April 15, 1952 E. C. QUACKENBUSH 2,593,182

MONOBLOCK CONNECTOR

Filed April 22, 1948

Fig. 1.

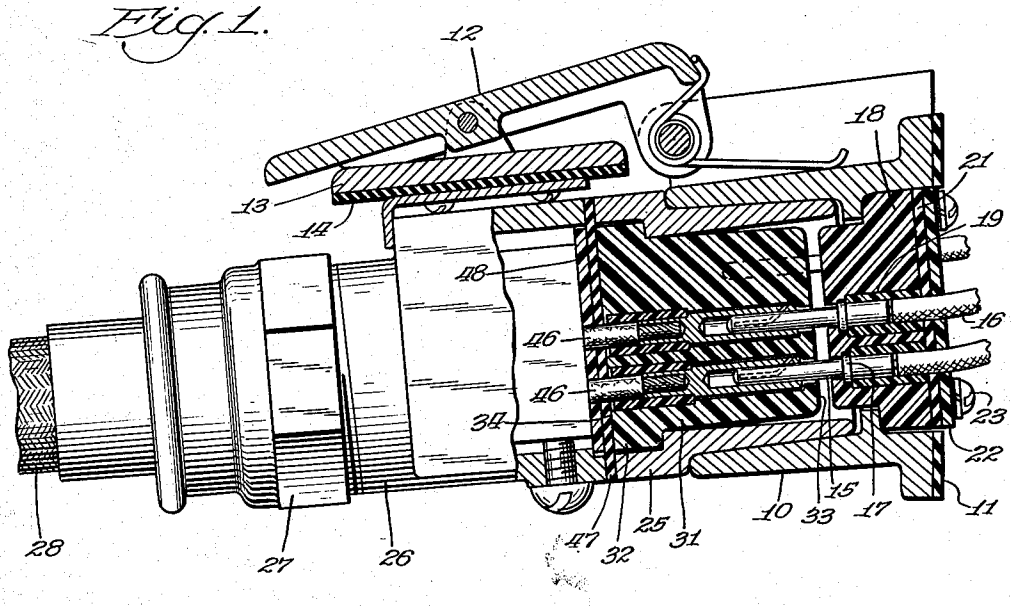
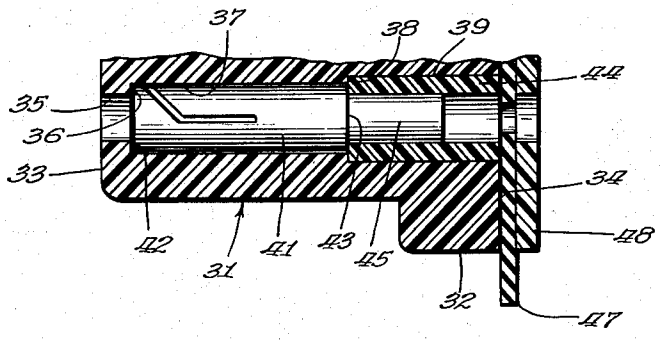


Fig. 2.



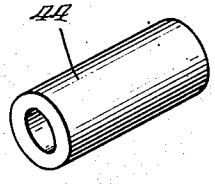


Fig. 3.

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MONOBLOCK CONNECTOR

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1 Claim. (Cl. 173—328)

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The present invention relates to electrical connectors and deals primarily with the provision of connector contacts of novel form, in combination with an improved mounting for the individual contacts whereby the effectiveness of the insulation between the several contacts of a connector is improved, and the liability of formation of electrical creepage paths between the separate contacts carried in a connector mounting block is largely eliminated.

The problem of maintaining effective insulation between a multiplicity of electrical contacts in a multiple connector is a difficult one, since the contacts must of necessity be quite closely grouped, and since the connectors not only are subjected to considerable physical abuse, but are also exposed to all extremes of climatic conditions.

It is requisite, of course, that to be acceptable to the trade a connector must be satisfactory from a mechanical as well as an electrical viewpoint, and it follows that the several contacts must be held in quite exact position, yet must have a certain freedom of movement, so that they may align themselves with their coacting contacts in the mating connector and fit into each other freely and without binding. In view of this, it has been almost universal prior practice to provide the individual metallic contacts with an enlarged mounting portion adapted to be loosely clamped between oppositely disposed abutment shoulders in each of two separate halves of an insulating mounting block. This expedient has been very satisfactory from a mechanical standpoint, but it involves serious electrical shortcomings; primarily due to the fact that repeated cycling of the connector into and out of zones of high and low temperatures, variable humidity, or both, often brings about sufficient condensation of moisture in the joint between the surfaces of the two pieces of the block to establish electric current creepage paths between the individual contacts. These paths are undesirable in any circuits, but are particularly troublesome in communication lines, where even a very minute leakage may cause serious operating difficulties.

It has been learned that the risk of formation of creepage paths across the exposed surfaces of the individual connector blocks is not particularly troublesome, probably due to the fact that these are ordinarily more widely spaced from each other and better ventilated, and because, when the connectors are disengaged, the surfaces are fully exposed and any moisture they carry has

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an opportunity to evaporate. The most serious difficulty appears to arise between permanently joined surfaces intermediate the opposite ends of the metallic contacts, where the length of the path between the contacts is very small.

Considerable research has been directed toward reaching a solution to this problem, and some progress has been made, as by devices designed to effect a moisture-proof seal around the critical areas, but despite the large sums of money expended to overcome it, the problem still persists; and no simple, practical and entirely successful solution has heretofore been forthcoming.

It is accordingly the primary object of the present invention to provide, in an electrical connector, a combination of a novel form of individual metallic contacts and a mounting block of insulating material so arranged and constructed that the contacts are carried loosely, yet in exact position, and wherein there are no intercontact surfaces through the insulating block at any point between the opposite faces of the block, so that the establishment of creepage paths between the individual contacts is unlikely.

A further object of the invention resides in the provision of an electrical connector wherein the insulating block in which the connector contacts are mounted is a single, unitary, one-piece structure, with the contact cavities extending entirely through it but separated by a solid, unbroken wall of insulation throughout their length. Thus, the formation of creepage paths in the block itself is eliminated.

A still further object is to provide a contact mounting block as indicated above, with the mounting portion of each contact substantially shorter than the length of the cavity, and terminating a considerable distance from the back face of the block. This expedient provides a particularly long contact-to-contact distance across the back face of the block, and largely avoids the risk of electrical leakage at the rear face of the block.

The manner in which these objects are accomplished will be apparent by reference to the following description and to the drawings of this disclosure, wherein:

Figure 1 is a side elevational view, partly in section, showing an electrical connector constructed in accordance with the teachings of this invention;

Figure 2 is an enlarged sectional view of the unitary mounting block, connector contact and spacing sleeve with which the present invention is specifically concerned; and

Figure 3 is a perspective view of one of the insulating spacing sleeves.

The preferred embodiment of the invention is illustrated in connection with a train line receptacle and connector including a fixed socket fitting and plug having mating male and female contacts. The fixed socket has a housing comprising a metallic casting 10 adapted to be mounted on a fixed supporting surface and sealed thereto by a gasket 11. A pivot arm 12 and cover 13 are hinged to the socket to close the outer end of the casting 10 when the connector is disengaged, and a gasket is positioned on the cover to establish a seal over the contacts.

The fixed socket of the connector carries a number of pin contacts 15, each of which is joined to a flexible conductor 16. The individual contacts 15 include enlarged mounting shoulders 17, received in one of the cavities of a mounting block 18, and held in position by spacing sleeves 19. A resilient rubber sealing member 21 is positioned over the rear surface of the block 18 and is held in position by an insulating sheet 22, secured by the cap screws 23 in any convenient manner.

The removable plug of the connector includes a housing comprising a forward portion 25 and a body portion 26 having a screw threaded fitting 27 by which the housing is joined to a multiple conductor cable 28. An insulating block 31 of unitary one-piece construction is mounted in the housing, and is securely held in place by an enlarged shoulder 32 fitted in a recess in the head portion 25 of the housing. The block 31 has a plurality of contact cavities in which the female contacts of the connector are mounted. Each of the cavities extends between the front face 33 and the rear face 34 of the block, and includes forward, center and rear portions of progressively increasing diameter. As shown, the forward openings 35 through the front face 33 constitute the portion of minimum diameter of the cavity, and terminate in a rearwardly facing abutment shoulder 36 from which the center, or mounting portion 37, of the cavity extends to a second shoulder 38 and to the rear portion 39 of maximum diameter (Figure 2).

The mounting portion of the female contacts comprises a relatively long tubular portion 41 (Figure 2), which terminates in a front stop surface 42 and a shoulder, or rearwardly disposed stop surface 43, and as shown, each of the contacts includes a reduced portion 45 having an internal bore or cavity in which one of the flexible conductors 46 of the cable 28 is secured. A cylindrical insulating sleeve 44 abuts against the shoulder 43 to retain the contact in position in the cavity. The sleeves, in turn, are secured in place in the cavities by a rubber sealing gasket 47 and insulating sheet 48. The sleeve may be of one-piece construction as shown in Figure 3, or may be split to permit it to be put in place after the contact is joined to its flexible conductor, but in either case it will function in a manner to limit rearward movement of the contacts towards the back face of the mounting block. The male contacts are secured in the same manner as the female, and although the mounting portion of the male contacts consists of the flange 17 and is, of course, notably shorter than the sleeve portion 41 of the female, yet its front and rear surfaces coact with the internal shoulders of the cavity and with the sleeves 19 in an identical manner.

It is to be noted that since the insulating

mounting blocks 18 and 31 are of unitary one-piece construction, there is no parting line extending between the individual contacts at any point between the opposite ends of the block, and it follows that no creepage paths can develop between the contacts unless they extend across the front faces. This is quite unlikely on the exposed face surfaces of the block, since long experience has shown that no great difficulty is encountered at this point, and that if creepage paths are to develop at all, they are more apt to establish themselves across the interior sealed surfaces of the connector. This is extremely improbable in a connector constructed according to this teaching, since it is obvious that no interior creepage path can develop unless it is to extend from the shoulder 38 along the full length of the bore 39, across the rear surface 34 of the block, and back the entire length of another bore 39 to the shoulder 38 of the next contact. This is an extremely long path, and its unusual length obviates the difficulties heretofore encountered in connectors having parting lines between the two sections of the mounting block, since while a creepage path might readily develop across a short, substantially straight line directly between the individual contacts, the surface contact-to-contact distance of the present construction may easily be seven or eight times the straight-line distance, and it is highly unlikely that paths will develop across this greatly increased distance.

From the foregoing, it will be apparent that the teachings of the present invention effect a happy reconciliation between the required mechanical characteristics of a connector and the best electrical characteristics, and that a connector designed and constructed in accordance with these teachings achieves a degree of electrical perfection not heretofore obtained, yet in so doing maintains the essential mechanical characteristics. That is, a connector according to this disclosure permits slight looseness of each individual contact, so that each may align itself with its mating contact to engage and disengage freely, although the entire group is nevertheless held in quite accurate relative position. The present disclosure thus offers, in a simple, rugged and compact structure, a practical solution to a problem that has long plagued workers in the field to which this invention is related, but to which no satisfactory solution has heretofore been forthcoming.

The drawings attached hereto illustrate a present commerical embodiment of the invention in the precise form deemed preferable for a train line connector, but it is recognized that various deviations from the exact structure disclosed may be indulged in without departing from these teachings, and it is accordingly pointed out that the inventive concept is not limited to the precise arrangement illustrated, but extends equally to any modified structure coming within the terms of the appended claim.

Having thus described the invention what I claim as new and desire to protect by United States Letters Patent is:

In an electrical connector having a metallic housing with an open front end adapted to engage a mating connector, a contact mounting block of dielectric material; said block having side walls secured within the housing, an exposed front face surface adapted to abut the front face surface of a similar block in the mating connector and a rear surface enclosed within the housing; at least one contact cavity in said

block, having a face orifice of relatively small diameter at the front surface of the block, with a rearwardly facing shoulder near the forward end of the cavity and an enlarged mounting portion of the cavity extending rearwardly from the shoulder; a metallic contact element having a mounting portion loosely fitted within the enlarged portion of the cavity; the mounting portion of said contact having a forwardly facing stop surface at one end and a rearwardly facing stop surface at its other end and being substantially shorter than the mounting block, with the forwardly facing stop surface positioned in engagement with the internal shoulder of the cavity to limit forward movement of the contact and the other stop surface positioned at a point substantially spaced inwardly from the rear face of the block to provide a relatively long surface distance between contacts at the rear of the block, together with an insulating spacing sleeve

loosely fitted within the cavity and bearing against the rearwardly disposed stop surface to limit rearward movement of the contact, and a sealing sheet including perforations closely surrounding an electrical conductor leading from each contact and bearing against the end of the spacing sleeve to retain the sleeve and contact in position in the cavity.

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