Nov. 1, 1938. M. ALDEN 2,135,267

ELECTRICAL PLUG AND SOCKET

Filed Feb. 25, 1936

Fig. 1.

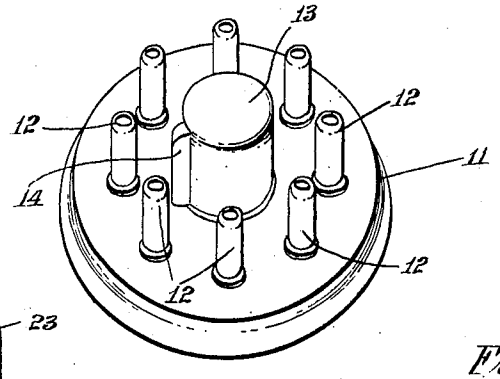


Fig. 2.

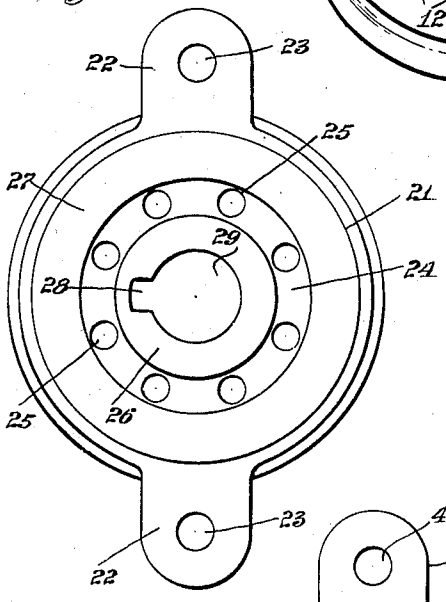


Fig. 3.

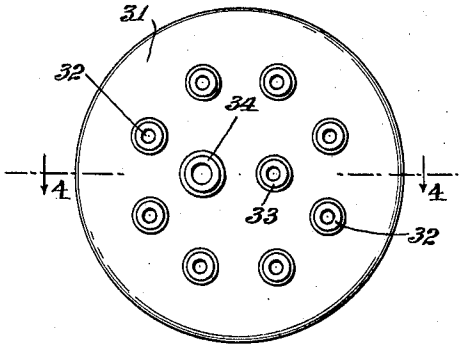


Fig. 4.

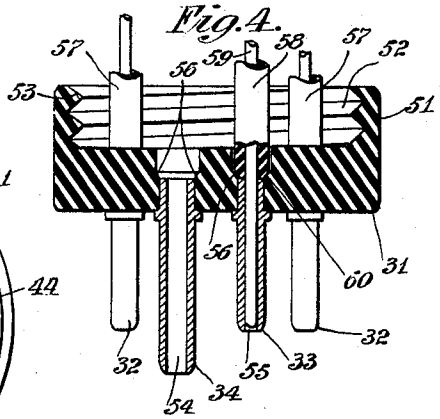
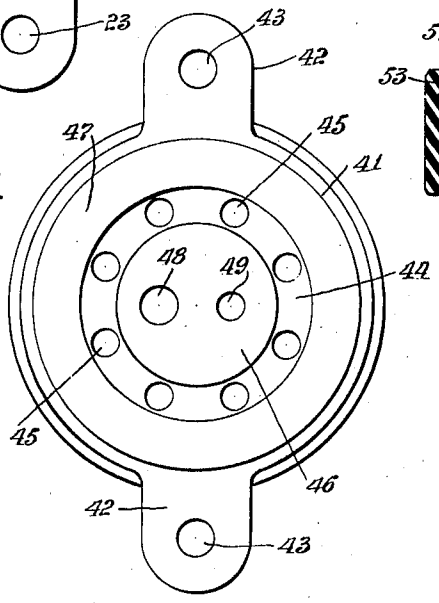


Fig. 5.



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ELECTRICAL PLUG AND SOCKET

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5 Claims. (Cl. 173—332)

This invention relates to connecting plugs or tube bases and sockets used in connection therewith but is also applicable to plug and socket combinations as used for other purposes.

More particularly this invention relates to such plugs and sockets as necessarily include a large number of electrically discrete circuits carried in a structure of comparatively small physical dimensions.

In the art of electron tube bases and sockets therefor, it has been found necessary with the advent of such electron tubes having a great number of elements therein, to provide a tube base and socket which could afford connection to the large number of elements in such tubes. Owing to space limitations, especially in connection with modern radio receiving sets, great difficulty has been found in affording a connection for more than eight circuits with such plug and socket type of connections. If an attempt is made to supply more than eight prongs in a circle of the largest radius which it is practicable to employ for such structures, there is encountered great difficulty in making the prongs and sockets therefor sufficiently large to have the required mechanical rigidity and strength, and at the same time to allow sufficient distance between such individual prongs and sockets as will afford adequate insulation for the comparatively high voltages which are often employed in modern radio receivers.

It has been found, for example, that even with the so-called "octal" type of tube base and socket, difficulty is very frequently experienced, which takes the form of a flash-over or short circuiting discharge between adjacent individual prongs, which carry a large difference of potential therebetween. Even if such a short circuit does not occur, yet the leakage path is so very short that detrimental leakage often occurs, especially under conditions of high humidity or upon the collection of dust or dirt between the prongs or the sockets.

This invention has as one object the provision of a tube base or plug member which will be physically stronger, easier to manufacture and cheaper to construct than the present type of octal tube base.

Another object of this invention is to provide such a tube base or plug which may be employed with sockets of the type now in use. In other words, the tube base of this invention will allow tubes or plugs equipped therewith to be inserted in sockets which may already exist in places such as radio receivers.

Another object of this invention is to provide a plug or base which, when used with the special socket of this invention, will allow the inclusion of at least ten circuits in an area not exceeding that required for the present eight circuits, and yet will furnish a degree of spacing and insulation at least equal to that of the present octal plug and socket.

A still further object of this invention is to provide a plug member of the type above described, into which insulated wires may be fastened and which will cooperate with the insulation upon such wires so as to afford an extremely high degree of insulation within the interior of such plug.

Yet another object of my invention is to provide an electrical connecting plug having provision for reducing opportunities for accidental short circuits or electrical leakage occurring in the interior thereof.

Another object of my invention is to provide a plug member which may be inserted into an octal base of the conventional type or into the improved base constructed according to my invention without the possibility of the prongs of such plug entering into apertures of the socket other than the particular aperture into which each individual prong is designed to enter.

A further object of this invention is to provide a plug and socket combination in which the individual members may readily be brought into conjunction with one another without the necessity of a high degree of visibility of the various parts, during the operation of bringing them into conjunction.

Referring now to the drawing I have illustrated typical embodiments of my invention.

Fig. 1 shows in perspective a tube base or plug as commonly constructed at present.

Fig. 2 is a plan view of an octal type socket as commonly employed at present.

Fig. 3 is a plan view of the bottom of a base or plug embodying my invention.

Fig. 4 is an elevation partly in section of the structure of Fig. 3, taken upon the line 4—4.

Fig. 5 is a plan view of a socket constructed according to my invention.

Referring now to Fig. 1, there is shown a body portion 11 of suitable insulating material, into which are fastened a series of projecting metallic pins 12, 12 extending at right angles to the plane of body 11. These pins are arranged substantially equi-distant from one another so as to occupy points on the circumference of a circle whose center will coincide with the center of the

surface of body 11. In the center of the surface of body 11 is located projecting insulating member or boss 13 provided at one point of its periphery with a projecting fin 14. Boss 13 is made somewhat longer than pins 12 so that it will come in contact with the surface of the socket into which the plug is to be inserted before pins 12 can enter such socket.

Referring now additionally to Fig. 2, there is shown a body member 21 provided with suitable fastening ears 22, 22 having therein apertures 23, 23 to allow the socket as a whole to be screwed or otherwise fastened on to a suitable panel or other support. Body member 21 is provided with an annular groove 24, in which are located a series of apertures 25, 25 designed to receive plug pins 42. Located closer to the center than groove 24 is another annular portion 26 whose surface may be substantially upon the same plane as the outer surface 27 of body 21. Annular portion 26 is provided at one point with a radially extending depression 28 cut out of the insulating material and the center 29 of the socket is also cut out so as to afford entry therein for boss 13, whose fin 14 registers with the portion 28, so as to allow boss 13 to enter cut-away portion 29 only when a certain angular relationship exists between the plug and the socket.

When the structure of Fig. 1 is produced on a commercial scale, there are encountered certain difficulties, especially in connection with the formation of the boss 13 and fin 14. The common method of producing such structures economically and uniformly, is to mold them from a suitable plastic insulating material, and it is to be understood that where I have referred in this specification to certain portions being cut out of the insulating material, that such cut away portions may equally well be formed by the use of a suitable mold.

When the molding of a structure such as that shown in Fig. 1 is attempted while maintaining all the parts constructed of insulating material as solid bodies, great difficulty is experienced with the boss 13, which will not cure, or reach a properly hardened condition in the same length of time as the comparatively thin base portion of the structure. Consequently it has been found desirable to construct boss 13 in a hollowed-out fashion, in order to ensure that it cure in approximately the same time as the rest of the structure and likewise in order to ensure that the insulating material used for molding will completely enter the mold, so that the outer surface of member 13 will be properly formed.

While the above method of making a plug such as that of Fig. 1 has been more or less successfully employed, yet certain difficulties have been experienced with the completed structure. When boss 13 is made hollow, it lacks a strength commensurate with the wear and stress to which it is subjected while inserting the plug into a socket. Such structural weakness frequently leads to the breaking off of this boss, and when the boss has broken off, the complete plug structure becomes practically useless since it may be inserted with the prongs registering at random with the holes in the socket. If the plug structure forms the base of an electronic tube, this disadvantage becomes increasingly important, since such a breaking off of boss 13 will then result in the effective loss of an electronic tube whose value is many fold that of the plug portion thereof.

If an attempt be made to use such a tube, whose plug portion has lost its property of properly locating the prongs with respect to the socket, the chances are that the tube prongs will make contact with the wrong electrical circuits. If such a wrong connection is made, not only may it permanently damage the tube itself, but likewise it may cause cross connections between the various circuits, which may cause the destruction of other tubes connected with the same circuits which supply the socket in which the thus mutilated tube is inserted.

Referring now additionally to Fig. 3, I have here illustrated an improved form of plug or tube base, which overcomes the difficulties in manufacture and use of the tube base shown in Fig. 1, as well as presenting certain further advantages to be hereinafter described.

The body 31 of my plug may conveniently be made of molded material as in the case of Fig. 1. A series of prongs 32, 32 are mounted upon the circumference of a circle around the center of this plug in a fashion similar to the prongs 12 shown in Fig. 1. These prongs are of such size and location as to correspond with the openings 25 as shown in the tube socket of Fig. 2, and may be connected either to electrical conductors or to the elements of an electronic tube according to whether this structure is to be used as a connecting plug or as a tube base.

It will be noted that the center of the circle constituted by prongs 32, does not contain a boss-like member, but in its stead are located two additional prongs 33 and 34, the latter prong being made considerably the larger in size. Prong 33 may conveniently be made of the same size as prongs 32. As will be more clearly apparent by reference to Fig. 4, prong 34 is not only larger in diameter but also has a greater length than the prongs 32 or 33.

The plug of Fig. 3 is adapted to enter the socket of Fig. 2 in the same general fashion in which the plug of Fig. 1 enters this socket. The longer prong 34 cannot enter any of the apertures 25, since its diameter is too large to permit this. Likewise unless all the prongs 32 are located in a position corresponding to the annular depression 24, prong 33 will rest upon some solid portion of the socket and will prevent the prongs 32 from entering apertures 25. When an attempt is made to insert the plug of Fig. 3 into the socket of Fig. 2, it will be found that the first step necessary is to allow prong 34 to enter the large central opening 29. If the plug is then moved about, it will be found that some one or more of the prongs will keep the plug from entering the socket sufficiently to allow any contact between prongs 32 and the socket contacts which are located in apertures 25. Such difficulty will be encountered until the plug has been so moved about that prong 33 lies within the radial depression 28. When this latter event occurs, it will be found that both prongs 34 and 33 will enter central aperture 29, and at the same time prongs 32 will enter their proper and respective apertures 25.

The advantages of the plug structure just described over the type of plug shown in Fig. 1, as far as its use in the conventional type of octal socket shown in Fig. 2 is concerned, are that the mechanically weak boss 13 and fin 14 which increase the difficulty and cost of manufacture of the plug, have been replaced by metallic prongs which may be molded in the body portion of the plug in exactly the same fashion that prongs 32 are molded therein. Thus the ability of the plug to withstand mechanical strain and wear has been greatly increased, with a consequent effective

lengthening of probable life of an electron tube of which such plug may constitute the base portion.

Referring now to Fig. 4, I have here shown the structure of Fig. 3 designed for use as an attachment plug affording connection to a large number of conductors which are attached to the various prongs of the plug. It will be noted that I have shown such conductors attached not only to prongs **32**, but also to the more centrally located prongs **33** and **34**, and the use of such additional prongs as contact making members will be hereinafter described.

The body portion **31** of the plug is shown with lateral walls **51** and with a hollow interior portion **52**. The inner surface of walls **51** may conveniently be threaded as indicated at **53** in order to allow a cap or other suitable closure member to be screwed therein, but it is to be understood that any other method of closure is possible, or that the plug may be left open at the top if so desired.

Prongs **34** and **33** are shown in section, illustrating the hollow passages **54** and **55** respectively which extend longitudinally of these prongs. The bottom of interior chamber **52** is tapered away from the upper end of each prong, as indicated at **56**, **56**. Several insulated conductors **57** are shown entering the prongs. Such conductors may consist of an outer insulating sheath **58**, and an internal metallic conductor **59**. The outer sheath **58** may be of a nature which will allow it to slide to a limited extent along the core **59**. Such a conductor is shown inserted in place within prong **33**. The metallic core **59** may occupy substantially the entire length of the prong and may conveniently be attached thereto by a drop of solder (not shown), inserted at the point indicated by reference numeral **55**. When such a conductor is inserted in prong **33**, the insulating sheath **58** may be pushed back to a limited degree and then the inherent elasticity of such sheath will tend to force it into the enlarged opening formed in body **31** by the space between the tapered portions **56**, **56**. This brings about a close insulating union between the insulating sheath of the conductor and the insulating material of which body **31** is composed, as indicated at the point **60**. In case that insulating sheath **58** is not of a nature such that it will slide along core **59**, a portion of the insulating sheath may be removed and the conductor inserted in prong **33** until sheath **58** is in close engagement with tapered portions **56**, and thereby substantially the same results as just pointed out may be secured.

It may be seen that the close engagement of the conductors with the body portion of my plug, as far as insulating portions are concerned, will minimize the current leakage and possibility of flash-overs, which difficulties have been herein before described.

Referring now to Fig. 5, I have here illustrated a type of socket, especially suited for use with the form of plug shown in Figs. 3 and 4. This socket comprises an insulating body **41**, provided with ears **42**. These ears may conveniently be provided with apertures **43** in order that the socket may be secured to a panel or other suitable mounting. An annular depression **44** is provided with apertures **45**, within which apertures may be located the socket contacts (not shown) for engaging the plug prongs entering such apertures. Within annular depression **44** is located a portion of the socket whose surface lies on substantially the same plane as the outer portion **47** of the socket. This portion **46** is provided with two apertures **48** and **49**, of which aperture **49** may conveniently be the same size as apertures **45**, while aperture **48** may be made considerably larger in diameter. Apertures **48** and **49** may likewise be provided with internal contacts (not shown) which enable them to afford electrical contact with plug prongs entering therein.

It can be seen that the plug structure shown in Figs. 3 and 4 will readily enter the socket shown in Fig. 5, the large prong **34** entering the large aperture **48** and the small prong **33** entering the aperture **49**.

The entry of these two particular prongs, not only will cause the other prongs **32** to register with their respective correct apertures **45**, but also will afford two additional circuit connections, by virtue of prongs **31** and **34** functioning as additional connecting prongs. Thus it can be seen that I have devised a plug which will afford a means of circuit connection for any number of circuits up to ten, without an increase in size over the usual plug employed in connection with octal sockets and also without reducing the factor of safety of insulation between such circuits. Likewise this same structure functions to afford up to eight circuit connections with already existing sockets of the type shown in Fig. 2.

The many practical uses of such a combination plug structure will be apparent to those skilled in the art. For example it is frequently desired to insert an attachment plug in a tube socket, in lieu of the tube base itself in order that all the circuits entering such socket may be brought out to an external measuring or indicating device such as a radio set analyzer. Likewise it is desirable for a plug and socket combination to carry more than eight circuits, especially in such cases as remote control devices which may be plugged into a set. It can be seen that by the use of the plug of this invention, a set analyzer or other measuring device may be plugged not only into already existing tube sockets having eight circuit connections, but also may be plugged into such sockets as are constructed according to the design of Fig. 5, where ten connections must be obtained.

With the development of the art, the number of element connections necessary for an electronic tube has been continually increasing and therefore when further advance in the art may render necessary the connection to nine or ten tube elements, the adoption of a socket in accordance with the form disclosed in Fig. 5 and the adoption of a tube base in accordance with the design of plug shown in Figs. 3 and 4, will afford a ready means of securing this result. Other uses and advantages of my invention will be apparent to those skilled in the art.

I claim:

1. In combination, a socket and plug, the socket having a plurality of prong openings arranged substantially in circular formation and also having two prong openings within said circular formation, one of said last mentioned prong openings being materially larger than the other prong openings, both said last openings lying away from the center of said circular formation, said socket being provided with a surface groove within which said circular formation of prong openings lies, and said plug having pins correspondent in relative position with said socket openings, whereby registration of the circularly arranged pins with said groove and registration of only one pin lying within said cir-

cular formation with the corresponding opening will determine registration of all the remaining pins with their correspondent openings.

2. A combination including a socket provided with a large central opening and a guiding depression on one side of said opening, and including a plug formed of an insulating body provided with at least two conducting pins of unequal diameter, spaced apart so that the distance between their most distant points is substantially equal to the maximum width of said central opening and guiding depression combined.

3. A plug and socket combination including a socket having a large central opening of keyhole shape and openings arranged circularly thereabout, and including a plug having pins circularly arranged to correspond to said circularly arranged socket openings, and also having within said circle of pins a rigid guiding structure, including a pair of spaced members each disposed eccentric with respect to the plug, the maximum width of said guiding structure being greater than the diameter of the circular portion of the key hole shaped opening and less than the maximum width of the key hole shaped opening, whereby said guiding structure can enter said keyhole opening only when a given angular relationship of plug and socket is provided, so that at least part of said guiding structure will at least partly enter the grooved portion of said keyhole opening.

4. A device according to claim 3 in which at least a portion of said guiding structure is provided with metallic edges.

5. A connector plug and socket combination, including a plug provided with a plurality of projecting contact pins at least one of which is longer and larger than the other pins, said longer pin and at least one other pin being disposed eccentric with respect to said plug and including a socket having at least one larger opening so shaped and located that said larger pin is capable of entry therewithin, said socket also having other and smaller openings into which said other smaller pins are capable of entry, some of said other pins lying in a circle and at least the majority of said other smaller openings lying in a circle, and said socket being provided with a surface groove embracing therein the entrances to said circularly arranged openings, whereby said longer pin will necessarily enter said larger opening before any one of the other pins can enter its respective opening when engagement of said plug and said socket is performed, and whereby registration of said larger pin with said larger opening and of said circularly arranged pins with said groove will simultaneously determine the registration of all other pins and their respective openings only when there exists a predetermined relationship of angular rotation between said plug and said socket.

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