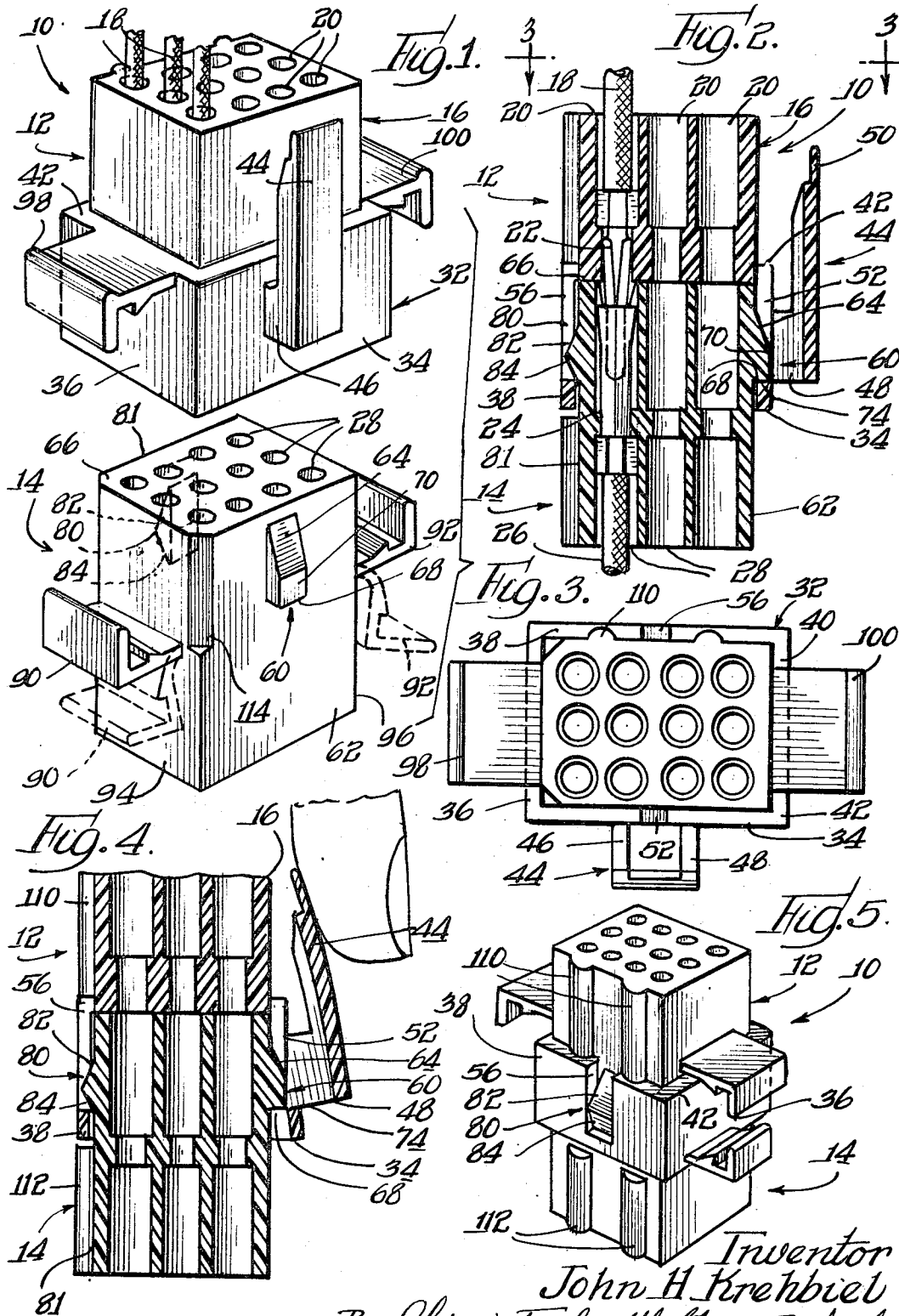


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J. H. KREHBIEL
ELECTRICAL CONNECTOR

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ELECTRICAL CONNECTOR

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This invention relates generally to an electrical connector and more particularly to an electrical connector having a selectively releasable latch means for interconnecting a plug and a receptacle portion of the connector.

Electrical connectors are commonly utilized for interconnecting groups of wires rather than separately joining together individual pairs of wires. The prior art electrical connectors commonly include a plug having terminals connected to a first group of wires and a receptacle having terminals connected to a second group of wires. The groups of wires are electrically interconnected by inserting the plug portion of the connector into the receptacle portion of the connector. A latch means is usually provided for preventing the plug from being accidentally pulled out of the receptacle.

The prior art electrical connector latches usually include a latch lug projecting from the plug into a recess in the receptacle. The latch is generally released by pressing a lug manually or with a tool out of engagement with the recess. Once the lug has been forced out of engagement, the plug and electrical connector can be separated. When the plug is reinserted in the receptacle the lug will again engage the recess to securely latch the two connector components together.

The generally satisfactory service provided by these prior art electrical connector latches is shown by the widespread industrial usage of the latches. However, the prior art connector latches have proven to be somewhat unsatisfactory, due to the difficulty in disengaging the latch lug from the associated latching recess. This difficulty is multiplied when one of the connector elements is mounted in a control panel or other location wherein access to the latch plug is limited.

Therefore, it is an object of this invention to provide an improved electrical connector structure having a readily engageable and disengageable latch structure for securely inter-connecting the mating parts of the connector.

Another object of this invention is to provide an electrical connector having a latch structure which can be released by depressing a readily accessible lever mounted on the connector.

Another object of this invention is to provide an electrical connector structure which is compact and inexpensive to manufacture.

Another object of this invention is to provide a quickly and easily disengageable latch structure for an electrical connector mounted in a control panel.

These and other objects and features of the invention will become more apparent upon a reading of the following detailed description taken in connection with the accompanying drawings, wherein:

FIG. 1 is a perspective view of an electrical connector including plug and receptacle elements which have been shown separated for purposes of clarity of illustration;

FIG. 2 is a sectional view, of the electrical connector of FIG. 1, illustrating the relationship between the plug element, the receptacle element, and a latch means engaged to hold the plug element in the receptacle element;

FIG. 3 is a detailed plan view, taken along the line 3-3 of FIG. 2, illustrating the arrangement of terminals in the receptacle element;

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FIG. 4 is a sectional view, similar to the view of FIG. 2, illustrating the latch means in a disengaged position to enable the plug to be withdrawn from the receptacle;

FIG. 5 is a perspective view, drawn to a reduced scale, further illustrating the interrelationship between the plug element and receptacle element when the plug element has been inserted in the receptacle element.

Referring now to the drawings in greater detail, an electrical connector 10, forming a preferred embodiment of my invention, is illustrated in FIGS. 1 and 2. The electrical connector 10 includes a receptacle element 12 which is adapted to receive a plug element 14 in a telescoping mating relationship, as illustrated in FIG. 2. The plug 14 and receptacle 12 are molded of a suitable polymeric material, such as nylon. The receptacle 12 includes a rectangular base section 16 which is adapted to encase terminal end portions of a plurality of wires 18 which are inserted in longitudinally extending cylindrical bores 20 formed in the base section 16. Terminals 22 (see FIG. 2) of a male form are crimped on the wires 18 in a known manner. The terminals are mounted in the bores 20 for mating engagement with associated female type terminals 24 which are connected to a second group of wires 26 extending into bores 28 in the plug 14. The terminals 22 and 24 are constructed in a manner similar to that illustrated in my prior United States Patent No. 3,178,673 and are mounted in the bores 20 and 28 in the manner set forth in that patent.

As is seen in FIGS. 1 and 3, the receptacle 12 includes a rectangular housing or socket 32 formed by a plurality of flexible side walls 34, 36, 38 and 40. The side walls 34 through 40 are connected to the base section 16 by an outwardly extending shoulder 42 which extends circumferentially around the base section 16. The receptacle includes a latch release lever 44 which is connected to the flexible side wall 34 of the socket 32 by the inwardly projecting walls 46 and 48. The inwardly projecting walls 46 and 48 are formed integrally with the side wall 34 of the socket 32. The latch release lever 44 extends parallel to the side wall 34, see FIG. 2, and has an outermost end portion 50 adjacent to the base 16 of the receptacle 12.

A recess or aperture 52 (see FIGS. 2 and 3) is positioned intermediate the two side walls 46 and 48 of the latch release lever 44. The recess 52 is formed by a generally U-shaped slot extending from the shoulder 42 of the socket 32 into the socket wall 34. The recess provides a latch bar or retainer at the front end of the side wall 34. The outwardly opening recess 52 facilitates the forming of the receptacle 12 by a molding process, since the recess or aperture can be readily formed by a suitable core member projecting into the mold.

A second generally U-shaped aperture or recess 56 (see FIGS. 2, 3 and 5) is formed in the opposite side wall 38 of the receptacle 12. The recess 56 is formed in the same manner as is the recess 52. Thus, the recess 56 opens outwardly at the shoulder 42 and extends for a substantial distance into the flexible side wall 38 of the socket 32 to facilitate molding of the receptacle 12.

Referring to FIGS. 1 and 2, the plug 14 is molded with a latch lug 60 integrally formed on an inflexible side wall 62 of the plug. The latch lug 60 includes an outwardly sloping cam surface 64 which extends away from an end surface or side 66 of the plug. A latch surface or shoulder 68 projects perpendicularly outwardly from the side wall 62 of the plug 14 and is connected to the cam surface 64 by a guide surface 70 which extends in a substantially parallel relationship to the side wall 62. As shown in FIG. 2, the latch surface or shoulder 68 engages a transversely extending retaining surface 74 of the generally U-shaped recess or aperture 52 to interlock the receptacle 12 and plug 14. It will be apparent to those skilled in the

art that the abutting engagement of the latch surface or shoulder 68 with the retaining surface 74 locks the plug against being withdrawn from the receptacle.

A cam lug 80 (see FIGS. 2, 4 and 5) is integrally formed with an opposite side 81 of the plug 14. The cam lug 80 includes a first cam surface 82 which is intersected by a second cam surface 84 at a transversely extending ridge. From an inspection of FIG. 2, it will be apparent that the cam lug 80 has a generally triangular cross-sectional shape and projects into the aperture or recess 56 to provide a further interlock against the plug 14 being withdrawn from the receptacle 12.

As is best seen in FIG. 1, a pair of resilient outwardly projecting mounting ears 90 and 92 are integrally formed with opposite sides 94 and 96 of the plug 14. The mounting ears 90 and 92 are resiliently deformable inwardly, as indicated by dashed lines in FIG. 1, to enable the ears to engage an aperture in a control panel to mount the plug 14 in the panel. The mounting ears 90 and 92 are constructed in accordance with my prior United States Patent No. 3,196,380 which is incorporated herein by this reference. A second pair of mounting ears 98 and 100 are integrally formed with the side walls 36 and 42 of the socket 32 to mount the receptacle 12 in a control panel. The ears 98 and 100 are constructed in much the same manner as are the ears 90 and 92.

The latch lug 60 is disengaged from the recess or aperture 52 by pressing the latch release lever 44 inwardly toward the base 16 of the receptacle 12, as illustrated in FIG. 4. When the latch release lever 44 is pressed inwardly, the flexible side wall 34 is resiliently deflected or flexed outwardly so that the retaining surface 74 clears the latch surface or shoulder 68 to enable the plug 14 to be withdrawn from the receptacle 12. As the plug is withdrawn from the receptacle 12, the flexible side wall 38 of the socket 32 is deflected or flexed outwardly by the forwardmost cam surface 84 of the cam lug 80 to disengage the cam lug 80 from the aperture or recess 56. Similarly, when the plug 14 is reinserted into the receptacle 12, the cam surface 82 of the cam lug 80 deflects or flexes the side wall 38 outwardly to reengage the cam lug 84 in the recess 56. Substantially simultaneously with this reengagement of the cam lug 80 with the recess 56, the cam surface 64 and guide surface 70 of the latch lug 60 resiliently cams or flexes the side wall 34 outwardly to enable the latch lug to reengage the aperture 52 with the latch surface 68 abutting the retaining surface 74.

As is best seen in FIG. 5, the receptacle 12 and plug 14 are both provided with outwardly protruding guide ridges 110 and 112 to facilitate orientating the plug for insertion into the receptacle. A positioning surface 114 (see FIG. 1) is provided for mating engagement with an inwardly projecting surface in the socket 32 to prevent the plug from inadvertently being inserted in an incorrect relationship with the receptacle 14. Thus, by means of the positioning surface 114 and the guide ridges 110 and 112, the plug can be readily oriented for insertion into the receptacle.

For purposes of affording a more complete understanding of the invention, it is advantageous now to provide a description of the mode in which the component parts cooperate. The plug 14 is inserted in a telescoping coaxial mating relationship with the socket 32 of the receptacle 10 to interconnect the terminal ends 22 of a first group of wires 18 with the terminal ends 24 of a second group of wires 26. As the plug 14 is inserted into the socket 32 of the receptacle 12, the cam surface 64 and guide surface 70 of the latch lug 60 will deflect the flexible side wall 34 resiliently outwardly to enable the side wall to clear the latch lug 60. Simultaneously with this outward movement of the side wall 34, the flexible side wall 38 will be deflected outwardly by the cam surface 82 of the cam lug 80 to enable the side wall 38 to clear the cam lug. As the inward movement of the plug is continued, the side wall 38 will clear the outermost ridge of the cam

lug 80 and the cam surface 84 will tend to cam the plug into the receptacle. As the insertion of the plug is continued, the side wall 34 will clear the forward latch surface 68 of the latch lug 60 to enable the side wall 34 to snap the aperture or recess 52 into engagement with the latch lug 60.

The latch lug 60 will interlock the plug 14 with the receptacle 12 with an abutting engagement between the latch surface 68 and the retaining surface 74 of the aperture 52. Simultaneously with the engagement of the latch lug 60 with the aperture 52, the cam lug 80 will engage the aperture or recess 56 to further interlock the plug 14 with the receptacle 12. When the plug is to be removed from the receptacle, the latch release lever 44 is depressed, as indicated in FIG. 4, to flex the side wall 34 resiliently outwardly to disengage the latch lug 60 from the aperture 52. When the latch lug has been disengaged from the aperture 52, the plug may be removed from the receptacle by pulling the plug axially outwardly. While the plug is being pulled axially outwardly, the forward cam surface 84 will flex the side wall 38 outwardly to disengage the cam lug 80 from the aperture 56.

Either the plug 14 or receptacle 12 can be mounted in a control panel by deflecting the mounting ears 90, 92, 98 and 100 inwardly to engage the sides of an aperture in a control panel. It will be apparent that the outwardly projecting latch release lever 44 will enable the plug 14 to be removed from the receptacle 12 by merely depressing the latch lever. Since the latch lever extends longitudinally and outwardly relative to the receptacle 12, the latch lever will be readily accessible in even the most cramped locations to facilitate the removal of the plug from the receptacle. As the plug is removed from the receptacle, the terminal end 22 of the wires 18 will be disengaged from the terminal end 24 of the wires 26 to disconnect the two groups of wires. Since both the plug and receptacle are made of a suitable elastomeric material, such as nylon, the plug and receptacle will electrically insulate the various wire terminals from each other.

It will be understood that the member 14 described herein for the purposes of this specification and claims as a plug member is also known in the electrical components industry as a "receptacle." The designation of the member 14 as a "receptacle" by the electrical components industry results from the fact that the female type terminals 24 are mounted in the member 14. It will also be understood that the member 12 described herein for purposes of this specification and claims as a receptacle member is also known in the electrical components industry as a "plug." The member 12 is known in the electrical components industry as a "plug" because the male type terminals 22 are mounted therein. However, since this disclosure is drawn primarily to the connector members 12 and 14, without substantial regard to the relationship of the terminals 22 and 24, and because the member 14 is inserted into the member 12, the member 12 has been designated as a receptacle into which the member 14, designated as a plug, is inserted.

Although a preferred embodiment of the invention has been illustrated with a cam lug on one side of the plug, and a latch lug on the other, it is contemplated that latch lugs could be positioned on opposite sides of the plug 14 to cooperate with latching recesses on opposite sides of the receptacle. Of course, if latch lugs were provided on opposite sides of the plug 14 latch release levers, similar to the lever 44, would be provided on opposite sides of the receptacle 12. It is also contemplated that a pair of latch lugs could, if desired, be positioned on one side of a plug to cooperate with a pair of latch release levers on one side of the receptacle. In view of the foregoing remarks, it will be apparent that various changes in structure will occur to those skilled in the art; and these changes are to be understood as forming a part of this invention insofar as they fall within the spirit and scope

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of the appended claims, since the specific structure herein shown and described is only illustrative of a preferred embodiment of the invention.

What is claimed is:

1. An electrical connector comprising: a receptacle element adapted to encase terminal ends of a first group of wires, said receptacle element having a front end and including a side wall having an aperture therein adjacent said front end, said side wall providing a latch bar between said aperture and said front end; latch release lever means connected to said side wall adjacent said aperture and extending outwardly therefrom and longitudinally away therefrom, said latch release lever means being manually movable transversely of the side wall resiliently to flex the side wall latch bar outwardly; a plug element adapted to encase terminal ends of a second group of wires, said plug element having an end portion adapted to be inserted in said receptacle element, said plug element including a wall means adapted for sliding engagement with an inner surface of the side wall of said receptacle; and latch lug means projecting outwardly from the wall means of said plug element and receivable in said aperture to engage the latch bar to interlock said plug element and said receptacle element, said latch release lever means being manually movable transversely of the side wall to deform said side wall and move said latch bar outwardly of said side wall to disengage said latch lug from said latch bar to enable said plug element to be withdrawn from said receptacle element.

2. An electrical connector as set forth in claim 1, further including: mounting means integrally formed with said plug element to mount said plug element in a control panel, said mounting means including a pair of ear members which are resiliently deformable to engage a control panel.

3. An electrical connector as set forth in claim 1 wherein: said latch release lever means is integrally formed with the side wall of said receptacle element and extends in a direction generally parallel to said side wall.

4. An electrical connector as set forth in claim 1 wherein: said latch release lever means includes a first side section extending outwardly from a position adjacent a first longitudinally extending side of said aperture, and a second side section extending outwardly from a position adjacent a second longitudinally extending side of said aperture, said first and second side sections being interconnected by a lever section extending longitudinally back away from said front end, whereby pressing said lever section inwardly causes said first and second side sections to flex said socket wall outwardly.

5. An electrical connector as set forth in claim 1 wherein said lever means extends back away from said front end,

6. An electrical connector as set forth in claim 1 wherein: said side wall includes a base wall section and a socket wall section, said socket wall section being interconnected with said base wall section at a shoulder means projecting outwardly from the base wall section, said aperture being a generally U-shaped aperture extending from said shoulder means into said socket wall section for a substantial distance.

7. An electrical connector as set forth in claim 6 wherein: said latch release lever means includes a first side section extending outwardly from a position adjacent a first longitudinally extending side of said aperture and a second side section extending outwardly from a position adjacent a second longitudinally extending side of said aperture, said first and second side sections being interconnected by a lever section extending longitudinally back away from said front end, whereby pressing said lever section inwardly causes said first and second side sections to flex said socket wall outwardly.

8. An electrical connector as set forth in claim 1 wherein: said receptacle element further includes a second aperture formed in a second side wall of the receptacle; and said plug element includes cam lug means projecting out-

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wardly from a second wall means of the plug element to engage said second aperture formed in said receptacle element to further interlock said plug element and said receptacle element.

9. An electrical connector as set forth in claim 8 wherein: said cam lug means includes a first cam surface for flexing the side wall of said receptacle element outwardly when said plug element is inserted in said receptacle element, and said cam lug means further includes a second cam surface for flexing the side wall of said receptacle element outwardly when said plug element is withdrawn from said receptacle element.

10. An electrical connector comprising: a receptacle element adapted to encase terminal ends of a first group of wires, said receptacle element having a front end and including first and second spaced-apart side walls, a first recess means formed in said first side wall adjacent said front end and providing a first latch retainer and a second recess means formed in said second side wall adjacent said front end and providing a second latch retainer; latch release lever means projecting outwardly from said first side wall adjacent said first recess means, said latch release lever means being integrally formed with said first side wall means and extending in a direction generally parallel to said first side wall away from said first recess means, said latch release lever means being manually movable transversely of said first side wall resiliently to flex said first side wall latch retainer outwardly; a plug element adapted to encase terminal ends of a second group of wires, said plug element having an end portion adapted to be inserted into said receptacle element intermediate said first and second side walls; said plug element including an inner end surface interconnecting first and second spaced-apart walls which are adapted for sliding engagement with inner surfaces of the first and second side walls of said receptacle element; latch lug means projecting outwardly from the first wall of said plug element, said latch lug means being integrally formed with the first wall of said plug element and including a cam surface sloping outwardly from the first wall and away from said inner end surface of said plug element to flex said first side wall of said receptacle element outwardly when said plug element is inserted into said receptacle element, said latch lug means further including a latch surface means projecting substantially perpendicularly outwardly from said first wall of said plug element for engagement with said first recess means and behind said first latch retainer means to lock said plug element in said receptacle element; and cam lug means projecting outwardly from the second wall of said plug element, said cam lug means including a first cam surface sloping outwardly from the second wall of said plug element and away from said inner end surface of said plug element to flex said second side wall of said receptacle element outwardly when said plug element is inserted in said receptacle element, said cam lug means further including a second cam surface sloping inwardly toward the second wall of said plug element to flex said second side wall of said receptacle element outwardly when said plug element is removed from said receptacle element, said latch lug means being disengaged from said first recess means by moving said latch release lever means inwardly to flex said first side wall means outwardly to facilitate removal of said plug element from said receptacle element.

11. An electrical connector as set forth in claim 10 further including: first and second resiliently deformable ears projecting outwardly from said plug element for mounting said plug element in a control panel.

12. An electrical connector as set forth in claim 10 wherein: said latch lever means includes a first wall portion extending outwardly from said first side wall at a location adjacent to a first side of said first recess means, said latch release lever means further including a second wall portion substantially parallel to said first wall portion and extending outwardly from said first side wall at a

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location adjacent to a second side of said first recess means.

13. An electrical connector as set forth in claim 10 wherein: said first side wall includes an inflexible base wall section and an outwardly projecting flexible socket wall section, said first recess means being formed by an aperture means in said socket wall section, said aperture means in the socket wall section extending for a substantial distance into said socket wall section from an intersection of said socket section and said base wall section.

14. An electrical connector as set forth in claim 13 wherein: said second side wall includes a second inflexible base wall section and a second outwardly projecting flexible socket wall section, said second recess means being formed by an aperture means in said second socket wall section, said aperture means in said second socket wall section extending for a substantial distance into said sec-

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ond socket wall section from an intersection of said second socket wall section and said second base wall section.

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