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PATENT SPECIFICATION

DRAWINGS ATTACHED

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Photographic exposure regulating device.

COMPLETE SPECIFICATION

We, EASTMAN KODAK COMPANY, a Company organised 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 (Assignees of HUBERT NERWIN) 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:—

This invention relates to devices for controlling exposure in photographic cameras and, more particularly, to a simple, one-piece exposure-controlling structure.

It is an object of this invention to provide a simple, economical one-piece structure for controlling exposure in cameras.

According to the present invention, there is provided a unitary exposure controlling device, for use in apparatus having an axis along which exposing light is received and having a movable element positionable in accordance with scene luminance, including an exposure-regulating portion, a mounting portion and a drive portion, the mounting portion being attachable to the apparatus to mount the unitary device therein and to support the exposure-regulating portion for movement to any one of a plurality of positions for controlling the amount of light passing along the axis, the drive portion being arranged to be coupled with the movable element for positioning the exposure-regulating portion in accordance with the position of the element, and the unitary device further including a resiliently flexible portion interposed between the mounting and drive portions to permit relative movement therebetween.

Although the subject invention is described with particularity in terms of a unitary structure including diaphragm-forming vane portions, the novel one-piece structure disclosed herein may be used to

position any exposure-controlling member, e.g. diaphragm rings, shutter speed controls, etc.

The invention will be described further, by way of examples, with reference to the accompanying drawings, in which:—

Fig. 1 illustrates one embodiment of a one-piece exposure-controlling device according to the present invention, as it might appear when initially formed and prior to actual assembly into a camera;

Figs. 2 and 3 show the device illustrated in Fig. 1 as it might appear when operatively assembled into a camera, Fig. 2 showing aperture-forming vanes in an open position, and Fig. 3 illustrating the vanes in a partially closed position;

Figs. 4, 5 and 6 illustrate a second embodiment of the one-piece exposure-controlling device of the present invention, Fig. 4 showing the device as initially formed, while Figs. 5 and 6 illustrate this embodiment of the device as mounted operationally in a camera in, respectively, an open and a partially closed position;

Figs. 7, 8 and 9 are similar illustrations of a third embodiment of the one-piece device of the present invention;

Figs. 10, 11 and 12 are similar drawings of a fourth embodiment of the device of the present invention;

Figs. 13, 14 and 15 are similar views of a fifth embodiment of the one-piece device of the present invention; and

Figs. 16, 17 and 18 are similar views of a sixth embodiment wherein two variable apertures are simultaneously formed by the one-piece device of the present invention.

In the drawings, reference numerals with like suffixes refer to similar parts.

Referring now to Fig. 1, a generally inverted bell-shaped one-piece exposure-controlling device is shown as it might appear immediately following fabrication and

prior to actual assembly and mounting in a camera. A pair of oppositely disposed vane portions 11 each include aperture-forming notches 12. A mounting portion 13 includes a hole 14 for receiving a mounting screw or pin.

The vane portions are connected to the mounting portions by means of resiliently flexible portions 15 which bias the vane portions to the position shown. The one-piece structure also includes a drive portion 16 in which a hole 17 is formed. The purpose of hole 17 is to receive a sensing member which is positioned in accordance with the output of a camera's automatic exposure control system in a manner well known in the art. The drive portion 16 is interconnected with the vane portions 11 by means of flexible portions 18 which form a resilient connection and permit the vane portions 11 to be positioned as a function of the position of the drive portion 16.

As was stated above, although the invention herein is not limited to any particular material, tests have shown that linear thermoplastic materials have a desired superior resistance to flexing fatigue for the satisfactory operation of the device over extended periods.

Particularly polymeric materials formed of long-chain linear molecules having substantially no side chains or cross-linking between them are preferred. Such materials are well known and include synthetic crystalline polymeric materials such as polyamides, polycarbonates, polyesters, and polyolefins. In selecting materials for devices which are to be used in cameras wherein the exposure regulating member is in close proximity to the film, the material from which such member is formed should also be substantially photographically inert. Further, in some instances it may be desirable that such material be substantially free of susceptibility to fungus growth, and it should retain its desired properties within temperature limits encountered in normal photographic usage, i.e., in the approximate range from -20°F. to 180°F. The material should be readily formable by cutting, stamping, moulding etc. into the desired configuration at minimum expense. The preferred material is polypropylene since it combines the properties of good memory (required for spring-like bias) as well as extremely high resistance to flexing fatigue.

Referring now to Figs. 2 and 3, the one-piece device illustrated in Fig. 1 is shown attached by means of a screw 14' to a camera mounting plate 29 which is provided with a lens 10 aligned with a picture-taking axis of the camera. The camera also includes a sensing member 19 which is

movable (when camera operation is initiated by the operator) to a position determined in accordance with the output of the camera's photoresponsive system. The positioning of the sensing member 19 can be accomplished in any number of ways which are well known in the automatic exposure control art, e.g., the member 19 may be a yieldably driven member which is moved into contact with a trapped pointer of a galvanometer included in a photoelectric circuit sensitive to the varying light intensity of the scene to be photographed. However, it should be noted that the member 19 may also be manually positioned by an operator of the camera in accordance with his estimate of the lighting conditions under which photographs are to be taken.

In the position indicated in Fig. 2, it is assumed that the sensing member 19 has been positioned in response to camera operation under conditions in which scene luminance (brightness) is relatively dim. In this case, the aperture forming notches 12 of the vanes 11 are only slightly overlapped providing a maximum aperture for film-exposing light passing through the picture-taking lens 10. When in the course of camera operation, the sensing member 19 is moved upwardly in response to increased scene luminance, it carries the drive portion 16 upwardly, and this motion is translated to the vane portions 11 by means of the flexible interconnecting portions 18 causing the vane portions 11 to move into a more overlapped relationship as shown in Fig. 3.

In between settings of the sensing member 19, the resiliently flexible portions 15 act as springs to bias the vane portions 11 back to the fully open limiting position illustrated in Fig. 2, and also to return the drive portion 16 to its initial limiting positions by means of the interconnecting action of the flexible portions 18. The biasing action of the resilient portions 15 is sufficiently fast to permit use of the one-piece vane structure in cinematographic cameras as well as in still cameras. Namely, this biasing action is fast enough to return the structure to its initial position shown in Fig. 2 following each frame of exposure in a cinematographic camera, the vane structure being reset in accordance with the lighting conditions prior to the exposure of the next succeeding frame.

As was stated above, although the invention herein is not necessarily limited to any particular material, the satisfactory operation of the device over extended periods requires the use of a material which combines the essential properties of good memory (required for spring-like bias) as well as extremely high resistance to flexing

fatigue. The material must also be of sufficient rigidity to form satisfactory vane portions 11, mounting portion 13 and drive portion 16, taking into account suitable supports than can be provided for maintaining the moving parts of the invention in desired paths of movement.

Further, in view of the overlapping action of vane portions 11, the material selected preferably is essentially free of any plasticizer that might "bleed" to cause the vanes to stick to each other. Of course, it is desirable also to avoid use of any plasticizer that during the normal expected life of the camera might evaporate to such degree as to deprive the material of its required properties.

Particular attention is called to the formation of the linkage portions of the device, namely, resiliently flexible portions 15 and flexible portions 18. The radius of curvature of portions 15 is selected so that the movement of vane portions 11 relative to mounting portion 13 does not exceed the elastic limit of the material forming the narrowed portions 11, thus assuring that portions 11 will maintain their resilient property and provide the desired bias referred to above. As to the narrowed, "necked-down" portions 18, the movement of drive portions 16 relative to vane portions 11 may be such as to exceed the elastic limit of the material forming portions 18. However, one of the properties of the materials having long-chain linear molecules referred to above is the ability to be subjected to just such repeated excessive flexure over extremely long periods without evidence of fatigue and, specifically, without rupture or severe weakness in the region of maximum flexure. As stated earlier, the synthetic polymeric materials have the various properties required for satisfactory operation of the one-piece devices disclosed herein, and, in tests of the invention herein, polypropylene has been found to be a preferred material.

It should be understood that the remarks which have just been made concerning selection of materials apply equally to the other embodiments of the invention which will now be discussed in detail.

Fig. 4 illustrates a generally invented pear-shaped one-piece exposure-controlling structure according to a second embodiment of the invention herein. Vane portions 21, with respective aperture-forming notches 22, are formed in respective legs of the device and are inter-connected with a mounting portion 23 by means of resiliently flexible portions 25 which provide a spring force to bias the vane portions 21 towards the position illustrated in Fig. 4. A pair of drive portions 26 are each for-

med at the free ends of the legs and each has a hole 27 for receiving a sensing member 19. The drive portions 26 are inter-connected with the vane portions 21 by means of flexible portion 28.

Figs. 5 and 6 illustrate the one-piece device shown in Fig. 4 operatively connected to a camera mechanism, the mounting portion 23 being attached to a camera mounting plate 29 by means of a screw 24' passing through a hole 24, whilst the drive portions 26 are aligned to receive the sensing member 19 in the manner shown. Fig. 5 illustrates the unitary device in its fully open position with the picture-taking lens 10 fully uncovered and the sensing member 19 in a position indicative of dim scene luminance. When a photograph is to be made under conditions of bright scene luminance, the sensing member 19 is moved downwardly in response to the altered output of the camera's photoresponsive means, resulting in increased overlap of the vanes 21 as illustrated in Fig. 6.

When used in either a cinematographic camera or a still camera, prior to the exposure of the next succeeding frame, the sensing member 19 and the vane portions 21 are returned by the biasing force of the resiliently flexible portions 25 to the positions as shown in Fig. 5.

It should be noted it has been found that the device of the second embodiment provides a substantially linear relationship between the distance through which the pin 19 and the drive portion 26 move and the size of the aperture formed by the vanes 21.

Figs. 7-9 and 10-12 illustrate one-piece exposure-controlling devices according to third and fourth embodiments of the present invention. In these multivane structures, each of the aperture-forming vane members 31 and 41, respectively, is integral with a vane mounting portion 33 and 43, respectively, each of the vane portions being individually mounted to the camera for movement about pins 34', 44' received through respective holes 34, 44 as can be seen in Figs. 8 and 9, and Figs. 10 and 11. In each of these embodiments, a single drive portion 36 and 46, respectively, receives a sensing member 19 and drives the multi-vane structure to form an aperture of size varying as a function of the position of the sensing member 19, and the operative interconnections between the respective drive portions 36 and 46 and their corresponding vane portions are provided by respective resiliently flexible portions 38 and 48.

Figs. 13-15 illustrate an approximately U-shaped one-piece exposure-controlling device in accordance with the fifth embodiment of the present invention. In this



70 portions

75

80

85

90

95

100

105

110

115

120

125

130

embodiment, vane members 51 with their aperture forming notches 52 are oppositely disposed on the legs of the U-shaped structure, and are attached to a mounting portion 53 by means of resiliently flexible portions 55 which act as springs to bias the vane portions 51 to the position illustrated in Fig. 13.

According to this embodiment, each drive portion 56 forms a part of its respective vane portion 51 and respective slots 57 are provided to receive a sensing member 19. Fig. 14 shows the unitary device attached to a camera mounting plate 29 by means of a screw 54'. When in the condition illustrated in Fig. 14, the sensing member 19 is in its initial limiting ("low light") position, and the vane portions 51 are biased by the resilient portions 55 to provide a maximum aperture for the camera lens 10. Prior to each exposure, the sensing member 19 is moved upwardly to a position indicative of the output of the camera's photoresponsive system, thereby driving the vanes 51 into greater overlapping relationship and reducing the aperture masking the lens 10. Similar to the first and second embodiments described above, following the exposure of each successive frame, the sensing member 19 is returned to its initial limiting position and the vanes 51 are biased to their fully open position by the spring action of the connecting portions 55, as illustrated in Fig. 14.

Figs. 16-18 illustrate a one-piece exposure-controlling device in accordance with the sixth embodiment of the present invention. This one-piece device is designed to provide two variable apertures which may be simultaneously controlled by a single movable member, and it has particular application to stereo cameras or to cameras having automatic exposure control systems of the "null" type which are well known in the art.

According to this sixth embodiment, the device is initially formed in a basic "S" shape as illustrated in Fig. 16. Vane members 61, with their notches 62, are integral with respective mounting portions 63 and are formed at the outer ends of the "S". Drive portion 66 is formed in the central section of the "S" and is attached to the vane and mounting portions by means of resiliently flexible portions 68.

When operatively connected to a camera, as shown in Figs. 17 and 18, the mounting portions 63 of the one-piece device are attached to a mounting plate 29 by means of screws 64' and the drive portion 66 is keyed to a movable member 19' which is rotated to an angular position which varies with the light intensity of the scene being photographed. As similarly noted above in relation to sensing member 19,

the member 19' may be positioned, manually or by a yieldable drive means cooperating with the camera's photoresponsive system. As lighting conditions vary from the relatively dim scene luminance assumed in Fig. 17 to the relatively bright conditions assumed in Fig. 18, the drive portion 66 is moved clockwise by the member 19'. As the drive portion 66 moves clockwise, the vane portions 63 are moved clockwise around respective mounting screws 64', and the notches 62 cooperate in overlapping relation with the edges of the drive portion 66 to provide two simultaneously controlled apertures for picture-taking lenses 10 and 10'. (A photocell would replace one picture-taking lens in the event the one-piece device were being used in a "null" type exposure control system). Stops 69 are provided to arrest movement of the one-piece structure in the respective limiting positions at which maximum and minimum apertures are formed.

As with the other embodiments described above, the resiliently flexible portions 68 provide the necessary linkage unifying the operation of the mounting, vane, and drive portions of this one-piece exposure controlling device.

WHAT WE CLAIM IS:—

1. A unitary exposure controlling device for use in apparatus having an axis along which exposing light is received and having a movable element positionable in accordance with scene luminance, including an exposure-regulating portion, a mounting portion and a drive portion; the mounting portion being attachable to the apparatus to mount the unitary device therein and to support the exposure-regulating portion for movement to any one of a plurality of positions for controlling the amount of light passing along the axis, the drive portion being arranged to be coupled with the movable element for positioning the exposure-regulating portion in accordance with the position of the element, and the unitary device further including a resiliently flexible portion interposed between the mounting and drive portions to permit relative movement therebetween.

2. A device according to claim 1 wherein the exposure-regulating portion comprises a vane member positionable in alignment with the picture-taking axis and movable to form a variable aperture for the film-exposing light.

3. A device according to claim 1 or 2, wherein the resiliently flexible portion biases the drive portion and the exposure-regulating portion towards predetermined limiting positions.

4. A device as claimed in claim 1, 2 or 3 formed from a linear thermoplastic



embodiment, vane members 51 with their aperture forming notches 52 are oppositely disposed on the legs of the U-shaped structure, and are attached to a mounting portion 53 by means of resiliently flexible portions 55 which act as springs to bias the vane portions 51 to the position illustrated in Fig. 13.

According to this embodiment, each drive portion 56 forms a part of its respective vane portion 51 and respective slots 57 are provided to receive a sensing member 19. Fig. 14 shows the unitary device attached to a camera mounting plate 29 by means of a screw 54'. When in the condition illustrated in Fig. 14, the sensing member 19 is in its initial limiting ("low light") position, and the vane portions 51 are biased by the resilient portions 55 to provide a maximum aperture for the camera lens 10. Prior to each exposure, the sensing member 19 is moved upwardly to a position indicative of the output of the camera's photoresponsive system, thereby driving the vanes 51 into greater overlapping relationship and reducing the aperture masking the lens 10. Similar to the first and second embodiments described above, following the exposure of each successive frame, the sensing member 19 is returned to its initial limiting position and the vanes 51 are biased to their fully open position by the spring action of the connecting portions 55, as illustrated in Fig. 14.

Figs. 16-18 illustrate a one-piece exposure-controlling device in accordance with the sixth embodiment of the present invention. This one-piece device is designed to provide two variable apertures which may be simultaneously controlled by a single movable member, and it has particular application to stereo cameras or to cameras having automatic exposure control systems of the "null" type which are well known in the art.

According to this sixth embodiment, the device is initially formed in a basic "S" shape as illustrated in Fig. 16. Vane members 61, with their notches 62, are integral with respective mounting portions 63 and are formed at the outer ends of the "S". Drive portion 66 is formed in the central section of the "S" and is attached to the vane and mounting portions by means of resiliently flexible portions 68.

When operatively connected to a camera, as shown in Figs. 17 and 18, the mounting portions 63 of the one-piece device are attached to a mounting plate 29 by means of screws 64' and the drive portion 66 is keyed to a movable member 19' which is rotated to an angular position which varies with the light intensity of the scene being photographed. As similarly noted above in relation to sensing member 19,

the member 19' may be positioned, manually or by a yieldable drive means cooperating with the camera's photoresponsive system. As lighting conditions vary from the relatively dim scene luminance assumed in Fig. 17 to the relatively bright conditions assumed in Fig. 18, the drive portion 66 is moved clockwise by the member 19'. As the drive portion 66 moves clockwise, the vane portions 63 are moved clockwise around respective mounting screws 64', and the notches 62 cooperate in overlapping relation with the edges of the drive portion 66 to provide two simultaneously controlled apertures for picture-taking lenses 10 and 10'. (A photocell would replace one picture-taking lens in the event the one-piece device were being used in a "null" type exposure control system). Stops 69 are provided to arrest movement of the one-piece structure in the respective limiting positions at which maximum and minimum apertures are formed.

As with the other embodiments described above, the resiliently flexible portions 68 provide the necessary linkage unifying the operation of the mounting, vane, and drive portions of this one-piece exposure controlling device.

WHAT WE CLAIM IS:—

1. A unitary exposure controlling device for use in apparatus having an axis along which exposing light is received and having a movable element positionable in accordance with scene luminance, including an exposure-regulating portion, a mounting portion and a drive portion, the mounting portion being attachable to the apparatus to mount the unitary device therein and to support the exposure-regulating portion for movement to any one of a plurality of positions for controlling the amount of light passing along the axis, the drive portion being arranged to be coupled with the movable element for positioning the exposure-regulating portion in accordance with the position of the element, and the unitary device further including a resiliently flexible portion interposed between the mounting and drive portions to permit relative movement therebetween.

2. A device according to claim 1 wherein the exposure-regulating portion comprises a vane member positionable in alignment with the picture-taking axis and movable to form a variable aperture for the film-exposing light.

3. A device according to claim 1 or 2, wherein the resiliently flexible portion biases the drive portion and the exposure-regulating portion towards predetermined limiting positions.

4. A device as claimed in claim 1, 2 or 3 formed from a linear thermoplastic

material.

5. A device according to claim 4 wherein the linear thermoplastic material is a polymer.

6. A device according to claim 5 wherein the polymer is polypropylene.

7. A device according to claim 4, 5 or 6 wherein the material is essentially free of plasticizer.

8. A device according to any preceding claim wherein the material of which the device is made is substantially photographically inert.

9. A device according to any preceding claim wherein the material of which the device is made is essentially free of susceptibility to fungus.

10. A device according to any preceding claim wherein the material of which the device is made retains its flexibility, semi-rigidity, and high resistance to fatigue failure on flexing within temperature limits from -20°F. to 180°F.

11. A device as claimed in any preceding claim wherein there are a plurality of exposure regulating portions each comprising an aperture-forming vane positioned to regulate light passing along said axis.

12. A device as claimed in claim 11 further including a plurality of the resiliently flexible portions for biasing the vanes toward a predetermined limiting position, the vanes being driven against the bias to any one of a plurality of positions in response to the movement of the drive portion whereby the light regulating aperture formed by the vanes varies as a function of scene luminance.

13. A device according to claim 11 wherein the light-regulating aperture is arranged to decrease as the drive portion is moved away from the mounting portion.

14. A device according to claim 11 wherein the light-regulating aperture is arranged to decrease as the drive portion is moved towards the mounting portion.

15. A device according to claim 11 wherein there are two aperture-forming vanes disposed on the legs of a generally U-shaped structure, and wherein the drive portion is comprised of two oppositely disposed members each integral with a respective one of the vanes, each drive member being formed with a slot therein for receiving the movable element when the drive members are placed in overlapping relationship.

16. A device according to any of claims 11 to 14 wherein the device is formed in an inverted belt-shape, the mounting portion and the drive portion being formed at opposite ends of the belt-shaped device, and the aperture-forming vanes being oppositely disposed between the mounting and drive portions.

17. A device according to any of claims 11 to 14 wherein the device is formed in an inverted pear-shape, and wherein the drive portion comprises a pair of drive members formed at one end of the device, the mounting portion being arranged at the other end of the device, each drive member being arranged for interconnection with the movable element, the aperture-forming vane portions being oppositely disposed along the two sides of the device intermediate each drive member and the mounting portion.

18. A device according to claim 11 wherein there are a plurality of the mounting portions and a single one of the drive portions, each mounting portion being contiguous to a respective one of the vane members and being attached to the camera to mount the device therein and to support the vane members in alignment with the picture-taking axis to provide a variable aperture for said film-exposing light, the drive portion being arranged to be coupled with the movable element for movement responsive thereto, and the device further including a plurality of the resiliently flexible portions interposed between the drive portion and the mounting portions to permit relative movement therebetween for controlling the size of the aperture formed by the vanes as a function of the movement of the drive portion.

19. A device according to claim 11 arranged for use in an apparatus having at least two axes along which light is transmitted, wherein the exposure regulating portion comprises at least two vanes each of which is arranged to be supported in the apparatus by a respective mounting portion for movement to a plurality of positions for controlling the amount of light passing along each respective axis, and each mounting portion being contiguous with its respective vane.

20. A device according to claim 19 of generally S-shaped form and wherein the vanes are formed, respectively, at the free ends of the S-shaped structure.

vanes



21. A unitary exposure regulating device substantially as hereinbefore described with reference to and as illustrated in Figs. 1 to 3 or Figs. 4 to 6 or Figs. 7 to 9 or Figs. 10 to 12 or Figs. 13 to 15 or Figs. 16 to 18 of the accompanying drawings.

22. A photographic or cinematographic camera comprising a picture taking lens on an exposure axis, a movable element positionable in response to scene luminance and a unitary exposure regulating device as claimed in any preceding claim mounted by its mounting portion within the camera and having its drive portion coupled with the movable member whereby, in use, to

regulate the exposure of a photosensitive material within the camera in accordance with scene luminance.

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