

March 23, 1948.

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DISENGAGEABLE ELECTRICAL CIRCUIT CONNECTOR

Filed July 21, 1944

4 Sheets-Sheet 1

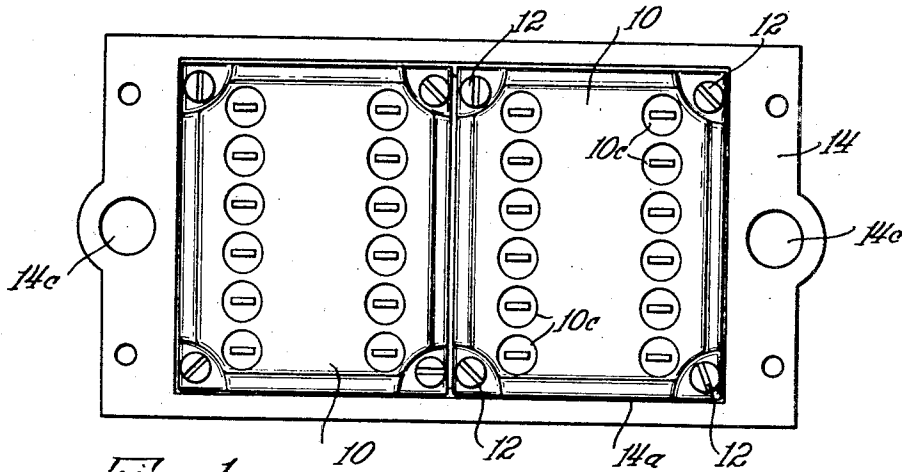


Fig. 1a

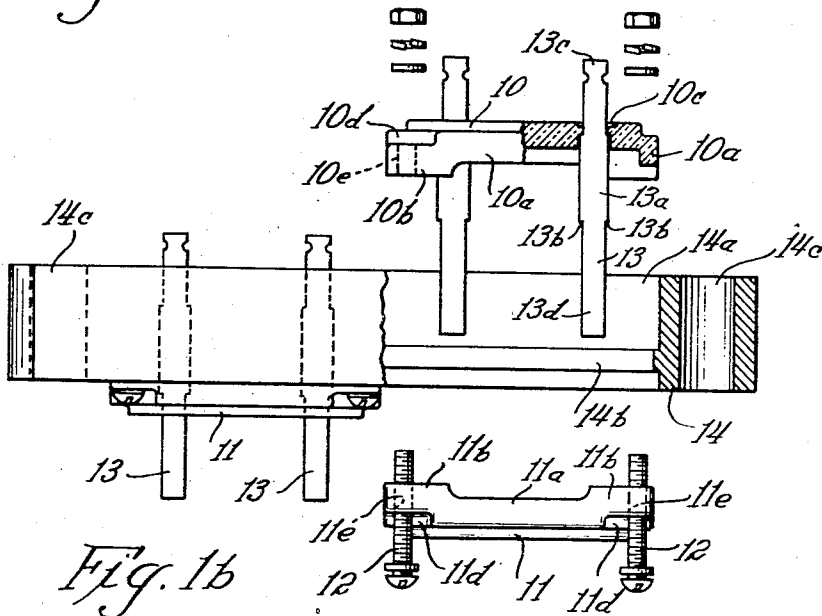


Fig. 1b

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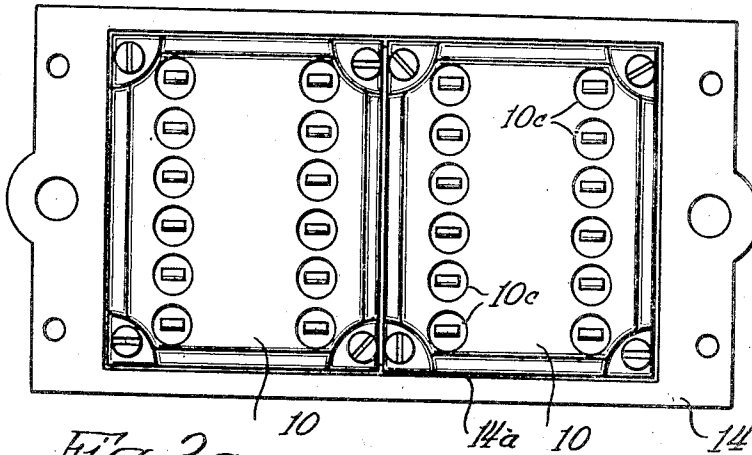


Fig. 2a.

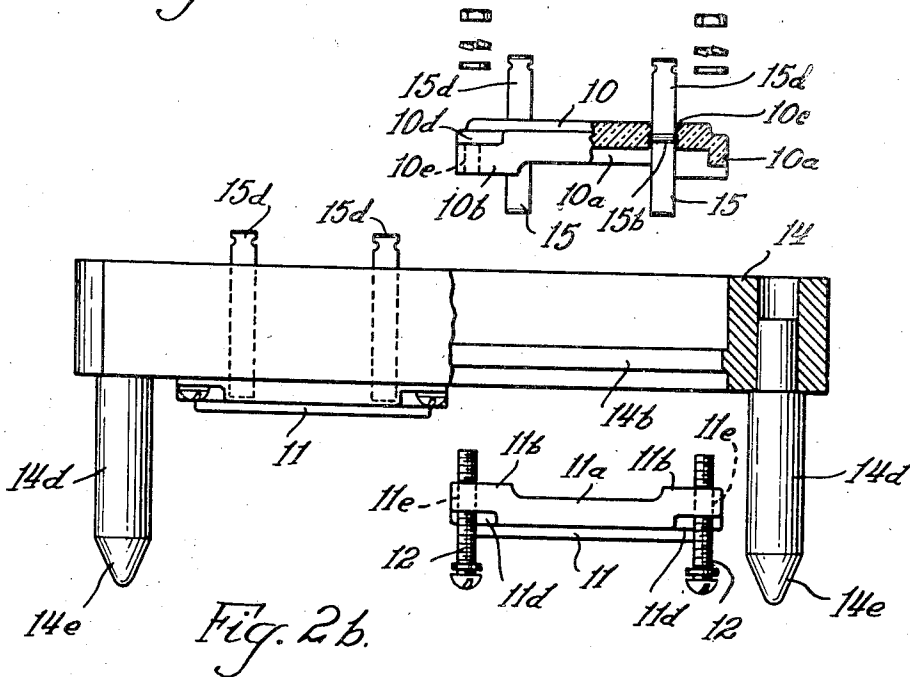


Fig. 2b.

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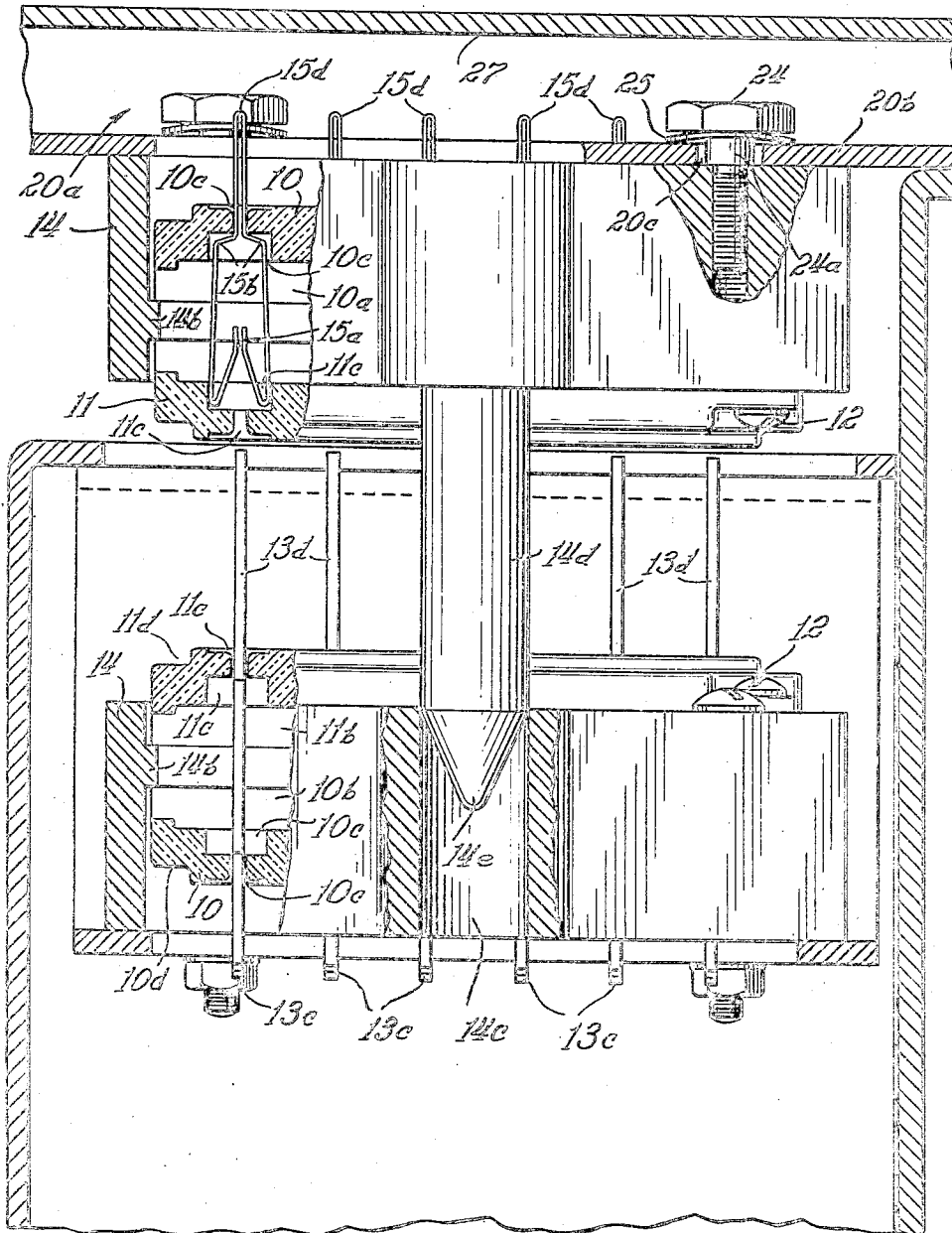
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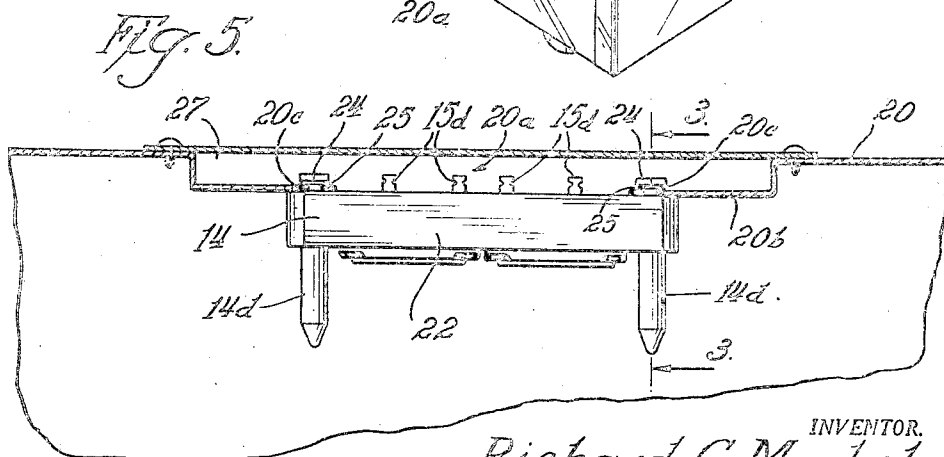
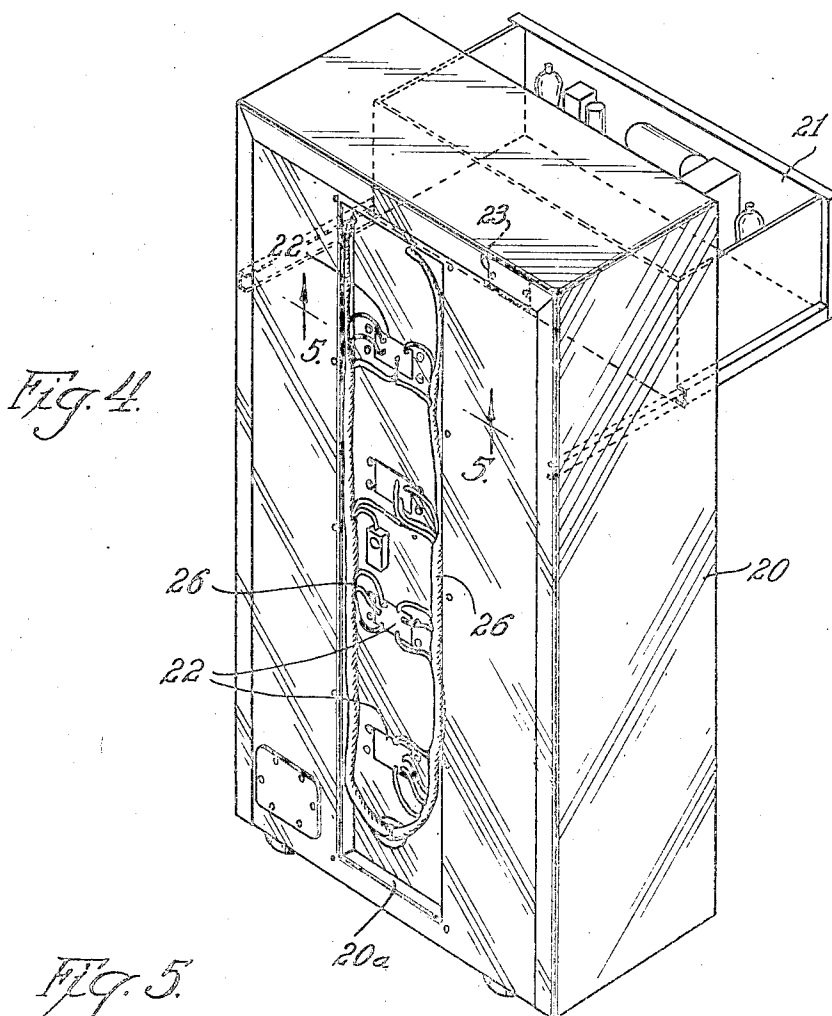
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DISENGAGEABLE ELECTRICAL CIRCUIT CONNECTOR

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4 Sheets-Sheet 4



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DISENGAGEABLE ELECTRICAL CIRCUIT CONNECTOR

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4 Claims. (Cl. 173—328)

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This invention relates to a disengageable electrical circuit connector of the full-floating contact type and, while it is of general application, it is particularly adaptable for application in a disconnectible plug and socket and will be described as embodied in such an application.

In many applications of disconnectible electrical plugs and sockets it is required that the complementary contact elements maintain a good electrical contact in spite of minor misalignments due to either manufacturing tolerances or to slight misalignments of the electrical apparatus with which the plugs and the sockets are associated. For example, in certain types of communication and control apparatus of complicated forms, the apparatus is constructed in the form of a chassis rack; that is, it is divided into a number of sub-assembly units or chassis and these chassis are removably mounted in a rack or cabinet much in the manner of a series of drawers in a chest, usually with the sockets mounted on the back of the rack and the plugs attached to the back of the chassis and adapted to engage the sockets when the chassis is fully inserted. This arrangement has a number of advantages in that, when the chassis is withdrawn for service or repair, it avoids numerous circuit changes and also usually breaks the connection of the circuit embodied in the chassis from the supply circuit, thereby removing the shock hazard to the operator.

It is, of course, difficult in such a unit construction to maintain the precise alignment of the mechanical parts necessary to ensure good electrical contacts from rigid-contact plug and socket connectors, so that it has been proposed to utilize full-floating-contact type connectors, that is, connectors of the type in which the contact elements are freely disposed in recesses in the connectors without any fixed engagement with the body of the connector, permitting limited movement of the contact elements in any direction. In some of these proposed connector constructions, the arrangement of the contact elements and parts is such that manufacturing tolerances on the individual elements are cumulative in the final structure, thus introducing difficult alignment problems. In this type of plug and socket connector, either of the rigid-contact type or the full-floating-contact type, the structures previously proposed have tended to apply excessive lateral strains upon the contact elements in case of any substantial misalignment of the plug and socket occasioned by inaccuracies of the mechanical structure of the rack and chas-

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sis units. These stresses in some instances have deformed the contact elements or chipped or broken the insulating material comprising the supporting body of the plug or socket, thus aggravating the difficulty upon subsequent engagements of the plug and socket.

It is an object of the invention, therefore, to provide a new and improved disengageable electrical circuit connector of the full-floating-contact type which is effective to overcome one or more of the disadvantages of the prior art arrangements.

It is another object of the invention to provide a new and improved disengageable electrical circuit connector of the full-floating-contact type which is particularly adapted for use in plug and socket connectors suitable for the unit type of rack and chassis construction of electrical apparatus.

It is another object of the invention to provide a new and improved disengageable electrical circuit connector of the full-floating-contact type which is simple and economical in construction and in which the effects of manufacturing tolerances on the individual elements are not cumulative but random.

It is another object of the invention to provide a new and improved disengageable electrical circuit connector of the full-floating-contact type for use in plug and socket connectors by means of which the lateral strains of the contact elements may be substantially removed.

In accordance with the invention, a disengageable electrical circuit connector of the full-floating-contact type comprises a pair of complementary wafers of insulation material, each of the wafers being formed with one or more recesses, and means for clamping the wafers in opposed relation with corresponding recesses in alignment. The connector includes an elongated contact element freely disposed in each of one or more selected pairs of aligned recesses in the wafers and positioned thereby, the clamping means being effective substantially parallel to the contact elements and the wafers, when clamped by the means, including provisions for engaging and retaining the elements while permitting limited motion thereof.

Further in accordance with the invention, a disengageable electrical circuit connector of the full-floating-contact type comprises a pair of wafers of insulation material, means for clamping the wafers in opposed relation, at least one of the wafers being formed with one or more recesses, and a contact element freely disposed in each of one or more of the recesses and posi-

tioned thereby. The insulation wafers, when clamped by the means, include provisions for engaging and retaining the contact elements while permitting limited motion thereof. The connector also includes a rigid, integral, supporting frame independent of the clamping means and means for securing the wafer and contact elements assembly, when clamped, to the frame. Preferably in a connector of this type the frame includes provisions for laterally positioning the wafers independently of the clamping means.

Further in accordance with the invention a disengageable electrical plug and socket embodies a connector of the full-floating-contact type described in any of the preceding paragraphs and the plug and socket include complementary aligning elements proportioned to engage each other before engagement of their associated contact elements.

For a better understanding of the invention, together with other and further objects thereof, reference is had to the following description taken in connection with the accompanying drawings while its scope will be pointed out in the appended claims.

Referring now to the drawings,

Figs. 1a and 1b are top and side views, respectively, the latter partly in exploded section, of a disengageable electrical connector of the plug type embodying the invention;

Figs. 2a and 2b are similar views of a disengageable electrical connector of the socket type embodying the invention and adapted to receive the plug of Figs. 1a and 1b;

Fig. 3 is an enlarged end view, partly in section, of the plug and socket connector of Figs. 1a, 1b and 2a, 2b in the proper relation just prior to engagement of the contact elements;

Fig. 4 is a perspective view, partially schematic of a chassis rack embodying the disengageable electrical connector of the invention, while

Fig. 5 is a cross-sectional detail of a portion of the rack of Fig. 4 along the line 5-5.

Referring now to Figs. 1a, 1b of the drawings, there is illustrated a disengageable electrical connector of the full-floating contact type adapted to be used as a disengageable plug. The plug of Figs. 1a, 1b comprises two pairs of complementary wafers 10, 10 and 11, 11 of insulation material, preferably of a molded ceramic material. The wafers 10 and 11 are of rectangular shape and are formed with upturned rims 10a, 11a terminating at the corners in pedestals 10b, 11b. At least one of each of the pairs of wafers 10, 11, preferably both, are formed with one or more recesses 10c, 11c (Fig. 3) preferably regularly spaced in one or more parallel rows as indicated in Fig. 1a. Each of the recesses is shown as comprising a generally conical depression in the outer face of one of the wafers 10 and 11 and a substantially cylindrical recess in the inner face of the wafer, joined by a narrow rectangular aperture. However, these recesses may take any of a variety of shapes in accordance with the particular design of the connector and these recessed portions are collectively referred to herein as the "recesses" in the insulation wafers.

The connector also includes means for clamping the wafers in opposed relation, this means comprising the depressions 10d, 11d at each of the corners of the wafers at which are located the holes 10e, 11e for receiving bolts 12. The connector also includes a plurality of contact ele-

ments 13, one being disposed freely in each of one or more selected recesses of one of the wafers or, in the embodiment illustrated, in selected pairs of aligned recesses 10c, 11c in the wafers and positioned by such recesses. The contact elements 13 are provided with enlarged middle sections 13a having shoulders 13b.

The connector also includes a supporting frame 14 for the wafer and contact assembly, when clamped in their normal positions, and this supporting frame is preferably a rigid integral structure, as illustrated, which is independent of, that is, forms no part of, the clamping means of the connector. The frame 14 includes provisions for positioning the wafer and contact assembly laterally independently of the clamping means, these provisions comprising the opening 14a proportioned closely to surround the periphery of the wafers 10 and 11 when in their clamped position. The frame 14 is formed with an internal peripheral rib 14b, the opposed wafers 10 and 11 in their normal positions being clamped with the pedestals 10b, 11b engaging opposite faces of the rim 14b. The pedestals 10b, 11b can be ground or otherwise finished to ensure an accurate spacing and positioning of the wafers 10 and 11 in the frame 14.

With the arrangement described, when the opposing wafers 10 and 11 are clamped by the bolts 12 to engage opposite faces of the rim 14b, the clamping means is effective substantially parallel to the contact elements 13b, which are full-floating, so that the pressure of the clamping means exerts no stress on the contact elements 13 nor on the wafers 10, 11 in a direction normal to the contact elements 13, which stress might tend to displace them laterally and impair their alignment with corresponding elements of the associated socket described hereinafter. As can be seen from Fig. 1b and Fig. 3, the wafers 10 and 11, when clamped, include provisions for engaging and retaining the contact elements 13 while permitting limited motion thereof, these provisions being either the inner surfaces of the opposed wafers 10 and 11 or the inner surfaces of the corresponding recesses 10c, 11c which engage the shoulders 13b of the enlarged central portions 13a of the contact elements and limit longitudinal movement thereof. Conversely, if desired, these provisions may comprise protrusions formed on the wafers 10, 11 engaging complementary recesses formed in the contact elements.

In the plug type of connector of Figs. 1a, 1b, the ends 13c of the contact elements 13, which in use are remote from the associated socket, extend through their respective recesses 10c of the upper wafer 10 to provide means for making an external electrical connection thereto. Similarly, the other ends 13d of the contact elements 13 which, when associated with a complementary socket, form elements of resilient frictional contacts, extend through the recesses of the wafer 11 for insertion in the complementary socket.

As illustrated in Figs. 1a, 1b, duplicate wafer and contact assemblies are disposed side by side in the frame 14, the wafers and contact elements of the duplicate assemblies being identified by similar reference numerals, but not requiring a repeated description. It will be apparent that any desired number of duplicate wafer contact element assemblies may be mounted within a single supporting frame.

Referring now to Figs. 2a and 2b, there are represented a disengageable electrical connector of

the socket type suitable for operation with the plug of Figs. 1a, 1b. The elements of the socket connector of Figs. 2a and 2b, with the sole exception of the contact elements, are substantially identical with those of Figs. 1a, 1b and for the sake of clarity corresponding elements are identified by the same reference numerals. In the connector of Figs. 2a, 2b each of the contact elements 15 is in the form of a strip of resilient conductive material, such as brass, bent double on itself with re-entrant portions 15a (Fig. 3) constructed to form a spring clip for receiving the protruding portions 13d of the contact elements 13 of the plug of Figs. 1a, 1b. One end 15d of each of the contact elements 15 extends through a recess 10c of its associated wafer 10, while the spring clip portion 15a thereof is in alignment with a recess 11c in the wafer 11 to facilitate the entry of the contact elements 13 of the plug connector of Figs. 1a, 1b. The contact elements 15 are formed with outwardly flaring shoulders 15b near their middle section, these shoulders engaging the inner face of the wafer 10 or the bottoms of the inner recesses 10c thereof while the other ends of the elements 15 fit into and engage the inner faces of the cylindrical recesses 11c of the inner face of the other wafer 11.

From the description of Figs. 1a, 1b and 2a, 2b it will be seen that the insulation wafers 10 and 11 are completely interchangeable, both as between the opposing wafers of each of the types of connectors and as between the plug and socket connectors. This has the apparent advantage of reducing the number of types of molded insulation elements required.

The supporting frame 14 of the plug connector of Figs. 1a, 1b and the frame 14 of the socket connector of Figs. 2a, 2b include provisions to ensure their proper alignment when brought into engagement before the engagement of their associated contact elements. Specifically, the frame 14 of the plug connector of Figs. 1a, 1b is provided with a circular socket or hole 14c at each end thereof while the frame of the socket connector of Figs. 2a, 2b is provided with a complementary pin 14d at either end thereof having a tapered end portion 14e to facilitate entry into the sockets 14c of the complementary connector.

As indicated in the enlarged detail view of Fig. 3, the length of the pins 14d is such that they enter the sockets 14c of the plug connector, during the engagement of the plug and socket, prior to the engagement of the contact elements 13 of the plug with the spring contacts of the socket and even prior to the entry of the contact elements 13 into the slot-like recesses or apertures 11c of the wafer 11 of the socket connector. By this arrangement the engagement of the plug and socket are facilitated in that any minor misalignments of the plug and socket due to manufacturing tolerances or to inaccuracies of their mountings in the chassis and rack portions of the associated electrical apparatus are taken up by the pins 14d and sockets 14c. Thus, the maximum possible accuracy of alignment is assured before it is attempted to force the plug and socket into engagement. This is particularly helpful when the plug and socket connectors include a large number of contact elements requiring a considerable force to effect their engagement. At the same time the rigid supporting frames 14 and sturdy pins 14d and sockets 14c absorb any lateral strains or shocks imposed upon the plug and socket connectors either during their engagement

or thereafter in the normal operation of the apparatus of which they form a part. This avoids deformation of the contact elements of the connectors, which would increase the difficulty of subsequent engagement and disengagement of the plug and socket, and also substantially eliminates strains on the insulation wafers 10 and 11. In the case of the use of molded ceramic material for the wafers 10 and 11, which is brittle, the described aligning means avoids substantial lateral stresses and strains which might crack or chip the wafers, particularly at the recesses 10c, 11c or at the holes 10e, 11e for the clamping bolts.

Referring now to Fig. 4, there is represented an electrical chassis rack including a housing or cabinet 20 in which are removably mounted a plurality of electrical apparatus chassis, such as the chassis illustrated at 21, the chassis being disposed one above the other in vertical alignment like the drawers in a chest. The cabinet 20 is provided with a vertical inset cable duct 20a the back of which is in the form of an apertured supporting plate. A disengageable plug and socket of the type described is provided for each of the chassis 21 and comprises complementary plug and socket members, corresponding ones of which are adapted to be mounted on the supporting plate of the cable duct 20a and the others being adapted to be individually mounted on the chassis. As illustrated, a series of sockets 22 are mounted on the back plate of the duct 20a while a complementary plug 23 is mounted on the back of each of the chassis 21. The details of the mounting of the sockets 22 on the back plate 20b of the cable duct 20a is shown in Fig. 5, the plate 20b being provided with a series of large apertures to permit access to the contact terminals 15a of the socket 22. The plate 20b is also provided with appropriately spaced apertures 20c for receiving a plurality of machine screws 24 under the head of each of which is inserted a spring washer 25. The details of the mounting of the socket from the back plate 20b are shown more clearly in Fig. 3. As there illustrated each of the screws 24 is formed with an enlarged shank 24a which engages the frame 14 of the associated socket. The shank has a diameter substantially less than that of the apertures 20c and a length substantially greater than the thickness of the back plate 20b, whereby the sockets 22 have a limited free transverse movement with respect to the backing plate 20b and are resiliently supported therefrom in a free-floating connection. The several sockets 22 may be interconnected by suitable electrical cables 26, whereupon a removable cover plate 27 may be secured to cover the cable duct 20a.

It will be apparent that, upon the insertion of any of the chassis 21 into the cabinet 20, the complementary socket 22 and plug 23 associated with such chassis will be brought into engagement. As described above, the aligning pins 14d and socket 14c preliminarily align the plugs and sockets and absorb any lateral strains due to misalignment of the chassis. At the same time the resilient or free mounting of the socket frames 14 on the back plate 20b of the cable duct 20a permits limited transverse movement of the sockets to accommodate inaccuracies in alignment of the chassis with the rack or cabinet 20.

While there has been described what is at present considered to be the preferred embodiment of the invention, it will be apparent to those skilled in the art that various changes and modi-

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fications may be made therein without departing from the spirit or scope of the invention.

I claim:

1. A disengageable electrical circuit connector including in combination an open frame, an internal rib within said frame, a pair of complementary opposed wafers of insulation material positioned within said open frame on opposite sides of said internal rib and each having a plurality of recesses oppositely positioned and each pair of opposed recesses providing a cavity therebetween, contact means in each pair of recesses having a portion in the cavity dimensioned for floating movement therein as limited by the walls of such recesses, said contact means having another portion extending out of a wafer for receiving a circuit connection thereto, and fastening means through said wafers to clamp the pair of wafers toward one another against the internal rib, said wafers being maintained rigid in the frame but each said contact means floating within limits in the wafers.

2. A disengageable electrical circuit connector including in combination a frame comprising an outer rim with top and bottom faces and open centrally thereof, an internal rib within said frame extending parallel to said faces and between the same, a pair of complementary opposed wafers of insulation material each having a plurality of recesses therein and said pair being positioned within said open frame supported on opposite sides of said internal rib with said recesses oppositely positioned and each pair of opposed recesses providing a cavity therebetween, contact means in each pair of recesses having a portion positioned in the cavity dimensioned for floating movement within the cavity as limited by the walls of such recesses, said contact means having at least one portion extending out of a wafer for receiving a circuit connection thereto, and fastening means extending through

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each wafer to clamp the pair of wafers toward one another against the internal rib, said wafers being maintained rigid in the frame but each said contact means floating within limits in the wafers.

3. In a connector as defined in claim 1 wherein said contact means comprises a metal member and said portion in said cavity comprises an enlargement engageable with the walls of said recesses.

4. In a connector as defined in claim 1 wherein said contact means comprises a metal member and said portion in said cavity comprises resilient prong receiving means with a bend at one end and a shoulder at the other end engageable with the walls of said recesses.

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