# United States Patent [19]

**Buescher et al.**

[11] **3,881,124**

[45] **Apr. 29, 1975**


[54] **FAST WARM-UP PICTURE TUBE CATHODE SYSTEM**


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[73] Assignee: **GTE Sylvania Incorporated,** Stamford, Conn.



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[52] **U.S. Cl.** ..... **313/37;** 313/47; 313/446

[51] **Int. Cl.** ..... **H01j 1/02**

[58] **Field of Search** ..... 313/37, 47, 337, 446



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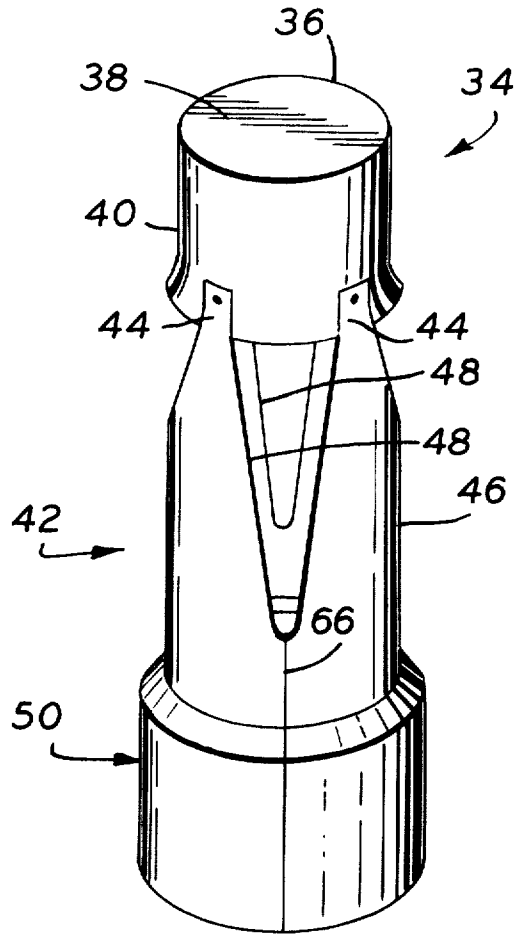
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[57] **ABSTRACT**

A closed end tubular cathode cap is attached to a cathode support by a plurality of limited contact area tabs which provide poor heat conduction between the cap and the stack. An insulated filamentary heater having a coil portion substantially entirely encompassed within the cathode cap and having legs which project from the stack is also provided. The diameter of the cap and the diameter of the stack or support are substantially the same at the top. The bottom can be larger to fit a cathode eyelet.


**7 Claims, 10 Drawing Figures**



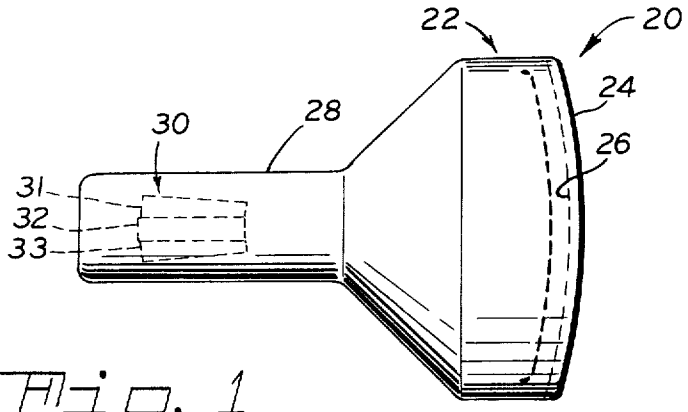



Fig. 1

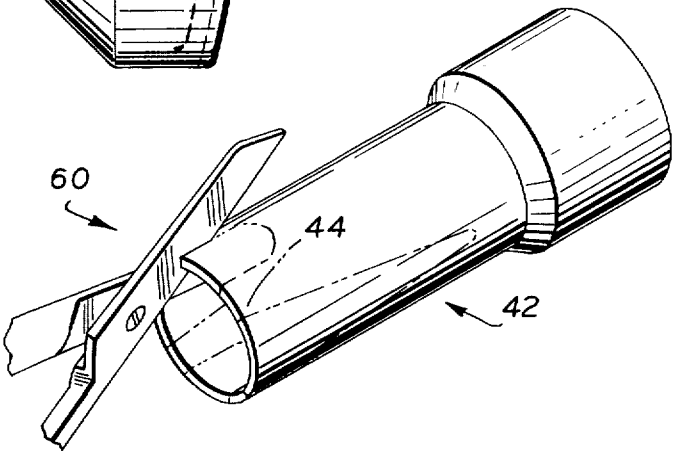



Fig. 5

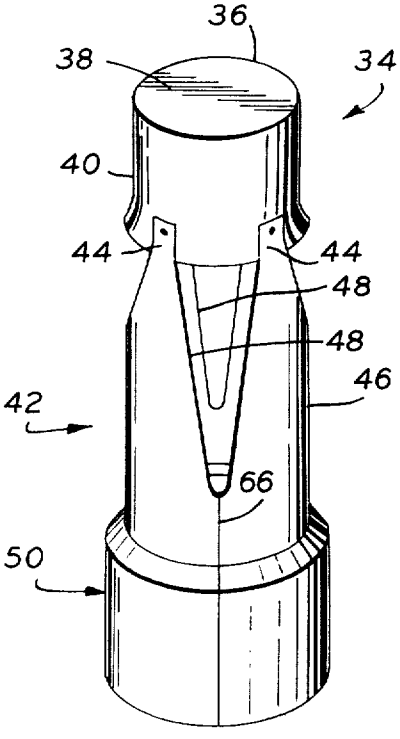



Fig. 2

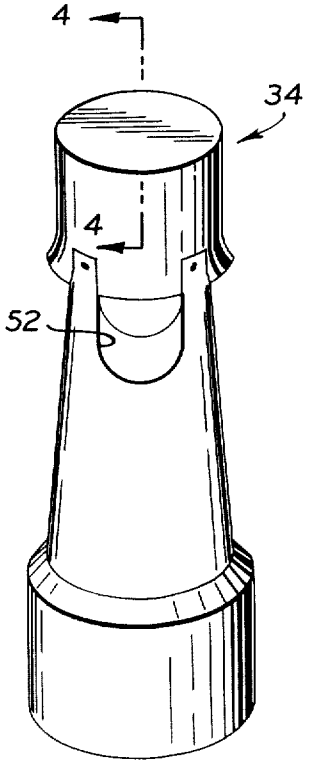



Fig. 3

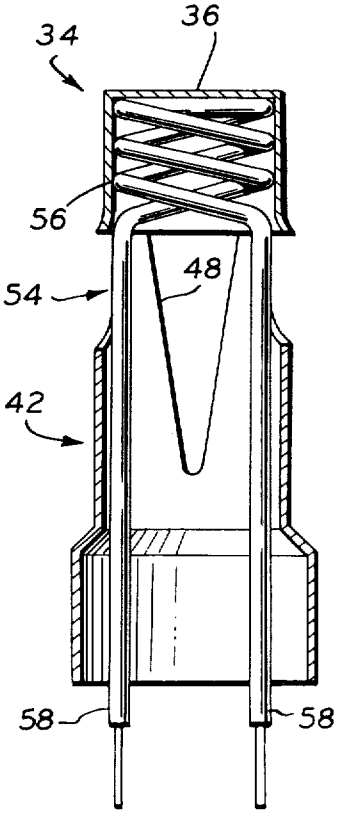



Fig. 4

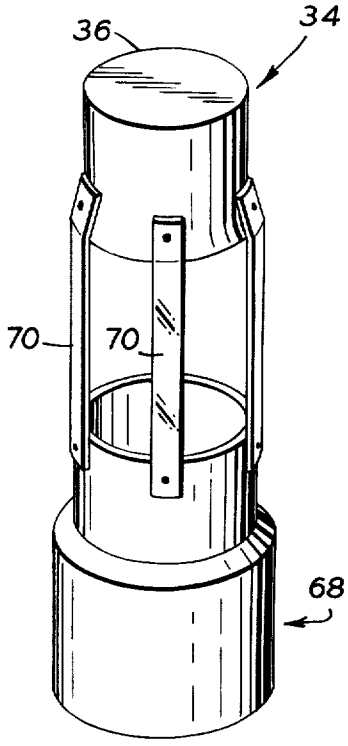



Fig. 8

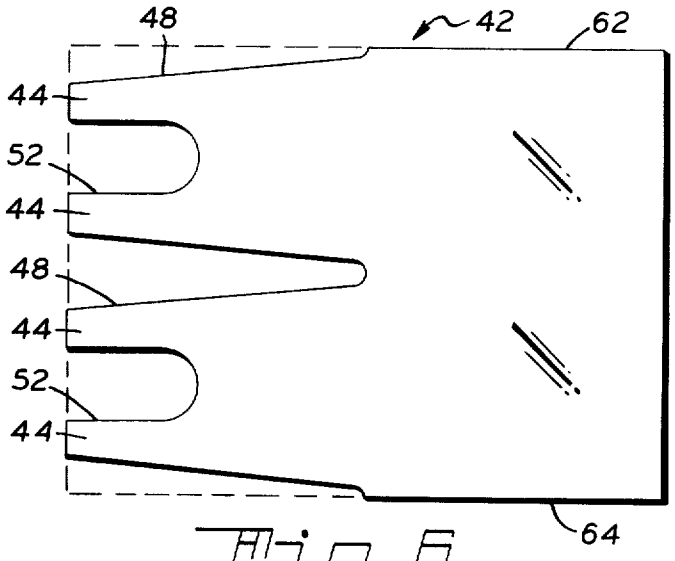



Fig. 6

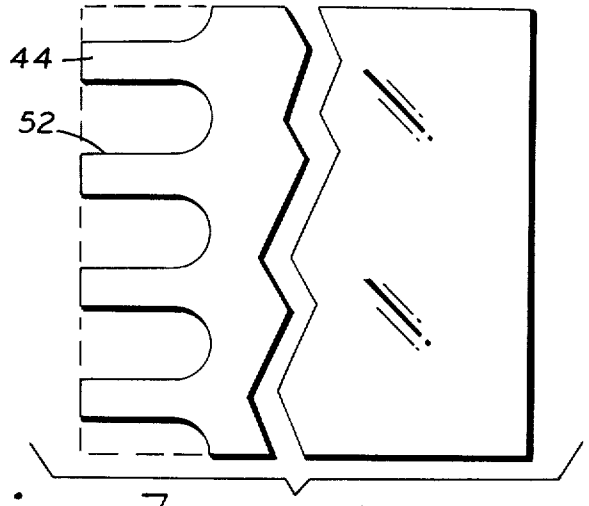



Fig. 7

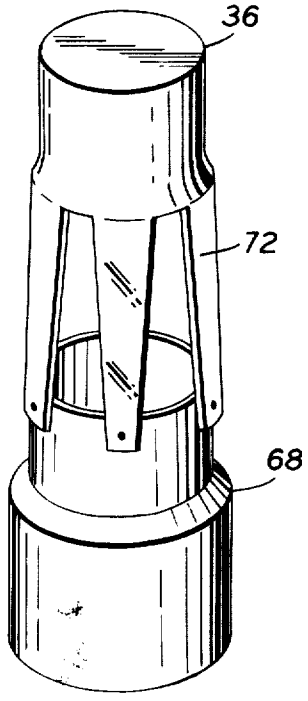



Fig. 9

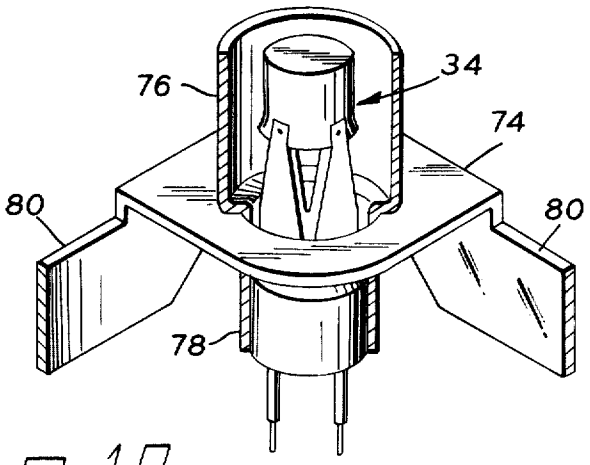



Fig. 10

# FAST WARM-UP PICTURE TUBE CATHODE SYSTEM

## BACKGROUND OF THE INVENTION

This invention relates to electron discharge device cathodes and more particularly to fast warm-up cathodes having particular application in cathode ray tubes. Still more particularly, the cathode has application in the multiple gun structure of color cathode ray tubes. Conventional cathode ray tubes of the color variety are provided with multiple electron guns each of which contains an electron emitting cathode. The cathodes are usually indirectly heated, that is, they comprise a tubular cathode assembly having an insulated filamentary heater contained therewithin to provide the heat necessary to cause an emissive material to emit electrons. The cathodes conventionally employed in color cathode ray tubes normally have a warm-up time of 12 to 15 seconds; that is it requires that long a time for sufficient electrons to be present from the cathode to be drawn to the anode and establish a raster on the faceplate of the picture tube. These warm-up times have been considered to be detrimental to the viewing public in that it requires a long wait from turn-on to an acceptable or viewable picture on the tube. In the past this detrimental condition has been obviated by the provision of an "instant on" feature provided by some television receiver manufacturers. With this feature a raster or viewable picture is obtained on the picture tube almost instantaneously with the turn-on of the set; however, this feature has not in the past been accomplished by a fast warm-up cathode but rather by a bleeder current which constantly maintains the cathode heater at a near normal operating temperature. Thus, in effect, the cathode ray tube is never completely turned off. When the television receiver is either a complete tube version including many receiving tubes or a hybrid version including some receiving tubes and some solid state devices, the bleeder current of the instant-on feature is also applied to the heaters of the other receiving tubes within the set. This condition has been alleged to provide a dangerous fire hazard in some receivers. It is also quite wasteful of electrical energy since, as mentioned above, the receiver is never completely turned off and the set is constantly drawing electrical power. It would be a decided advance in the art if a more economical fast warm-up system could be provided. Attempts have been made in the past to provide fast warm-up cathodes, however, many of the proposed types have been either extremely difficult to build or have been very expensive or have required considerable design changes in the conventional electron gun structures.

## OBJECTS AND SUMMARY OF THE INVENTION

It is, therefore, an object of the invention to obviate the disadvantages of the prior art.

It is another object of the invention to enhance the warm-up characteristics of color cathode ray tubes.

It is yet another object of the invention to provide an acceptable and economical fast warm-up cathode for color cathode ray tubes.

Yet another object of the invention is the provision of a fast warm-up cathode in a configuration such that no other changes are necessary in the gun structure of a conventional color cathode ray tube other than the inclusion of the new cathode.



These objects are accomplished in one aspect of the invention by the provision of a fast warm-up cathode assembly for a cathode ray tube which assembly comprises a tubular cathode cap having one closed end which contains thereon an electron emissive material. A tubular support for the cap is also provided, the support having both ends open and having substantially the same diameter as the cathode cap. Low heat conductivity providing means connect the cap and the support so that little heat conduction is lost from the cathode cap. To further accomplish the negligible loss of heat through conduction between the cap and the stack a filamentary heater of particular design is positioned within the cap and the support. The heater has a coil section which is substantially contained within the cap and has extending legs within the support and projecting therefrom. This cathode provides excellent warm-up conditions; that is, an emission time of between 5 and 6 seconds to provide a raster. The heat loss from the cap to the cathode support is negligible because of the limited area contact therebetween. Further, this cathode has virtually an identical configuration to a normally used cathode and is replaceable within the gun structure without any modifications to the gun.

## BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a diagrammatic elevational view of a conventional color cathode ray tube;

FIG. **2** is a perspective view of a fast warm-up cathode built in accordance with the invention;

FIG. **3** is a similar perspective view with the cathode assembly rotated 90°;

FIG. **4** is a sectional view of a cathode assembly taken along the line **4—4** of FIG. **3**;

FIG. **5** is a perspective illustration of one method of warming a portion of a cathode assembly;

FIG. **6** is a plan view of an alternate method of forming a portion of the cathode assembly;

FIG. **7** is a view similar to FIG. **6** showing an alternate configuration;

FIG. **8** is a perspective view similar to FIGS. **1** and **2** and showing an alternate embodiment of the invention;

FIG. **9** is a view similar to FIG. **8** showing yet another alternate embodiment of the invention; and

FIG. **10** is a view of the cathode of the invention mounted in a more or less conventional manner in a cathode support suitable for use with a conventional electron gun.

## DESCRIPTION OF THE PREFERRED EMBODIMENTS

For a better understanding of the present invention, together with other and further objects, advantages, and capabilities thereof, reference is made to the following disclosure and appended claims in connection with the above-described drawings.

Referring now to the drawings with greater particularity there is shown in FIG. **1** a cathode ray tube **20** which comprises a bulbular portion **22** having one end thereof closed by a transparent face panel **24** having on the interior surface thereof a phosphor screen **26.** The other end of bulbular portion **22** is closed by a neck portion **28** which encloses within it an electron source **30.** Electron source **30,** in the case of a color cathode ray tube, generally comprises three electron guns **31,** 32, and **33** respectively. Each of the electron guns com-

prises a series of grids or electron lenses and a cathode for supplying the electrons.

A fast warm-up cathode typical of the invention is shown in FIG. **2.** Herein a cathode assembly **34** is shown as comprising a cathode cap **36** which is generally tubular and has a closed end **38** which is provided with an electron emissive material (not shown). The cathode cap has a circumferential wall **40.** The cathode cap **36** is supported from a cathode support **42** of substantially the same diameter. In this particular instance the cathode support **42** is tubular and open at both ends. At one end it is provided with a plurality of limited area cathode cap contacting means **44.** These means are formed in this instance on the cathode support **42** and exist as tabs, in this instance four in number, (three tabs have been tried and are satisfactory) which are welded to the cathode cap. The tabs can be formed by removing portions of the side wall **46** of the tubular support **42.** In FIG. **2** two triangular cutouts **48** are shown. The lower portion of support **42,** that is the portion removed from the cathode cap, can be provided with a widened diameter section **50** for attachment to a cathode mounting means, such as an eyelet.

FIG. **3** is a similar view of cathode assembly **34** which is rotated 90° from that position shown in FIG. **2.** The major difference in the view merely illustrates that deep V cutouts **48** are not necessary all the way around the cathode but U shaped cutouts **52** of a much shallower nature can also be provided. The function of the cutout areas is to provide the tabs **44** and to remove excess material from the cathode support **42** in order to provide good mechanical support for the cathode cap while exhibiting poor heat conduction away from the cathode cap.

The sectional view of FIG. **4** illustrates the heater arrangement employed with cathode assembly **34.** Herein, a heater **54** is provided with a coil portion **56** which is in the form of a reverse wound coil. The turns of the coil are all substantially contained within cathode cap **36.** The legs **58** of the heater project downwardly along the length of the cathode support **42** and extend therefrom so that electrical and mechanical connection can be made thereto.

The cathode cap is generally formed by a die drawn operation. The cathode support **42** can be made in several ways, one of which is diagrammatically illustrated in FIG. **5.** Herein, the cathode support **42** is formed from drawn seamless tubing. The tabs **44,** which are illustrated in phantom, are formed by cutting or otherwise physically removing the cutout portions such as **48** or **52.** A cutting means **60** is shown as the blades of a pair of scissors in this instance, though it will be apparent that this is exemplary only.

An alternate method for forming the cathode support **42** is shown in FIG. **6.** Herein, the support **42** is formed from flat stock and the cutouts **48** and **52** are merely stamped therefrom, thus leaving the necessary connecting tabs **44.** The flat stock is then rolled into a tubular configuration and the edges **62, 64** are butt-welded together to form a seam **66** as appears in FIG. **2.** The widened diameter portion, if desired, can be formed in this instance by a coining operation.

An alternate embodiment of cutout configuration is shown in FIG. **7** wherein the tabs **44** are formed by a plurality of similarly shaped cutouts which in this instance are comparable to cutouts **52** of the prior stack **42.**

The material concept of a low mass cathode cap having poor heat conducting qualities to the support therefor can also be accomplished in other ways. One of these is shown in FIG. **8** wherein the cathode cap **36** is connected to a shortened stack **68** by means of a plurality of low conductivity ribbons **70.** These ribbons are welded or otherwise permanently affixed to both the cathode cap **36** and the cathode support **68.** Yet another alternative method of mounting is shown in FIG. **9** wherein connecting tabs **72** are formed as part of the cathode cap **36** and are welded or otherwise permanently affixed to a shortened cathode support **68.**

In FIG. **10** the cathode assembly **34** of this invention is shown mounted within a more or less conventional cathode support utilized in the three gun electron system of color cathode ray tubes. This support is provided with a planar surface **74** having an aperture therein which seats a cathode shield **76.** The cathode shield has a depending portion **78** to which the lower portion of the cathode support is affixed. The cathode support is also provided with two projecting ears **80** which are affixed into glass beads which unitize the electron gun structure. This is conventional in the cathode ray tube art and is not shown in great detail. From a study of FIG. **10** it can be seen that one of the prime objects of this invention is achieved in that the fast warm-up cathode described herein is readily replaceable within conventional electron gun mounts. This, of course, greatly simplifies and reduces the expense necessary to put this new fast warm-up cathode into operation.

For optimum results, that is a warm-up time between 5 and 6 seconds, it has been found that a 6.3 volt heater is the preferred type. Also, a low coating weight of insulator material on the heater, that is about 5.5 milligrams, is a preferred coating weight. Experiments have shown that as coating weight increases the warm-up time necessary for raster forming emission also increases. The cathode cap material is preferably a K30 alloy of 3/1000 inch thickness. K30 is a well-known cathode material and is available from GTE Sylvania Incorporated, Towanda, Pa. The cathode support or stack material can be Tophet A which is a nichrome material of 2 to 3/1000 inch thickness available from W. B. Driver Co. or Driver Harris. Cathodes utilizing the above materials with the above-described preferred heater have repeatedly evidenced warm-up times in cathode ray tubes of between 5 and 6 seconds. As noted above, warm-up time and emission time as discussed herein, refers to that period of time from turn-on until a raster or lighted screen appears on the face of a cathode ray tube.

As regards temperature, it has been found that this heater cathode arrangement will provide a raster when the cathode cap reaches a temperature of 550°C. The heater voltage is limited to that which will result in a final cathode temperature of 850°C. This is a suitable operating temperature for maintaining good emission levels from a nickel alloy cathode having conventional barium, strontium, calcium oxide emission materials, and will also provide good life expectancy.

It will be seen from the above description that utilization of this cathode will obviate for all practical purposes the necessity of the prior art instant on feature in television receivers. The elimination of this questionable feature will result in great energy savings and lower operating costs for the individual user. The cath-

ode assembly is remarkably stable and mechanically strong and is readily adaptable to use without major modifications to existing electron guns.

While there have been shown and described what are at present considered the preferred embodiments of the invention, it will be obvious to those skilled in the art that various changes and modifications may be made therein without departing from the scope of the invention as defined by the appended claims.

What is claimed is:

**1.** A fast warm-up cathode assembly for a cathode ray tube comprising; a tubular cap having one closed end and having an axial length less than its diameter; a tubular support of low thermal conductivity for said cap, said support having both ends open and having at least one end substantially the same diameter as said cap and having an axial length greater than its diameter; means connecting said cap and said support providing poor heat conduction therebetween; and an insulated filamentary heater positioned within said cap and said support, said heater having a coiled section contained solely within said cap and having extending legs within said support and projecting therefrom.

**2.** The assembly of claim **1** wherein said means connecting said cap and said support comprises a plurality of relatively thin tabs of low thermal conductivity.

**3.** The assembly of claim **2** wherein said tabs are welded to both said cap and said support.

**4.** The assembly of claim **2** wherein said tabs are integral with said support and are welded to said cap.

**5.** The assembly of claim **2** wherein said tabs are integral with said cap and are welded to said support.

**6.** The assembly of claim **4** wherein said tabs are formed in said support by the provision in one end thereof of a pair of diametrically opposed, relatively shallow U-shaped notches and a pair of diametrically opposed relatively deep V-shaped notches, each of said pairs of notches lying on a major axis of said support.

**7.** A cathode assembly for a cathode ray tube comprising: a tubular cap having one closed end; a tubular support of low thermal conductivity for said cap, said support having both ends open and having at least one end substantially the same diameter as said cap; means connecting said cap and said support providing poor heat conduction therebetween, said means comprising a plurality of relatively thin tabs integral with said support and welded to said cap, said tabs being formed in said support by the provision in one end thereof of a pair of diametrically opposed, relatively shallow U-shaped notches and a pair of diametrically opposed relatively deep V-shaped notches, each of said pairs of notches lying on a major axis of said support.

* * * * *