Nov. 2, 1965 R. J. KINKAID 3,215,975

CONNECTOR BLOCK ASSEMBLY

Filed Nov. 27, 1961 2 Sheets-Sheet 1

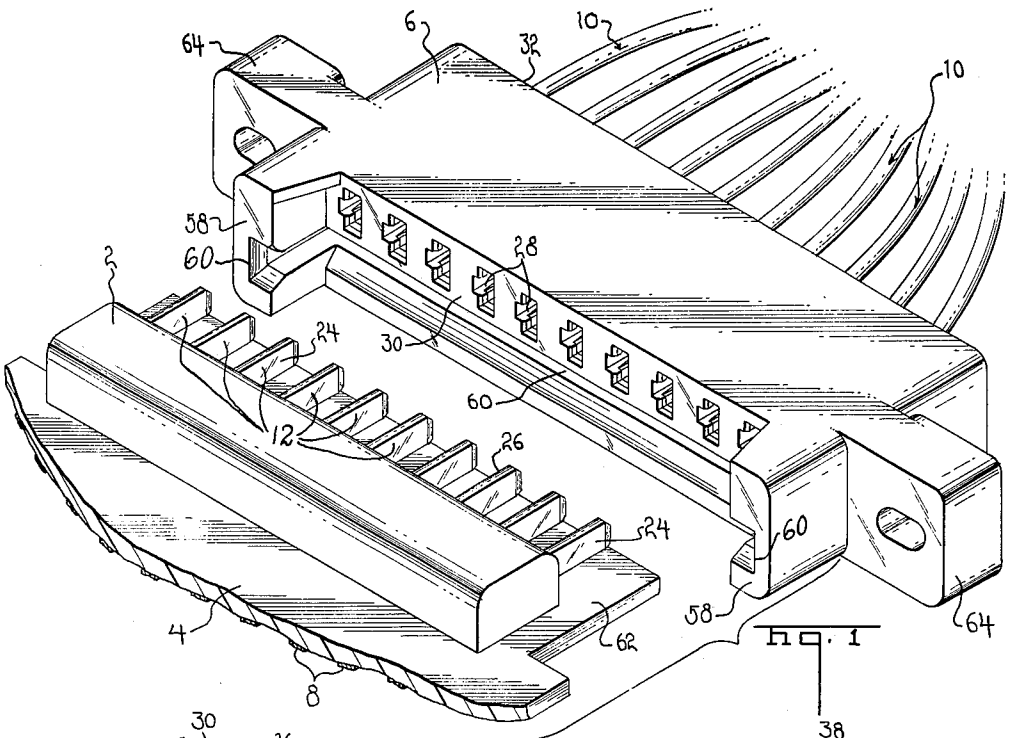

Fig. 1

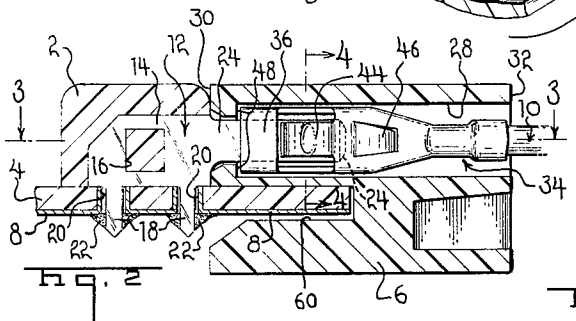

Fig. 2

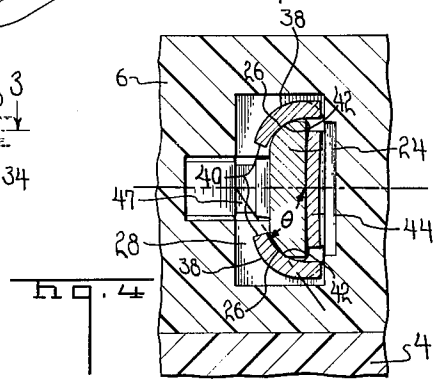

Fig. 4

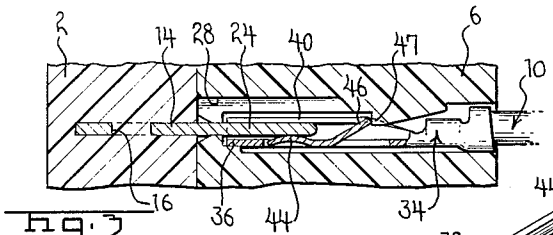

Fig. 3

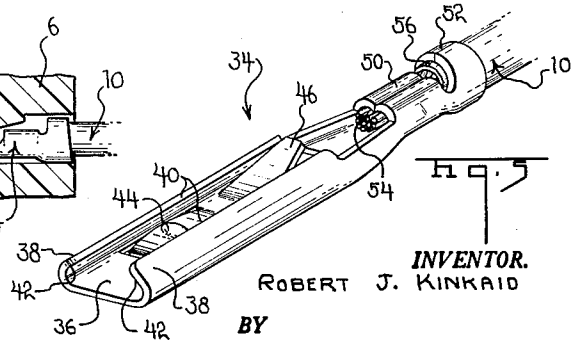

Fig. 5

INVENTOR.
ROBERT J. KINKAID

BY

Lawrie, Morris + Safford

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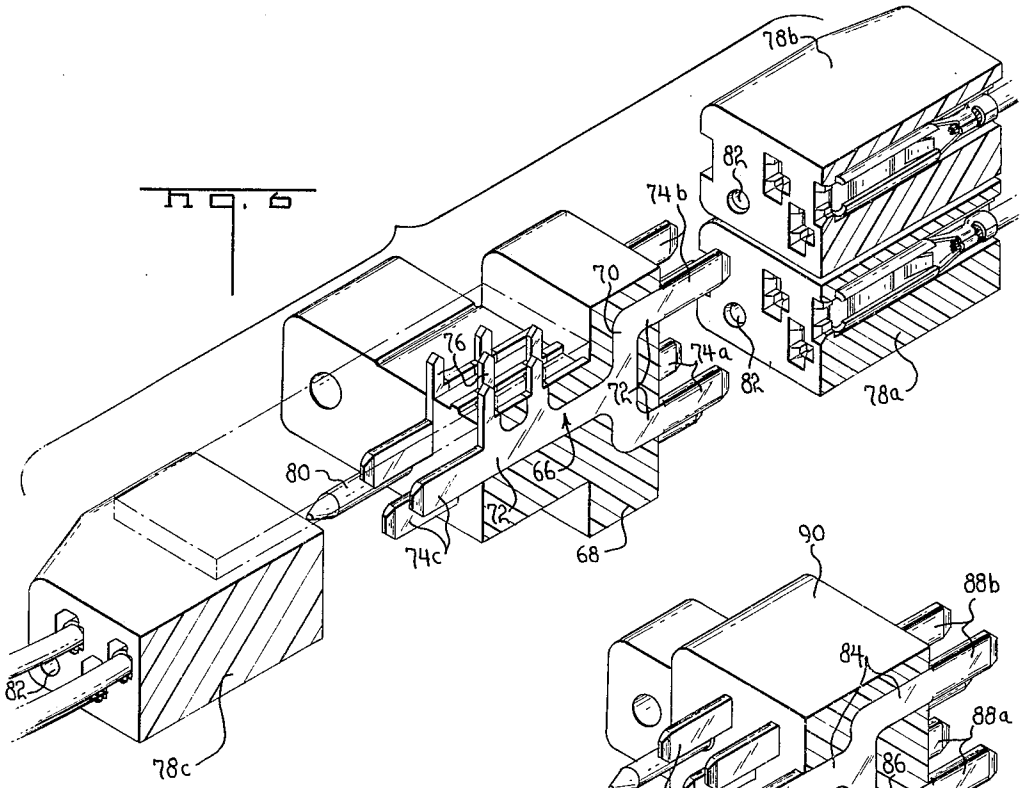

Fig. 6

Fig. 7

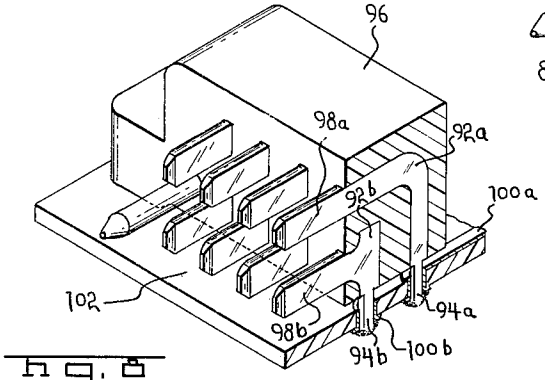

Fig. 8

INVENTOR.
ROBERT J. KINKAID

BY

Lewis, Morris & Safford

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CONNECTOR BLOCK ASSEMBLY

Robert J. Kinkaid, New Cumberland, Pa., assignor to AMP Incorporated, Harrisburg, Pa.

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3 Claims. (Cl. 339—256)

This invention relates, in general, to a connector block assembly for wiring electrical systems, particularly for a system including banks or arrays of printed circuit boards or cards. This application is a continuation-in-part of my prior application, Serial No. 75,955, filed December 15, 1960 now abandoned.

A variety of connectors have been proposed for incorporating banks of printed circuit cards in a system, but the lack of versatility, reliability, ruggedness and economy, in more or less degree, is a common failing.

An important feature of the invention, therefore, is the provision of a rugged and reliable connector assembly easily adaptable to a variety of functions and forms in the wiring of printed circuit card banks in electrical systems. To this end, as an objective the connector assembly of this invention includes a multi-contact plug block and a mating socket block, wherein the plug block may be formed so as to connect a printed circuit card individually into one of an array of socket blocks, or additionally may provide connections for two or more socket blocks to a single printed circuit card, or merely to provide feed-through connections for two or more socket blocks.

Another feature of the invention concerns the character of the contacts in the plug and socket blocks which are simple and rugged, yet are producible with a wide range of manufacturing tolerances. Another feature lies in the preservation of long life of the contacts by providing a slide-fit engagement which is highly wear-resistant. Closely allied with this feature lies the reliability of contact engagement by multiplicity of contact points between the contacts of the plug and socket blocks, and between the plug contacts and the printed circuit cards.

An additional feature resides in the provision of a commercially feasible organization of parts which overcomes certain disadvantages inherent in the structures of the prior art, which features will become apparent to those skilled in the art upon reading the following detailed description when taken in conjunction with the drawings in which:

FIGURE 1 is a perspective view of an embodiment of a connector block assembly according to the present invention;

FIGURE 2 is an enlarged side view, in section, of the connector assembly of FIGURE 1, but with the connector blocks engaged;

FIGURE 3 is a fragmentary sectional view taken along lines 3—3 of FIGURE 2;

FIGURE 4 is a fragmentary sectional view, further enlarged, taken along lines 4—4 of FIGURE 2;

FIGURE 5 is an enlarged perspective view of a contact for insertion in the socket block of the assembly;

FIGURE 6 is a sectional perspective view illustrating a modified form of a connector block assembly of the invention;

FIGURE 7 is a sectional perspective view illustrating another modified form of the plug block; and

FIGURE 8 is a sectional perspective view of another embodiment of a plug block of the invention.

With reference to the embodiment of the invention, as shown in FIGURES 1–5, the connector block assembly includes a plug block 2 mounted on a printed circuit card 4 for cooperation with a socket block 6 to complete circuit connections from the printed circuit lines 8 and the electrical components (not shown) on card 4 to lead

wires 10 associated with socket block 6 which lead to other apparatus of the electrical system involved.

The body of plug block 2 is of suitable insulating material and carries a row of plug contacts 12 which preferably are sheet-metal stampings from brass coated with a gold plating, especially when used for dry circuit connections. Conveniently, plug contacts 12 are insert-molded in plug block 2, and to this end the main body portion 14 has a central aperture 16 through which insulation of block 2 may extend for firmly anchoring the contacts. Each plug contact has a pair of tangs 18 projecting from the bottom surface of plug block 2 and received in a pair of apertures 20 in printed circuit card 4 for solder connection 22 in the usual manner to a printed circuit line 8 that passes by the apertures. Two such tangs are preferred to protect against faulty solder connections by multiplicity. Each plug contact 12 further has a plug part projecting from the forward face of plug block 2, advantageously in the form of a generally rectangular blade 24 having smoothly rounded corners on one side to provide a pair of longitudinally extending contact surfaces 26 as best shown in FIGURE 4. Preferably, the rounded corners are achieved by coining the edges of a flat sheet metal blank, thus to maintain close tolerances. In cross-section, contact surfaces 26 are arcuate on a radius of curvature which breaks the corners of the blade to the extent of about one-half the stock thickness. The side of the blades containing the contact surfaces 26, for convenience in assembly, all face in the same direction.

Socket block 6, also preferably molded from a suitable insulating plastic material, is generally rectangular and has a row of through passageways 28 extending between its front and back faces 30 and 32 respectively, thus to admit in their front end the row of plug blades 24 for cooperative engagement with a corresponding set of socket contacts 34 received into the back face of the passageways and supported in the socket block. The socket contacts also are of a form suitable for fabrication by sheet metal stamping techniques, preferably from a metal having spring qualities; e.g., Phosphor bronze with a highly conductive and corrosive-resistant coating such as a gold plating, and include an alongated blade-receiving socket section defined by a base 36 having a pair of opposed side flanges 38 bent back upon the base toward one another with their end edges 40 spaced less than the width of blades 24. Side flanges 38 additionally are curved, preferably by a coining operation to achieve close tolerances, on a radius of curvature slightly larger than the radius of curvature of plug contact surfaces 26, thus to provide mating contact surfaces 42 on their inside surfaces, the tangent at end edges 40 to this curvature projecting at a diverging angle relative to socket base 36. A radius of curvature for side flanges 38 of approximately 1½ times the radius of curvature of plug surfaces 26 has been found to be mechanically optimum.

As thus constructed, when a blade 24 is telescoped with a socket contact 34 and relatively pressed against side flnages 38, plug contact surfaces 26 are accommodated within the curvature of socket contact surfaces 42, effecting a predictable and constant quality of electrical engagement in their areas of meeting regardless of a wide range of configurational departures caused; for example, by accidental deformation or design tolerances. A spring prong 44 struck out of base 36 and extending inwardly and forwardly in socket contact 34 supplies the spring pressure for biasing or pressing blade 24 against flanges 38. Further, prong 44 is generally arcuate transversely of its axis with its free end normally positioned below the inside surface of base 36 so as not to interfere with the plug blade on insertion.

Socket contacts 34 advantageously are rather loosely mounted in socket block 6 in a snap-in relation so that

they can adjust individually to the entrance angle of the rigidly mounted plug blades **24** into passageways **28**. In this regard, a spring detent **46** struck out of base **36** and extending inwardly and rearwardly in socket contact **34** is arranged to engage behind a stop shoulder **47** extending inwardly from a sidewall of passageway **28** as the forward end of the socket contact approaches lips **48** at the forward end of the passageway upon insertion of the socket contact from the back face **32** of the socket block. Stop shoulder **47** is centrally arranged on the sidewall of the passageway so that on proper insertion of a socket contact **34**, it will be passed in the space between end edges **40** of side flanges **38**. If an attempt is made to insert the socket contact upside down, however, base **36** will be obstructed by stop shoulder **47**, thus to assure that all the socket contacts will be properly inserted to face in the same direction and in proper orientation relative to blade contacts **12**.

At the rearward end of each socket contact, suitable means are provided for connection with lead wires **10**. Typically, such means, as shown in FIGURE 5, may comprise two pairs of ears **50** and **52** crimped about the stripped metallic core **54** and the insulation **56**, respectively, of the lead wire in a manner well-known in the art.

To interfit the blocks simply and accurately, alignment and guide means are provided, preferably of a form adding no parts or manufacturing complexity. Thus, socket block **6** is molded with a pair of integral guide lugs **58** projecting forwardly from front face **30** along which extends a slot **60**. Lugs **58** are spaced to guide an extended portion **62** of printed circuit card **4** into slot **60** as blades **12** are thereby aligned with and enter passageways **28**.

A pair of side lugs **64** for rack-mounting socket block **6** may be provided, if desired.

As thus constructed and arranged, the parts are seen to be of simple and rugged construction, yet highly reliable and effective in performance. For example, the spring portions, viz., prong **44** and detent **46**, are wholly protected by being enclosed within the channel configuration of socket contact **34**. Further, it is contemplated that in normal use the solid crimp section of the socket contact, including ears **50** and **52**, will have slightly larger cross-sectional dimensions than the contact section including flanges **38**, thereby tending first to absorb any external shocks.

Moreover, even should flanges **38** become distorted as by being bent more or less closed, the quality of electrical contact will not suffer so long as blade **24** is capable of entering the socket contact channel, since the accommodation of curved contact surfaces **26** to contact surfaces **42** is essentially independent of the angle of flanges **38** or the relative thickness of the blade. Forceful insertion of a blade **24** is also effective to reform the flanges to operative condition. It is to be understood, however, that in normal use the main body of socket contact **34**, including side flanges **38** and base **36**, is intended to be a rigid structure which does not bend or deflect to any significant extent on insertion of blade **24**. That is to say, the character and control of the contact pressure between the mating parts is preferably determined primarily by the character and design of spring **44**. More constant and predictable quality of electrical contact can be thus achieved.

In relation to the character of the electrical contact and contact pressure between surfaces **26** and **42**, it will be apparent that under the force exerted by spring **44**, blade **24** tends to wedge and bend side flanges **38** apart. The magnitude of the wedging force, for a given spring pressure, will depend upon the angle θ between the line tangent to the contact point of surfaces **26** and **42**, and the line along which the force of spring **44** is applied, i.e., a line perpendicular to the base of blade **24**. More specifically stated, the normal force, F_n, at the point of contact is equal to the applied force, F_p, delivered by spring **44**, divided by sin θ. Where angle θ is low, i.e., the contact point is low along the side of blade **24**, the normal force can become quite high, disadvantageously tending to bend flanges **38** and increasing the force required to insert the blade and the wear on the parts during insertion, perhaps to the point of destruction of any gold plating. Accordingly, it is important that angle θ have a high value; in practice 68° have been found to be optimum, although angles within the range 63° to 73° are acceptable.

It is also important to note that the contact assembly is polarized; that is, blade **24** cannot be inserted into the channel of socket contact **34** upside down because the unbroken or square side corners of the blade would interfere with flanges **38**. In other words, side flanges **38** are turned inwardly sufficiently far that, relative to the width and thickness of rectangular blade **24**, the channel of the socket contact will not admit the blade but for the breaking of side corners **26**.

Turning now to FIGURE 6, there is illustrated a modified form of the connector block assembly according to the invention, wherein provision is made for coupling multiple socket blocks to a plug block arranged to carry a single printed card, as is occasionally required in wiring or testing more complex electrical systems. As shown, the plug contacts **66** of plug block **68** each include a bus bar **70** having a number of lateral strips **72** on opposite sides terminating in contact blades **74***a*, **74***b* and **74***c* projecting from opposite faces of the block. Tangs **76** for eletcrically and mechanically mounting a printed circuit card extend laterally from one such strip **72** through the top side of the block. Similar blades, **74***a*, **74***b* and **74***c*, staggered to conserve center-to-center spacing of the various plug contacts **66**, are arranged in rows for cooperation with socket blocks **78***a*, **78***b* and **78***c* respectively, but it will be understood that bus bar **70** may be extended to provide as many rows of contact blades on only one or both faces of the plug block as required by the conditions of a particular use. A guide pin **80** on the plug block, there being preferably one such on each end of each row of contact blades in cooperation with associated bores **82**, serves to align and guide the socket blocks into proper interfitting relation on the plug block.

Alternatively, as shown in FIGURE 7, the plug block may serve merely as a feed-through connector for coupling the row of contacts of one socket block to the contacts of one or more other socket blocks as desired, omitting the tangs for coupling to a printed circuit card. In this form, the multiple strips **84** extending from bus bar **86** simply terminate in contact blades **88***a*, **88***b*, **88***c* and **88***d* in multiple rows on opposite faces of the plug block **90**.

The pair of tangs depending from each contact blade advantageously affords multiplicity of contact with a single circuit strip on the printed circuit card. Occasionally, however, it may be necessary to sacrifice this advantage in favor of increasing the number of circuit lines to the card. In this event, as shown in FIGURE 8, in each vertical station of the plug contacts, strips **92***a* and **92***b* are separated to terminate in electrically disconnected tangs **94***a* and **94***b* projecting from the bottom side of plug block **96** and contact blades **98***a* and **98***b* on the front face of the block, respectively. Tang **94***a* may then be solder-connected to a printed circuit line **100***a* on the upper side of circuit card **102**, for example, while tang **94***b* connects with another circuit line **100***b* on the lower side of circuit card **102**.

In this specification and accompanying drawings, I have shown and described a preferred embodiment of my invention and suggested various modifications; but it is to be understood that these are not intended to be exhaustive nor limiting of the invention but, on the contrary, are given for purposes of illustration in order that others skilled in the art may fully understand the invention and the principles, and the manner of applying it in practical use so that they may modify and adapt

it in various forms, each as may best be suited to the conditions of a particular use.

I claim:

1. A slide-fit electrical contact assembly comprising a rigid blade and a socket adapted to interfit telescopically, said blade being generally rectangular in cross-section with flat top and bottom surfaces and having rounded corners on one side, said socket including a base having a pair of spaced, opposed side flanges extending toward each other generally at an acute angle away from said base, said flanges being rounded over substantially their full extent on a radius of curvature no less than the curvature of said rounded corners, and spring means arranged to press the blade against said flanges with the rounded corners engaging the curved portions of said side flanges, at points within the engagement portions intermediate the extent of said side flanges, said flanges being inflexible relative to said spring means, the width of said blade adjacent said bottom surface being less than the width of the base of said socket to avoid contact between the socket and the sides of said blade, said width being greater than the maximum spacing between the engagement portions of said side flanges.

2. A contact assembly according to claim 1 wherein

the radius of curvature of said flanges being approximately 1½ times that of said rounded corners.

3. A contact assembly according to claim 1 wherein said angle is approximately 68°.

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JOSEPH D. SEERS, *Primary Examiner.*