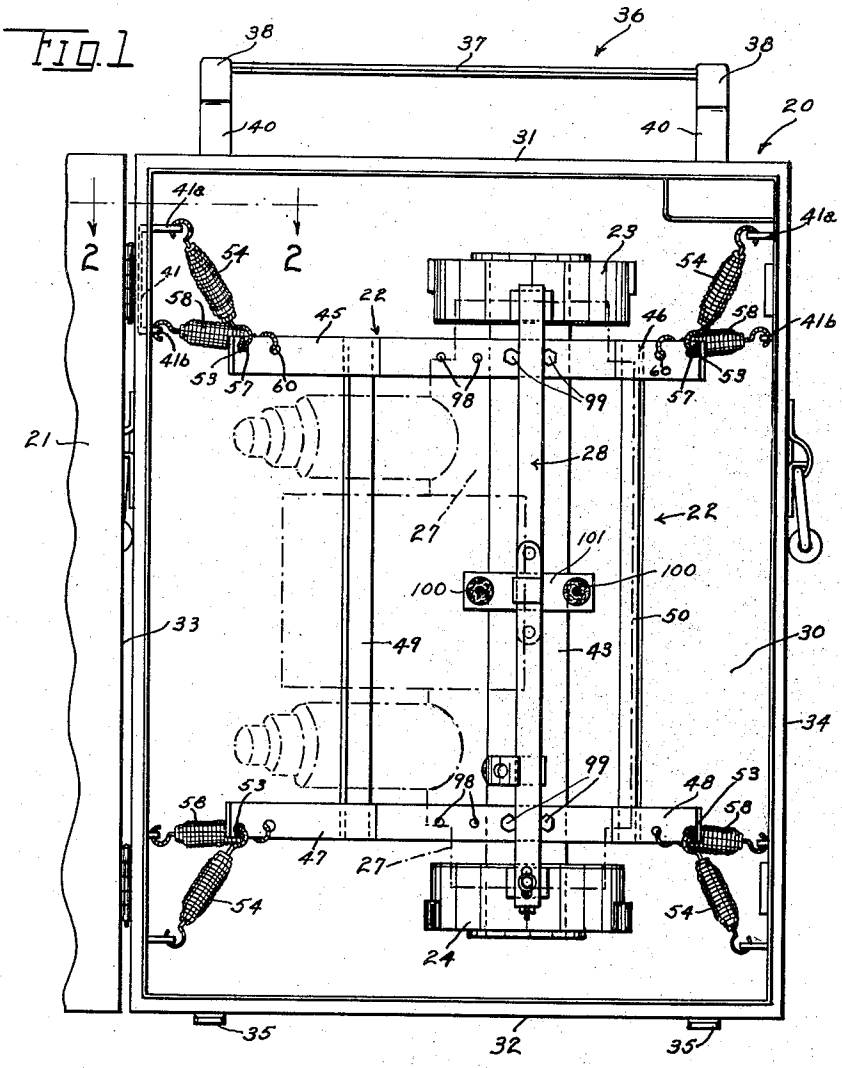
Jan. 10, 1950 E. R. GOLDFIELD ET AL 2,494,170

TUBE SHIPPING CRADLE

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FIG. 1



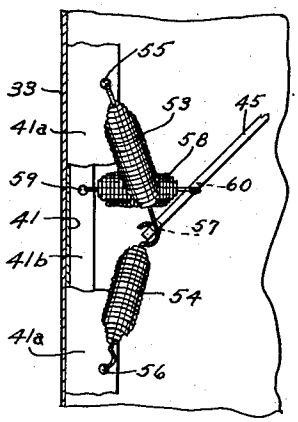


FIG. 2

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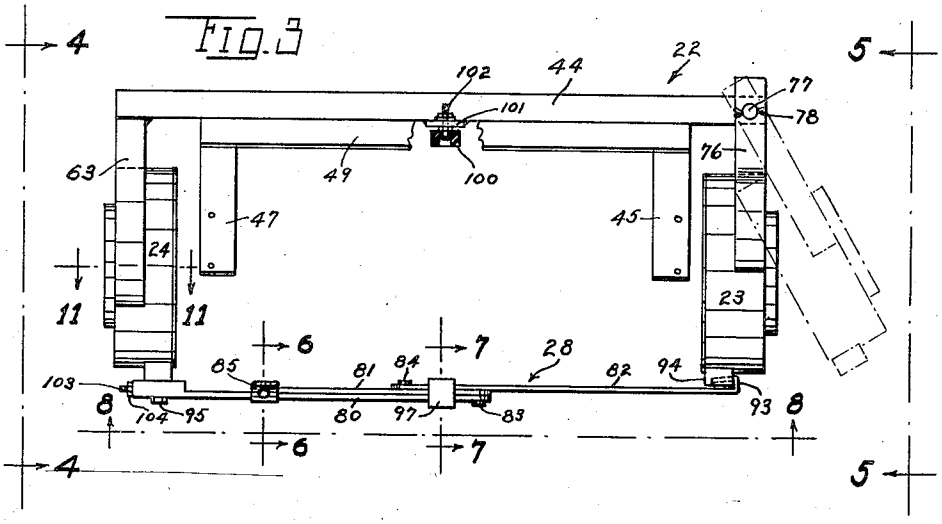
BY Hyde, Meyer, Baldwin & Doram
ATTORNEYS

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TUBE SHIPPING CRADLE

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FIG. 3



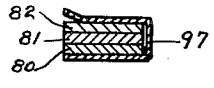


FIG. 7

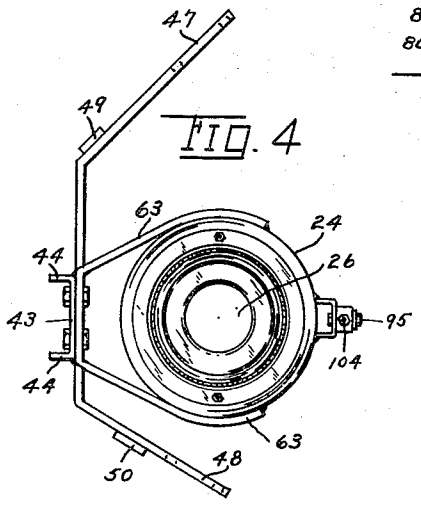


FIG. 4

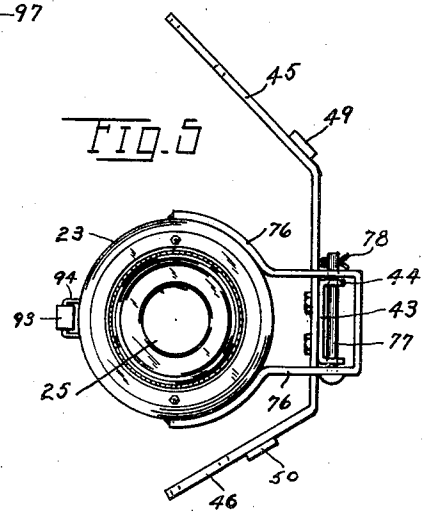


FIG. 5

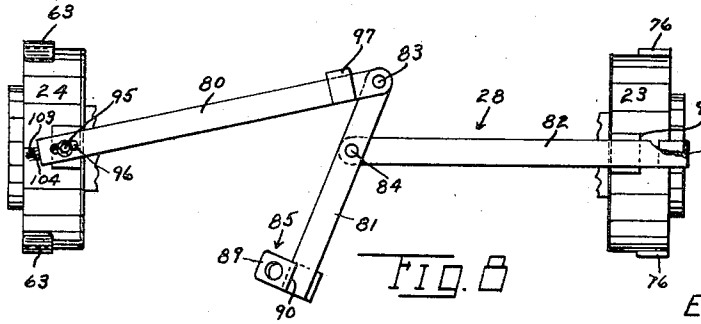


FIG. 8

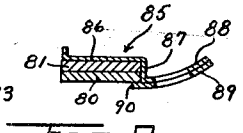


FIG. 6

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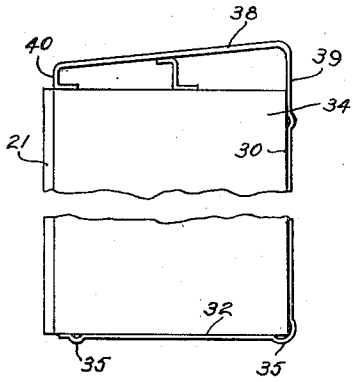


FIG. 9

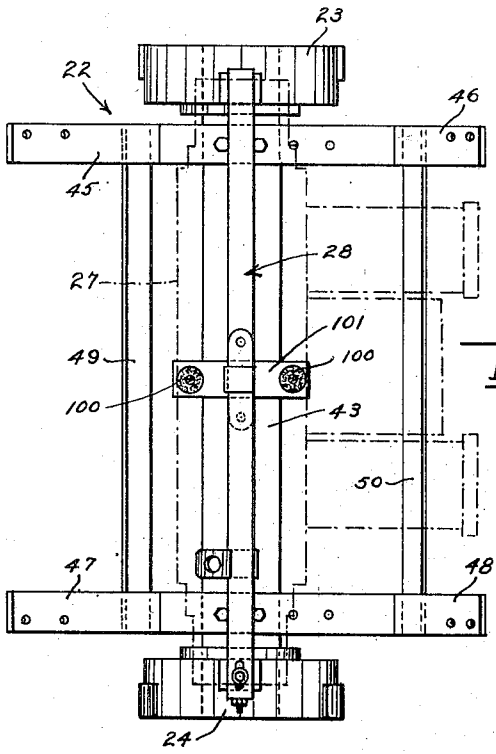
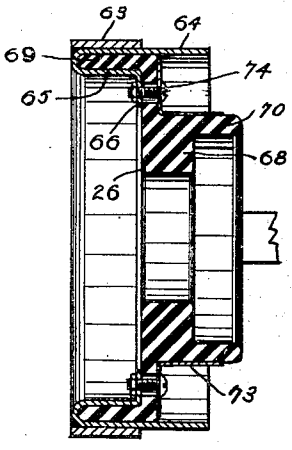


FIG. 10



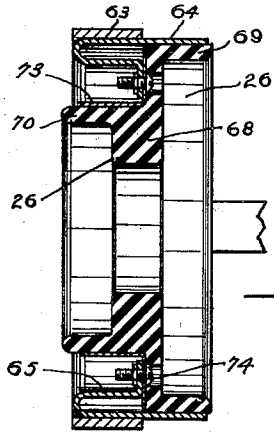


FIG. 11

FIG. 12

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Patented Jan. 10, 1950

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UNITED STATES PATENT OFFICE

2,494,170

TUBE SHIPPING CRADLE

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Application June 8, 1946, Serial No. 675,486

8 Claims. (Cl. 217—55)

1

The invention relates to a novel and improved shipping container, and more specifically to a shock-proof container for the protection of fragile and expensive X-ray generating tubes during their transportation or shipment.

An object of the invention is to provide novel and improved means whereby a tube may be resiliently mounted in a shipping container, entirely out of contact with any rigid portion of the container interior.

A further object is to provide cradle means for the reception of such tube, said cradle being resiliently mounted within the container, and said tube being further resiliently seated but securely held within said cradle.

A further object of the invention is to provide novel and improved shock-proof shipping means of the character described, such means being adapted to maintain the tube in such position with respect to a vertical axis as is required by the character of the tube, and its interior construction. Other objects and advantages will be apparent from a study of the following specification, in conjunction with the accompanying drawings, in which:

Fig. 1 is a front elevational view of a shipping container embodying the present invention, the cover of the container being open to reveal internal construction;

Fig. 2 is a sectional view taken on the line 2—2 of Fig. 1;

Fig. 3 is a side elevational view of the cradle mechanism for holding the tube;

Figs. 4, 5, 6 and 7 are sectional views taken respectively on the lines 4—4, 5—5, 6—6 and 7—7 of Fig. 3;

Fig. 8 is a view taken from the position of the lines 8—8 of Fig. 3, but showing the clamping lever in released position;

Fig. 9 is a side elevational view of the container, as seen from the right of Fig. 1, parts being broken away;

Fig. 10 is a front elevational view of the cradle mechanism, generally similar to the showing of the corresponding part in Fig. 1, but with portions of the mechanism moved to a different operating position to accommodate another type of tube;

Fig. 11 is a sectional view of a housing for holding a tube base, a resilient reversible socket being shown in one operating position in the housing, the view being taken on the line 11—11 of Fig. 3;

Fig. 12 is a sectional view similar to Fig. 11 but showing the sockets reversed to accommodate a tube base of modified structural characteristics.

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Before proceeding to a description of the present invention it should be understood that the said invention is not limited to the details here shown for purposes of illustration, the scope of the invention being determinable from the appended claims.

Speaking first generally, the present invention comprises a box-like container 20 having a hinged or otherwise removable cover 21. Within the container is resiliently suspended a tube receiving cradle 22, seen in operating position in Fig. 1, and removed from the container in Figs. 3 and 10. The cradle is provided with upper and lower end caps 23 and 24 respectively which carry respective resilient nesting sockets 25 and 26 between which the tube body 27 is gripped and retained, such tube body being indicated in broken line in Figs. 1 and 10. A releasable locking lever 28, best shown in Figs. 1, 3 and 8, maintains the end caps in tube gripping position so as to prevent accidental displacement of the tube during movement of the container.

As is well-known to those skilled in the art, a high voltage X-ray tube is an object of considerable structural intricacy. It is extremely sensitive to physical shock, and is especially susceptible to injury particularly when maintained in certain positional orientations with respect to its operating elements. Certain types of tubes, for example, should be maintained in vertical position with their anodes down. The novel cradle mechanism here disclosed is particularly suited for the protection of X-ray tubes and, as will appear, it is provided with means readily conformable to receive more than one tube type.

Special structural features of the container and cradle will now be described in greater detail.

The container 20 is of conventional box-like appearance in external contour, having a rear wall 30, top and bottom walls 31 and 32 respectively, and left and right side walls 33 and 34 respectively, as seen in Fig. 1. A hinged cover 21, previously identified, is here shown as carried by side wall 33, although this arrangement is purely a matter of convenience.

The outer top wall 31 is provided with indicating obstruction means 36, serving to prevent the container from being inadvertently placed with wall 31 downward. The obstruction means comprises a pair of U-shaped brackets 38 formed from strip metal, one leg 39 of each U being longer than the other leg 40. The part of the bracket extending between the legs is conse-

quently tilted from the horizontal, and if an attempt is made to dispose the container with the obstructed end down, the instability of the container will immediately warn the operator that such disposition is improper. The strips from which the brackets **38** are formed may be continued downwardly along the exterior face of rear wall **30**, and along the bottom wall **32** thereby substantially strengthening the container structure, and likewise providing skid portions **35** upon which the container may be slidably moved.

The means for supporting the tube carrying cradle within the container will now be described.

Adjacent the inner top and bottom ends of side walls **33** and **34** are inwardly projecting lugs adapted to receive the outer ends of spring clusters, as will appear. For convenience, and also to materially strengthen the walls, the said lugs are formed by welding lengths of channel sections **41** to the inner faces of walls **33** and **34**, in such manner that the flanges of the channel members extend horizontally inwardly. In the case of each channel member, its flange **41***a* nearest the adjacent end of the container is somewhat longer than flange **41***b*, this arrangement being especially adapted to the disposition of the suspension springs later to be described.

The cradle heretofore referred to by reference character **22** is constructed as follows. It comprises a body member consisting of a vertically extending back strip **43** of channel section, having rearwardly extending flanges **44**, as best seen in Figs. 4 and 5. Fixed near but spaced inwardly from its top and bottom ends are transverse strips extending in opposite directions from strip **43** and providing pairs of top arms **45**, **46** and bottom arms **47**, **48**. Towards their outer ends said arms **45**, **46**, **47** and **48** are inclined forwardly towards the open face of the box, the inclined portions on each side being connected and braced by vertically extending connecting strips **49** and **50** respectively.

The cradle thus formed is resiliently suspended at its four corners, represented by the respective tip ends of arms **45**, **46**, **47** and **48** by means of four spring cluster units which are fixed both to said tip ends and to adjacent points on the inturned flanges of channel members **41**. Since all four suspension points are similar in construction and arrangement, only one will be described, referring particularly to Figs. 1 and 2. Each spring cluster consists of three helical springs. Two springs **53** and **54** are hooked at their outer ends in spaced apertures **55** and **56** in flange **41***a* of the channel **41**. These two springs, for convenience herein termed load springs, are mounted so as to converge to a common suspension point in an aperture **57** in arm **45**. In Fig. 1, in each cluster, spring **53** is directly back of spring **54**. The third spring **58**, herein termed an equalizing spring, extends almost horizontally inwardly from an aperture **59** in flange **41***b* to an aperture **60** in arm **45**. As a result of the peripheral spacing of the four spring clusters, and the specific orientation of each cluster, it will be apparent that when the cradle is suspended as shown in Fig. 1, it is adapted to resist sudden shocks or rapid vibrations of any character, and from any direction, such as might be encountered in normal handling or shipping. The function of the suspension is, of course, to cushion such shocks and vibrations and to guard the cradle, and particularly the tube held therein, from coming in contact with the container walls, or from receiving sudden shocks.

The tube is resiliently gripped in the cradle in the following manner. Referring first to Figs. 3 and 4 the bottom end of the cradle is provided with an end cap **24** which is supported on a strap bracket **63** fixed to the lower end of the back strip and attached thereto by welding or otherwise, the end cap being welded between the opposed strap ends. The end cap structure is best seen in Figs. 4, 5, 11 and 12. The latter two figures show two possible positions of the cap assembly. The cap comprises an annular housing having an outer wall **64** which is reversely bent to provide an inner wall **65** spaced from the outer wall, and terminating in the transverse shoulder **66**. The cap **24** further comprises an annular reversible resilient cushion receptacle **26** of rubber or the like having a transverse annular web **68** and a pair of oppositely disposed cylindrical flanges **69** and **70** of unequal diameter. As shown in Fig. 12 flange **69** of the socket **26** is nested in the annular space between walls **64** and **65**; in Fig. 11 the receptacle has been removed and reversed so that flange **69** now lies along the free inner face of wall **64**. The receptacle is united, by vulcanization or otherwise, to a retaining ring **73** of shoulder contour, the ring being affixed to shoulder **66** by the screw and nut **74**. Reversal of the receptacle is readily accomplished simply by removing the screw and nut, turning the cushion with its ring **73** end for end, and replacing the screw and nut. The purpose of this reversal will immediately appear.

An X-ray tube of the type adapted to be carried in the present container and cradle is provided with a tubular body, having reduced end projections at its opposite ends, and insulators transversely disposed to the tube body between said ends. The end projections of one standard line of tubes nest snugly into the cushion receptacles **25** and **26**, and within flange **69**, when the socket is disposed as shown in Fig. 11. The smaller end projections of another widely used type of tube nest snugly in receptacles **25** and **26**, and within flange **70**, when the receptacle is disposed as shown in Fig. 12.

The arrangement of the resilient receptacle in the top cap **23** is identical with that shown and described with respect to the bottom cap **24**, the top receptacle being likewise reversible so that it need not be further described herein. Fig. 1 shows in broken line a tube of one type gripped between end caps in which the larger receptacle flange is inturned, whereas Fig. 10 shows the end cap and cradle assembly wherein the smaller receptacle flange is inturned, such reversal being necessitated by a variation in the cylindrical diameter of the end projections of the respective tubes as shown in broken line in Figs. 1 and 10.

To permit disposal of the tube in nested position between the end caps **23** and **24**, cap **23** (Figs. 1, 3 and 5) is pivotally carried on the top end of the back strip **43**. The strap **76** supporting cap **23** is swingable on an axis consisting of the pivot pin **77** which passes through strap **76** and upper end of the flanges **44** of strip **43**, and is retained by a cotter pin **78**. When inserting the tube for shipment the top cap is lifted, the tube is disposed in vertical position with its lower end resting in the bottom receptacle, and the upper cap **23** is then swung downwardly into contact with the upper tube end.

The caps are locked in tube gripping position by

a special locking lever now to be described, and shown in various aspects in Figs. 1, 3, 6, 7 and 8. The locking lever heretofore designated generally by reference character 28 comprises three articulated links 80, 81 and 82 respectively. Links 80 and 82 are pivoted at their inner ends to respective spaced pivots 83 and 84 on link 81. A latching clip 85 is affixed to the free end of link 81 beyond both pivots. The latching clip has a base portion 86 welded in lapped arrangement to link 81. The clip further has a flange 87 normal to base 86 and extending beyond the edge of link 81, and an outwardly curved extension 88. Overlying extension 88 is a finger tab 89 extending inwardly at 90 slightly beyond flange 87 and consequently overlying link 81. This projecting portion 90 serves as a detent member to hold link 80 in locked position as will appear. In the position shown in Fig. 8 the locking lever has been lengthened from the locked position of Figs. 1, 3 and 10 by extension of the toggle structure of the lever. This is accomplished, after release of the latching clip, by swinging link 81 in counter-clockwise fashion around pivot 83, thereby releasing the hooked end 93 of link 82 from a lug 94 on cap 23. The bottom end of the lever is pivotally fixed at 95 to cap 24, link 80 having a slot 96 which receives the pivot 95 and which facilitates manipulation of the lever.

To lock the lever the operation just described is reversed, the hook 93 being first inserted in lug 94. The end of link 81 carrying clip 85 is then swung clockwise around pivot 83 (Fig. 8). In engaging the latching clip with link 80 the clip must first swing under and past link 80 until said link 80 can snap inwardly under the detent projection 90 of the clip, such final position being shown in section in Fig. 6.

Link 80 carries a U-clip 97 one leg of the U being welded in lapped position to the link as shown for example in Fig. 7. The space between the legs of the clip 97 is wide enough to accommodate all three links when in register in the position shown in Fig. 7. When the lever is in locked position, for example as shown in Figs. 1, 3 and 10, it is braced against undesired yielding in one direction by clip 85 and in the opposite direction by clip 97. It will be evident that to achieve the position of Fig. 8 the latching clip 85 must first be released as hereinbefore described.

To adjust the locking lever, link 80 is provided with means for adjusting its effective length to avoid the possibility of objectionable play. Such means in the present embodiment consists of an adjustable screw 103 threaded in an aperture extending from the end of slot outwardly through the end of link 80. This screw adjusts link 80 relative to pivot 95. The position of the screw is fixed by nut 104.

Referring to Fig. 1, a pair of spaced bolt apertures 98 may be seen extending through each of arms 45 and 47, slightly to the left of the position of the back strip 43. These are adapted to receive the bolts 99 when it becomes desirable to move the arm assembly laterally from the position shown in Fig. 1 to the position shown in Fig. 10. Such change is made when changing tube types as hereinabove mentioned. It permits the tube insulators to be disposed in an opposite direction, thus permitting the use of a narrower container than if the arms were fixed in an unchangeable position.

In Figs. 3 and 10 there is shown a pair of resilient bumpers 100 carried on a cross piece 101 attached to the back strip by means of the double

nut assembly 102, such nut assembly being adapted to be raised or lowered to change the height of the bumpers so as to make suitable contact with the rear mounting plate of any of the several types of tubes disposed in the cradle.

The operation of the device will be obvious from a consideration of the structure already described. As hereinbefore indicated the particular embodiment disclosed is adapted for the transportation of X-ray tubes of two general types. With slight modification, apparent to those skilled in the art from a consideration of the present structure, the device can accommodate tubes of other structural characteristics.

Having determined the type of tube which is to be shipped, the resilient bumpers 100 and the end receptacles 25 and 26 are adjusted as heretofore described, the tube is held with its anode end down, its bottom end portion is nested in the lower receptacle, the rear mounting plate of the tube is pushed backwardly against the bumpers, and the top cap is swung downwardly to contact with the top end of the tube. The locking lever is finally engaged and locked, the door is closed, and the container is ready for shipment.

What we claim is:

1. A tube-carrying cradle adapted to hold an X-ray tube, and to be resiliently suspended in a shipping container, said cradle comprising tube supporting means, a pair of end caps attached at spaced points on said tube supporting means, a cushion receptacle disposed in each end cap, said receptacles being adapted to receive respectively opposed ends of said tube, and articulated lever means for maintaining said end caps in tube-gripping position.

2. A tube-carrying cradle adapted to hold an X-ray tube, and to be resiliently suspended in a shipping container, said cradle comprising tube supporting means, a pair of end caps attached at spaced points on said tube supporting means, a cushion receptacle disposed in each end cap, said receptacles being adapted to receive respectively opposed ends of said tube, and articulated lever means for maintaining said end caps in tube-gripping position, each said receptacle having a nested depression in each of two opposed faces, each said receptacle being likewise reversibly secured in its respective cap whereby to accommodate more than one type of tube end.

3. A tube-carrying cradle adapted to hold an X-ray tube, and to be resiliently suspended in a shipping container, said cradle comprising tube supporting means, a pair of end caps attached at spaced points on said tube supporting means, a cushion receptacle disposed in each end cap, said receptacles being adapted to receive respectively opposed ends of said tube, and articulated lever means for maintaining said end caps in tube-gripping position, one of said end caps being pivotally attached to said tube supporting means to permit insertion of the tube between said caps and subsequent relative gripping movement between said caps.

4. A tube-carrying cradle adapted to hold an X-ray tube, and to be resiliently suspended in a shipping container, said cradle comprising tube supporting means, a pair of end caps attached at spaced points on said tube supporting means, a cushion receptacle disposed in each end cap, said receptacles being adapted to receive respectively opposed ends of said tube, and articulated lever means for maintaining said end caps in tube-gripping position, said articulated lever means consisting of three links mutually pivotally

connected in tandem, the two outer links having their inner ends carried on spaced pivots on the intermediate link, the effective length of said lever being changeable by swinging movement of said intermediate link on said pivots.

5. In a shipping container of the character described wherein an X-ray tube is gripped between end-retaining members of cushion-like character in a cradle resiliently suspended in the container, articulated locking lever means for holding said end-retaining members, said lever means consisting of three links mutually pivotally connected in tandem, the two outer links having their inner ends carried on spaced pivots on the intermediate link, the effective length of said lever being changeable by swinging movement of said intermediate link around said pivots, one said outer link being pivotally connected at its free end to one of said end-retaining members, the other said outer link being releasably attachable at its free end to the other of said end-retaining members.

6. A tube-carrying cradle adapted to hold an X-ray tube, and to be resiliently suspended in a shipping container, said cradle comprising a body, a pair of arms extending transversely in opposed directions at each end of said body and adapted to be attached to resilient suspension means, a pair of cushioned tube-supporting receptacles disposed one adjacent each end of said body, and adapted to receive respectively opposed ends of said tube, lever locking means for maintaining said receptacles in tube-gripping position, and resilient bumper means fixed at an intermediate position on said body, and adapted to support an intermediate portion of said tube.

7. A tube-carrying cradle adapted to hold an X-ray tube, and to be resiliently suspended in a shipping container, said cradle comprising a body, a pair of arms extending transversely in opposed directions at each end of said body and adapted to be attached to resilient suspension means, a pair of cushioned tube-supporting receptacles disposed one adjacent each end of said body, and adapted to receive respectively opposed ends of said tube, lever locking means for maintaining said receptacles in tube-gripping position, and resilient bumper means fixed at an intermediate

position on said body, and adapted to support an intermediate portion of said tube, each of said receptacles being provided with a plurality of tube end receiving nests of different diameters to accommodate different types of tube.

8. A shock-proof shipping container for transporting an X-ray tube, comprising an outer box, a tube-carrying cradle within and spaced from said box, means on said cradle for resiliently gripping the opposite ends of said tube to hold the latter in vertical position, said cradle being substantially rigid with said tube gripped therein, two clusters of springs connected with said cradle at upper points respectively on opposite sides of said tube, each of said clusters including two springs extending upwardly and respectively forwardly and rearwardly, each said cluster including a spring extending laterally away from said cradle, two clusters of springs connected with said cradle at lower points respectively on opposite sides of said tube, each of said last named clusters including two springs extending downwardly and respectively forwardly and rearwardly, each of said last named clusters including a spring extending laterally away from said cradle, and all of said springs being secured to the walls of said box so that all of said springs are held in tension.

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