Dec. 29, 1959 H. J. MODREY 2,919,421

ELECTRIC CONNECTOR FOR CONNECTING TWO CONDUCTORS THROUGH A WALL

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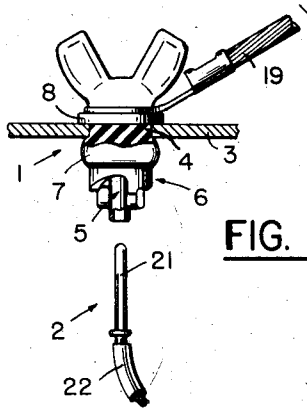


FIG. 1

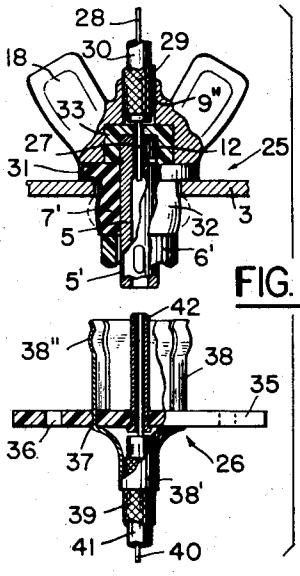


FIG. 3

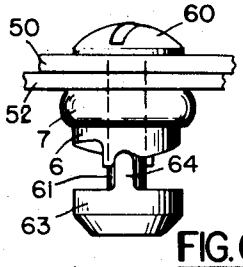


FIG. 6

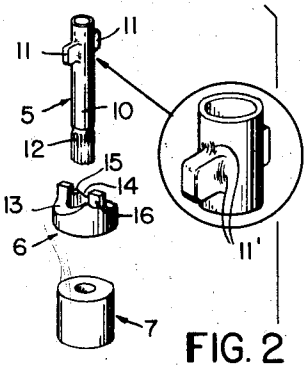


FIG. 2

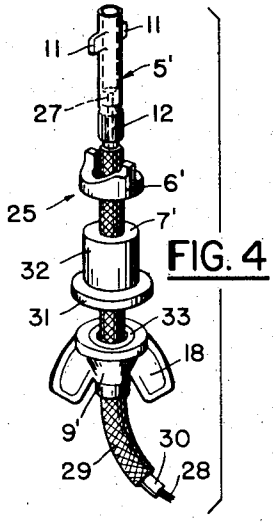


FIG. 4

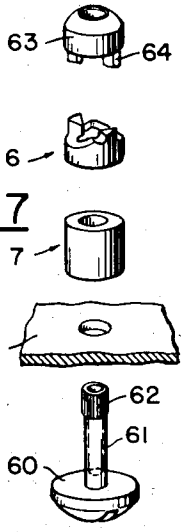
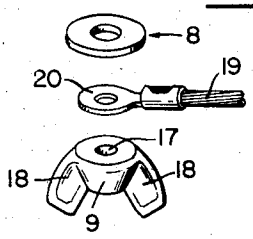


FIG. 7



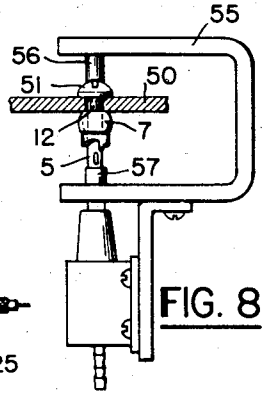


FIG. 8

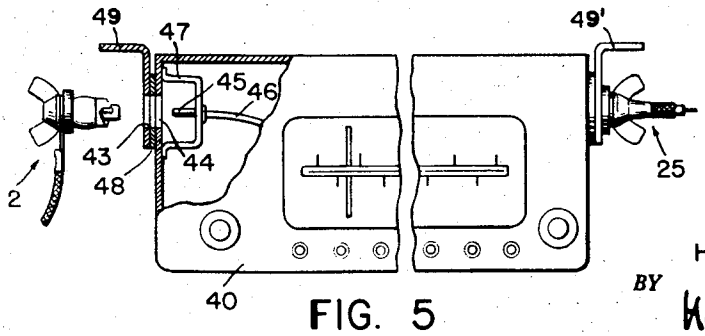


FIG. 5

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ELECTRIC CONNECTOR FOR CONNECTING TWO CONDUCTORS THROUGH A WALL

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5 Claims. (Cl. 339—59)

This invention relates to electric connectors having a plug member and a jack member, and more particularly to electric connectors of this kind for connecting two conductors through a wall for example a panel or a bulkhead.

Connections through a wall frequently require that the connector seals the wall opening through which it extends. It is further often essential that the connection can be rapidly and readily established or separated, that it has satisfactory and substantially constant electric properties and that it is vibration proof.

Accordingly, one of the objects of the present invention is to provide a novel and improved electric connector of the kind above referred to, one of the members of which, generally the plug, can be fastened in and sealed to the panel or wall by simply turning one of the components of the plug in one direction and equally conveniently released by turning the said component in the opposite direction.

Another object of the invention is to provide a connector member which can be fastened in and sealed to the panel or wall without requiring special anchoring means or openings in the wall. In other words, a connector member according to the invention can be fitted in any suitably dimensioned aperture of the panel or wall thereby greatly simplifying the mounting of the connector and reducing the costs of both, manufacture and installation.

Still another object of the invention is to provide a connector member which incorporates as a component an elastic axially deformable sleeve performing the triple function of fastening, sealing and vibration proofing the member.

Another object of the invention, allied with the preceding ones, is to provide a novel and improved shielded or coaxial bulkhead or panel connector which can be readily and conveniently detachably fastened in and sealed to a bulkhead or panel and which includes novel means automatically establishing a ground connection when the jack and the plug of the connector are applied to each other.

Yet another object of the invention is to provide a novel and improved connector design which requires a small number of parts, can be inexpensively manufactured by mass production methods and be rapidly and conveniently assembled and installed.

While the device according to the invention is primarily designed for use as an electric connector, certain features of the design make the same also advantageous for use as a quick-release mechanical fastener.

Other and further objects, features and advantages of the invention will be pointed out hereinfater and set forth in the appended claims forming part of the application.

In the accompanying drawing several preferred embodiments of the invention are shown by way of illustration and not by way of limitation.

In the drawing:

Fig. 1 is a side view, partly in section, of an electric connector according to the invention, the jack and the plug of the connector being shown separated from each other.

Fig. 2 is an exploded view of the components of the plug.

Fig. 3 is a sectional side view of a shileded or coaxial bulkhead or panel connector according to the invention, the jack and the plug of the connector being shown separated from each other.

Fig. 4 is an exploded view of the plug of the connector according to Fig. 3.

Fig. 5 is a diagrammatic view of the installation of a car radio employing the connector of Fig. 1 as current connector and the connector of Fig. 3 as connector for the aerial.

Fig. 6 is a side view of a modification of the connector employed as mechanical fastener.

Fig. 7 is an exploded view of Fig. 6, and

Fig. 8 is a diagrammatic view of an assembly gun for assembling a connector according to the invention.

Referring first to Figs. 1 and 2 in detail, the connector according to these figures comprises a jack **1** and a plug **2**. The connector, or more specifically the jack thereof is designed to be fastened in and sealed to a wall **3** which for this purpose is provided with a suitably dimensioned opening **4**. Wall **3** may be visualized as a metal panel or bulkhead.

As can best be seen in Fig. 2 the jack comprises an operating stud **5**, a cam member **6**, an elastic axially deformable sleeve **7**, a washer **8** and a head nut **9**.

Operating stud **5** comprises a stem **10** from one end of which a protrusion, preferably a two-sided protrusion **11** extends. The protrusion may be formed by a pin which extends through a transverse bore of the stem and is either fixedly or removably seated in the bore. However, for small dimensions and also for reasons of mass production and mass installation the stud design as shown in some of the figures of the present application is preferable. As appears from Fig. 2 and the magnified insert associated with the showing of the stud, protrusions **11** are produced by pinching two wings out of the stud material. The hollows or indentations left by the gripping of the material during the pinching operation are clearly indicated in the insert at **11'**. The stud is drilled axially after the pinching operation, or it may be formed originally from tube stock. The end of the stud opposite protrusions **11** is longitudinally knurled at **12**. As is apparent, the stud is a one-piece design.

It has been found that a stud as shown herein can be conveniently manufactured for very small dimensions of the connectors down to about ¼ inch diameter of sleeve **7** and has yet sufficient strength to withstand the rather substantial axial pressure of about 60 lbs. exerted by the sleeve as will be more fully explained hereinafter.

Cam **6** is slidably and rotatably fitted upon the stud. It has on one end a flat face intended for abutment against the respective face of sleeve **7**. The other side of the cam member is formed with two camming surfaces **13** and **14** respectively, each occupying slightly less than 180° of the periphery. The peak of each camming surface is preferably indented to form rest notches **15** and **16** respectively.

The cam may be made of any suitable rigid material, generally metal or molded plastic.

Sleeve **7** is cylindrical and may be made of any material capable of outwardly bulging in response to an axial pressure and of substantially regaining its initial configuration upon relaxation of the axial pressure. Materials suitable for the purpose are various types of natural and synthetic rubber, rubber compositions or plastics. It is essential for the sleeve material to possess a high co-efficient of friction in contact with surfaces made from metal, plastic or the like.

The length of the sleeve is critical for the operation of the socket and the considerations governing the length of the sleeve will be more fully discussed hereinafter.

Washer 8 is made of insulation material. To serve its purpose in the structure in which it is used, the washer material must have a high friction surface. It may be made of any material satisfying this requirement, for instance a suitable rubber or rubber composition or coarse fiber.

Head nut 9 has a central bore 17 dimensioned to fasten the head with a force fit upon the knurled portion 12 of stud 5. To facilitate turning of head 9 when fitted upon stud 5 for a purpose which will be more fully explained hereinafter, wings 18 are preferably provided.

The jack as hereinbefore described, is assembled by first slipping cam 6 upon stud 5 so that wings 11 will ride on camming surfaces 13 and 14. Then, sleeve 7 and washer 8 are successively slipped upon stud 5. Finally, head 9 is mounted by forcing it upon the knurled stud portion 12.

One of the conductors to be connected by the connector is attached to the jack by any suitable means. There is shown an insulated conductor 19 ending in a closed lug 20. The lug is fitted upon the stud prior to the attachment of head 9. It is of course also possible to employ a lug of the spade type in which event the lug may be laterally slipped upon the stud, or the conductor end may be simply clamped between washer 8 and head 9.

As is apparent from the previous description and Fig. 1, turning of stud 5 relative to cam 6 after assembly of the jack will cause an axial displacement of the cam on the stud within limits controlled by the rise of the camming surfaces thereby correspondingly varying the axial space available for sleeve 7 between washer 8 and the flat face of cam 6. The axial length of the sleeve is such that the length of the sleeve in its fully relaxed condition is somewhat in excess of the available space when wings 11 occupy the base of the camming surfaces, or in other words when the space available for the sleeve is at a maximum. This position of the cam constitutes the unlocked position of the plug. Due to the aforedescribed excess length of the sleeve the same is slightly axially compressed and shows a slight outward bulging.

The jack assembly as hereinbefore described, is now ready for insertion in metal panel 3, the diameter of opening 4 and the maximum diameter of sleeve 7 being correlated to permit passage of the slightly bulging sleeve through opening 4. Rubber washer 8 when resting on panel 3 as shown in Fig. 1, insulates head 9 and conductor 19 from panel 3, the thickness of the washer controlling thte dielectric resistance of the connector plug toward the panel.

To turn the jack from the described unlocked position into the locked position of Fig. 1, wings 11 must be turned from the position occupying the base of the respective camming surfaces into the upper position in which they occupy indentations 15 and 16 respectively. In other words, stud 5 must be rotated relative to cam member 6. The aforedescribed precompression or preloading of sleeve 7 produces sufficient friction between the faces of the sleeve and the adjacent sides of cam member 6 and washer 8 respectively to permit rotation of stud 5 when the assembly including cam member 6, sleeve 7 and washer 8 is held stationary. This is effected by pressing head 9 toward the panel simultaneously with the turning of the head. The aforedescribed comparatively high friction of the surface of washer 8 abutting against the panel will then supply the required starting friction without the necessity of anchoring any part of the jack to the panel by special anchoring means such as hooks extending from the jack and engaging a corresponding hole in the panel.

As the wings ride along on the camming surfaces, the friction between the engaging surfaces of the assembly within which stud 5 turns is rapidly increased so that the components of the assembly remain stationary relative to each other and to the panel. At the same time, the loading of the sleeve and with it the outward bulging thereof are increasing until finally sleeve 7 assumes the strongly outwardly bulged shape shown in Fig. 1. As is evident, the bulging of the sleeve which now considerably overhangs the peripheral outline of opening 4 locks the jack tightly and moisture proof within the panel. To unlock the plug, stud 5 is simply turned in the opposite direction so that wings 11 return into the position permitting reexpansion of the sleeve into its initial slightly bulged shape.

The properties of the rubber material used for the sleeve require that the sleeve is not axially compressed beyond a definite maximum compression to prevent a permanent set of the sleeve material. The camming arrangement employed by the invention affords the advantage that it positively limits the maximum axial compression of the sleeve to a desired value.

The plug part of the connector is shown as a single contact pin 21 which is simply pushed into the hollow stud 5 which thus forms the receiver element of the connector. Pin 21 is suitably secured to the second conductor 22. The pin may be fastened to an insulated bracket or holder in such a manner that upon fitting the plug through the panel, the hollow stud 5 slides over the fixed pin 21 which in this design forms a stationary outlet.

Figs. 3 and 4 show a modified connector design using the same principle as described in connection with Figs. 1 and 2. The connector of Figs. 3 and 4 is particularly suitable for use as a shielded or co-axial bulkhead connector but it can also be used for connecting ordinary conductors.

A shielded connector must connect the core conductors and should also establish unbroken ground continuity completely surrounding the conductor core.

The connector of Figs. 3 and 4 again comprises a jack part 25 and a plug part 26, the jack part being shown in Fig. 4 in an exploded view.

Cam member 6' is identical in shape with the cam member 6 used in the socket of Figs. 1 and 2, but preferably made of nylon. Nut 9' is similar to nut 9 but formed with a sleeve opening 9'' for extending the end of a coaxial cable through the nut. Stud 5' is similar to the stud 5 of Fig. 1 except that the inner diameter of the stud part opposite to wings 11 is preferably reduced at 27 to receive the inner core conductor 28 of a coaxial cable 29. The outer conductor of the cable, which is of conventional design, is formed by metal braiding 29 insulated from core conductor 28 by insulation material 30. Core wire 28 is secured to stud 5' by crimping or soldering it in the narrow bore 27 of the stud as can best be seen in Fig. 3. The sleeve 7' of the socket is formed with a flange or collar 31 instead of the separate washer 8. The outer wall of the sleeve and part of flange 31 are covered with a metalized layer 32 to the extent shown in Fig. 3. The metallized coating must have sufficient flexibility to permit expansion of the sleeve from its slightly bulged shape shown in Fig. 3 into its strongly bulged shape when the plug is locked as shown in Fig. 1 and described in connection therewith. A metal coating of sufficient flexibility may be obtained by spraying the rubber sleeve with a metallic deposit, or gluing a slashed metal foil skirt onto the sleeve.

The contact between metal braid 29 and nut 9' is generally sufficient for grounding purposes. However, if a stronger mechanical attachment of the coaxial cable to the plug is desired, the nut may be pressed upon the metal braid 29 by a simple pressing operation, or may be soldered thereto. Nut 9' and with it metal braid 29 are insulated from core conductor 28 by an insulation sleeve 33 fitted in a corresponding bore of the unit. This sleeve may consist of a nylon insert.

The assembly of the jack is apparent from the previous description. Fig. 3 shows the jack in its assembled and unlocked condition. The jack is locked by turning

stud 5' into the position in which wings 11 occupy the indentations 15 and 16 at the upper end of the camming surfaces thereby forcing the rubber sleeve in the strongly bulged position indicated in dotted lines. The necessary starting friction is again supplied by the preloading of the sleeve and the frictional engagement between collar 31 and panel or bulkhead 3. As can be clearly seen in Fig. 3, braiding 29 is electrically connected to panel or bulkhead 3 through nut 9' and the metal coating 32 on sleeve 7'. Panel or bulkhead 3 should be visualized as being grounded.

The plug part 26 of the connector is shown as being assembled on an insulation base plate 35 formed with mounting holes 36 and several circumferentially spaced slots 37 for the passage of fingers 38. The fingers are joined below plate 35 to form a crimping sleeve 38' through which is extended the second coaxial wire or cable to be connected. This cable consists of an outer metal braiding 39 and an inner or core conductor 40 insulated from the braiding by insulation material 41. The coaxial cable is suitably secured within sleeve portion 38', for instance by crimping the sleeve portion. The core conductor is inserted within a hollow contact pin 42 mounted within a further bore through base plate 35.

Let it be assumed that it is desired to connect the two coaxial cables through panel 3. For this purpose, the jack 25 is pushed together through the hole in the panel onto the stationary plug 26. Contact pin 42 will then enter stud 5' thereby connecting core conductor 28 with core conductor 40 through stud 5'. Fingers 38 will frictionally engage the metallized coating 32 of bulging sleeve 7'. To accommodate the bulging of the sleeve, fingers 38 are preferably outwardly bulged at 38''.

As is apparent, the engagement of fingers 38 with metal coating 32 establishes a direct connection of metal braid 39 with metal braid 29 and also with panel or bulkhead 3.

The connectors heretofore described serve as lead-through connectors which seal and moisture proof the opening in which the plug part 25 of the connector is fitted.

The strongly expanding rubber sleeve used in both connector designs heretofore described renders the connectors capable of performing a second function, to wit, to fasten two components to each other.

Fig. 5 shows a device 40 which may be visualized as a conventional car radio to be mounted on two brackets 49 and 49'. The depending arm of each bracket has an opening 43 corresponding to opening 4 in panel 3. Opening 43 is aligned with an opening 44 of similar diameter through the side wall of the casing of the radio. The left side of Fig. 5 shows a stationary plug of the type illustrated in Fig. 3, but used to connect a one-wire conductor rather than a coaxial cable. This plug when inserted in openings 43 and 44 and locked as previously described, secures the radio casing to bracket 49. At the same time the stud of the jack enters a plug 45 thereby connecting a wire 46 to the plug wire which may be visualized as leading to the source of current for the radio. Plug 45 is secured to the casing of the radio by any suitable means such as a bracket 47. A rubber washer 48 is preferably interposed between the brackets and the radio casing. This washer is likewise held by the connector and serves a vibration insulator.

The right hand side of Fig. 5 shows a jack 25 as described in connection with Figs. 3 and 4 used to connect coaxial cables. The jack may be visualized as establishing the connection with the aerial for the radio and serves the additional purpose of securing the radio casing to bracket 42.

As is apparent, the radio in addition to being electrically connected and fastened by the connectors to its brackets is suspended with full protection against shock and vibration because the suspension is effected without direct metallic connection between the radio casing and the brackets which in turn are connected to or form part of the body of the car.

Figs. 6 and 7 show a connector which uses the principle and also some of the components of the connector described in connection with Figs. 1 and 2, but makes use of the mechanical functions of the connector only. The cam member and the elastic sleeve 7 are the same as in Figs. 1 and 2 and designated by the same reference numerals. The stud of the connector is shown as comprising a stem 61 secured on an end in or integral with a rounded head 60 and having on the other end a longitudinal knurling 62. The knurled stem end serves to receive with a force fit a cam follower member 63 from which depend two noses 64 which coact with the camming surfaces of cam member 6. As is apparent, noses 64 correspond in function to noses 11 of stud 5.

The connector of Figs. 6 and 7 is assembled by fitting stem 61 through the holes in a panel 50 and in a second panel 52 to be joined. Sleeve 7 and cam 6 are thereupon slipped upon the protruding portion of stem 61. Finally, member 63 is force fitted upon knurling 62 so that its noses 64 engage the camming surfaces of cam 6. The axial length of sleeve 7 is again so selected that it is preloaded and hence slightly bulging when noses 64 occupy the base of the camming surfaces of cam member 6. The connector is locked by turning the stud relative to the cam member until noses 64 enter the indentations 15 and 16 at the upper end of the camming surfaces. The preloading of sleeve 7 supplies the necessary starting friction between the engaging surfaces of sleeve 7, cam member 6 and plate 50 respectively.

Fig. 6 shows the connector in its assembled and locked position.

Fig. 8 shows a gun for conveniently assembling a connector of the kind shown in Figs. 1 and 2, except that the wing nut 9 is replaced by rounded head 51. The gun comprises a U-shaped bracket 55 from which extends an upper support 56 and a lower support 57 between which the several components of the connector are assembled on support panel 50. The lower support 57 serves as a duct for supplying a fluid under pressure such as compressed air to the face of stud 5. The pressure fluid may be supplied to the gun through a hose connection. The figure shows stud 5 with its knurled portion 12 outside or just entering head 51. By suitably regulating the axial pressure applied to stud 5, the same is forced into head 51 just sufficiently deep to assure the required preloading of sleeve 7 when the connector is unlocked.

While the invention has been described in detail with respect to certain now preferred examples and embodiments of the invention it will be understood by those skilled in the art after understanding the invention, that various changes and modifications may be made without departing from the spirit and scope of the invention, and it is intended, therefore, to cover all such changes and modifications in the appended claims.

What is claimed as new and desired to be secured by Letters Patent is:

1. In a two-part electric connector for releasably connecting two coaxial cables each having a core conductor and an outer conductor through an opening in a metal wall, one of the connector parts comprising a metal stud fittable through said wall opening, said stud supporting on one end an enlarged conductive head electrically insulated from the stud and on the other end a lateral protrusion, a rigid cam member slidably and rotatably supported on said stud between the head and the protrusion, said cam member having a camming surface coacting with said protrusion to effect axial displacement of the cam between a position of maximum distance and a position of minimum distance relative to said head upon rotation of the stud relative to the cam member, a vibration suppressing axially deformable sleeve supported on said stud between the head and the cam member, and also fittable through the wall opening

the axial length of said sleeve being such as to cause an initial predetermined axial deformation of the sleeve preloading the same when the stud with the cam member and the sleeve supported thereon are fitted through said wall opening and the cam member is in its position of maximum distance, said pre-loading of the sleeve effecting a frictional engagement between the cam member and the respective face of the sleeve sufficient to permit rotation of the stud and the protrusion thereon relative to the camming surface for increasing said initial axial deformation of the sleeve to a predetermined maximum axial deformation which causes an outward expansion of the sleeve overhanging the wall opening for effecting fastening and sealing of said connector part within said wall opening, the outside wall of said sleeve being metallized so as to be in metallic engagement with said head and said metal wall upon fitting the stud through the wall opening, said stud having means for conductive attachment of the core conductor of one of the coaxial cables and said head having means for conductive attachment of the outer conductor of said cable.

2. In a two-part electric connector for releasably connecting two co-axial cables each having a core conductor and an outer conductor through an opening in a metal wall, one of the connector parts comprising a metal stud fittable in said wall opening, said stud supporting on one end an enlarged conductive head electrically insulated from the stud and on the other end a lateral protrusion, a rigid cam member slidably and rotatably supported on said stud between the head and the protrusion, said cam member having a camming surface coacting with said protrusion to effect axial displacement of the cam between a position of maximum distance and a position of minimum distance relative to said head upon rotation of the stud relative to the cam member, a vibration suppressing axially deformable sleeve supported on said stud between the head and the cam member, rotation of the stud and its protrusion relative to the camming surface effecting an axial compression of the sleeve to cause a predetermined maximum outward expansion of the sleeve overhanging the wall opening for fastening and sealing said connector part within said wall opening, the outside wall of said sleeve being metallized so as to be in metallic engagement with said head and said metal wall upon fitting the stud through the wall opening, said stud having means for conductive attachment of the core conductor of one of the co-axial cables and said head having means for conductive attachment of the outer conductor of the said cable; and the other connector part comprising an inner contact element engageable with said stud and an outer contact element engageable with said metallized sleeve wall, said inner contact element having means for conductive attachment of the core conductor of the other coaxial cable and said outer contact element having means for conductive attachment of the outer conductor of the latter cable.

3. An electric connector according to claim 2, wherein said outer contact element of the other connector part is a springy sleeve disposed in coaxial relationship with the inner contact element.

4. An electric conductor according to claim 3, wherein said stud is hollow and said inner contact element terminates in a contact pin insertable in said hollow stud, and wherein said springy sleeve is frictionally engageable with the metallized outside wall of said sleeve.

5. An electric connector according to claim 1, wherein said sleeve has a collar abutting against said head and overhanging the peripheral outline of said wall opening to form an area of frictional engagement between the collar and the wall when the stud is fitted in said wall opening, the outside wall of the collar part abutting against said head being also metallized.

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