Jan. 25, 1966 K. M. HAMMELL 3,231,849

PLUG RECEIVING RECEPTACLE AND CONTACT INSERTS THEREFOR

Original Filed Sept. 30, 1963 2 Sheets-Sheet 1

Fig. 1

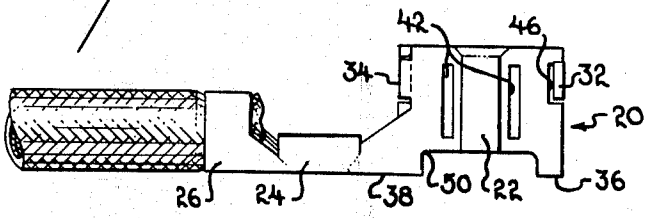


Fig. 2

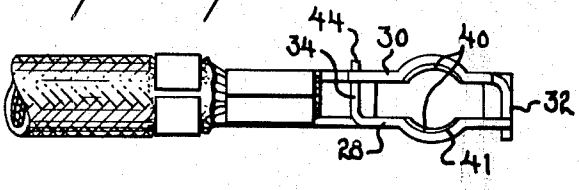


Fig. 3

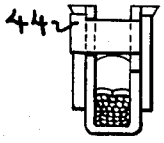


Fig. 4

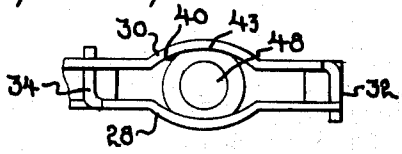


Fig. 5

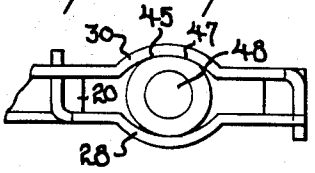


Fig. 6

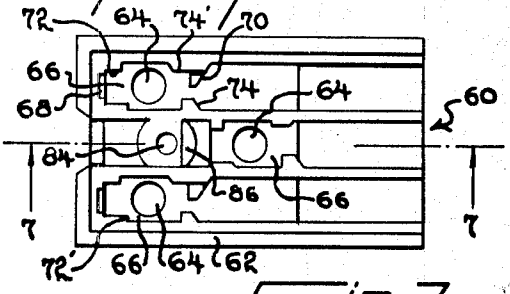


Fig. 8

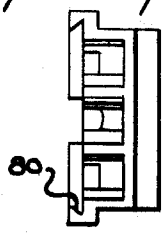
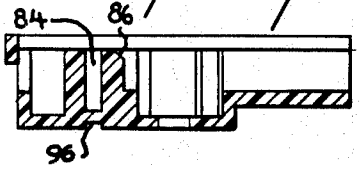


Fig. 7



Jan. 25, 1966 K. M. HAMMELL 3,231,849

PLUG RECEIVING RECEPTACLE AND CONTACT INSERTS THEREFOR

Original Filed Sept. 30, 1963 2 Sheets-Sheet 2

Fig. 9

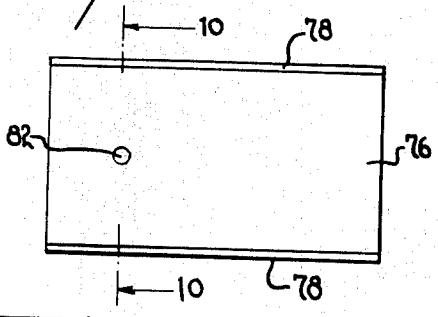


Fig. 10

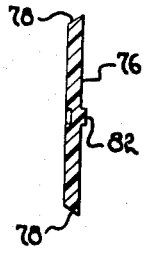


Fig. 11

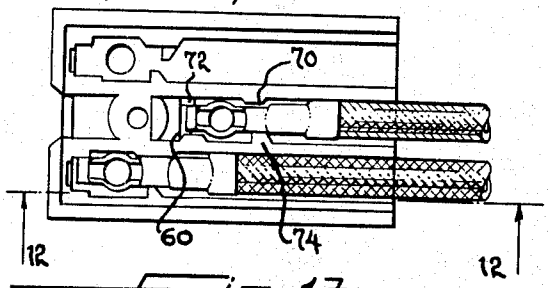


Fig. 12

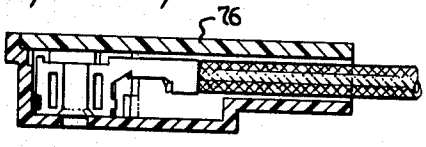


Fig. 13

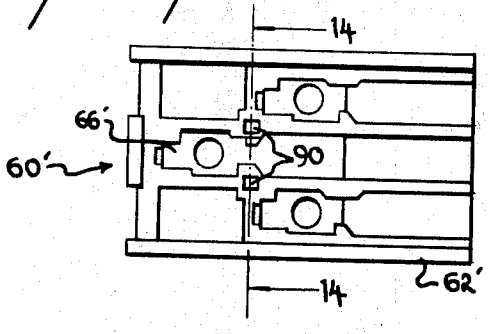


Fig. 14

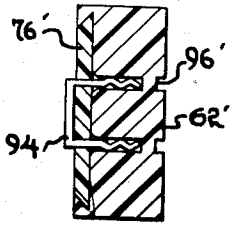
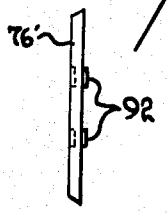


Fig. 15



United States Patent Office 3,231,849
Patented Jan. 25, 1966

3,231,849

PLUG RECEIVING RECEPTACLE AND CONTACT INSERTS THEREFOR

Kemper M. Hammell, 5430 Windsor Road, Harrisburg, Pa.

Application Sept. 30, 1963, Ser. No. 313,414, which is a continuation of application Ser. No. 614,551, Oct. 8, 1956. Divided and this application Feb. 8, 1965, Ser. No. 440,977

6 Claims. (Cl. 339—191)

This application is a division of my co-pending application Serial No. 313,414, filed September 30, 1963, which is, in turn, a continuation of my application Serial No. 614,551, filed October 8, 1956, now abandoned.

This invention relates to disconnect electrical terminations of the so-called friction type and more particularly to a pin receptacle connector and a pin receptacle cluster block.

In many applications it is desirable to terminate wire leads from an apparatus in a group of pins or posts which are adapted to be frictionally engaged in a female receptacle connected to suitable cables for connection to the rest of the electrical circuit. Typical applications for connections of this type are in the refrigerating and air conditioning fields where portions of the equipment are hermetically sealed and connection must be made to a series of pins or posts extending through the shell of the hermetically sealed portion.

Heretofore various pin receptacle connectors have been suggested and have been partially successful for certain limited application. However under severe operating conditions, both temperature and humidity, it has been found that all connections heretofore known have failed to give the desired low resistance contact over a long period of time necessitating either frequent cleaning or replacing of the connections. According to the present invention I have discovered that by placing special "wrap-around" pin contacting surfaces on a pair of parallel bridge-like flexible spans that a greatly increased contact area of low unit contact pressure can be obtained resulting in a superior long life connection.

It is an object of the present invention to provide a pin receptacle having substantially more than a line or point contact with the pin inserted therein. It is another object of the present invention to provide a pin receptacle that has low unit contact pressure over a large area of contact. It is another object of the present invention to provide a low contact resistance pin receptacle that will maintain its low resistance contact throughout a long period of time under adverse atmospheric and temperature conditions. It is another object of the present invention to provide a pin receptacle of improved low contact resistance that may be made of cheaper, more readily available materials than heretofore known. It is another object of the present invention to provide an improved pin receptacle block that will more securely position the pin receptacle for engagement with the pins to be contacted. It is another object of the present invention to provide a pin receptacle block for connecting a plurality of pin receptacles to a plurality of pins that orients the pin receptacle in a more positive and superior fashion and yet allows proper alignment for greater area contact on each pin as the pin receptacle is connected thereto. It is a still further object of the present invention to provide a pin receptacle with "wrap-around" contact surfaces to provide substantial areas of contact with a pin inserted therein. These and other further objects will be in part apparent and in part pointed out as the specification proceeds.

In the drawings:

FIGURE 1 is a side elevation of the pin receptacle of the present invention;

FIGURE 2 is a top plan view of the pin receptacle of the present invention;

FIGURE 3 is an end view of the pin receptacle of FIGURE 2;

FIGURE 4 is a framentary view of the contact portion of the pin receptacle of FIGURES 1 through 3 prior to insertion of a pin showing the relative curvature of the pin and contact surfaces thereof;

FIGURE 5 is a view similar to FIGURE 4 showing the pin inserted in the pin receptacle;

FIGURE 6 is a top plan view of the pin receptacle block according to the present invention, the top surfaces of the cavity walls being cross-hatched for clarity;

FIGURE 7 is a sectional view on line VII—VII of FIGURE 6;

FIGURE 8 is an end elevation of the block of FIGURE 6;

FIGURE 9 is a top plan view of the cover of the block of FIGURE 6;

FIGURE 10 is a cross-section on the line X—X of FIGURE 9.

FIGURE 11 is a plan view similar to FIGURE 6 showing the pin receptacle inserted in the block;

FIGURE 12 is a sectional view taken on line XII—XII of FIGURE 11;

FIGURE 13 is a view similar to FIGURE 6 of another embodiment according to the present invention;

FIGURE 14 is a sectional view on line XIV—XIV of FIGURE 13; and

FIGURE 15 is a cross-sectional view of the cover for the receptacle of FIGURE 13 before insertion of the staple of FIGURE 14.

Referring now to FIGURE 1 the pin receptacle **20** comprises generally the receptacle portion **22**, a barrel portion **24** and an insulation support portion **26**. The barrel portion **24** and insulation support portion **26** are of conventional design and crimped according to a well-known crimp and are not described in detail herein for the sake of brevity. The receptacle portion **22** comprises generally two thin gauge spans **28** and **30** which are supported at the top by the tabs **32** and **34** and at the bottom by the U-shaped root sections **36** and **38** respectively of the connector. Each of the spans **28** and **30** has an inwardly concave contact surface **40** at approximately the center thereof and a pair of slots **42** cut therein as will be described in detail herein.

As may be seen in FIGURES 1 through 3 the locking ears **32** and **34** are formed integrally with the spans **28** and **30** and then bent substantially at right angles thereto to engage the opposite span. FIGURES 2 and 3 show at the end of the ears **32** and **34** a locking tab **44** which extends upwardly to engage the side of the opposite span. The locking ears **32** and **34** as they are bent around to engage the opposite span seat in a cut-out **46** which cooperates with the tabs **44** to provide the desired support of the upper edges of spans **28** and **30**.

In addition to giving the superior performance as will be described herein in actual operation the foregoing construction together with the root sections **36** and **38** allow an independent control of the width of both the top and bottom of the recepacle portion **22** in the manufacture thereof which results in increased flexibility of the product and better quality control in the manufacturing thereof.

The spans **28** and **30** are formed of a relatively thin gauge stock so that they are somewhat flexible and act like bridge spans joined at the end but free to flex in the middle. The contact areas **40** have a radius somewhat

greater than the radius of the pin to which they are to be connected and are spaced apart somewhat less than the diameter of the pin to which the receptacle is to be joined. This may be seen in FIGURES 4 and 5. Also the upper edge of the contact surfaces **40** are swaged or otherwise beveled outwardly at **41** in somewhat the manner of a bell mouth to facilitate the entrance of the pin therein.

FIGURE 4 shows receptacle **20** in its normal position with a pin **48** about to enter into the receptacle portion thereof. As may be clearly seen the pin **48** is slightly larger in diameter than the spacing between the contact surfaces **40** of the receptacle **20**. However it will be noticed that the radius of curvature of the contact surfaces themselves are greater than the radius of curvature of pin **48**. In FIGURE 5 the pin **48** has been inserted into the receptacle **20** and as may be readily seen this has sprung the spans **28** and **30** somewhat apart and in so doing has caused them to wrap around the pin **48** to provide a relatively large area of contact between the contact areas **40** and the pin **48**. This flexing has taken place between the suspension points at the top and bottom of the ends of the spans **28** and **30** as previously described. The flexing or bending actually takes place in the contact surface portions **40** insuring a complete and intimate "wrap-around" contact over a substantially larger area of the pin than heretofore possible.

Without the bending of the surfaces **40** contact is obtained along a line such as **43** in FIGURE 4. With the flexing taking place in surfaces **40** a wide area of contact is obtained as between lines **45** and **47** in FIGURE 5.

Since the spans **28** and **30** are of relatively thin gauge metal the pressure necessary to produce this flexing is relatively slight and the actual contact pressure is of a low unit magnitude although the total pressure holding the receptacle on the pin may be considerably greater than that encountered with other types of receptacles having single line or point contacts but very high unit pressures. This not only facilitates the connection and disconnection of the receptacle and pin but also provides a greatly increased life and a much lower average contact resistance between the receptacle and the pin.

With the high unit pressure line or point contact type of receptacle occasionally the initial contact obtained between the receptacle and pin may be greater than that obtained with the receptacle of the present invention. However it has been conclusively found that such a connection in the presence of high temperature and humidity very soon loses its low initial resistance and in a short period of time will have developed a relatively high contact resistance that progressively gets worse until the joint or connection fails. On the contrary with applicant's broad area, low unit contact pressure connection while the initial contact resistance may be slightly greater than with other types of high unit pressure contacts the resistance remains substantially constant and does not increase materially under the influence of high temperature and humidity.

For instance with the former type line contact, high unit pressure terminal, a terminal temperature of as high as 380 degrees Fahrenheit is not uncommon in an ambient temperature of approximately 200 degrees Fahrenheit. With applicant's broad area, low unit contact pressure terminal the maximum temperature observed has been only 250 degrees Fahrenheit with an average somewhere in the neighborhood of 230 degrees Fahrenheit. Furthermore the voltage loss in the connection has been measured at more than 300 millivolts at 5 amperes load for the former, while with applicant's connection the average drop has been 15 millivolts with a maximum of between 25 and 50 millivolts. It is obvious from this data that the minimum service life of a connection according to the present invention would be many times that of a connection of the line or point, high unit contact pressure type.

This low temperature of applicant's receptacle has a further advantage in that it is possible to utilize cheaper materials since the temperature requirements are not as severe. For instance, in the example given above it is possible to use with applicant's receptable a Phosphor bronze material which has very satisfactory creep stability at the 250 degree Fahrenheit maximum temperature encountered, however, with the line contact type of terminal a beryllium copper which is three to four times as expensive is necessary if creep stability is to be maintained at the elevated temperature of 380 degrees Fahrenheit encountered with that type of connection.

Referring again to FIGURES 1 through 5 it will be noted that the spans **28** and **30** are substantially parallel from top to bottom thereof and that in actual application such as FIGURE 5 they are still substantially parallel from top to bottom. This, it has been found, is a very important feature of applicant's pin receptacle in that if the contact areas **40** are not maintained substantially parallel when the pin **48** is inserted therein it will cause a spreading out of the contact areas such that only a line or ring contact is established at the lower or upper end so that only a very small area of contact will be obtained at either the upper or lower end of the contact surfaces **40**. As described herein, by adjusting the locking ears **32** and **34** and the spans **36** and **38** during the manufacture of the receptacle the spans **28** and **30** will be maintained very closely parallel. In actual operation I have found that if the distance between the tops of the spans **28** and **30** is not over two- to three-thousandths greater and not over four-thousandths less than the distance at the bottom that uniform low resistance contact throughout the entire length of the contact area **40** will be obtained.

Referring now to FIGURE 1 a cut-out **50** will be seen at the bottom of the receptacle **20**. This is provided to ensure the resilient bridge span action of the spans **28** and **30**. The slots **42** help in the accurate forming of contact surfaces **40** and under certain conditions help to reduce the frictional drag where ease of application is of paramount consideration.

FIGURES 6 through 10 show the receptacle block **60** which comprises generally a molded triple cavity bottom portion **62** having an open top and three holes **64** drilled in the bottom thereof with three receptacle cavities **66** centered about the holes **64**. Each cavity **66** is molded so as to support the pin receptacle therein in an accurate "floating" fashion to properly align the contact surfaces **40** about the pin **48** as the block **60** is applied to a corresponding group of pins. To accomplish this each cavity has front and back stops **68** and **70** which cooperate with the locking ears **32** and **34** (see FIGURES 11 and 12) to position the receptacle longitudinally within the cavity **66**. Also each cavity has therein side stops **72–72'** and **74–74'** which engage the sides of the pin receptacle and in cooperation with the ends of ears **32** and **34** abutting on the opposite walls (FIGURE 11) align the pin receptacles laterally within the cavities **66**. I thus obtain a six-point positioning within the cavities **66** and in the manufacture of the block and receptacle a nominal .01 float is maintained so that the receptacle may be aligned properly on the pin when connected thereto to ensure full wide area contacts throughout the entire length of the surfaces **40**.

To hold the pin receptacles **20** within the block **60** there is provided a cover plate **76** which has beveled edges **78** (see FIGURE 10) which cooperate with inwardly beveled edges **80** of the block **60** (see FIGURE 8) to securely hold the cover plate **76** over the receptacles **20** and to properly position them within their respective cavities **66**. A small detent **82** is punched into the cover **76** so as to engage the hole **84** in the block **60** when the cover is in the fully closed position. This locks the cover plate **76** in position so that it cannot accidentally fall out. To facilitate the insertion of the cover plate **76** a small

ramp 86 is formed just ahead of the hole 84 in the block 60. This permits the cover plate 76 to slide, quite readily, into its locked position. As shown the detent 82 is merely punched partially out of cover 76. For certain applications detent 82 may be tapered in cooperating fashion with ramp 86 to facilitate engagement while still maintaining a secure locking engagement.

In the closed position shown in FIGURE 12 it can be seen how the cover 76 accurately holds the receptacle 20 within the cavities 66 so that they are properly and accurately oriented relative to holes 64 and the pins to be received therein.

The plate 76 is generally of a laminated construction although other materials and configurations may be used. The tapered groove effect of the surfaces 80 in block 60 provides a simple yet adequate engagement for the cover plate 76 yet permits a block form that is self stripping from the mold so that the block 60 may be quickly and economically manufactured.

If for any reason the receptacles 20 are to be subjected to severe lifting or the insulation is extra thick the cover 76 may be secured firmly into the block 60 by inserting a small screw (not shown) through the detent 82 into the hole 84 to securely engage the cover to the block 60.

It will be noted that the holes 64 are drilled in the bottom of the molded block 60 which provides a much stronger and more rigid opening through the block so that when it is pried from the pins the block will not be damaged in any manner.

Referring now to FIGURES 13 through 15, there is shown another embodiment of the receptacle block according to the present invention. In certain applications it is desired that the insulation supporting portion of the block 60 extend in the opposite direction or a different direction from that as shown in FIGURES 6 through 10. In such situations a block 60' such as that shown in FIGURE 13 has been found to be advantageous. As may be readily seen the central cavity 66' is in the full left position of FIGURE 13 while the two outer cavities are in the right hand position. The individual cavities 66' are the same as in the embodiment of FIGURE 6 but there is provided a pair of holes 90 in place of the retaining hole 84 of FIGURE 6. It will also be seen that these holes are somewhat rectangular rather than circular and are chamfered for easy entrance at the top. As may be seen in FIGURE 15 the cover plate 76' carries thereon a pair of indentations 92 rather than the single locking notch 82 of FIGURE 10. As may be seen in FIGURE 14 when it is desired to more securely fasten the cover plate 76' to the block 60' a corrugated staple 94 is driven through the indentations 92 into the holes 90 to securely hold the cover plate 76' thereon.

If it is desired to remove the cover plate 76 or 76' after it has been secured by a staple or screw this may be readily accomplished by inserting a small instrument through the bottom of hole 84 or 90. As may be readily seen in FIGURE 7 the holes 84 and 90 extend very closely to the bottom of the block 60 or 60' as the case may be so that it is very simple to break the cap 96 and drive the staple or screw from the hole.

While there is given above certain specific examples of this invention and its application in practical use, it should be understood that this is not intended to be exhaustive or to be limiting of the invention. On the contrary, these illustrations and explanations herein are given in order to acquaint others skilled in the art with this invention and the principles thereof and a suitable manner of its application in practical use, so that others skilled in the art may be enabled to modify the invention and to adapt and apply it in numerous forms each as may be best suited to the requirement of a particular use.

I claim:

1. An electrical connector cluster block adapted to receive therein three electrical connectors each having a receptacle contact portion and an electrical conductor engaging portion comprising in combination a molded outer shell member of generally rectangular configuration; three longitudinal cavities disposed side by side therein, said cavities being open on one end and said shell being open on the top to expose said cavities; a receptacle receiving portion and an electrical conductor supporting portion in each of said cavities; three spaced holes in the bottom of said shell one each disposed in the receptacle portions of each of said cavities; longitudinal stop members positioned at each end of said receptacle portions of said cavities to longitudinally orient said receptacle contact portion relative to said holes in said shell; side stop members disposed adjacent each end of said receptacle contact areas in said cavities to laterally align said receptacle contact portions relative to said holes and to maintain them in a substantially perpendicular relationship to the bottom of said shell; a cover plate for the open top of said shell having tapered longitudinal edges; a pair of tapered tracks along the longitudinal edges of said open shell sides adapted to receive therein said cover plate; a cover locking receptacle mounted in said shell between said cavities and adapted to receive therein a screw, detent or other locking means; and locking means in said cover adapted to cooperate with said cover locking receptacle.

2. A device as described in claim 1 wherein said locking receptacle comprises a hole molded in said shell between said cavities and said locking means comprises a small fastener member inserted through the detent area of said cover plate into said hole to securely hold said cover plate in the closed position in said block.

3. An electrical connector cluster block of the type adapted to receive therein a plurality of electrical connectors in a predetermined relationship for connection to cooperating electrical terminals and the like comprising in combination a molded outer shell open on one side and having therein a plurality of longitudinal cavities; a plurality of holes punched in the closed side of said shell, one in each of said cavity areas; a cover plate having outwardly tapered edges for closing the open side of said shell; a pair of inwardly tapered grooves adjacent each longitudinal edge of the open side of said shell adapted to receive therein tapered edges of said cover plate; locking means for retaining said cover plate in a closed position in said shell; each of said cavities having a contact receiving area and an insulation supporting area; said contact receiving areas having front and rear stop members positioned adjacent to and on opposite sides of said holes; and a pair of side stops, extending from top to bottom of said cavities, positioned adjacent the ends of said contact receiving area and on opposite sides thereof about said hole; said insulation supporting areas of said cavities being generally of more restricted dimensions than said receptacle receiving areas whereby said electrical connectors are securely and accurately positioned in said cavities in proper alignment about the holes therein to receive said electrical terminals in low resistance contact.

4. A device as described in claim 3 wherein said locking means includes a small hole in said shell and a cooperating detent in said cover plate, the portion adjacent said hole in said shell having a tapered ramp disposed to cam said detent over the edge portions defining said hole for seating the detent, and a small opening in the closed end of said shell providing access to the interior side of said cover plate adjacent said detent for unlatching said detent from said hole.

5. An electrical connector cluster block adapted to receive therein three electrical connectors each having a receptacle contact portion and an electrical conductor engaging portion comprising in combination a molded outer shell member of generally rectangular configuration; three longitudinal cavities disposed side by side in said shell, the two outer cavities extending to the closed end and the middle cavity extending only slightly past the

middle of said shell, said cavities being open on one end and said shell being open on the top to expose said cavities; a receptacle receiving portion and an electrical conductor supporting portion in each of said cavities; three spaced holes in the bottom of said shell one each disposed in the receptacle portions of each of said cavities; longitudinal stop members positioned at each end of said receptacle portions of said cavities to longitudinally orient said receptacle contact portion relative to said holes in said shell; side stop members disposed adjacent each end of said receptacle contact areas in said cavities to laterally align said receptacle contact portions relative to said holes and to maintain them in a substantially perpendicular relationship to the bottom of said shell; a cover plate for the open top of said shell having tapered longitudinal edges; a pair of inwardly tapered tracks along the longitudinal edges of said open shell sides adapted to receive therein said cover plate; a cover locking receptacle mounted in said shell at the end of said middle cavity between said outer cavities and adapted to receive therein a screw, locking detent or other means; a detent in said cover adapted to cooperate with said cover locking receptacle.

6. An electrical connector cluster block adapted to receive plural electrical connectors each having a receptacle contact portion and an electrical conductor engaging portion comprising a molded outer shell member of generally rectangular configuration; plural longitudinal cavities disposed side by side therein, said cavities being open on one end and said shell being open on the top to expose said cavities; a receptacle receiving portion and an electrical conductor supporting portion in each of said cavities; spaced holes in the bottom of said shell, one each disposed in the receptacle portions of each of said cavities; longitudinal stop members positioned at each end of said receptacle portion of said cavities to longitudinally orient said receptacle contact portion relative to said holes in said shell; side stop members disposed adjacent each end of said receptacle contact areas in said cavities to laterally align said receptacle contact portions relative to said holes and to maintain them in a substantially perpendicular relationship to the bottom of said shell; a cover plate for the open top of said shell having longitudinal edges; a pair of tracks along the longitudinal edges of said open shell sides adapted to receive therein said cover plate; a cover plate locking abutment in said shell; and locking means on said cover plate adapted to cooperate with said cover locking abutment, said abutment interfering with the sliding movement of said cover plate, said cover plate being yieldable outwardly to disengage the locking means relatively laterally away from said abutment for releasing and shifting the cover plate to an open position exposing said cavities for insertion of said electrical contacts.

References Cited by the Examiner

UNITED STATES PATENTS

697,436	4/1902	Betts	220—41
1,895,791	1/1933	Garford	220—3.8
2,267,080	12/1941	Clay.	
2,663,457	12/1953	Shaffer	220—41
2,720,636	10/1955	McKinley	339—192
2,728,060	12/1955	Doeg	339—192

JOSEPH D. SEERS, *Primary Examiner.*