location as for example is shown at **34** on the common axis of the members. The interfaces **32** and **33** may be further characterized as being re-entrant as illustrated, as tapering axially oppositely, and as having substantially equl taper angularity. It is chracteristic of this phase of the invention that relative thermal expansion and contraction of the members which are clamped together at the interfaces will not result in appreciable variation of the clamping force transmitted at the interfaces, in spite of the fact that the members have different thermal coefficients of expansion. Accordingly, should fluid gain entrance or access from the exterior past the thread **21** and to the annular gap **35** surrounding the flanged section **36** of the insert **13** such fluid will not be able to pass the seal effected at the clamped together interface locations **32** and **33** in spite of wide temperature changes, provided that sufficient clamping pressure is developed at the interfaces when the plug and receptacle are assembled. Specifically, the nut member **21** may be tightened on the receptacle housing **12** to develop the required sealing pressure. As previously mentioned the insert may comprise a hardened plastic material such as tetrafluoroethylene and the members **19** and **12** may comprise metal such as steel.

Referring now to FIG. 2 a ball bearing is shown at **40** with the inner race **41** thereof mounted on a shaft **42**, and the outer race **43** thereof carried by the bore **44** of a support member **45**. The latter is typically annular and may have a shoulder **46** for locking the outer race of the bearing as illustrated.

The support **45** is shown as clamped between members **47** and **48** and specifically at the interfaces **49** and **50**, these being substantially frusto-conical and having apices proximate the same location such as is shown at **51** on the member common axis **52**. Here again the interfaces **49** and **50** taper axially oppositely and have substantially equal taper angularity. However, the members **45**, **47** and **48** may in general comprise materials having different thermal coefficients of expansion, and as an example the members **45** and **47** may comprise steel, while the housing member **48** may comprise aluminum or an aluminum alloy. In this regard, the member **47** may be threaded into the housing member **48** as shown at **53**.

It is again characteristic of the interfaces **49** and **50** that relative thermal expansion and contraction of the members **45, 47** and **48** will not result in appreciable variation of clamping force transmitted at the interfaces, and accordingly the support **45** will not become loosened due to temperature change. It is also seen that the gap **54** provided by the support **45** and the bore **55** of the housing member **48** allows for coaxial mismatch as between the housing **48** and the shaft **42**. However, once the nut member **47** is tightened into the housing the bearing has fixed location and temperature change will not appreciably affect the clamping force transmitted at the interfaces **49** and **50**.

I claim:

1. A temperature compensated clamp assembly including the combination of

a plurality of coaxial members having different thermal coefficients of expansion,

said members being clamped together at first and second re-entrant frusto-conical interfaces,

said first and second interfaces tapering axially oppositely and having apices proximate the same location on the axis whereby relative thermal expansion and contraction of said members will not result in appreciable variation of the clamping force transmitted at said interfaces.

2. A temperature compensated clamp assembly including the combination of

a plurality of coaxial members having different thermal coefficients of expansion,

said members being clamped together at first and second re-entrant frustro-conical interfaces,

said first and second interfaces tapering in axially opposite directions at substantially equal angles and having apices proximate the same location on the axis whereby relative thermal expansion and contraction of said members will not result in appreciable variations of the clamping force transmitted at said interfaces.

3. A temperature compensated clamp assembly including the combination of

a plurality of coaxial members having different thermal coefficients of expansion,

said members including a hardened plastic insert and tubular metallic bodies containing said insert,

said insert and said tubular bodies being clamped together at first and second re-entrant frusto-conical interfaces,

said first and second interfaces having apices proximate the same location on the member axis whereby relative thermal expansion and contraction of said members will not result in appreciable variations of the clamping force transmitted at said interfaces, and

a gap at the periphery of a flanged section of said insert, said flanged section being disposed between the first and second interfaces.

4. A temperature compensated clamp assembly including the combination of

a plurality of coaxial members having different thermal coefficients of expansion,

said members including a hardened plastic insert and tubular metallic bodies containing said insert,

an electrical terminal structure embedded in said insert,

said insert and said tubular bodies being clamped together at first and second re-entrant frustro-conical interfaces, and

a gap at the periphery of a flanged section of said insert, said flanged section being disposed between the first and second interfaces,

said first and second interfaces having apices proximate the same location on the member axis whereby relative thermal expansion and contraction of said members will not result in appreciable variations of the clamping force transmitted at said interfaces.

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