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(54) CAMERA BELLOWS

(71) We, EASTMAN KODAK COMPANY, a Company organized under the Laws of the State of New Jersey, United States of America of 343 State Street, Rochester, New York 14650, United States of America do hereby declare the invention for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to a camera bellows and a photographic camera incorporating such a bellows.

Cameras having large film formats normally require a taking lens having a correspondingly long focal length. It is convenient if such cameras can be folded while not in use so as to occupy a minimum of storage space. It has long been known that bellows coupling the camera body and a lens assembly of such folding cameras provide a practical means for achieving a light-tight enclosure between the lens and the camera body.

In one known type of folding camera, the lens is supported at one end of a cover door that is hinged to the camera housing at its opposite end. A collapsible folding bellows allows the lens to be extended by opening the door to an oblique angle relative to the camera housing. In keeping the overall dimensions of the folded camera to a minimum, a major consideration has been the thickness and location within the camera of the folded bellows.

One approach has been to locate the folded bellows between the film plane and the cover door when the cover door is closed. To keep the overall thickness of the camera to a minimum, it is known to provide the bellows with just a single pleat. This arrangement is shown in U.S. Patent No. 2,880,658. U.S. Patent No. 1,851,095 shows a two-part bellows. The main part

of the bellows has one pleat and folds flat between the cover door and the film plane. The second bellows part connects the main part of the bellows to the lens housing to enable the lens housing to be folded into the same plane as the cover door when the cover door is closed. In this arrangement, when the cover door is open and the lens housing is in a picture taking position, the second bellows part is collapsed.

Although the single pleated bellows take up a minimum of space when folded, they are very unstable and the lateral portions which pivot inwards are subjected to considerable strain in the regions where the pleat edges join, with the result that the bellows are subject to failure in these areas.

Bellows having several or many accordion-like pleats are more stable and tend to be more durable because they are subjected to less strain when folded. However, because of their construction they can be folded no thinner than the combined thickness of all the pleats. A camera of the type having a multi-pleated accordion-like bellows is shown in U.S. Patent No. 2,906,182. In this camera, the front cover door has been hollowed out to receive the folded bellows with a consequent increase in the overall thickness of the camera. To minimize the overall thickness of the camera, it is known to employ a U-shaped accordion-pleated bellows that is stored, when the camera is closed, around three sides of a film pack. Such a camera is shown in U.S. Patent No. 3,677,160. Since the U-shaped bellows surrounds the film pack on three sides, the overall thickness of the camera is minimized, but the width and length of the camera are increased by an amount sufficient to accommodate the folded bellows around the film pack.

Bellows of the kind which have multiple pleats for minimum strain and which fold flat between the camera cover and the film

plane are known for use with a folding camera of the type in which the optical path is deflected to the negative material by a mirror. An example of this type of bellows is shown in U.S. Patent No. 3,678,831. However, the deflection of the optical path results in a smaller pivot angle between the camera housing and the cover door and consequently a smaller bellows. Thus the smaller bellows can be folded relatively flat in a minimum of space. Such a bellows as described above is not, however, suitable for folding cameras which do not have optical path deflection, since in that case a larger pivot angle between the camera body and the cover is necessary. The number of pleats must be increased to produce a low-strain bellows in a camera without optical path deflection. Such a bellows would be thicker when folded, thus increasing the overall thickness of the camera.

In accordance with the present invention there is provided a camera bellows comprising a first portion which, in the extended position, forms a substantially wedge-shaped enclosure open at both ends thereof and movable to a collapsed position about an edge of the larger end thereof, and a second portion which, in the extended position, forms a substantially pyramidal enclosure, the base of which is open and connected to the smaller end of the first portion and one of the walls of which has an opening for the passage of light through the bellows to the large end thereof, the second portion being movable to a collapsed position about an axis remote from said edge.

According to the present invention there is also provided a photographic camera comprising a box-like housing having an outward facing wall portion, a cover door having a main cover portion which is coupled at one end to a lens support and has its other end pivotally connected to the housing for movement of the cover door from an open position in which the main cover portion projects outwardly from the housing to a closed position in which the main cover portion lies substantially parallel with the wall portion and a camera bellows comprising a first portion coupled to the housing and the main cover portion, the first portion forming with the main cover portion, when the cover door is in its open position, a substantially wedge-shaped enclosure and, when the cover door is in its closed position, lying substantially flat against the main cover portion, and a second portion coupled to the first portion and the lens support, the second portion forming with the lens support portion, when the cover door is in its open position, a substantially pyramidal enclosure and,

when the cover door is in its closed position, lying substantially flat against the lens support portion.

In the accompanying drawings:

Fig. 1 is a perspective view of a bellows 70 constructed according to the present invention, the bellows being in an open condition;

Fig. 2 shows the bellows of Fig. 1 in a partially closed condition; 75

Fig. 3 is a side view of a folding camera having a bellows according to the present invention, the camera being shown in an open condition;

Fig. 4 is a view similar to Fig. 3, but showing the camera in a closed condition; 80

Fig. 5 shows the bellows of Fig. 2 with a means for venting the bellows to the outside air; and

Fig. 6 is a view similar to Fig. 5, but showing an alternative means of venting the bellows. 85

Reference is now made to Fig. 3 wherein a box-like camera housing 4 is depicted having a cover door with a main cover 90 portion 6 coupled to the front wall 9 of the housing by means of a hinge 7. A camera lens 3 and a shutter (not shown) are carried by a lens support portion 6a of the cover door. The cover door can be moved about its hinge between an open position as shown in Fig. 3 to a closed position as shown in Fig. 4. When the cover door is closed, it is substantially flush with the front wall 9 of the camera housing. The relatively small size of the closed camera makes it convenient to carry and store. 100

From Fig. 3 it can be seen that the cover door 6 is coupled to the camera housing 105 by means of a light-tight bellows 1 which will be described in greater detail below. The bellows is secured to the cover door by means of a rigid holding sheet having a first portion 2 corresponding to the main cover portion of the cover door and a second portion 2a corresponding to the lens support portion of the cover door. The bellows is attached to the rigid holding sheet by means of adhesion or heat sealing. The bellows is secured to the camera housing 4 by means of a frame 5 which is likewise connected to the bellows by adhesion or heat sealing. If desired, the rigid holding sheet may comprise the bottom wall of the bellows, the side walls of the bellows being secured thereto. 115

The bellows construction itself will now be described in greater detail with reference to Fig. 1. The collapsible bellows 1 is formed of two parts. When open, the first part of the bellows describes a generally wedge-shaped enclosure with the first portion of the holding sheet 2 as one side of the wedge. The points A-B-C-D-E-A de- 120 130

note a boundary of one side of the first part of the bellows. This first bellows part has three pleated U-shaped segments denoted by the points A-B-C, A-C-D, and A-D-E which are pivoted about the point A in the manner of a fan for folding. The dotted lines represent inward folding pleat edges and the solid lines represent outward folding pleat edges.

10 The second part 1a of the bellows, when open, describes a generally pyramidal enclosure with the second portion 2a of the holding sheet forming one face of the pyramid. The points D-E-F-D denote a side face of the pyramid. This second part of the bellows has pleats with folds occurring on opposite sides faces only. The edges of the second part of the bellows which correspond to the perimetric edges of the base of the pyramid join the top edges of the first bellows part to complete the light-tight enclosure.

The inward folding pleat edges of the second bellows part are met by the inward folding pleat edges of the segment A-D-E of the first bellows part at point G. The edges D-F and E-F of the second bellows part are of equal length.

As can be seen from Fig. 2, illustrating the bellows in a partially collapsed condition, the pleats in the first bellows section are of varying widths so that the folds are staggered when the bellows is collapsed, thereby ensuring the most compact configuration when collapsed.

Referring now to Fig. 3, it can be seen that when the cover door is open in its picture taking condition, both bellows parts are in their fully open positions.

When the cover door is closed as shown in Fig. 4, the pleat segments A-B-C, A-C-D, and A-D-E of the first part of the bellows fold up like a fan pivoting around the point A and rest flat against the main cover portion 6 of the cover door. The second part 1a of the bellows collapses about point F corresponding to the tip of the pyramid. The pleat edges D come to rest adjacent to point E.

The taking lens 3 is shown stored in a recess 4a when the camera is closed. Alternatively, the lens support portion 6a of the cover door can be hinged so that when opened, the lens support portion controlled by linkage not shown, would assume an angular position with respect to the main portion of the door, and when closed would assume an extended position substantially coplanar with the main portion of the cover door, coming to rest on the external surface of the camera rather than in the interior thereof.

Although the bellows 1 can be folded extremely flat and assume an almost fully extended form when open, it is not sub-

jected to high tensile stress in either the open or closed condition.

Returning now to Fig. 2, air entering the bellows when the camera is opened and exiting from the bellows when the camera is closed is conducted through an opening 8 in the holding sheet 2. To keep dust from entering the interior of the bellows, the opening can be provided with a covering of suitably porous opaque material that will trap dust and allow air to enter and exit. Such an arrangement is shown in Fig. 5, wherein a disc of porous material 19 is inserted and held in a recess 2c formed in the holding sheet. A hole 2b in recess 2c allows air to pass through the porous material. A corresponding opening in the cover door 6 could be provided to allow air to pass through the cover door.

Alternatively, as shown in Fig. 6, the arrangement for the passage of air to and from the bellows could comprise two diaphragm valves 10 and 11 covering holes 12 and 13, the valves being effective in opposite directions. Each of these diaphragm valves 10 and 11 is composed of a resilient plate made of rubber, plastic, or another suitable material which is attached to the holding sheet 2 at several points, such as 10a or 11a around its periphery by means of adhesion or heat sealing. In order that the diaphragm valves may be effective in opposite directions, they are arranged on opposite sides of the holding sheet. The valve openings are covered by a bonnet 14 which is fastened to the holding sheet 2, to prevent light from entering the bellows when the valves are open.

When the camera is opened, a partial vacuum is created inside the bellows, and the diaphragm valve 10 located inside the bellows is lifted slightly by the outside air pressure so that the outside air can flow in through the hole 12.

When the camera is closed, excess pressure inside the bellows causes diaphragm valve 11, located on the other side of holding sheet 2, to be lifted, allowing air in the bellows to escape through the hole 13. When the camera is not being opened or closed, the diaphragm valves 10 and 11 lie against the holding sheet 2, thereby preventing dust from entering the bellows.

WHAT WE CLAIM IS:—

1. A camera bellows comprising a first portion which, in the extended position, forms a substantially wedge-shaped enclosure open at both ends thereof and movable to a collapsed position about an edge of the larger end thereof, and a second portion which, in the extended position, forms a substantially pyramidal enclosure, the base of which is open and connected to the smaller end of the first portion and one of the walls of which has an



note a boundary of one side of the first part of the bellows. This first bellows part has three pleated U-shaped segments denoted by the points A-B-C, A-C-D, and A-D-E which are pivoted about the point A in the manner of a fan for folding. The dotted lines represent inward folding pleat edges and the solid lines represent outward folding pleat edges.

The second part 1a of the bellows, when open, describes a generally pyramidal enclosure with the second portion 2a of the holding sheet forming one face of the pyramid. The points D-E-F-D denote a side face of the pyramid. This second part of the bellows has pleats with folds occurring on opposite sides faces only. The edges of the second part of the bellows which correspond to the perimetric edges of the base of the pyramid join the top edges of the first bellows part to complete the light-tight enclosure.

The inward folding pleat edges of the second bellows part are met by the inward folding pleat edges of the segment A-D-E of the first bellows part at point G. The edges D-F and E-F of the second bellows part are of equal length.

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When the camera is closed, excess pressure inside the bellows causes diaphragm valve 11, located on the other side of holding sheet 2, to be lifted, allowing air in the bellows to escape through the hole 13. When the camera is not being opened or closed, the diaphragm valves 10 and 11 lie against the holding sheet 2, thereby preventing dust from entering the bellows.

WHAT WE CLAIM IS:—

1. A camera bellows comprising a first portion which, in the extended position, forms a substantially wedge-shaped enclosure open at both ends thereof and movable to a collapsed position about an edge of the larger end thereof, and a second portion which, in the extended position, forms a substantially pyramidal enclosure, the base of which is open and connected to the smaller end of the first portion and one of the walls of which has an



opening for the passage of light through the bellows to the large end thereof, the second portion being movable to a collapsed position about an axis remote from said edge.

2. A camera bellows according to Claim 1, wherein the first portion includes a plurality of pleats that are foldable in a fan-like manner about said edge.

10 3. A camera bellows according to Claim 2, wherein the pleats, when folded, define folds of unequal widths.

4. A camera bellows according to Claim 3, wherein the widths increase as the folds extend farther from the larger end.

5. A camera bellows according to Claim 2, 3 or 4, wherein the pleats comprise U-shaped pleat segments having triangular side sections that are foldable inwardly of the first portion in response to collapsing of the bellows.

6. A camera bellows according to any one of the preceding Claims, wherein the axis about which the second portion is collapsed includes the tip of the pyramidal enclosure.

7. A camera bellows according to Claim 6, wherein the second portion includes sides defining two symmetrically arranged triangular portions which, on collapsing the bellows, are folded inwardly of the second portion.

8. A camera bellows according to any one of the preceding Claims, wherein a frame is connected to the larger end of the first portion for connecting the bellows to a camera housing.

9. A camera bellows constructed substantially as hereinbefore described with reference to, and as shown in, Figs. 1 and 2 of the accompanying drawings.

10. A photographic camera comprising a box-like housing having an outward fac-

ing wall portion, a cover door having a 45 main cover portion which is coupled at one end to a lens support and has its other end pivotally connected to the housing for movement of the cover door from an open position in which the main cover portion 50 projects outwardly from the housing to a closed position in which the main cover portion lies substantially parallel with the wall portion, and a camera bellows comprising a first portion coupled to the hous- 55 ing and the main cover portion, the first portion forming with the main cover portion, when the cover door is in its open position, a substantially wedge-shaped enclosure and, when the cover door is in its 60 closed position, lying substantially flat against the main cover portion, and a second portion coupled to the first portion and the lens support, the second portion forming with the lens support portion, 65 when the cover door is in its open position, a substantially pyramidal enclosure and, when the cover door is in its closed position, lying substantially flat against the lens support portion. 70

11. A photographic camera according to Claim 10, further comprising a holding sheet coupled to the first and second portions and the cover door.

12. A photographic camera according 75 to Claim 11, wherein the holding sheet includes a first part coupled to the main cover portion and the first portion of the bellows, and a second part coupled to the lens support portion and the second por- 80 tion of the bellows.

13. A photographic camera having a bellows substantially as hereinbefore described with reference to, and as shown in, Figs. 1 to 4 of the accompanying drawings. 85

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