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Tomita et al.

[11] **3,884,818**

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[54] **FILM CASSETTE FOR RADIOGRAPHIC APPARATUS**

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[73] Assignee: **Hitachi Medical Corporation,** Tokyo, Japan

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[52] **U.S. Cl.** **250/480;** 250/481

[51] **Int. Cl.** **G03b 41/16**

[58] **Field of Search** 250/480, 481

[56] **References Cited**

UNITED STATES PATENTS

2,371,843	3/1945	Powers	250/480
2,878,389	3/1959	Raffman	250/481
3,412,244	11/1968	Sherwood	250/480

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Assistant Examiner—C. E. Church
Attorney, Agent, or Firm—Wenderoth, Lind & Ponack

[57] **ABSTRACT**

A film cassette for radiographic apparatus comprising: an upper lid, a lower lid, a packing fixed to one surface of said lower lid at marginal portions thereof, a space defined by one surface of each of said lids and by the proximal peripheral surface of said packing for containing therein a film and intensifying screens, and a valve means provided on the lower lid for rendering said space communicative with external atmosphere and for sealing said space from external atmosphere. Such a cassette ensures tight adherency between the film and the intensifying screens uniformly throughout the entire portions of them as said space is rendered substantially vacuous by discharging air from said space through said valve means. Thus, the cassette can be provided in a very thin structure, thereby enabling a number of cassettes to be set in a small size chamber in the radiographic apparatus. Moreover, such a cassette provides a greatly enhanced convenience in its handling, and reduces its manufacturing cost remarkably.

8 Claims, 11 Drawing Figures

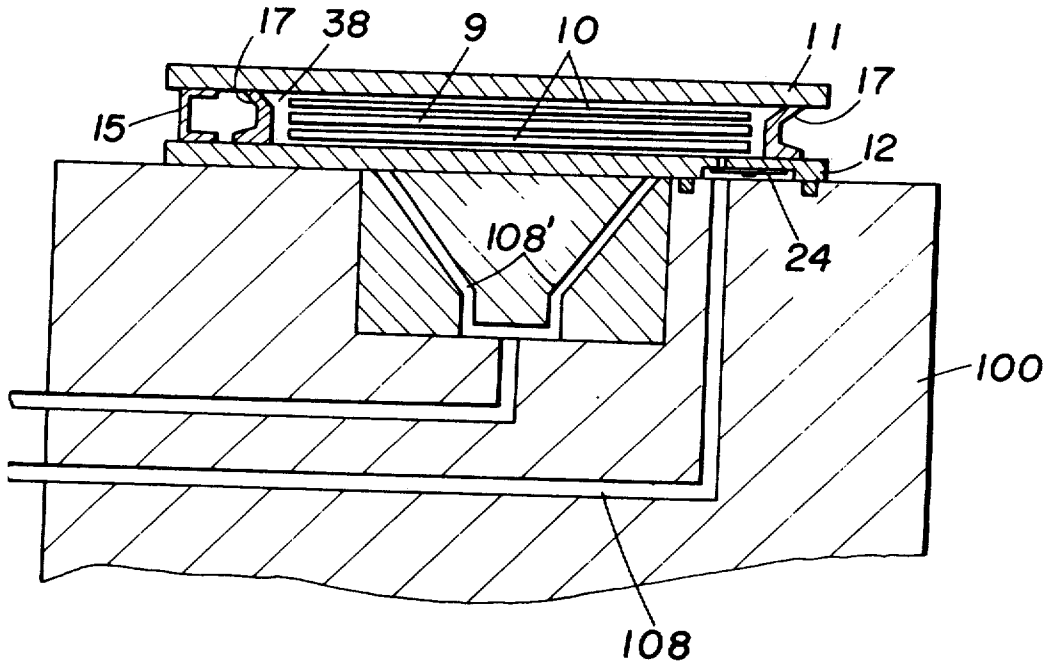


FIG. 1

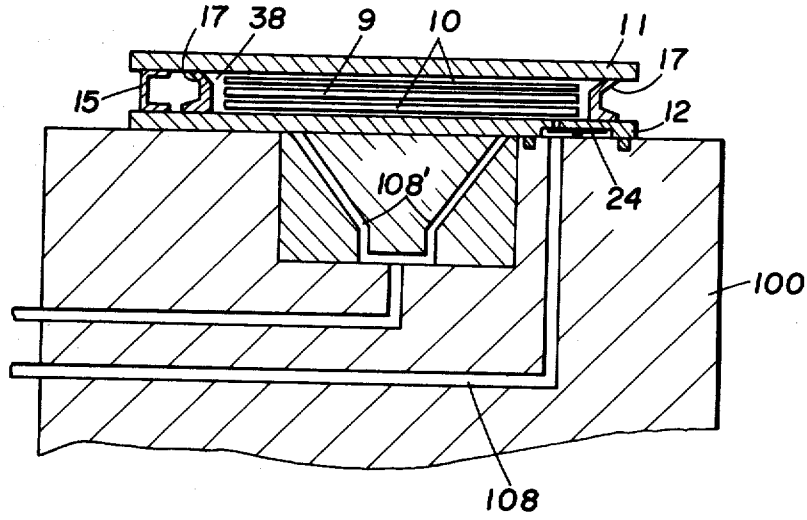

17
38
9
10
11
17
15
12
108'
24
100
108

FIG. 6

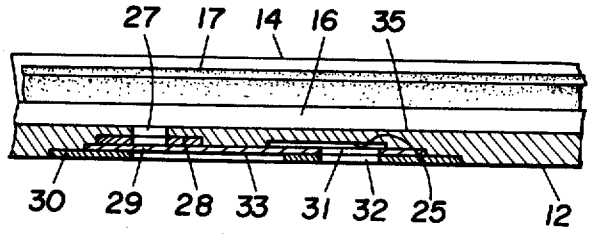

27
17
14
16
35
30
29
28
33
31
32
25
12

FIG. 2

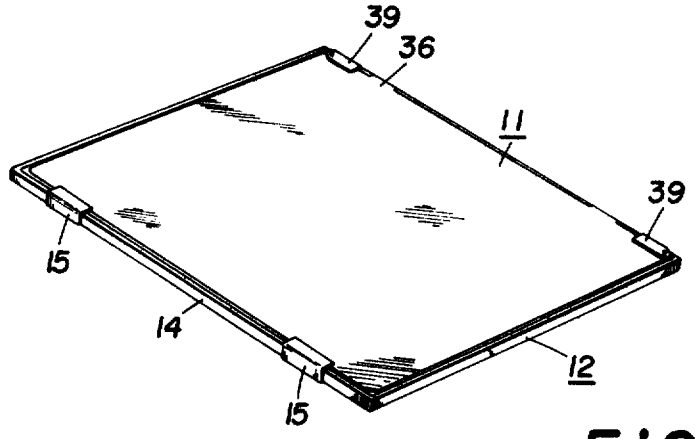


FIG. 4

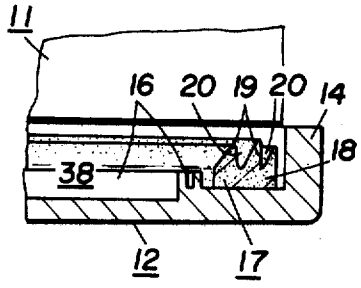


FIG. 3

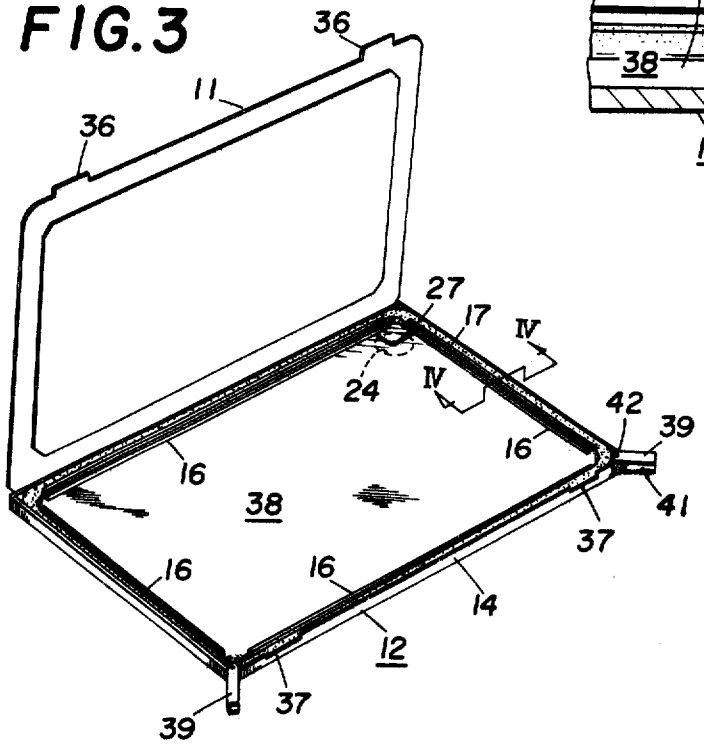


FIG.5

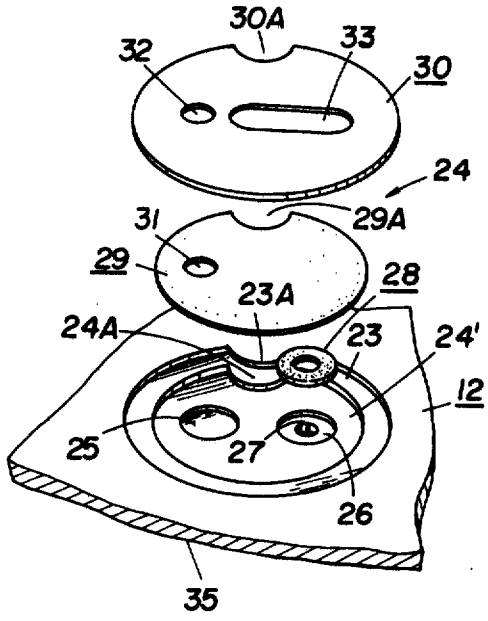

30A
33
32
30
24
29A
31
29
28
23A
24A
23
24'
12
25
27
26
35

FIG.8

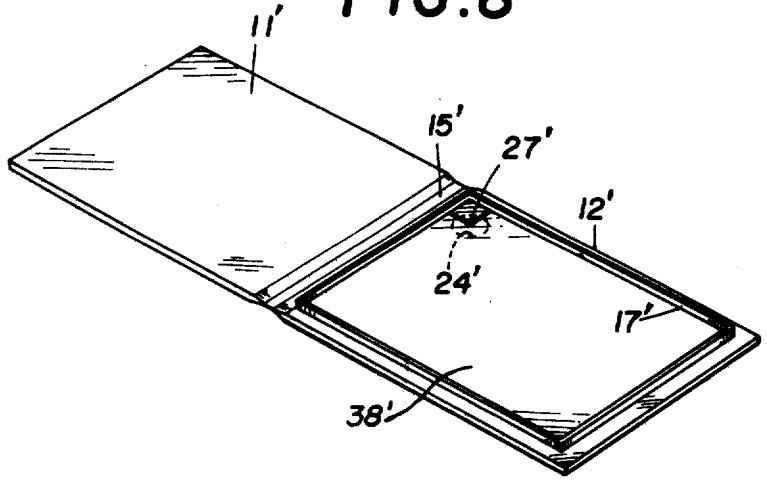

11'
15'
27'
12'
24'
17'
38'

FIG. 7A

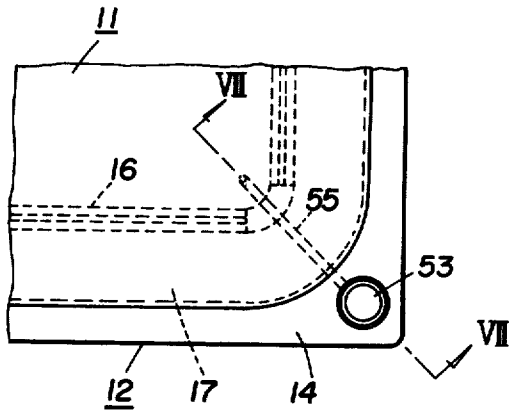


FIG. 7B

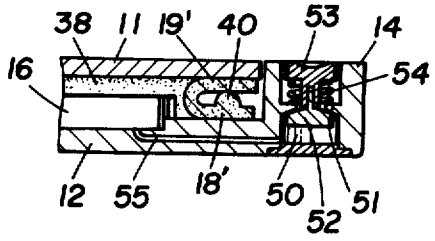


FIG.9

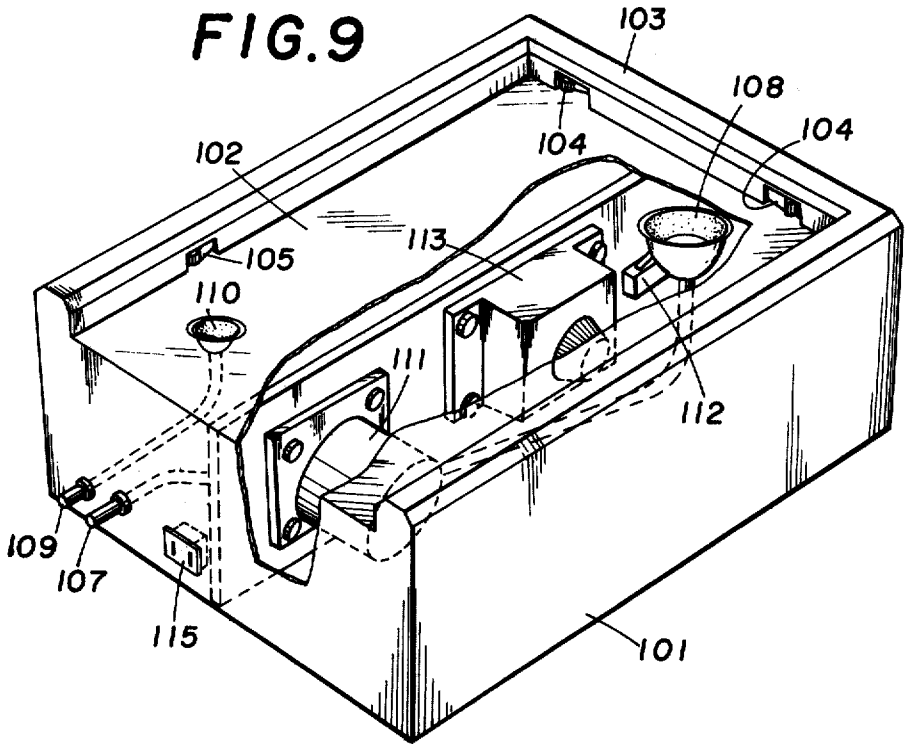
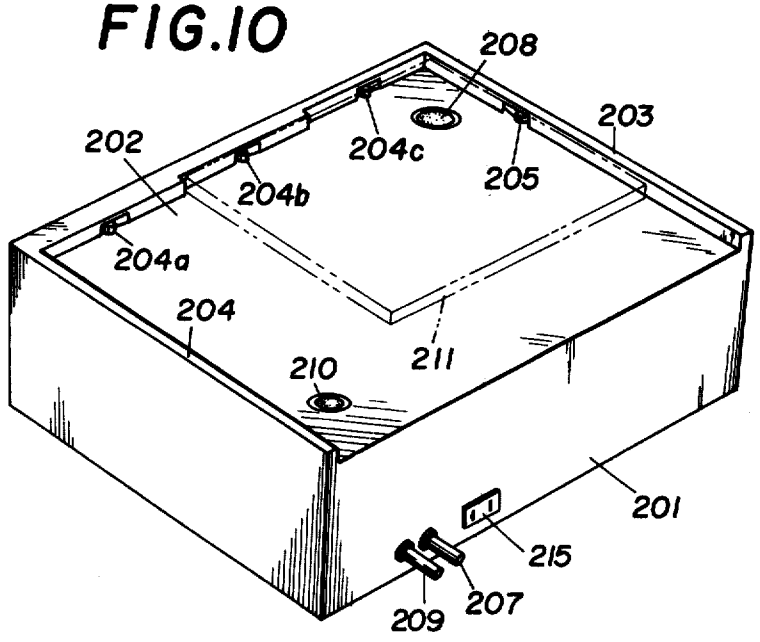

103
108
104
104
102
113
105
110
111
112
109
107
115
101

FIG.10


208
203
202
204c
205
204b
204a
204
211
210
201
215
209
207

FILM CASSETTE FOR RADIOGRAPHIC APPARATUS

BACKGROUND OF THE INVENTION

1. Field of the invention

The present invention is concerned with a film cassette for radiographic apparatus, and more particularly, it relates to a film holder for use in, for example, roentgenographic apparatus, which is arranged so that its inner space for holding a film and intensifying screens is rendered vacuous to secure an improved state of contact between the film and the intensifying screens.

2. Description of the prior art

In order to protect X-ray operators from being exposed to radiation hazards, there are being widely used roentgenographic apparatus arranged to be operative in such a way that a plurality of pre-set X-ray film holders are pulled out one after another from the non-photographing position to the photographing position, through means for operation at a distance in a so-called remote control fashion, for the purpose of exposure and so that the holder having been subjected to exposure is returned to its initial non-photographing position to allow a subsequent cassette to advance to the photographing position, while the object to be photographed is being watched on a television screen.

Conventional film holders as described above which are conveniently called "cassettes" for use in X-ray apparatus comprise a box and a platelike lid. In operation, an X-ray film sandwiched between two sheets of intensifying screens is placed in this box. Then, the lid plate is placed onto the box to cover the film entirely therebeneath. This lid is then secured to the box by an appropriate fastening means. Such a conventional film holder is arranged so that the film and the intensifying screens may be placed in tight contact with each other by the pressure of the applied lid plate. It has been experienced by the operators, however, that there is always a considerable difficulty in establishing a uniform tight contact between the entire surfaces of the X-ray film and the intensifying screens and that, accordingly, portions of uneven contact develop which do not give a satisfactorily clear image of the photographed object at such portions. This results in difficulty in making an adequate and accurate evaluation of the specific portion or portions of the object requiring examination.

There has been also proposed another type of film cassette or film holder arranged so that the film sandwiched between intensifying screens is contained and sealed in an air-evacuated bag made of a vinyl material. This type of film cassette may be said almost satisfactory in terms of tightness of contact between the film and the intensifying screens and of its compactness. However, such film cassette requires quite a large device for the exclusive use in performing air-evacuation and sealing of the container bag. Furthermore, it is troublesome and is pretty difficult to put the film and screens in place in the bag. In addition, there is one fear that the film may be damaged during the operation of placing the contents in the bag. The bag is used only once, which is uneconomical. Morover, those bags which have been used must be disposed of in some way or other. Thus, the film holders and the film cassettes of the prior art have many drawbacks and inconveniences.

SUMMARY OF THE INVENTION

It is, therefore, a main object of the present invention to provide a film-holding cassette for use in X-ray apparatus, which has a vacuum inner space for containing an X-ray film sandwiched between intensifying screens and which itself is of a very small thickness to enable a relatively large number of cassettes to be accommodated in a relatively small space.

Another object of the present invention is to provide a cassette of the type described, which permits easy loading and unloading of the film and the intensifying screens in a relatively short time and which is convenient to handle.

Still another object of the present invention is to provide a cassette of the type described, which is simple in structure and can be fabricated at a low cost.

These and other objects as well as the advantages and features of the present invention will become apparent by reading the following detailed description of the preferred embodiments when taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an explanatory illustration, in sectional view and partly broken away, of the essential portion of the film cassette according to the present invention, to give the general conception of the arrangement of the cassette and a suction device therefor.

FIGS. 2 to 6 show an embodiment of the present invention in which: FIG. 2 is a perspective view of the film cassette as a whole; FIG. 3 is a perspective view, showing the state where the upper plate-like lid of the cassette is opened; FIG. 4 is a sectional view taken along the line IV — IV in FIG. 3, showing, on an enlarged scale, the edge portion of a lower lid of the cassette and also showing a packing inserted; FIG. 5 is an exploded view of a valve means of the cassette, showing in perspective the component members of the valve means; and FIG. 6 is a vertical sectional view of the valve means in its assembled state.

FIGS. 7A and 7B show a modified example of the film cassette embodying the present invention in which: FIG. 7A is a plan view of a corner of the cassette; and FIG. 7B is a vertical sectional view taken along the line VII — VII in FIG. 7A.

FIG. 8 is a perspective view of a further embodiment of the cassette according to the present invention, showing the upper lid in its opened state.

FIG. 9 shows, in perspective, an example of the suction device for use with the film cassette of the present invention, with parts broken away.

FIG. 10 is a perspective view of a modified example of the suction device.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring first to FIG. 1, which is intended to give the general conception of the arrangement of the film cassette according to the present invention and its suction device, this arrangement will hereunder be discussed in detail. In FIG. 1, upper and lower plate-like lids 11 and 12 are both made of opaque materials such as a synthetic resin. These lids 11 and 12 are provided with hinges 15 on one of their edges, respectively, in such a way that the upper lid 11 is adapted to open relative to the lower lid 12 about these hinges 15. The hinges are

made of an elastic material such as rubber and arranged to allow the lids **11** and **12** not only to pivot thereabout but also to move, though slightly, in opposite directions away from each other due to the elasticity of the hinges, when these lids are placed one upon the other. An elastic member **17**, intended for airtight sealing, is made of an elastic material and disposed along the marginal portion on the inner surface of one of said upper and lower lids **11** and **12** to constitute an airtight sealed box, when the lids are in the closed positions, in cooperation with the upper and lower lids **11** and **12**. In FIG. **1**, this elastic airtight-sealing member **17** is secured to the inner surface of the lower end **12**. That portion of its member **17** which is brought into contact with the upper lid **11** is made in a skirt-like fashion throughout the length thereof. Film **9** is sandwiched between two intensifying screens **10** and the film and screens are placed in space **38** defined by said box which is constituted by the upper and lower lids and said sealing member. In this cassette shown in FIG. **1**, the intensifying screens **10** may be prepared independently of the lids so that they may be inserted in said space **38** together with the film **9** at the same time. Alternatively, the inner surfaces of the upper and lower lids **11** and **12** may be subjected to a treatment to give them an intensifying property. Still alternatively, the intensifying screens prepared separately from the lids may be securely applied to the inner surfaces of the lids **11** and **12**. At an appropriate site of the lower lid **12** is provided a valve means **24** which serves to close, from the external atmosphere, the space **38** intended for containing both the film and the intensifying screens and also to render this space **38** communicative with the external atmosphere, as required.

In case it is intended to set a film in the cassette described above, there is used a support block **100** like the one as shown in FIG. **1**. This support block is of a flat surface and has a plurality of air-channels **108'** which communicate with a vacuum pump (not shown). Another air-channel **108** is provided in this support block **100**. This air-channel **108** is also connected to a vacuum pump (not shown). The outlet opening of this air-channel **108**, located at the flat surface of the block **100**, is surrounded by a gasket as illustrated. Such a support block **100** is placed in a dark room. On the flat upper surface of this block **100** is placed the lower lid **12** of the cassette in such a way that the valve means **24** is superposed on the gasket surrounding the opening of the air-channel **108**. Then, the vacuum pump (not shown) which communicates with the air-channel **108'** is operated to cause the lower lid **12** to be brought into tight contact with the flat upper surface of the support block **100** to thereby establish a perfect contact plane between the two. Thereafter, the upper lid **11** is held in its open state relative to the lower lid **12**. Under this condition, a film which is sandwiched between two intensifying screens is inserted in the space defined by the elastic sealing members **17**, followed by closure of the upper lid **11** while paying attention so that this lid **11** is in tight contact with the sealing members **17**. Thereafter, the vacuum pump communicating with the air-channel **108** is operated. Upon activation thereof, the air contained in the space defined by the upper lid **11**, the lower lid **12** and the elastic sealing member **17** is exhausted via the valve means **24**. Thus, the upper lid **11** is attracted toward the lower lid **12** by virtue of the suction force produced by the pump. As a result, the film is brought into perfect contact with the intensifying screens. In case of the cassette shown in FIG. **1** which is intended to give a general concept of the invention, the suction device is comprised of the support block having the aforesaid air-channels connected to vacuum pumps. It will be understood that the state of contact between the upper and lower lids **11** and **12** can be improved further by applying to the inner surfaces of the lids **11** and **12**, an X-ray transmissible supple material, not shown, such as foamed polyurethane sheets which are each of an area substantially identical with that of the intensifying screens and also the foamed sheets are each of an appropriate thickness. After the air contained in the space has been exhausted to a predetermined degree, the action of the vacuum pump is stopped. The lower lid **12** can then be easily removed from the flat upper surface of the block **100** of the suction device. However, no external air is allowed, owing to the valve means **24**, to enter into the space in which the film **9** and the intensifying screens **10** are contained. Thus, the vacuous state of the interior of the cassette can be maintained at a constant level, and accordingly the upper and lower lids **11** and **12** are attracted tightly toward each other without requiring any external force. The cassette in which the film **9** and the intensifying screens **10** have been contained in the manner as stated above is then set on the X-ray apparatus ready for a roentgenographic operation conducted in a conventional manner. Following this photographing operation, air is supplied through the valve means **24** into that space **38** in which the film **9** and sheets **10** are still located. This air supply operation is performed in a dark room. The upper lid **11** returns to a state in which it can be easily detached from the lower lid **12**, and the film **9** can thus be taken out freely. The film **9** which is taken out from the cassette is then subjected to the developing process. The resulting empty cassette is again supplied with a fresh film and intensifying screens in the manner as stated above to be ready for the next radiographic operation.

FIGS. **2** to **6** show an embodiment of the cassette according to the present invention.

In this embodiment, the upper and lower plate-like lids **11** and **12** employed are made of an opaque synthetic resinous material. The lower lid **12** is provided, at the peripheral edges of its inner surface, with a wall **14** surrounding the sides of the lower lid **12** to form an open-top box shape. The upper lid **11** has such a dimension that it snugly fits inside said surrounding wall **14**, so that the upper lid **11** can be fittingly received in the box shape structure. This arrangement prevents casual opening of the upper lid **11** relative to the lower lid **12** when, for example, the upper lid **11** hits some obstacle. These upper and lower lids **11** and **12** are connected to each other at one of their edges by hinge means **15**. The upper lid **11** is adapted to pivot about these hinge means **15**. each hinge means **15** is made with a piece of a synthetic resinous sheet, one side of which is coated with an adhesive. Substantially one half of this piece of sheet is bonded to the outer surface of the upper lid **11** and substantially other one half of this piece of sheet is bonded to the outer surface of the wall **14** and also to the outer surface of the lower lid **12** to function as a hinge **15**. The upper lid **11** is provided with spaced lugs **36** projecting therefrom at the edge of that side opposite to the side which carries the hinge means **15**. The wall **14** of the lower lid **12** is provided

with spaced cut-outs 37 at sites corresponding to the positions of said lugs 36 of the upper lid 11. These lugs 36 and cut-outs 37 cooperate together, when they are engaged, to position the upper lid 11 at a predetermined location when they are thus closed and also to limit to a given constant level, the amount of the compression or collapse rate of a packing 17 which will hereunder be explained in detail.

Four pairs of guide means comprising ridges 16, more specifically each pair of which is comprised of two straight rows of guide ridges, are arranged on the four sides of the inner surface of the lower lid 12 in a parallel and proximally spaced relationship with the wall 14 of the lower lid 12. A strip of packing 17 is fixed to the surface of the lower lid 12, in a fitted mode, in the space defined by the outer one of the guide ridges 16 and the wall 14. The inner surfaces of the upper and lower lids 11 and 12 and the surface of the packing 17 cooperatively constitute the space 38 for containing both the film 9 and the intensifying screens 10. When the upper lid 11 is closed onto the lower lid 12, the packing 17 is pressed by the inner surface of the upper lid against the lower lid to thereby perfectly seal the space 38 from the external atmosphere.

The packing 17 is made of rubber and its surface has, as shown in FIG. 4, a plurality of indentations 19, forming projections which project upwardly toward the inner surface of the upper lid 11. Between each two of the projections, there is formed a recessed groove 20. Each projection 19 has a substantially right-angled triangular cross section. The projections are compressed by the inner surface of the upper lid 11 when the latter is closed, and thus the space 38 is sealed off from the external atmosphere. It should be noted that the respective indentations 19 are formed in such a way that the hypotenuse of each of the substantially right-angled triangles is positioned to face the space 38 so that all of the projections of the indentations are always coercively kept in their outwardly fallen postures whenever the upper lid 11 is closed onto the packing 17. Such packing 17 has the advantage that in case there are small pieces of film-protective paper or other small foreign pieces or dust, sticking to the packing 17 they can and tend to drop into said recessed grooves 20 of the indentations 19. Therefore, it is easy to clean the surface of the packing 17 because of the above-stated structure thereof, and even in case such foreign bodies fail to drop into the grooves, it is still possible to obtain perfect sealing of the space 38 due to the above-described behavior of the aforesaid unique-structured packing 17. It should be noted that a packing designed as above for the aforesaid purposes not only must possess its inherent ability as a packing, but also it must function to maintain the vacuum state inside the cassette. To this end, the aforesaid packing 17 is preferably made with nitrile rubber.

In this cassette, considerations are given to the imparting of uniform fastening load onto the packing and also to the prevention of spontaneous or casual opening of the upper lid during use of the cassette. To these ends, there is provided an arrangement so that the upper lid 11 can be securely anchored to the lower lid 12 by two engaging means 39. The engaging means 39 are provided on the lower lid 12 at that side thereof opposite to the side on which hinge means 15 are provided. As is best seen in FIG. 3, these engaging means 39 each is of a bifurcated hollow cross section. Its bifurcated portion 41 on one side thereof receives a corner edge of the lower lid 12 where it is pivotally secured by a pin 42. The upper lid 11, on the other hand, has two of its corners — corresponding to the positions of the pins 42 — cut-out in semi-circular shape to avoid these pins. These engaging means 39 can be rotated freely about their pins 42, thereby receiving, in the other open end of the bifurcated portion, both the upper and lower lids together — when these two are in the closed positions. Thus, these two lids can be clamped together by the engaging means.

Rendering the aforesaid space 38 vacuous or the exhausting of air from this space 38 in which are to be contained the film 9 and the intensifying screens 10 is effected through the valve means 24 which is provided on the lower lid 12. As shown in FIGS. 5 and 6, this valve means 24 is arranged so that it is received within the thickness of the lower lid 12 so as not to protrude from either one of the inner and outer surfaces of the lid 12. FIG. 5 shows an exploded view of the valve means 24 as seen from the outer side of the lower lid 12. The outer surface of the lower lid 12 has a recessed portion including a first shallow recess 23 for receiving a pressing plate 30 of the valve means 24. Within this pressing plate-receiving recess 23 of the lower lid 12 is formed a second recess 24' for receiving a valve plate 29. This second recess 24', in turn, is provided with a channel outlet 25 and with a depression 26 for receiving a valve seat 28. This valve seat-receiving depression 26 has, therein, a through-hole 27 extending to the inner surface of the lower lid 12 and accordingly communicating with the space 38. The valve seat 28 and the valve plate 29, both made of rubber, are fitted in the valve seat-receiving depression 26 and also in the valve plate-receiving recess 24', respectively. The pressing plate 30 which is fittedly received in the first shallow recess 23 functions to position and fix said valve seat 28 and the valve plate 29 in place. The valve seat 28 is bored to have a hole corresponding to said through-hole 27, these two holes being sealed by the valve plate 29 which tightly contacts the valve seat 28. The valve plate 29 is also bored to have a hole 31 at the position corresponding to that of the channel outlet 25. The pressing plate 30 is provided with a hole 32 capable of communicating with the hole 31 of the valve plate 29 and also provided with an elongated slot 33 capable of communicating with both the channel outlet 25 and the through-hole 27. In this arrangement of the valve means 24, the application of vacuum through the hole 32 and the slot 33 of the pressing plate 30 will cause the air contained in the space 38 for the film and intensifying screens to enter into the through-hole 27, thereby releasing the valve plate 29 from the valve seat 28 to provide a gap therebetween. The air is allowed to pass through this gap formed between the valve plate and the valve seat to enter into the channel outlet 25 and is discharged through the respective holes 31 and 32 of the valve plate 29 and the pressing plate 30. When the application of vacuum to the hole 32 and the slot 33 of the pressing plate 29 has been accomplished, the atmospheric pressure applied through the slot 33 of the pressing plate 30 will urge the valve plate 29 toward the valve seat 28 and will close the throughhole 27. At the same time, the lower lid 12 is urged toward the packing 17 due to the vacuum produced in the space 38, and thus this vacuous state in said space 38 can be maintained. In case there is a need to change this vacu-

ous state in the space 38 to an air-filled state, it is only necessary to force pressurized air to pass through the hole 32 of the pressing plate 30 and the hole 31 of the valve plate 29 into the channel outlet 25. The attendent rise in pressure in the channel outlet 25 will act to release the valve plate 29 from the valve seat 28, so that the pressurized air is allowed to pass through the through-hole 27 into the space 38, and thus the vacuous state of the cassette will be broken. In order to position the valve seat and the valve plate exactly in place, the pressing plate-receiving recess 23 and the valve plate-receiving recess 24' are provided with engaging portions 23A and 24A, respectively, and also the valve plate 29 and the pressing plate 30 are cut-out to provide guide portions 29A and 30A, respectively. These engaging portions 23A and 24A are complementary in shape with guide portions 30A and 29A, respectively.

The air contained in the film-and-intensifying-screen carrying space of the cassette described above can be exhausted by the use of the suction device as shown in FIG. 1. However, this vacuum producing operation can be effected more easily and rapidly by the use of the modified suction device shown in FIG. 9. Referring to this Figure, a support block 101 has a flat top surface 102 for receiving the cassette as a whole. Along the top edges of three sides of the receiving surface 102 are provided a continuous guide 103 which defines a space inside the guide. This space has an area whose dimensions are such that the cassette can be moved sideways to a substantial amount inside this space. This guide 103 is provided with limit switches 104 and 105 which are actuated only when the cassette bears against the guide 103. Throughout the actuation of these limit switches, a vacuum pump is kept driven. Said receiving surface 102 is provided with a suction outlet 108 which is connected via a piping 107 to the vacuum side of the vacuum pump. The receiving surface 102 is also provided with an air-supply opening 110 which, in turn, is connected via a piping 109 on the pressure side to the pressure side of the vacuum pump. At an intermediate portion of the piping 107, there is provided a vacuum valve 111 which is arranged to break the vacuous state produced in the piping on the vacuum side. The suction outlet 108 is arranged so that it can move vertically, and so that the peripheral end portion of this outlet will project only slightly beyond the receiving surface 102 when this suction outlet is in its lowermost position. Moreover, it is arranged so that as this suction outlet 108 is elevated, the limit switch 112, which is provided just behind the suction outlet 108, is actuated. A time switch 113 is provided as shown, and it is started by the activation of the limit switch 112. After the lapse of a predetermined time, the vacuum valve 111 is energized by said time switch 113. A connector 115 for the connection of this suction device with an actuator switch of the vacuum pump is provided to control this actuator switch by means of the limit switches 104 and 105. In order to evacuate the air contained in the cassette by the use of this suction device shown in FIG. 9, the cassette is placed on the receiving surface 102 in such a way that the portion carrying the hole 32 and slot 33 of the valve means 24 is positioned on the suction outlet 108 on the vacuum side. Then this cassette is pushed to the corners of the receiving surface 102. The limit switch 105 is thereupon operated to drive the vacuum pump. Accordingly, the interiors of the hole 32 and slot 33 are rendered vacuous, and thus the air contained in the space 38 is exhausted progressively. After this space is made vacuous to a certain extent, the interior of the suction outlet 108 is rendered vacuous also, so that the edge portion of the suction device becomes deformed and sucked toward the cassette placed on the receiving surface 102. Then, the limit switch 112 is actuated to drive the time switch 113. At the end of the lapse of a predetermined time the time switch sets the vacuum valve 111 in motion to break the vacuous state produced in the piping 107 on the vacuum side. As a result, the suction power in the opening 108 is lowered, and thus the cassette can be removed easily. Upon removal of the cassette from the suction device, the limit switch 105 returns to its initial position to stop the motion of the vacuum pump. In order to break the vacuous state of the space 38, that region of the pressing plate containing the hole 32 is placed, in register, onto that region of the suction device containing the compressed air supply opening 110, and then the cassette is pushed toward the guide. This activates, the limit switches 104 and 104 and the vacuum pump is driven to supply air through the compressed air supply opening 110 into the space 38. Thus, the vacuous state is broken. When the vacuous state of the cassette has been broken in this way, the cassette is removed from the receiving surface 102. The suction device described above can effect the evacuation and supply of air from and to the cassette by a very simple procedure of directing the valve portion of the cassette toward the predetermined position and by pushing the cassette toward the corner portion of the suction device. Accordingly, the suction device, having a very compact size and simple structure can effect the control of both suction and supply of air.

By the use of a suction device of this kind, dozens of cassette are successively evacuated of air before photographic operation and supplied with air after the photography is over. Thus, the efficiency of operation can be greatly enhanced.

However, it is difficult to evacuate air from many cassettes of various different sizes to an invariably equal level of vacuum by the use of the above mentioned suction device. Also, it is known that the pressure inside the cassette need not be kept at a lowest possible level; that no hazards occur so long as this pressure is kept below a predetermined level. Based on these facts, a method can be adopted, which is to perform the evacuating operation for a certain constant length of time for all operations. However, if this method is to be adopted, the length of suction will have to be determined in accordance with the amount of air contained in the largest cassettes. This will mean that after all, the air contained in smaller size cassettes will be discharged to a greater degree than necessary, and thus there will arise a waste of suction time, which is not desirable from the viewpoint of efficiency of operation.

The suction device shown in FIG. 10 is designed so as to make adjustments of operating time in accordance with the size of the cassette to provide maximum uniformity in the pressure within the space in the cassette irrespective of its size, thereby contributing to the enhancement of the film-loading efficiency.

In this suction device of FIG. 10, a main block 201 has a flat receiving-surface 202. Along three of the four side edges of the receiving surface 202 is provided a guide 203. One side wall of this guide 203 is formed to have several stepped portions. On these stepped por-

tions, limit switches **204***a*, **204***b* and **204***c* are provided, one for each stepped portion. Another limit switch **205** is provided on a wall of the guide **203** other than said stepped wall. Also, in a similar way as stated in connection with the preceding example of suction device, a receiving surface **202** of the block **201** is provided with an air-suction opening **208** and an air supply opening **210** which are connected to a vacuum pump via connecting pipes **207** and **209**, respectively. In the block **201** is provided a time switch which operates in association with the limit switches which, in turn, are actuated interlockingly with the air-suction opening **208**.

Let us now assume that it is intended to evacuate air from cassettes which are same in thickness but different in both length and breadth. One such cassette is shown by two-dots-lines at **211**. This cassette **211** is placed on the receiving surface **202** of the block **201** in such a way as to position the valve means of this cassette close to the air-suction opening **208**. Then, the cassette is pushed toward those walls of the guide **203** carrying the limit switches. These limit switches **204***b* and **205** are accordingly, actuated to drive the vacuum pump thereby exhausting air from the space in the cassette **211**. When a cassette having a size different from the cassette **211** is to be evacuated, another pair of switches **204***a* and **205**, or **204***c* and **205** will be actuated depending on the size of the cassette to drive the vacuum pump via the time switch in a like manner to that stated above. Thus, a desired equal level of vacuum is obtained in cassettes of various sizes.

FIGS. 7A and 7B show a modification of the cassette according to the present invention. The cassette shown in these Figures is different from that stated above in that it has a different type of packing and that it is arranged so that the vacuous state in the space in the cassette can be broken without the aid of a suction device. The packing employed in this cassette has base portion **18'** fixed to the lower lid **12**, a projection **40** extending from this base portion **18'**, and a flexible lip portion **19'** which extends first inwardly from the base portion **18'** toward the space and then turns outwardly away from said space. The flexible lip portion of this packing has a length extending outwardly beyond said projection **40**. The packing of such structure is used such that, when the space is to be sealed off from the external atmosphere, the lip **19'** is positioned on top of the projection **40** and the upper lid **11** is superposed on this lip **19'**. As the air contained in the space **38** is exhausted pregressively, the inner surface of the upper lid **11** is progressively pressed against the lip portion **19'** by virtue of the external atmospheric pressure. With the increase in the vacuum level in the space **38**, the lip portion **19'** is, as shown, pressed more tightly against the projection **40** to seal the space **38** more intensively.

This cassette is further provided with a release means which operates so that the film and the intensifying screens can be removed from the cassette after the photographing operation without the use of an air-discharging device. As shown in FIG. 7A, this release means is arranged on the wall **14** of the lower lid **12** at one corner of this lid **12**. The wall **14** is provided with a bore **50** in which is housed a valve seat **51**. A valve body **52** is contained in the lower chamber defined in said bore **50** by the valve seat **51**. A shaft extending upwardly from this valve body **52** is fixed to a push button **53** housed in the upper chamber of the bore **50**. A coil spring **54** is disposed between the flanged portion of the push button **53** and the valve seat **51** to support the push button and urge the valve body **52** against the valve seat **51**, thus sealing the bore **50**, more specifically the lower chamber thereof, from the external atmosphere. Into the lower chamber opens a passage **55** leading to the space **38**. With this cassette having the above-stated arrangement, the push button **53** may be depressed at the end of a photographic operation. Whereupon, the valve body **52** is released from the valve seat **51**, and along with this, air enters into the space **38** via the bore **50** and the passage **55**, thereby breaking the vacuous state produced therein. As a result, the upper lid **11** is open relative to the lower lid **12**. The push button **53** desirably is arranged so that it does not protrude beyond the top surface of the wall **14** to prevent any casual release of the vacuous state in the space. In the aforesaid release means, the open bottom end of the bore **50** is closed by a cover plate to facilitate the assembling of the valve means.

FIG. **8** shows a further modification of the cassette according to the present invention. This cassette is molded with a synthetic resin into an integral structure. The upper and lower plate-like lids **11'** and **12'** are constructed with flat plate-like members, respectively. Between the upper and lower lids is provided a hinge means **15'** which is molded as an integral body with the upper and lower lids **11'** and **12'** and is flexible and thinner than these lids **11'** and **12'**. Accordingly, the upper lid **11'** can be pivoted about the hinge means **15'** to be superposed onto the lower lid **12'**. The packing **17'** is molded integrally with the lower lid **12'**. The space **38'** is defined by the inner peripheral surface of the packing **17'** and the inner surfaces of the upper and lower lids. The packing **17'** is structured so that it has a progressively decreasing thickness as it goes toward its top. Moreover, this packing **17'** has a cross section such that about one half thereof, including the top, is inclined outwardly to provide a locally bent shape. The valve means **24'** used in this cassette is the same in structure as that shown in FIGS. **4** and **6**. In FIG. **8**, there is seen only the through-hole **27'** of this valve means **24'**. The cassette having the above-mentioned arrangement can provide the same function as that of the foregoing two types of cassettes but it can be fabricated more easily and at a lower cost as compared with said two types.

As will be clear also from the foregoing examples, the cassette according to the present invention is of the arrangement that the space in which the film and intensifying screens are to be contained is defined by the upper lid, the lower lid and the packing. Thus, it can have a relatively small size, especially a small thickness. Moreover, the cassette as a whole has a quite simplified structure and can be made to have a light weight. The fact that the cassette is light in weight contributes to enhancing the velocity with which it is moved from one position to another during its use on, for example, a roentgenographic apparatus. What is more, this cassette hardly gives rise to troubles in conducting quick photography. The space for containing the film and the intensifying screens is rendered vacuous, so that there can be established desirable tight and uniform adherency between the film and the intensifying screens contained in the cassette. As a result, photographs of superior quality can be obtained. Besides, the insertion and removal of the film and the intensifying screens into and from the cassette can be performed very easily.

Thus, it has a very superior operability and allows for very easy handling.

We claim:

1. A cassette for use in radiographic apparatus, comprising:

an upper lid and a lower lid, both comprised of a quadrilateral thin plate and having flat surfaces, said lower lid having an aperture extending therethrough;

a packing having a base portion fixed to said a flat surface of said lower lid, a projection extending from said base portion and a flexible lip having an upper portion overlaying a lower portion thereof and extending beyond said projection, a space being defined by said flat surfaces of the upper and lowerlids and also by said packing for containing a film and intensifying screens, said lower lid defining a passageway between said aperture and said space; and

valve means positioned within said aperture for selectively sealing said space from the external atmosphere and allowing the space to communicate with the external atmosphere, said valve means comprised of a valve seat, said valve seat defining lower and upper chambers in said aperture, a valve body positioned in said lower chamber, a shaft coupled to said valve body and upwardly extending therefrom into the upper chamber, a push button coupled to said shaft and housed in the upper chamber, and a coil spring disposed between said push button and said valve seat, said coil spring biasing said valve body against said valve seat.

2. A cassette for use in radiographic apparatus, comprising:

an upper and a lower lid, both comprised of a quadrilateral thin plate and having flat surfaces, said lids each having opposing surfaces and external surfaces, said lower lid defining a pressing plate receiving recess in the external surface thereof, a valve plate receiving recess within the pressing plate receiving recess, a channel outlet through the valve plate receiving recess, and a through hole within the valve plate receiving recess and extending through said lower lid, said through hole being adjacent the channel outlet; and a valve seat receiving depression around the through hole;

a packing fixed to the opposing surface of said lower lid and having a proximally-facing peripheral surface upwardly protruding therefrom, said opposing surfaces of said upper and lower lids and said proximally-facing peripheral surface defining a space in which a film and intensifying screens may be positioned, said space being in communication with the through hole; and

valve means provided on the lower lid for selectively sealing the space from the external atmosphere and for placing the space in communication with the external atmosphere, said valve means comprised of a valve plate adapted to be received in the valve plate receiving recess, said valve plate having a hole therein communicating with the channel outlet, a pressing plate adapted to be received in the pressing plate receiving recess, said pressing plate having a hole therein communicating with said channel outlet and having a long slot at a location corresponding to the channel outlet and the through hole, and a valve seat positioned within the valve seat receiving depression, said valve seat having a hole therein communicating with the through hole.

3. A cassette according to claim 2, further comprising a wall formed on a flat surface of said lower wall and extending at the respective side edges of the lid, and guide means formed on said a flat surface inside said wall in spaced parallel relation therefrom, a gap being defined between said guide means and said wall, said packing being provided in said gap.

4. A cassette according to claim 2, further comprising a flexible lip outwardly extending from the base portion of said packing at a location where said packing is fixed to the opposing surface of the lower lid, and a projection extending from the top surface of said base portion.

5. A cassette as recited in claim 2, further comprising a plurality of pivotable engaging means provided on the lower lid and adapted to clamp the upper lid to the lower lid when the upper lid is closed onto the lower lid, said pivotable engaging means being provided in spaced relation with each other on one side edge of the lower lid, said engaging means each having a bifurcated cross section, peripheral end portions of the lower lid being adapted to be received in one end of each of the engaging means, said one end of each said engaging means being pivotably secured by a pin to a peripheral end portion of the lower lid, and an open free end of each said pivotable engaging means being adapted to receive both the lower and upper lids when the upper lid is in its closed position.

6. A cassette as recited in claim 2, wherein said packing has a plurality of indentations formed in its base portion where said packing is fixed to the opposing surface of the lower lid, projections extending from said indentations and recessed grooves being located between adjacent projections, said projections each having a triangular cross section, the hypotenuse of this triangular shape facing said space containing film and intensifying screens.

7. A cassette according to claim 2, in which said upper and lower lids are movably coupled together at one side by hinge means.

8. A cassette according to claim 2, in which said pressing plate-receiving recess and said valve plate-receiving recess of said valve means have engaging portions, respectively, and said pressing plate and said valve plate have guide portions complementary in shape with those of said engaging portions, thereby enabling these guide portions to receive said engaging portions of said recesses, respectively.

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