Nov. 4, 1941. R. C. YEOMAN 2,261,602

LOAD TRANSFER DEVICE

Filed Aug. 15, 1939 2 Sheets-Sheet 1

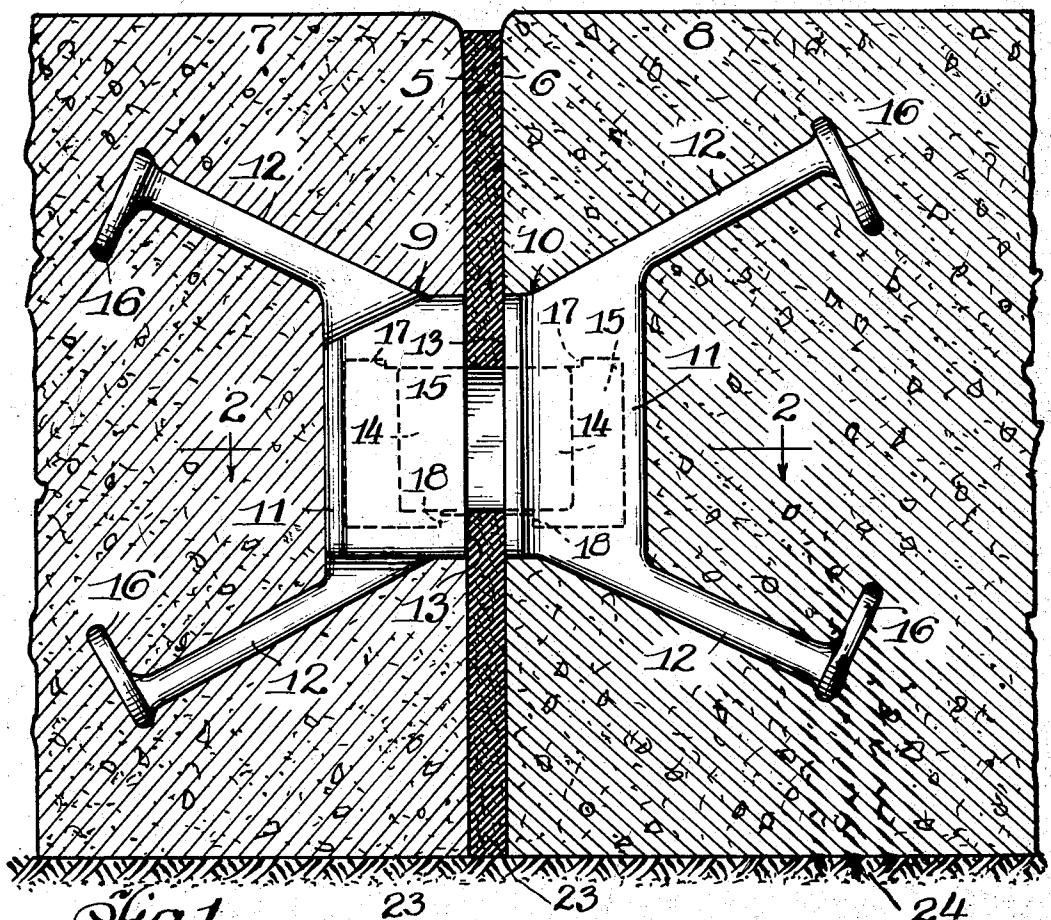


Fig. 1

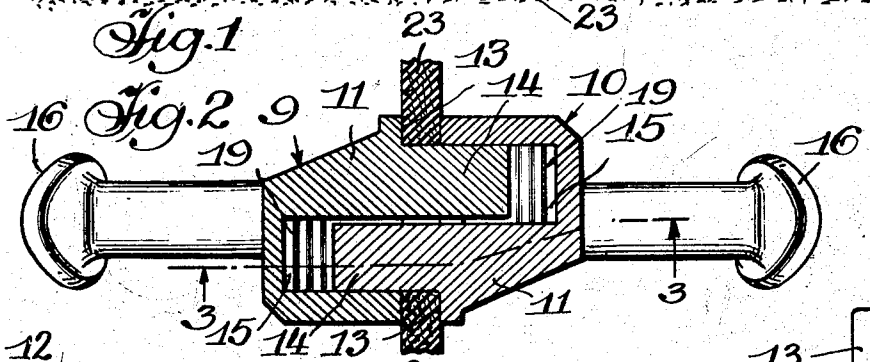


Fig. 2

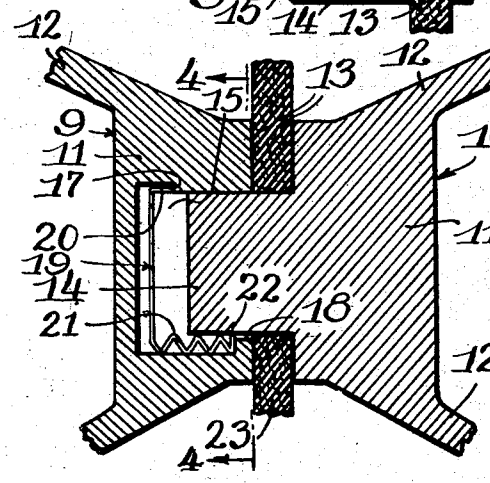


Fig. 3

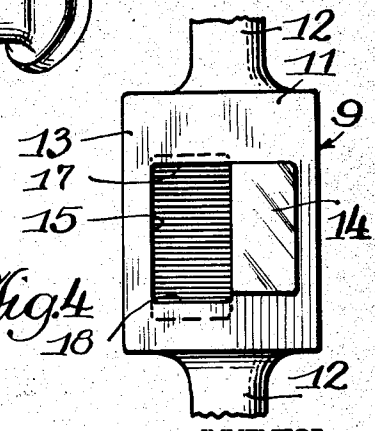


Fig. 4

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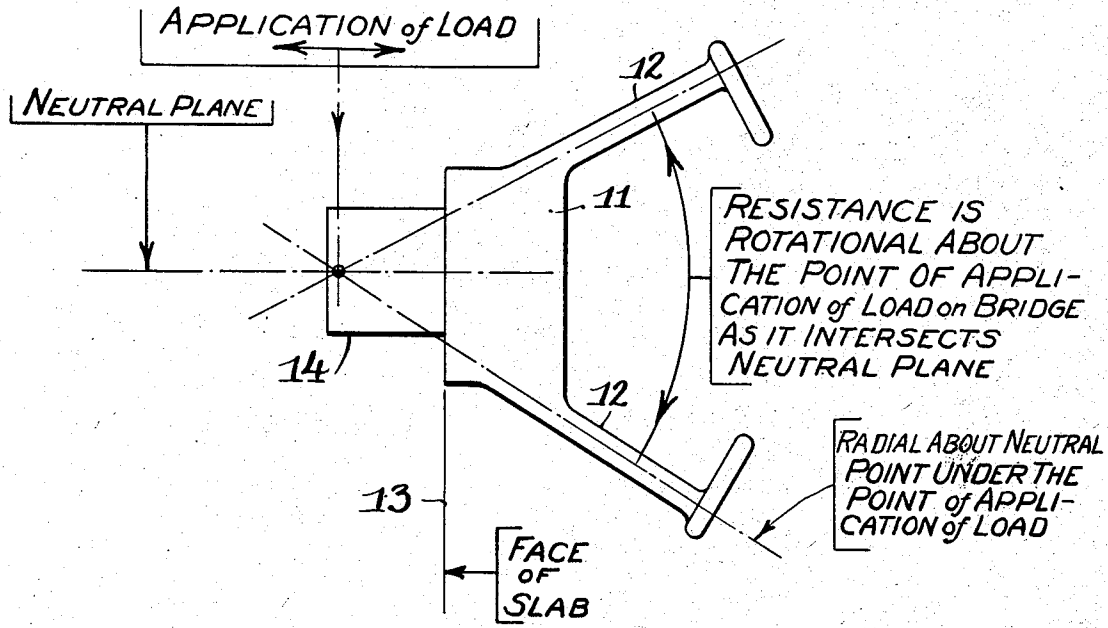
ATTORNEY.

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LOAD TRANSFER DEVICE

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Fig. 5



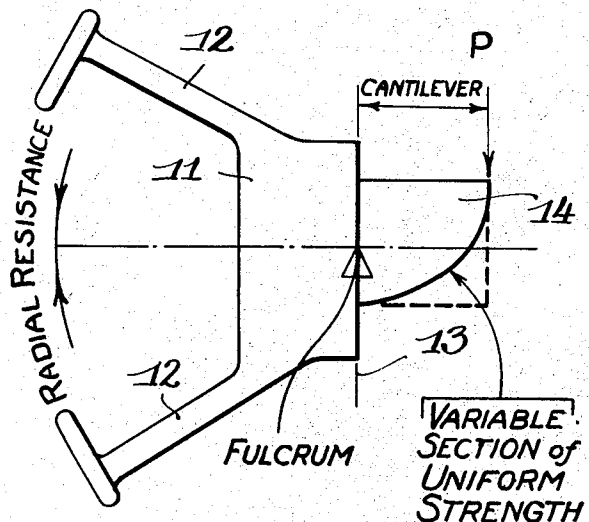
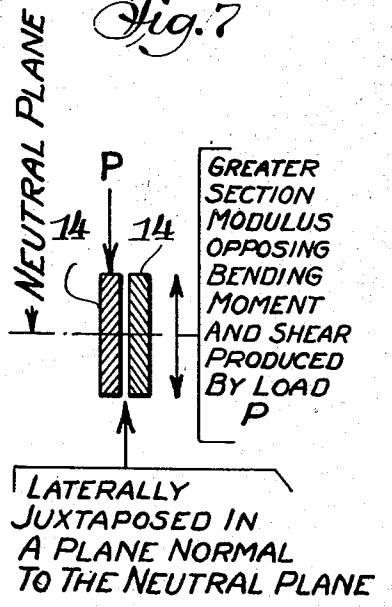


Fig. 6

Fig. 7



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Patented Nov. 4, 1941

2,261,602

UNITED STATES PATENT OFFICE

2,261,602

LOAD TRANSFER DEVICE

Ray Cyrus Yeoman, Chicago, Ill., assignor to Texas Foundries, Inc., Lufkin, Tex., a corporation of Texas

Application August 15, 1939, Serial No. 290,261

6 Claims. (Cl. 94—8)

My present invention relates to the construction of bridges, masonry and other concrete structures, and particularly to the building of concrete pavements, and more particularly to an improved load carrying unit adapted to replace the common dowel to adequately provide for transmitting a concentrated load across the space intervening between the end faces of adjoining concrete road slabs.

In the building of concrete pavements, engineers have been confronted with the problem of maintaining the surface of the concrete smooth and uninterrupted by breaks and blow-ups occasioned by the relative movement of the adjoining slabs. More and more the pavement is being originally constructed in relatively short slabs, as it has been found that long ribbons of concrete ultimately break up into relatively short slabs which readily disintegrate due to lack of reinforcement at the joint face. When constructing a concrete pavement comprising a series of short adjoining slabs, it has been found necessary to bridge across the space intervening between the slab ends, to reinforce the slab ends to prevent curling, and primarily to carry the imposed loads of vehicular traffic from one slab to the next adjoining. The common dowel has been used extensively for this purpose. Many have provided means for reinforcing the common dowel when imbedded in the slab. But the common dowel, when subjected to repeated load, is likewise subjected to reversal of stress under load, regardless of its reinforcement. The constant and repeated reversal of stress in any metallic bar is fatiguing and ultimately leads to the complete destruction of the bar and renders it useless as a load transfer element.

Therefore, the primary object of my invention is to provide a device which when placed in series and at intervals along the slab edge and when anchored into the end faces of the adjoining concrete slabs, will support the slab ends against transverse local bending when acted upon by a load applied to one or both slabs and over any one or all of the devices in the series; and further,

To produce a two-piece structure of counterpart and complemental members identical in construction—duplex, i. e. having but two parts that operate at the same time and in the same way, whereas the common dowel—the simpler form—has but one; and,

To devise a structure which is self-aligning and adaptable to self adjustment to the irregularities presented in field assembly occasioned by improper placement or displacement during the building of the pavement; and

To provide a structure which is not susceptible to excessive wear, corrosion or freezing due to erosion or corrosion of the component parts; and

To construct each part of the device as a single casting which may be inter-changeable when used in pairs, inexpensive, simple and durable; and

To minimize the machining or tooling required to effect bearing surfaces; and

Particularly to eliminate any clearance between bearing surfaces and thus to accomplish maximum bearing instantly upon the application of load; and

To eliminate destructive stresses and strains occasioned by the wedging action due to the lateral misalignment of the unit; and

To provide a unit which is adaptable to the inclusion of an expansion element between the end faces of the adjoining slabs to keep the concrete constantly under compression as disclosed in my co-pending application, Serial Number 180,290; and

To produce a cantilever type bridging element which eliminates and has no reversal of stress under load as the load crosses the joint as is the case of any dowel whether or not it is in bearing; and

To reduce the high bearing stresses existing at the edge of the slab by providing a greater bearing area in contact with the material of the slab; and

To minimize the high edge stresses by virtue of radiating anchors adapted to absorb, transmit and distribute the load to and within the slab; and

To reduce the deflection of the bridging member by reducing the effective length of the bridging member; and

To increase the load transmission capacity of the bridging member by virtue of its cross section and reduction in length; and

To provide an air chamber at the end of the bridging member so that the slabs may freely move without obstruction by the bridging and load transfer member; and

To produce a unit which is also adaptable for installation where one slab is poured at a considerably later period than the adjoining slab whereby the companion units may be affixed at a subsequent date without destroying the efficiency of the load transfer; and

To give to the engineer an inexpensive, simple, durable, positive action, two-piece construction

load transmission unit which requires no great skill or expensive equipment to install, make, or use, and which may be permanently sealed; a load transfer device for holding the ends of adjacent concrete road slabs in surface alignment while providing for the relatively lateral expansion and contraction thereof.

My present invention has these and other objects, all of which are explained in detail and may be more readily understood when read in conjunction with the accompanying drawings (two sheets) which illustrate a preferred embodiment of my invention, it being manifest that changes and modifications may be resorted to without departure from the spirit of the claims forming a part hereof.

In the drawings:

Fig. 1 is a fragmentary vertical section through the ends of horizontally disposed adjoining concrete road slabs showing my device in elevation;

Fig. 2 illustrates a section on line 2—2 of Fig. 1;

Fig. 3 is a sectional view on line 3—3 of Fig. 2;

Fig. 4 is an elevation taken on line 4—4 of Fig. 3; and

Figs. 5, 6 and 7 are diagrammatical presentations of the elementary functions inherent to my invention.

The structure illustrated involves the specific application of one form of my invention to a roadway slab. For purposes of description only, I choose to so define my invention as applied to this particular construction; however, I wish it understood that my invention is equally effective when adapted or used in any poured or precast structure, whether it be a roadway slab, retaining wall, swimming pool, reservoir, canal lining, warehouse floor, dock, industrial plant, sidewalk, driveway, airport runway, bridge, etc., for, as a matter of fact, it is applicable to an almost unlimited number of structures. And while I describe my invention in its preferred embodiment, it is to be further understood that the words which I use are words of description and not of limitation. Reference characters refer to similar parts throughout the several views of the drawings.

My invention contemplates a load transfer device for bridging a gap between the adjacent ends of two horizontally disposed and aligned concrete slabs 7 and 8 with opposed end faces 5 and 6, and comprises two counterpart and relatively reversed rigid members 9 and 10 having their major parts respectively imbedded in the two slabs, positioned at substantially mid-depth of the slabs, having their major axis parallel with the top surface thereof, normal to the plane of the joint, and spaced in pairs at intervals throughout the width of the slab.

Each bridge or unit which preferably comprises the pair of malleable castings 9—10 is duplex in character; they are complemental to each other—interchangeable. The casting for the bridge member 9 may be made from the same pattern as is the casting for the bridge member 10.

Each casting or major part comprises a cup-like sleeve portion 11 opening at the end of the slab in which that part is imbedded and having the axis of its bore 15 horizontal and at right angles to its respective slab end.

A pair of integral arms 12, so called load-transmittal elements, diverge away from the open end of the cup-like portion 11, and are symmetrically arranged with respect to a horizontal plane at right angles to the slab end. The outer face 13 of the sleeve 11 preferably is cast flush with the end face of its companion slab as shown, and the anchors 12 extend back into the body of the slab, preferably both above and below the neutral plane of the slab.

From the face of the hub projects an integral tongue-like portion or bridge 14, positioned directly adjacent and parallelly disposed to the axis of the bore of the cup-like portion 15. The bridge is adapted to project beyond the mouth of the cup-like portion and extend into and slidably engage the bore of the cup-like portion of the counterpart member.

In cross section both the bridge and the sleeve are rectangular, and in dimension the bridge is slightly smaller than the internal dimensions of the sleeve. The outer end of each radiating anchor or arm 12 is terminated in a foot or shoe 16 to provide a substantial key to the concrete.

Referring particularly to Fig. 3 of the drawings, it will be seen that the cup-like sleeve portion generally designated 11, extends back from its face 13, and the bore 15 is enlarged back of this face which establishes a shoulder 17 in its top wall and a similar shoulder 18 in its bottom wall. Into this sleeve is fitted a spring member 19 adapted to conform in general with the contour of the bore, the spring has its top portion 20 flanged outwardly to impinge and lock against the shoulder 17 and likewise has its bottom portion 21 flanged outwardly but in a serrated pattern to impinge and lack against the shoulder 18 within the bore 15. The end 22, of the bottom portion of the spring 21 is adapted to extend upwards a slight distance above the face of the recess and a slight distance above the tops of the serrations of the spring portion 21, thus presenting a part of the spring in the air space between the end of the bridge and the rear wall of the cup-like portion 11, and another part of the spring alongside of the bridge (Fig. 3).

Operation

In operation, two identical units 9 and 10 are usually employed. As a pair they are duplex in character, design and function. Each has two complemental parts—the bridge 14 and the sleeve 11. Each operates at the same time in the same way, that is, the bridge 14 on one and the bearing seat on the other act or co-operate simultaneously, thus differentiating from the common dowel—the simpler form, and likewise differentiating from those structures employing the use of a dowel in assembly.

As shown at Fig. 1 a strip of asphalt, saturated felt or joint member 23 is placed in the gap between the end faces 5 and 6 of adjacent concrete road slabs 7 and 8 (I have shown this particular type of joint member for illustration only, as any of the well known designs of joints such as the air cushion metallic joint, rubber joint or metal plate may be employed with equal effect). Openings are made in the joint member through which openings pass the bridges 14 as a pair of units 9 and 10 are assembled one on each side of the joint member with their respective faces 13 flush with and tightly locked against the outer walls of the joint member. The bridge 14 of the unit 9 entering the sleeve 11 of the unit 10 and the bridge 14 of the unit 10 entering the sleeve 11 in the unit 9. And the units are cast to the slabs in this relationship.

It should be particularly noted that in assembly the top surface of the bridge has direct bearing against the inside top or bearing surface of the sleeve; any clearance whatsoever between these members is on the sides and bottom. There be-

ing no clearance between the top surface of the bridge and the internal bearing surface of the sleeve, maximum bearing is constantly maintained as differentiating from the common dowel which has to deflect to seat or find its bearing however so small the clearance be.

For illustration—as the moving wheel load passes from the slab 7 towards and onto the slab 8, slab 7 deflects, the load is picked up by the unit 9 and carried across the joint on the bridge 14 of the unit 10. When the load continues on and passes over the joint to slab 8, the unit 10 picks up the load which in turn is carried back and distributed into the slab 7 through the bridge 14 on the unit 9. There is here a reversal, but not a reversal of stress in the bridging element 14 per se. The individual bridging element 14 of each unit, due to its clearance on the bottom and its constant bearing on top carries the load in but one direction only as compared to the common dowel assembly whereby the dowel—a single element—is constantly subjected to a reversal of stress which has been found to be fatiguing and highly detrimental, calling for a greatly increased cross-section and double bearing surfaces.

In assembly and installation it is desirable that the units be affixed to the joint member, the completed assembly then installed on the subgrade 24 as a unit. To do this it is particularly advantageous that the load transfer units be locked or affixed to the joint member in a manner preventing their accidental removal or displacement during this period. I have accomplished this feature by providing the spring 19 in the sleeve portion of each unit. The bottom of the bridging element is adapted to frictionally engage the serrations as well as the flanged end 22 of the spring which exerts pressure against the under side of the bridge and effectively locks the units together regardless of any inequalities in the joint thickness. And as the assembled bridge does not extend the full depth of the bore provided in the sleeve of its complemental unit, an air chamber is established between the end wall of the sleeve and the end of the bridge which permits the slabs to uninterruptedly go and come due to their change in volume, with the consequent expanding and contracting of the joint space between the adjacent end faces of the respective slabs.

Referring particularly to Sheet 2 of the drawings, Figs. 5, 6 and 7, it will be apparent to those skilled in the art that the anchors 12 are in reality radial anchors, radial about their neutral point under the point of application of load P on the bridge 14 which is a point carried even beyond the face of the slab, to thus anchor and distribute the load back from the critical point—the face of the slab. And as the fulcrum point approaches the face of the slab, the load P as it is applied to the cantilever portion or bridge member 14, is distributed into the slab meeting with the rotational resistance of the anchors 12. This resistance is rotational about the point of application of load on the bridge member 14 as it intersects the neutral plane of the installation which usually is mid-depth of the slab. Fig. 7 particularly illustrates the juxtaposed relationship of the assembled bridge members 14 of the units 9 and 10, and graphically displays my statement that these bridging members are lateraly juxtaposed in a plane normal to the neutral plane of installation. Further, this figure illustrates that the greater section modulus of the bridging members opposes the bending moment and shear stresses produced by the loading forces.

It is here mentioned that the cantilever or bridge 14 may be of a variable section of uniform strength as illustrated by Fig. 6. The dotted lines showing its relation to the structure previously shown in Figs. 1 to 5 inclusive.

It is contemplated that the load transfer units may be installed in plastic concrete, cast in situ; and whereas I have not shown the specific structure, I wish it understood that my invention is equally applicable to pre-cast concrete, art marble, imitation stone, glass, terra cotta and other similar products or combinations thereof.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent is:

1. A load transfer device for use in association with adjoining concrete slabs, comprising a pair of spaced sleeves each having a horizontally disposed bore opening at the face of its related slab, each sleeve having a horizontally disposed bridging member, the bridging members extending oppositely and adapted to span a gap between the adjoining slabs, each bridging member extending into and slidably engaging the bottom face of the top wall of the bore of the oppositely disposed sleeve with a clearance between the bottom of each bridging member and the top face of the bottom wall of the oppositely disposed sleeve, said clearance being of a dimension greater than the deflection of the related slab when under normal load, so that a portion of the load applied to either sleeve is imparted in a downward direction only to the opposite sleeve, and means for anchoring each sleeve to its related slab.

2. A load transfer device as per claim 1, which includes independent means for yieldingly latching the bridging member to the bore of the oppositely disposed sleeve, said means being housed within the bore of the sleeve to engage a portion of the associated bridging member.

3. A load transfer device as per claim 1, wherein the means for anchoring each sleeve to its related slab comprises a pair of arms radially disposed about the neutral point under the point of application of load and symmetrical with respect to a horizontal plane normal to the slab face.

4. A load transfer device as per claim 1 wherein the bridging member variably decreases in height from its connection to the sleeve to its free extremity, the variation in height being such that the cantilever beam formed by the bridging member is of uniform resistance at all points in its length to vertical bending underload.

5. A load transfer device for use in association with adjoining concrete slabs comprising a bearing member provided with anchoring means for anchoring the member to a slab, and a bridging member projecting from the bearing member and having parallel side faces, said bridging member variably decreasing in height from its junction with the bearing member to its free extremity, the variation in height being such that the cantilever beam formed by the bridging member has uniform resistance to vertical bending at all points in its length.

6. A load transfer device for bridging a gap between the adjacent ends of two substantially horizontally aligned concrete slabs comprising two complemental rigid members having their

major parts respectively adapted to be imbedded in their related slabs, each major part comprising a cup-like sleeve portion opening at the end of the slab in which that part is imbedded and having the axis of its bore horizontal and at right angles to said slab end, a tongue-like bridging portion horizontally offset from its integral sleeve portion projecting beyond the mouth thereof and adapted to extend into and slidably engage the bore of the sleeve portion of the complemental member, and means for yieldingly latching the tongue of each member in the bore of the sleeve portion of its complemental member, said means consisting of a resilient metal member housed by said sleeve portion and presenting a part thereof in the open bore of said sleeve portion and another part alongside the tongue of its complemental member.

RAY CYRUS YEOMAN.