

Oct. 20, 1964

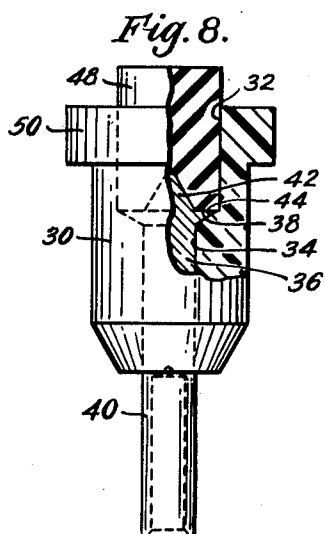
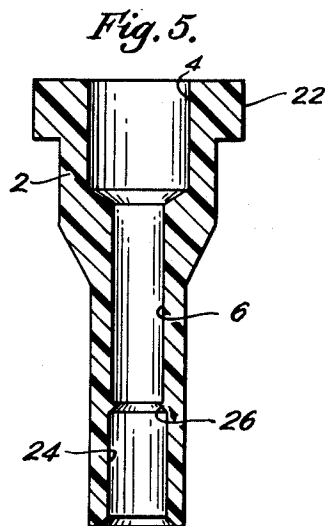
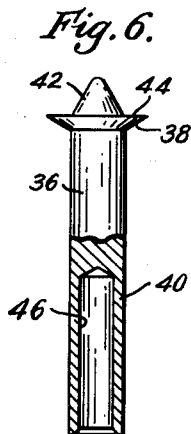
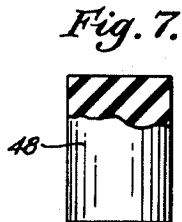
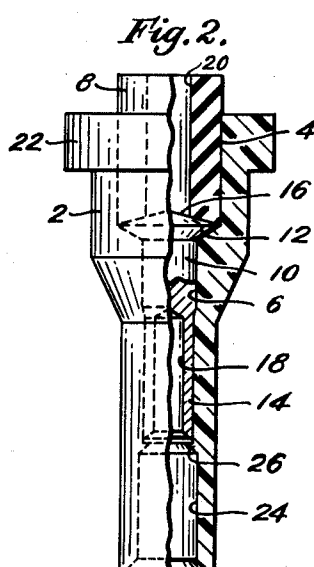
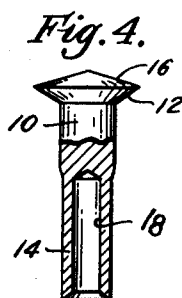
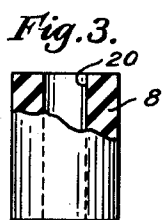
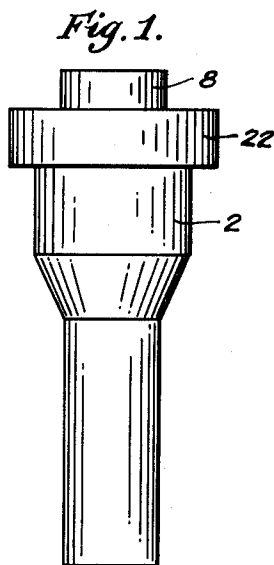
J. S. COONEY

3,153,561

RESILIENT ELECTRICAL CONNECTOR

Filed June 9, 1960

2 Sheets-Sheet 1



Inventor,
James S. Cooney,
by *Townsend M. Gunn*
Att'y.

Oct. 20, 1964

J. S. COONEY

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RESILIENT ELECTRICAL CONNECTOR

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2 Sheets-Sheet 2

Fig. 9.

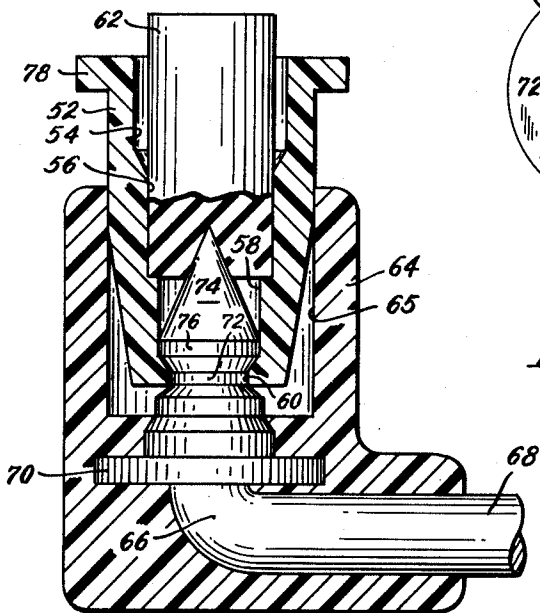


Fig. 11.

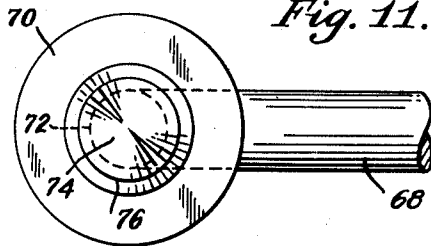


Fig. 10.

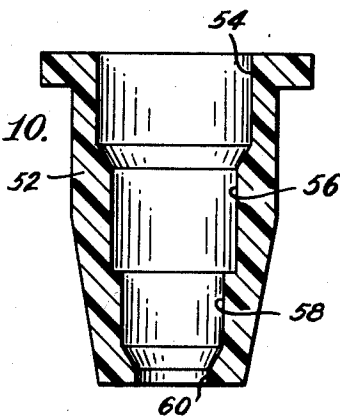


Fig. 12.

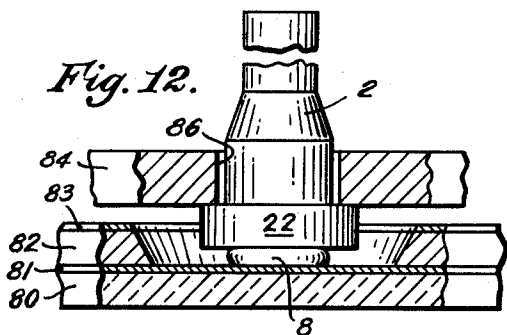


Fig. 13.

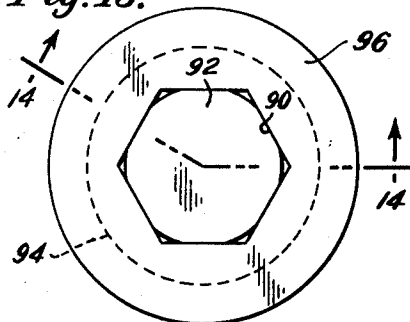


Fig. 15.

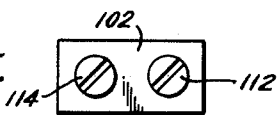


Fig. 16.

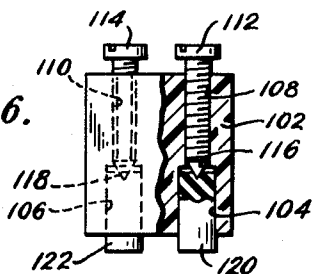
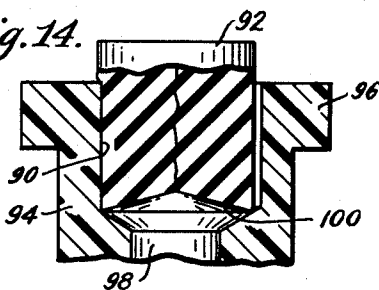


Fig. 14.



Inventor,
James S. Cooney,
by Townsend M. Gunn
Att'y.

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RESILIENT ELECTRICAL CONNECTOR

James S. Cooney, Attleboro, Mass., assignor to Pylon Company, Inc., Attleboro, Mass., a corporation of Massachusetts

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14 Claims. (Cl. 339-61)

This invention relates to electrical connectors and in particular to connectors especially adaptable to making electrical connection with frangible or easily injured materials or material layers to which it is difficult if not impossible to make a soldered connection.

Among the several objects of the invention, therefore, may be noted the provision of an electrical connector adapted to make resilient connection with a layer of conductive or semi-conductive material; the provision of an electrical connector which makes electrical connection over an area of another material rather than a point contact; the provision of a resilient electrical connector which maintains good electrical contact with another body, by means of its own inherent resilient nature; the provision of an electrical connector of the contact type which is resiliently soft and therefore eliminates or greatly lessens the likelihood of frangible or easily-injured surfaces becoming chipped off or worn away; the provision of an electrical contact structure which lends itself to being made in many sizes; the provision of an electrical contact structure which has an inherent shock-absorbing or anti-vibration characteristic; and the provision of electrical connectors and contacts of all of the above classes which are readily and economically made on automatic or semi-automatic machinery. Other objects and advantages of this invention will be in part obvious and in part pointed out hereinafter.

The invention accordingly comprises the elements and combinations of elements, features of construction, and arrangement of parts which will be exemplified in the structures hereinafter described, and the scope of the application of which will be indicated in the following claims.

In the accompanying drawings in which are illustrated several embodiments of the invention:

FIG. 1 is a vertical view of one embodiment of the invention;

FIG. 2 is a view similar to FIG. 1, but with a portion broken away to show details of construction;

FIG. 3 is an elevation, partly in section, of an element of the FIG. 1 embodiment;

FIG. 4 is an elevation, partly in section, of another element of the FIG. 1 embodiment;

FIG. 5 is an elevation, in section, of still a third member of the FIG. 1 embodiment;

FIG. 6 is an elevation, partly in section, of a member of a second embodiment of this invention;

FIG. 7 is an elevation of a second member of the said second embodiment;

FIG. 8 is an elevation, partly in section, of said second embodiment showing the several parts assembled together;

FIG. 9 is an elevation, in section, showing the construction of a third embodiment of this invention;

FIG. 10 is an elevation, in section, of a member or part of the FIG. 9 embodiment;

FIG. 11 is a plan view of a member or part of the FIG. 9 embodiment;

FIG. 12 is an elevation, partly in section, showing the use of the FIG. 1 embodiment to make electrical connections to a layer of electrically conductive material;

FIG. 13 is a plan view of a fourth embodiment of this invention;

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FIG. 14 is an elevation, in cross-section, of a portion of the FIG. 13 embodiment;

FIG. 15 is a plan view of a fifth embodiment of this invention; and

FIG. 16 is an elevation of the FIG. 15 embodiment, partly in section.

Throughout the drawings, similar reference characters illustrate corresponding parts of the embodiment. The various drawings are many times enlarged in order to show detail with greater clarity.

In the field of electrical apparatus today, there are many instances where it is desired to make an electrical connection to a layer or plate of coating material made of non-metallic or metalloid materials, and it is sometimes exceedingly difficult, if not impossible to get a fool-proof, long-wearing, and otherwise satisfactory joint or connection. In addition it is sometimes desired to make an electrical connection to a relatively fragile layer of metal such as silver or copper which has been deposited as a thin layer on a supporting body. As examples of where such connections are desired but sometimes are difficult to make, may be mentioned cathode-ray tubes, photo-electric cells of the barrier layer type, and electroluminescent panels. It is with this problem that this invention is concerned, and the invention provides a quick and very economical way of making electrical connections to the easily-damaged coatings of such devices, in a safe and quick way.

Turning now to FIGS. 1-5, there is shown a first embodiment comprising a housing 2 made of electrically insulating material such as a molded resin. For example, housing 2 may be made of Bakelite or nylon. Housing 2 is tubular and, as shown in FIG. 2 has interior bores 4 and 6 which are axially aligned and meet as shown. Bore 4 is the larger and is adapted to receive snugly therein a plug or cylindrical body 8 (shown in FIG. 3) which is made of electrically conducting, resilient, rubber-like material or elastomer, such as silicone which has been "loaded" with carbon black to make it electrically conductive. Such materials are common in the market today. A metal connector or insert 10 is received as shown in the bore 6, this insert being shown in FIG. 4. Insert 10 comprises an enlarged head portion 12 and a shank 14. Head 12 is provided with the conical top 16, and shank 14 is provided with a terminal receiving bore 18. As shown in FIG. 2, the complete connector is assembled by first inserting the insert 10 into bore 6 (which receives the insert with a snug fit), and then plug 8 is squeeze fitted into bore 4, being inserted far enough to seat firmly on the conical head 16 and make good electrical contact therewith.

As shown in FIG. 3, the plug 8 is also provided with a central bore 20, which is an optional feature. Its purpose is to make easier the insertion of plug 8 into bore 4, and to give a more positive contact with conical head 16.

Housing or bushing 2 is provided with an enlarged shoulder portion 22 the purpose of which will be described later. The interior bore 18 in shank 14 is adapted to receive a snugly fitting electrical connector such as, for example, a banana-type connector, whereby electrical connection may be made via insert 10 to electrically-conductive plug 8. If desired, the end of the connecting wire can be inserted in the bore 18 and the assembly crimped together in customary fashion.

Bore 6 can, if desired, be the same diameter throughout its length. However, it may be advantageous for ease in inserting terminals into bore 18, to increase the diameter of bore 6 as shown at 24, in such a case, the molding is done so as to leave the inwardly projecting shoulder 26, the upper surface of which provides a seat against which the end of shank 14 can butt, and the bot-

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tom surface of which is inclined or chamfered (as shown) to facilitate entry of the connecting terminal or plug.

Instead of carbon, very finely divided metal powder may be used to "load" the elastomer.

Turning now to FIGS. 6-8, there is shown a second embodiment of this invention, somewhat like FIGS. 1-5 but differing in certain aspects. Again, a tubular housing 30 is provided of electrically insulating material such as Bakelite or nylon, having the interior bores 32 and 34 axially aligned and meeting. In this case, bore 34 is the same diameter throughout its length. A metal connector or insert 36 is provided having a head portion 38 and shank 40. Head 38 is provided with the conical pointed end projection 42 seated on the laterally extending flat shoulder 44. Shank 40 is provided, as before, with a terminal receiving bore 46. In this embodiment, the shank 40 projects from the housing or bushing 30 as shown in FIG. 8.

A cylindrical plug 48 of electrically conducting, resilient, rubberlike material is provided, such as silicone impregnated or "loaded" with electrically conductive material such as carbon black. In this instance, the plug 48 is solid.

As shown in FIG. 8, the insert 36 is first inserted into its bore 34, and then plug 48 is squeeze-fitted into its respective bore 32, being inserted far enough to seat firmly on the flat shoulder 38, the conical point or projection 42 penetrating the rubber-like material.

An outwardly extending flange or shoulder 50 is provided on housing or bushing 30, as shown, whose purpose will be explained below.

Referring now to FIGS. 9-11, there is shown a third embodiment of this invention, in which there is provided a housing or bushing 52 of electrically insulating material such as Bakelite, or nylon, or Teflon, or other moldable material. Housing 52 has three internal bores, 54, 56, and 58, axially aligned and meeting, as shown. The end of bore 58 is constricted, as shown, by an internally projecting shoulder 60.

As in the FIGS. 6-8 embodiment, there is provided a plug 62 of electrically-conducting, resilient, rubber-like material such as silicone, which is impregnated or "loaded" with carbon black to make it conducting. Plug 62 is a squeeze fit into bore 56, and thus is smaller in diameter than bore 54.

A second housing or cap 64 is provided which contains the molded metal insert 66. (By "molded insert" is meant the usual construction in which plastic material is molded around a metal insert.) Cap 64 is made of a resilient molded material such as nylon or Teflon, and has the interior bore 68 which fits over the outside of housing 52 as shown in FIG. 9. (It will be noted that the housing 52 is somewhat tapered to permit easy fitting of the cap 64 over the housing, as shown.)

The insert 66 comprises the stem or wire portion 68, a laterally extending shoulder 70, a neck-portion 72 of reduced diameter, and a pointed conical tip 74. The diameter of neck 72 is substantially the same as the inside diameter of constriction 60, and the diameter of the base 76 of the conical tip 74 bears such a relation to the interior diameter of constriction 60 as to permit the conical tip portion and its base 76 to be snapped past the constriction, as shown. Thus, the configuration of parts is such as to make the base 76 a snap-fastener for holding the cap 64 onto the housing 52.

It will be noted that in the "snapped-on" position of cap 64 and insert 66, the pointed end of conical tip 74 penetrates the plug 62 and makes good electrical contact therewith.

A laterally extending shoulder 78 is provided as shown.

Referring now to FIG. 12, there is shown the manner of use of the connectors of this invention. (To illustrate this use, the FIGS. 1-5 embodiment is used.) A glass plate 80 is shown having thereon a customary composite layer of material for electro-luminescent purposes, com-

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prising, for example, layer 81 of metal, layer 82 of electro-luminescent material, and layer 83 of metal. Connection is desired to the layer 81, which is relatively fragile. To this end, a support plate 84 of rigid material is fastened by conventional means parallel to and a short distance away from plate 80. A hole 86 is provided in plate 84 of a size to receive the body of the housing 2, but too small to permit passage of the shoulder 22. The distance of plate 80 from support 84 is such that the protruding end of plug is resiliently compressed against the layer 81, the plug material deforming laterally as shown. Thus there is made a gentle, resilient, non-destructive electrical connection to the layer 81, and by means of an electrical connection to insert 10, current and voltage may be applied to the layer 81. The embodiments of FIGS. 6-8, and 9-11 are similarly used, with respective shoulders 50 and 78 serving as retaining means.

Plate 84 may be made of electrical insulating material, if desired; but since the particular FIGS. 1-5 embodiment uses an electrically insulating housing or body 2, the plate 84 may be metal, as shown.

If desired, the housings 2, 30 and 52 may be made of metal, with the plate 84 of electrically insulating material. In such an event, electrical connection to the plugs 2 and 48 could be accomplished through the housings per se. The forms shown in the various embodiments are, however, the preferred forms.

In all cases, the connectors 10, 36 and 66 are made of metal such as silver, copper, or brass, that has good electrical conductivity.

In all of the above embodiments, the bores that receive the plug or rubber-like material are shown as round. Referring now to FIGS. 13 and 14, there is shown a modification in which the said bores 90, for example, are hexagonal rather than round. The purpose of this is to make easier the insertion of the rubber-like plugs 92, for example, into their respective bores, and to provide room for deformation of the plug when in use, thus providing greater resilience. Other cross-sectional shapes can be used, if desired. In each instance, the diameter of the plug 90 is just slightly greater than the distance from one side of the hexagonal bore 92 to the diametrically opposite side. When the plug is inserted in the bore, it will deform slightly to accommodate the difference in diameters, and provide easy insertion of the plug. As shown in FIGS. 13 and 14, the housing 94, shoulder 96 and connector 98 having head 100 are similar to those shown in FIGS. 1-5, except for the hexagonal bore 90.

In all of the above embodiments, the connectors have been shown as single units. Referring now to FIGS. 15 and 16, there is shown another embodiment illustrating the adaptability of the invention to multiple connections. In this instance, the housing 102 is made of electricity insulating material, such as nylon, Teflon, or Bakelite (all as examples only), and consists of a rectangular block having provided therein the bores 104 and 106, which terminate, respectively, with the axially aligned, internally threaded holes 108 and 110. Holes 108 and 110 receive the pointed terminal screws 112 and 114, which penetrate, by their pointed inner ends 116 and 118 the connecting plugs 120 and 122 of resiliently deformable electrically conductive rubber-like material of the kind specified for the previously described embodiments. Electrical connections are made, as pointed out for the previous embodiments, to the terminal screws 112 and 114. In use, the protruding ends of the plugs 120 and 122 are pressed against the layers to which it is desired to make electrical connections, thus deforming these ends and assuring a good electrical contact, as has been described above for all of the embodiments.

In the above embodiments certain materials have been mentioned. This has been done by way of example only, as has been indicated. It is preferred, for ease of manufacture, that the various housings be made of a moldable

resin which is relatively rigid and electrically insulating. The various electrically contacting plugs are to be rigid enough to be inserted and held in the respective housings and yet resilient enough to deform under pressure as indicated. As an example of such a material, a silicone gum loaded with 25-40% by weight of carbon black and having a durometer of 35-60 has been found to work satisfactorily.

In view of the above, it will be seen that the several objects of the invention are achieved and other advantageous results attained.

As many changes could be made in the above constructions without departing from the scope of the invention, it is intended that all matter contained in the above description, or shown in the accompanying drawings, shall be interpreted as illustrative and not in a limiting sense.

I claim:

1. An electrical connector comprising a finite length of electrically-conductive, resiliently-deformable elastomer having incorporated therein finely divided carbon particles, and a holder for said length, said holder providing means for making electrical connection with said length and said holder being provided with a bore, at least a portion of said length fitting loosely in said bore thereby to permit said elastomer to deform radially within said bore, the end of said length of elastomer adjacent to that portion which fits loosely in the bore protruding from said holder, said protruding end being radially and axially deformable.

2. An electrical connector comprising a finite length of resiliently-deformable rubber-like material, finely divided particles of electrically conductive material dispersed in said rubber-like material, and a holder for said length, said holder providing means for making electrical connection with said length and said holder being provided with a bore, at least a portion of said length fitting loosely in said bore thereby to permit said rubber-like material to deform radially within the bore, the end of said rubber-like material adjacent to that portion thereof which fits loosely in said bore protruding from said holder, said protruding end being radially and axially deformable.

3. An electrical connector comprising a finite cylinder of resiliently deformable rubber-like material, finely divided particles of electrically conductive material dispersed in said rubber-like material, and a holder for said cylinder, said holder providing means for making electrical connection with said length and said holder receiving said cylinder with a loose fit for at least a portion of the length thereof thereby to permit said cylinder to buckle and to deform radially within said holder, an end of said cylinder protruding from said holder and being radially and axially deformable.

4. An electrical connector comprising a finite length of electrically-conductive, resiliently deformable rubber-like material, a holder for said length, and a metal electrical contacting member mounted in said holder with part thereof in engagement with an inner end of said length, said holder being provided with a recess therein receiving said length loosely for at least a portion of the length thereof thereby to permit said length to deform radially in said recess, the other end of said length protruding from said holder and being both radially and axially deformable.

5. An electrical connector comprising a body having a first tubular bore therein opening on one end of said body and having a second tubular bore axially aligned with and connecting with said first bore and opening on another end of said body, a plug of electrically-conductive, resiliently deformable elastic material mounted within

said first bore and having a portion protruding therefrom, and a metal insert mounted in said second bore and in electrical engagement with said plug, said plug fitting loosely in said first bore and being adapted to deform radially in said first bore, and the protruding portion of said plug being both radially and axially deformable.

6. The connector of claim 5 in which said first tubular bore is hexagonal in cross-section, and said plug is circular in cross-section and of diameter greater than the distance from one side of said hexagon to the diametrically opposite side.

7. The connector of claim 5 in which said body is made of electrically-insulating material and said plug is made of silicone impregnated with finely divided particles of electrically conductive material.

8. The connector of claim 7 in which said finely divided particles are carbon.

9. The connector of claim 7 in which said finely divided particles are metal.

10. The connector of claim 5 in which said first bore is of larger diameter than said second bore and a portion of said plug is engaged firmly in said second bore.

11. An electrical connector comprising an elongated body having thereon a laterally extending shoulder, said body being provided with a bore extending therethrough, a first portion of said bore being greater in diameter than a second portion of said bore; a metal insert in said bore, said insert being provided with a shank and head, said shank fitting said second portion of the bore and said head fitting said first portion; and a plug of electrically-conductive, resiliently deformable elastic material mounted in said first portion, one end of said plug protruding from said body, and the other end of said plug in electrical engagement with said head, that portion of the plug having the protruding end fitting loosely in said first portion of said bore, thereby being radially deformable within said first portion of said bore.

12. The connector of claim 11 in which said plug comprises silicone impregnated with finely divided particles of carbon.

13. The connector of claim 11 in which said first portion of said bore is hexagonal in cross-section, and said plug is circular in cross-section.

14. An electrical connector comprising a finite length of electrically-conductive, resiliently-deformable elastomer having incorporated therein finely divided particles of electrically-conductive material, and a holder for said length, means within said holder for making electrical connection with said length and said holder being provided with a bore therein of polygonal cross-section and said length of elastomer fitting in said bore, said length engaging portions of the sides of said bore to hold said length in said bore but leaving spaces between said length and said bore into which said length can deform laterally of the axis of the length, and an end of said length protruding from said holder and being radially and axially deformable.

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