United States Patent [19]

Adler

[11] **3,818,278**

[45] **June 18, 1974**

[54] **TUBE SOCKETS FOR USE WITH PRINTED CIRCUIT BOARDS**

[75] Inventor: **Harold J. Adler**, Skokie, Ill.

[73] Assignee: **Alcon Metal Products, Inc.**, Chicago, Ill.

[22] Filed: **Aug. 7, 1972**

[21] Appl. No.: **278,587**

[52] **U.S. Cl.** ..... **317/101 CC**, 313/318, 339/143, 339/193

[51] **Int. Cl.** **H05k 1/04**

[58] **Field of Search** ..... 313/318, 225; 339/14 T, 339/17 D, 193 P, 143 R, 143 T, 193 R; 317/101 CC

[56] **References Cited**

UNITED STATES PATENTS

2,863,131	12/1958	Carlzen et al.	339/17 D
3,031,635	4/1962	Gluck	339/14 T
3,087,136	4/1963	Peterson et al.	339/193 R
3,131,988	5/1964	Jensen et al.	339/14 T
3,240,980	3/1966	Schuster	313/318
3,423,720	1/1969	Pittman	339/143 T
3,502,933	3/1970	Leimontas et al.	313/318
3,566,338	2/1971	Startin	339/14 T

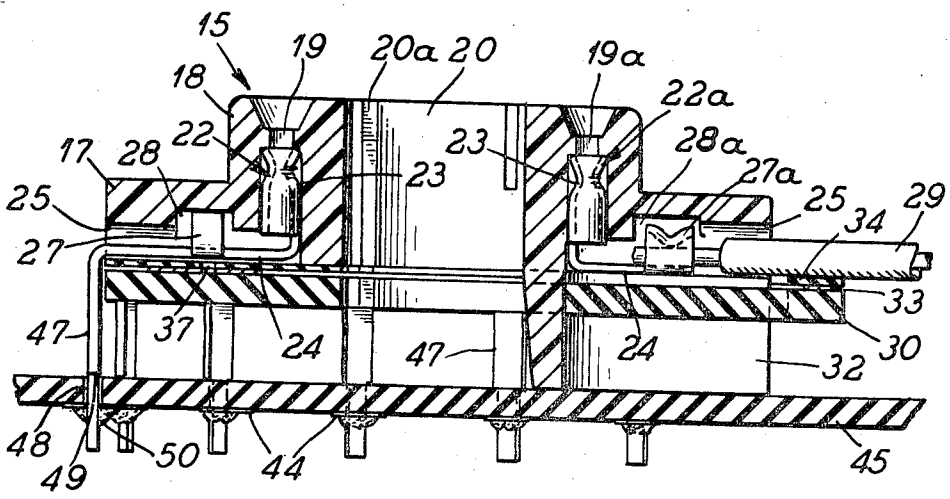
Primary Examiner—David Smith, Jr.

Attorney, Agent, or Firm—Hill, Gross, Simpson, Van Santen, Steadman, Chiara & Simpson

[57] **ABSTRACT**

Tube sockets, such as for cathode ray tubes, have contacts provided with tail terminals arranged to extend through printed circuit boards for direct soldered connection to the printed circuit. Thereby the circuit board and socket become a unit for removable attachment to the pins of the CRT. Either a grounding ring is provided in the socket with a grounding terminal projecting in the opposite direction from the tail terminals, or spark gaps may be provided for on the printed circuit board or on a substrate board applied to the tails. Resistors and capacitors as required may be connected in the printed circuit.

12 Claims, 10 Drawing Figures



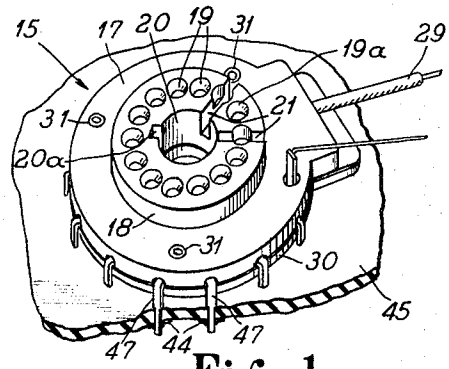


Fig. 1

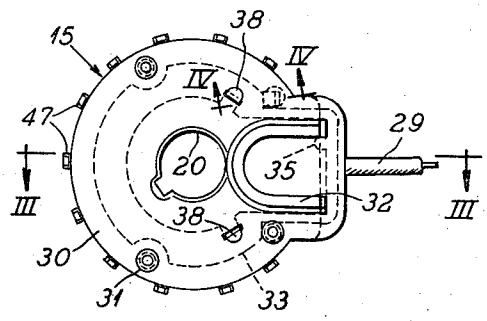


Fig. 2

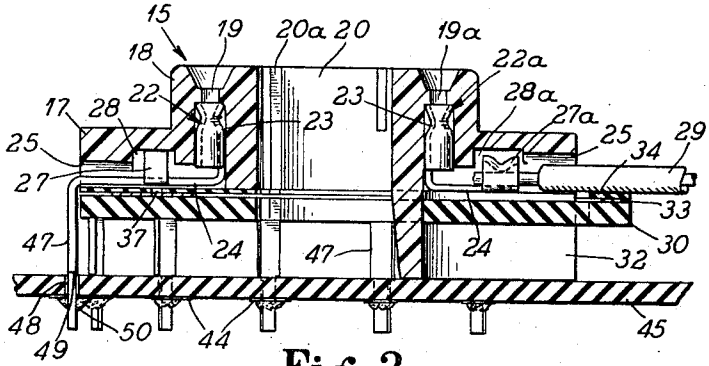


Fig. 3

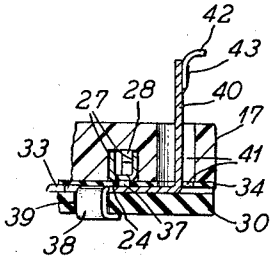


Fig. 4

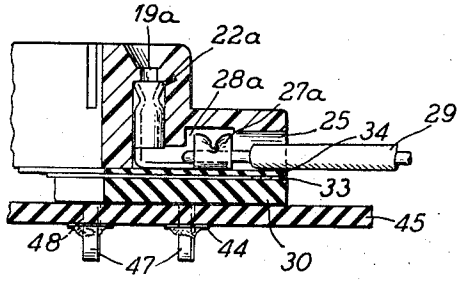


Fig. 5

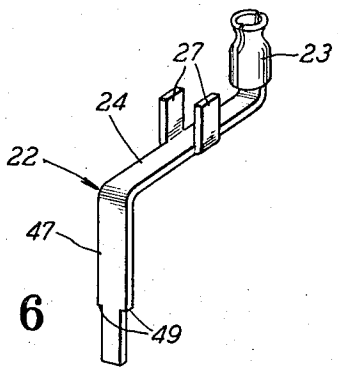


Fig. 6

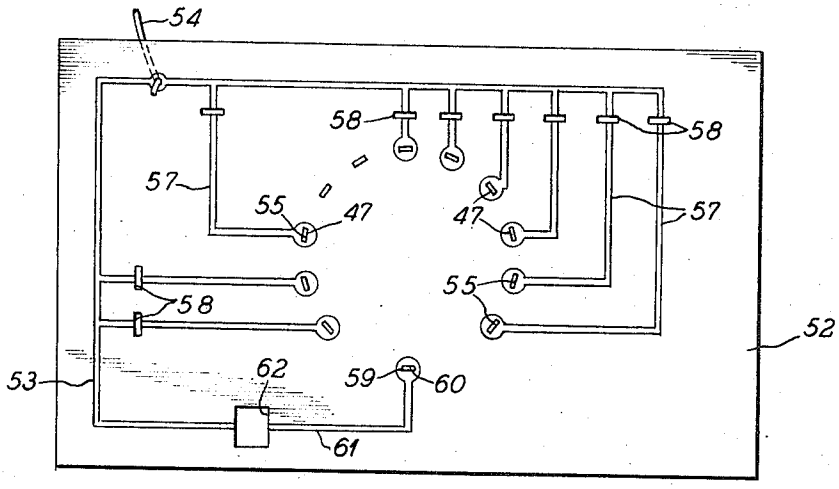


Fig. 8

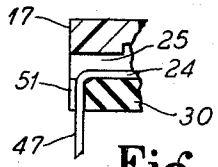


Fig. 7

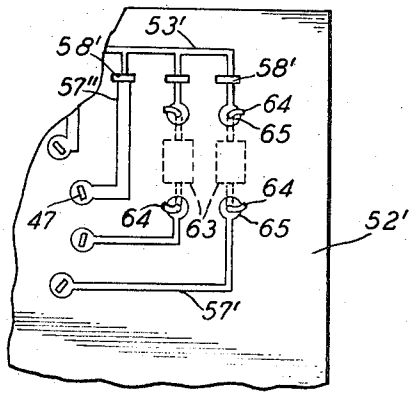


Fig. 9

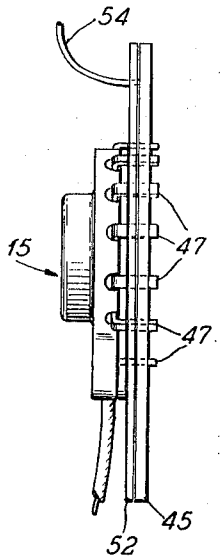


Fig. 10

TUBE SOCKETS FOR USE WITH PRINTED CIRCUIT BOARDS

This invention relates to improvements in the art of effecting electrical connections in relatively high voltage electronic apparatus, and is more particularly concerned with tube sockets, such as for cathode ray or TV tubes and means for effecting electrical connections therewith.

As heretofore constructed, tube sockets of the character indicated have been provided with contacts equipped with terminals which has been individually soldered to respective electrical lead wires in the circuitry of the apparatus such as in a television set wherein the tube socket provides a separable coupling between the lead wires and the TV tube. This requires costly, time consuming labor and has the further disadvantage of liability of imperfect solder connections.

Another problem in respect to tube sockets of this type, has been in providing for grounding, and more particularly in preventing over-loading of any circuit or part of the circuit related to any one of the cathode ray tube pins.

An important object of the present invention is to overcome the foregoing and other disadvantages, defects, defficiencies, shortcomings and problems in prior high voltage tube sockets and electrical connections therewith, and to attain important advantages and improvements as will hereinafter become apparent.

Another object of the invention is to provide a new and improved tube socket especially adapted for use with printed circuit board.

A further object of the invention is to provide a new and improved tube socket contact structure especially equipped to enable efficient connection to a printed circuit board conductor.

Still another object of the invention is to provide a new and improved tube socket assembly and printed circuit board to function in unitary relation.

A yet further object of the invention is to provide new and improved means for grounding the contacts of a high voltage tube socket.

Other objects, features and advantages of the invention will be readily apparent from the following description of certain preferred embodiments thereof, taken in conjunction with the accompanying drawings although variations and modifications may be effected without departing from the spirit and scope of the novel concepts embodied in the disclosure, and in which:

FIG. 1 is a perspective view of a tube socket and printed circuit board mounted thereon;

FIG. 2 is a back side plan view of the tube socket;

FIG. 3 is an enlarged sectional elevational view taken substantially along the line III—III of FIG. 2;

FIG. 4 is a fragmentary sectional detail view taken substantially along the line IV—IV of FIG. 2;

FIG. 5 is a fragmentary sectional elevational detail view taken substantially in the same plane as FIG. 3 but showing a modification;

FIG. 6 is a perspective view of one of the contacts for the tube socket;

FIG. 7 is a fragmentary sectional elevational detail view showing a slightly modified disposition of the terminal tails of the tube contacts;

FIG. 8 is a more or less schematic plan view of a spark arrester or overload grounding printed circuit for high voltage tube sockets;

FIG. 9 is a fragmentary plan view showing a slight modification in the spark arrester printed circuit; and

FIG. 10 is a side elevational view showing a combination with the tube socket of a main printed circuit board and a substrate printed circuit board carrying a spark arrester grounding circuit.

On reference to FIGS. 1, 2 and 3, illustrating one representative practical embodiment of the invention, a socket body 17 which may be molded from a suitable dielectric material, is of generally disk-like form having a front face from which projects a smaller diameter tube mount platform boss 18. This boss has an annular series of tube terminal pin-receiving socket holes 19 therethrough about a central keyhole 20 within which the customary base boss of a cathode ray tube is received and which has a longitudinally extending key receiving slot 20*a* within which a radial key on the tube boss is engaged for properly orienting the contact pins on the tube base with the respective pin holes 18 which are, as is usual, identified to receive specific ones of the pins therein. One of the pin holes, identified as 19*a*, is isolated from the remaining pin holes by radial air gap slots 21 in the boss 11 and is adapted to receive the high potential pin of the tube.

In order to effect electrical coupling with apparatus in the set with which the tube is associated, the socket 15 is provided with contacts 22 (FIGS. 1 and 6) operatively associated with each of the pin holes 19 and a contact 22*a* associated with the pin hole 19*a*. Each of the contacts has a pin receptacle or socket 23 constructed to receive the respective tube pin therein with a frictional electrical coupling grip. These sockets are mounted coaxially within the pin holes 19 to open from the front face of the body. Each socket 23 is integral with one end of an elongated metal strip 24 comprising a tail piece from which the socket extends in one direction. To accommodate the tail pieces 24, the back face of the body 17 is provided with respective radial grooves 25 communicating at their inner ends with the inner ends of the pin holes 19 and opening at their outer ends through the perimeter of the body. Intermediately each of the tail pieces 24 of the contacts 22 is desirably provided with angular retainer flange structure comprising a pair of parallel coextensive narrow flanges 27 which extend into receiving recesses 28 in the grooves 25. On the tail piece 24 of the contact 22*a* retainer flange structure 27*a* extends into a recess 28*a* in the associated body groove 25 and serves also as a crimped connector for a so-called "black wire" lead 29 for the high potential pin of a cathode ray tube which extends from the outer open end of the respective groove 25. Locking of the contacts 22 and 22*a* in the body 17 is effected by means of a dielectric cover plate 30 applied to the back of the body and secured thereto as by means of rivets 31.

Electrical isolation of the high potential contact 22*a* from the remaining contacts is desirably effected by means of a high voltage barrier wall 32 of generally horseshoe shape projecting integrally from the back side of the body 17 and through the cover plate 30. Further guarding against arcing between the high potential contact and the remaining contacts and also guarding against arcing between any of the remaining contacts 22, are means comprising a thin conductive grounding ring 33 which is sandwiched between the cover plate 30 and a thin insulating gasket 34 clamped

to the back face of the body **17.** A relatively wide arcing gap between the grounding ring and the contact **22***a* is provided by a projection **35** extending into the horseshoe barrier area (FIG. **2**). A spark gap for each of the contacts **22** for which it is desired to have one is provided by a pin hole **37** through the gasket **34** in line with and exposing the respective contact tail piece **24** to the grounding ring. Attachment of the grounding ring to the panel **30** is desirably effected by means of integral attachment ears **38** on the ring extending through respective slots **39** in the panel and bent over into securing relation (FIGS. **2** and **4**). As will be best observed in FIGS. **3** and **4,** the angular flanges **27** extending into the recesses **28** are dimensioned to maintain the tail pieces **24** of the contacts **22** in close proximity, and as shown in FIG. **4** firmly, against the thin insulating gasket **34** to provide for efficient breakdown voltage gap through the respective gap holes **37,** rather accurately as determined by the thickness of the insulating gasket **34.** Similarly, the flange structure **27***a* of the high voltage contact **22***a* retains the tail piece **24** thereof close to the plane of the insulating gasket **34** and thus efficiently adjacent to the grounding ring projection **35.**

To effect grounding of the ring **33** to the frame or chassis of the associated apparatus such as a TV set, the grounding ring is provided with an integral grounding tab extension terminal **40** which projects through aligned clearance holes **41** in the gasket **34** and the lateral flange portion of the body **17** suitably spaced from the mounting boss **18** but as close as practicable to the high voltage terminal grounding projection **35,** as shown. The grounding terminal **40** is of sufficient length to project an adequate distance from the front face of the body **17** to facilitate electrical attachment thereto of a grounding lead or strap **42** as by means of soldering **43,** the other end of the grounding member **40** being suitably attached to the frame or chassis.

New and improved means are provided for enabling connection of the contacts **22** to printed circuit conductors **44** on a dielectric printed circuit board **45** in a manner to effect unitary assembly of the socket **15** and the printed circuit board. To this end, the tail strip portions **24** of the pin socket contacts **22** are respectively provided with tail terminals **47** which extend from the opposite end of the strip from the sockets **23** and angularly in the opposite direction to project past the edge of the panel **30** to and through the back of the board **45** which is provided with respective tail terminal slot holes **48** through which the free end portions of the terminals **47** extend into contiguous relation to the conductors **44,** as best seen in FIGS. **1** and **3.** To cooperate with the barrier **32** in providing a stable spaced relation between the back of the socket assembly **15** and the board **45,** the tail terminals **47** are preferably provided with lateral stop shoulders **49** located substantially in a plane with the seating edge of the barrier **32** so as to engage the board **45** in a common plane with the barrier edge. Beyond the shoulders **49,** the tail terminals extend to a sufficient length and greater than the thickness of the board **45** to present adequate terminal area for permanent electrical connection to the conductors **44** by means of solder **50.** Soldering is readily effected by dip soldering according to any preferred method. Thereby all of the tail terminals are adapted to be simultaneously soldered to the respective conductors **44.** In addition, the terminal extremities of the tail terminals projecting beyond the printed face of the board **45** to provide terminal area to which any desired capacitors, resistors, or the like may be secured as by soldering if desired.

As best observed in FIGS. **1, 2** and **3,** not only does the projection of the contact tails **24** of the contacts **22** radially to the perimeter of the body **17** and the edge of the cover plate **30** place the terminals **47** about the maximum diameter of the socket assembly and thus efficiently spaced from one another to avoid sparking therebetween, but the terminals **47** are efficiently spaced radially outwardly relative to the outer perimeter of the grounding ring **33** which has its outer perimeter spaced substantially radially inwardly from the outer perimeter of the socket body **17** and the insulating disks **30** and **34.** This relationship assures that potential transfer through the contacts **22** will occur as desired, without leakage between the contacts themselves or the contacts and the grounding ring and, nevertheless, controlled surge relief between the contact tails **24** is provided for through the holes **37** as desired.

Where it is preferred to dispense with the horseshoe barrier **32,** as shown in FIG. **5,** for example, the back of the socket assembly **15** may be placed in back-to-back engagement with the printed circuit board **45,** and in such event the tail terminals **47** may be shorter and do not need to be provided with the shoulder **49.** In other respect, the unit comprising the socket assembly and the printed circuit board **45** carried thereby may be the same as already described.

If preferred, as shown in FIG. **7,** instead of having the tail terminals **47** extend along the outer edge of the cover panel **30,** the panel may be provided with axially extending notches **51** recessed into the edge and within which the tail terminals **47** are inset, thereby leaving the perimeter of the socket assembly free from projections. This arrangement also assists in holding the contacts in steady relation in the socket assembly.

In a simplified spark arrester for the socket **15,** as enabled by the unique contacts having the tail terminals **47** for printed circuit board connection, a printed circuit spark arrester may be provided as more or less schematically shown in FIG. **8.** Accordingly, a printed circuit board **52** carries a continuous grounding conductor **53** which is adapted to be solder connected to a ground wire or strap **54** which is electrically grounded to the frame or chassis of the associated apparatus. A pattern of terminal holes **55** in the board **52** have the tail terminals **47** extending therethrough and soldered to respective grounding conductor leads **57** carried by the board **52** and integrally connected with the grounding conductor **53.** In each of the conductor leads **57** is a suitable arcing gap provided by a void in the board **52** as by means of a slot **58** in the board across the area along which the lead **57** extends. Fairly narrow gap slots will suffice for the contacts **22** which in association with a typical TV tube may only require about 2,500 volts breakdown across the spark gap. In providing for grounding the high voltage connector **22***a,* which for this purpose may be provided with a tail terminal **59** extending through a clearance hole slot **60** in the board **52,** a grounding conductor lead **61** soldered thereto and connected integrally to the grounding conductor **53** has a relatively large spark gap provided by a hole **62** in the board **52** across the area traversed by the conductor **61.** Size of the opening **62** between the

interrupted ends of the conductor lead **61** should be determined by the breakdown voltage desired. For example, the opening **62** may be of a size to enable a 10,000 volts jump and permit the spark to continue for about two minutes without destroying the 10,000 volts breakdown ability of the grounding conductor **61.** It will be apparent that a wide range of arc or spark arresting control can thus be attained by proper dimensioning of the spark gaps **58** for the minor voltage pins of the electronic tube with which the socket **15** is used and by determining the size of the spark gap **62** for the major voltage pin of the tube. Design variation in the spark gap by increasing or decreasing the respective spark gap spacings in the board to meet the specific requirements is easily effected. Further, the spark ring **33** and insulating gasket **34** can thus be eliminated.

Although in general, no resistors will be needed in the printed circuit grounding circuit, where it is desired to provide a resistor in any one or more of the grounding circuits from the respective pin contact to the grounding conductor, that may be done as illustrated by way of example in FIG. **9.** To this end, any one of the grounding conductors **57'** may be provided with a suitable resistor **63** having its terminals **64** soldered to respective terminals **65** of the conductor at opposite ends of a suitable gap in the conductor. Each of the grounding conductors **57'** has the spark air gap **58'** across it adjacent to the main grounding conductor **53'**. Instead of a soldered in resistor, the printed circuit grounding lead itself may have so-called built in resistance provided as indicated at **57''** which may, for example, be an etched copper grounding conductor having the resistance feature in the portion between the pin terminal and spark gap **58'**. Any preferred method of printed circuit production may be employed. Substantial flexibility in designing printed grounding circuitry is thus indicated.

Where practicable the grounding circuitry may be provided directly on the printed circuit board **45.** Where this is not practicable the grounding circuitry may be carried by the board **52** separately from the board **45** and mounted in unitary relation with the socket assembly **15** as a substrate as shown, by way of example, in FIG. **10.** Thus, the grounding circuit board **52** may be applied to the socket assembly **15** first, with the tail terminals **47** dip soldered to the grounding conductors. In this instance projection of the terminals **47** beyond the board **52** will be sufficient to also project through the printed circuit board **45** for connection as by dip soldering with the conductors on this board. Inasmuch as the grounding circuitry on the board **52** is flat, the board **45** may be applied in close laminar relation to the printed surface of the board **52.** Both of the boards **45** and **52** will, of course, be of suitable dielectric material. If desired, the grounding circuit board **52** may be of thin ceramic material.

It will be understood that variations and modifications may be effected without departing from the spirit and scope of the novel concepts of this invention.

I claim as my invention:

1. A cathode ray tube socket assembly for use with a printed circuit board, comprising:

a socket body provided with opposite faces and having a tube boss receiving hole therethrough and a plurality of smaller tube terminal pin-receiving holes in circumferentially spaced relation to one another and radially spaced from said boss-receiving hole and extending parallel thereto into said body from one face;

respective electrical contacts each equipped with a socket to receive a tube terminal pin and aligned with said pin-receiving holes;

said contacts having elongated tail pieces extending radially therefrom in respective grooves in the opposite face of said body aligned with said pin-receiving holes and extending radially outwardly through the outer perimeter of said body;

a thin insulating gasket seated against said opposite face of the body in closing relation to said grooves;

an insulating panel clamping said gasket against the body;

a thin grounding ring clamped between said gasket and said panel;

said gasket having respective small spark gap holes aligned with at least certain of said tail pieces and communicating with said grounding ring;

said grounding ring having a grounding terminal adapted to be grounded to a television chassis; and

said tail pieces having integral flange structure extending angularly relative to the length of the tail pieces and in the opposite direction from said spark gap holes and toward said body whereby to maintain said tail pieces close to said insulating gasket for efficient spark gap relation of said tail pieces relative to said grounding ring through said spark gap holes.

2. An assembly according to claim **1,** wherein said tail pieces have on end portions thereof at the radially outer ends of said grooves integral terminals which extend angularly past the edges of said gasket and said closure panel for engagement with a printed circuit board.

3. An assembly according to claim **1,** wherein said tail pieces have radially outer portions thereof at the outer ends of said grooves, said closure panel having peripheral notches therein aligned with said grooves, and said end portions of the tail pieces having terminals extending angularly therefrom through said notches and beyond the panel for engagement with a printed circuit board.

4. An assembly according to claim **1,** said body including a high voltage barrier wall about one of said pin-receiving holes and the one contact aligned with said one hole for isolating a high voltage connection with said one contact, said grounding ring having a grounding projection extending toward said one contact in a space defined within said barrier wall, said body having a clearance aperture opening through said one face and outside of but adjacent to said barrier wall, and said grounding ring terminal comprising a tab extension extending outwardly through said aperture.

5. An assembly according to claim **1,** wherein said tail pieces comprise flat sheet metal parts, and said angular structure comprises short flanges extending from the sides of the tail pieces.

6. An assembly according to claim **5,** wherein said grooves have respective recesses therein within which said flanges are received to provide contact retainer means.

7. An assembly according to claim **1,** including a generally horseshoe shaped barrier wall about one of said

contacts isolating it for connection with a high voltage conductor, said barrier wall projecting a substantial distance from said opposite face of said body, said tail pieces having terminals extending angularly therefrom along the edges of said gasket and panel and in the same direction as said barrier wall, said terminals being of greater length than said barrier wall, and shoulders on said terminals in the plane of the end of said barrier wall whereby the barrier wall end and said shoulders will support the assembly in stable relation on a printed circuit board through which said terminals extend beyond said shoulders for connection with printed circuit leads on a face of the circuit board opposite to a face of the board engaged by said shoulders and said barrier wall end.

8. A cathode ray tube socket assembly, comprising:

a socket body provided with a cathode ray tube base socket hole and a plurality of circumferentially spaced terminal pin-receiving socket holes spaced about said base hole and each having within said body an electrical contact receptive of a contact pin of the contact ray tube;

said contacts having terminal tail pieces through grooves in a face of said body opposite to the face from which said contact holes open;

a grounding ring laminated between insulators mounted on said opposite face in closing relation to said grooves;

means providing sparking connection between certain of said tail pieces and said grounding ring;

one of said terminals being a high voltage terminal isolated relative to the remaining terminals;

said grounding ring having a grounding projection angular to the ring plane adjacent to said high voltage terminal;

a grounding terminal on said ring; and

said body having a clearance opening communicating with said grounding ring through the face of said body adjacent to but isolated from said high voltage terminal and opening through the face through which said terminal openings of the body open and said grounding ring terminal extending outwardly through said clearance opening for grounding connection to a television chassis.

9. A tube socket contact structure comprising:

an elongated metal strip;

a tube pin socket integral with one end of said strip and extending angularly thereto in one direction;

said strip providing a tail piece extending laterally from said socket; and

short angular flanges extending from an intermediate portion of said tail piece separate from said socket for retaining engagement within a recess in a tube socket.

10. A tube socket assembly and a printed circuit board comprising, in combination:

tube pin receiving contacts having tail terminals;

a dielectric body supporting said contacts and from which the tail terminals project;

said printed circuit board having holes therethrough oriented to receive said tails therethrough and aligned with printed circuit conductors carried by the board;

said tail terminals extending through the holes in the board;

means electrically connecting said tail terminals to said printed circuit conductors;

said printed circuit conductors comprising grounding leads;

a main grounding conductor carried by said board and with which the grounding leads are electrically connected;

said board having spark gap holes therein across said grounding leads.

11. An assembly according to claim **10**, wherein said printed circuit board has assembled therewith a second printed circuit board with which said terminals are in engagement.

12. An assembly according to claim **10**, including electrical resistance means in said printed circuit conductor grounding leads.

* * * * *