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PNEUMATIC EXPOSURE REGULATING DEVICE FOR PHOTOGRAPHIC CAMERAS

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Fig.1

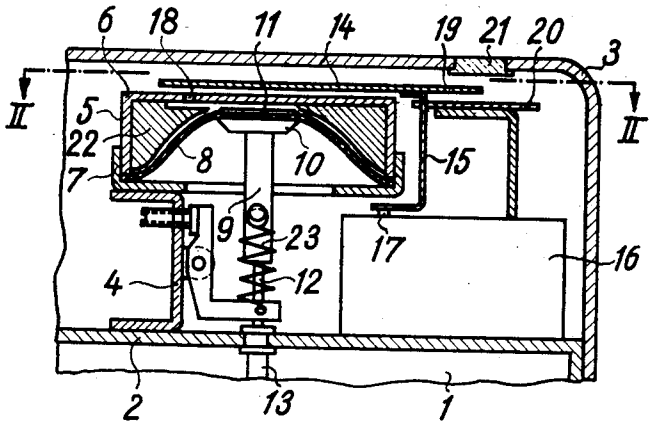


Fig.2

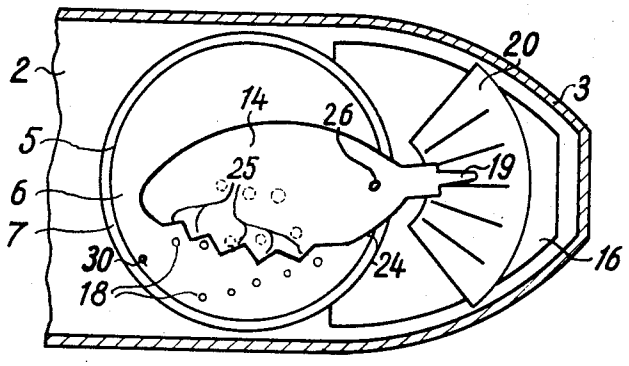
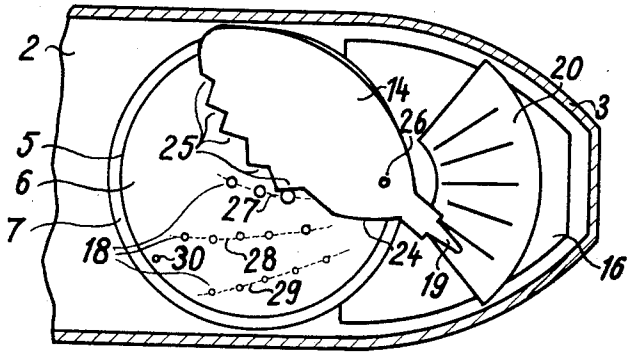


Fig.3



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PNEUMATIC EXPOSURE REGULATING DEVICE FOR PHOTOGRAPHIC CAMERAS

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10 Claims. (Cl. 95—53)

This invention relates to a pneumatic exposure regulating device for photographic cameras which includes a perforated valve plate and a movable flow-obstructing member, and more particularly relates to such a device in which the movement of the flow-obstructing member is photoelectrically controlled to permit it to block the orifices or perforations in the valve plate to a degree which varies in accordance with the existing available illumination for photographic exposure.

In heretofore existing devices of this kind, the valve plates have sometimes included a single slot-shaped orifice. However, it is difficult to manufacture an orifice of this type with enough precision to obtain precise regulation over a wide range. Valve plates have also been made including several small orifices arranged on an arc concentric with the center of a round valve plate. In the later structure, the pivoting point of the flow-obstructing member also lies in the center of the valve plate. Therefore, the same portion of one edge of the obstructing member passes successively over all of the orifices during the course of its regulating movement. Since these orifices for practical manufacturing reasons must be positioned at a certain minimum distance from each other, in this situation also a high degree of precision in the regulation of exposure, is difficult to obtain.

In accordance with this invention, at least some of the valve plate orifices in a perforated exposure regulating device of this aforementioned type are so arranged that they are traversed by separate portions of an edge of the flow-obstructing member during the course of its regulating movement. For example, the orifices in the valve plate are arranged on one or more curves, each of which are oriented along lines which are inclined slightly ahead of lines perpendicular to the direction of movement of the traversing portions of the flow-obstructing member. These curves are successively traversed by the aforementioned edge of the flow-obstructing member during the course of its regulating movement.

Further in accordance with this invention, at least some portions of the aforementioned edge of the flow-obstructing member are disposed substantially perpendicular to its direction of regulating movement, and the orifices in the valve plate are each arranged within areas which are traversed by the aforementioned portions of the edge of the flow-obstructing member during the course of its regulating movement.

Still further in accordance with this invention, the aforementioned edge of the flow-obstructing member is preferably constructed in a saw-toothed or similar shape. This saw-toothed flow-obstructing member is rotatably mounted with the edges of its saw-toothed portions disposed in a direction to cause lines passing through them to approximately intersect the axis of rotation of the flow-obstructing member, and the rotatable flow-obstructing member is preferably made approximately elliptical in overall shape to conserve space.

For reasons explained in detail later and still further in accordance with this invention, an additional orifice is provided which is not traversed by the flow-obstructing member. This permits the condition of maximum retarding influence of the pneumatic device upon the shutter to be more precisely regulated.

Novel features and advantages of the present invention will become apparent to one skilled in the art from a reading of the following description in conjunction with the accompanying drawings wherein similar reference characters refer to similar parts and in which:

FIG. 1 is a cross-sectional view in elevation of an embodiment of this invention;

FIG. 2 is a cross-sectional view taken through FIG. 1 along the line II—II and looking in the direction of the arrows; and

FIG. 3 is a cross-sectional view similar to FIG. 2 in another phase of operation.

In FIGS. 1 and 2 is shown a portion 1 of the camera housing including a plate 2, for example, horizontally disposed a short distance below the top of housing cover 3. A structural member 4 is mounted upon plate 2 for supporting cylinder 5 of a pneumatic shutter retarding device which automatically adjusts the exposure time provided by the shutter. This pneumatic retarding device, is for example, generally similar to the device disclosed in Belgian Patent 516,387 granted on January 15, 1953, but this present device includes features not therein disclosed and as described in detail in the following.

This present pneumatic shutter retarding device includes a valve plate or disc 6 and a flexible diaphragm 8 which is secured between the wall of cylinder 5 and the bottom of a mounting ring 7 within which cylinder 5 is inserted. A rod 9 is connected substantially with the center of diaphragm 8 by means of opposed flanges 10 and 11. The other side of rod 9 is connected, for example, by a stem or cable 12 through hollow tube 13 with a movable element (not shown) of the shutter (not shown). This movable element is characterized in that the exposure time provided by the shutter is a function of the speed of movement of the movable element. This movable element is, for example, the main drive member of the shutter. Instead of stem or cable 12 and hollow tube 13, other coupling means may be utilized for connecting rod 9 with a movable element of the shutter. Such means are, for example, other types of mechanical linkages or universal joints.

A flow-obstructing element 14 is connected to the moving element (not shown) of a galvanometer 16 by means of an arm 15. Flow-obstructing element 14 is, for example, approximately elliptical in overall shape; and it is, for example, made of a sythetic or plastic material whose upper and lower surfaces are coated, for example with a conductive metal to prevent electrostatic charging.

The moving element of the galvanometer 16 is, for example, a rotating coil which is electrically connected with a photoelectric cell (also not shown) of the photoelectric exposure regulating device. Flow-obstructing member 14 is, therefore, moved with support arm 15 which is rotated by shaft 17 connected to the rotating galvanometer coil, for example, in accordance with the current developed by the photoelectric cell as it measures the ambient illumination. Member 14, therefore, covers a greater or smaller amount of the perforations or orifices 18 incorporated in valve plate 6. These orifices or perforations are preferably of varying size.

In FIG. 1, diaphragm 8 and rod 9 are shown in the position that they assume when the shutter is cocked or tensioned. As the shutter is operated, diaphragm 8 and rod 9 move downward in response to movement of the main drive member of the shutter (not shown). This draws a flow of air through orifice 18 which flow is greater or smaller in accordance with the position of flow-obstructing member 14 relative to valve plate 6 and its orifices 18. The retarding affect of diaphragm 8 on the movable element of the shutter to which it is connected is correspondingly greater or smaller which accordingly regulates the automatically controlled exposure time of the shutter.

This exposure time is indicated on scale **20** by a pointer **19** attached to flow-obstructing member **14**. The position of pointer **19** relative to the indicia on scale **20** is visible through a window **21**. These indicia are constructed and arranged to indicate predetermined exposure times provided by corresponding positions of pointer **19** on flow-obstructing member **14**.

A profile ring **22** is constructed and arranged to provide a curved or somewhat conical space under valve plate **6** which maintains the volume of air between diaphragm **8** and valve plate **6** as small as possible when the shutter is in a tensioned condition and before it initiates a downward movement of diaphragm **8**. Diaphragm **8** is, therefore, capable of being tightly maintained in contact with the adjacent surface of profile ring **22** when the shutter is in a tensioned condition as shown in FIG. 1.

A spring **23** reacts between a stationary portion of the housing and rod **9** in the direction of operating movement of the shutter to compensate for the resistance of the pneumatic retarding device, for example, to balance this resistance and substantially completely eliminate the influence of the pneumatic retarding device upon the shutter when it is regulated to a minimum influence condition.

The edge **24** of flow-obstructing member **14**, which performs the act of selectively covering or uncovering the orifices **18**, is preferably constructed and arranged in a saw-toothed shape. The saw-toothed sections include edges **25** which are disposed substantially perpendicular to their direction of movement about the axis of rotation **25** of flow-obstructing member **14**. These edges **25** are, accordingly, disposed in a direction to have extensions thereof intersect axis of rotation **26** which is an upward projection of shaft **17** which represents the rotational axis of the movable element or coil of the galvanometer **16**.

Furthermore, orifices **18** incorporated in valve plate **6** are disposed on curves **27**, **28** and **29** which are, for example, oriented substantially perpendicular to the direction of movement of surface **25** of flow-obstructing member **14**. Orifices **18** are arranged upon these curves in positions where orifices on separate curves are successively traversed by an edge **25** during the course of rotation of member **14** about its axis of rotation **26**.

This arrangement is instrumental in maintaining edges **25** during the course of covering and uncovering groups of orifices **18** disposed substantially perpendicular to the direction of travel of each of the individual saw-toothed sections. This maintains the required angle of rotation of obstructing member **14** about axis **16** for covering or uncovering an orifice **18** of a given diameter at a minimum. Therefore, a relatively large orifice area can be disposed within the rotational range of a given flow-obstructing member **14**. As schematically illustrated in FIG. 2, for example, a relatively small angular rotation of flow-obstructing element **14** can vary the degree of covering of the orifice area to a relatively great extent which permits the automatically controlled exposure time to be adjusted with relatively great precision. A change in the proportion of uncovered orifices can thereby be abruptly made at precisely predetermined positions of member **14**, preferably at positions between indicia on scale **20**.

The elliptical shape of flow-obstructing member **14** is particularly advantageous because it does not require any additional clearance beyond the circumference of the cylinder **5** even when all of the orifices **18** are covered or uncovered.

An additional orifice **30** is incorporated in valve plate **6** in a position which is never covered by flow-obstructing element **14**. A precisely regulated predetermined flow of air is thereby provided even when all of the orifices **18** are covered by flow-obstructing element **14**. In the absence of additional orifice **30**, it would be extremely difficult to precisely regulate the slight flow of air which passes through the space between orifice **18** and

flow-obstructing member **14** when they all are covered. This flow is affected by the distance from the face of plate **6** to the adjacent face of flow-obstructing element **14** which distance is extremely difficult to precisely regulate. Additional orifice **30**, therefore, provides a means of precisely regulating the slight flow of air through the pneumatic shutter retarding device when all of the orifices **18** are covered which permits the exposure time provided under this condition to be correspondingly precisely regulated. The area of additional orifice **30** is made great enough in comparison to the flow area through the space between orifices **18** and flow obstructing element **14** to make the leakage of air through this space insignificant in comparison to the precisely regulated flow of air through additional orifice **30**.

What is claimed is:

1. In combination with a photographic camera including a shutter, a pneumatic exposure regulating device comprising a perforated valve disc including a number of relatively small orifices dispersed over its surface, a flow-obstructing member which is movably mounted to cause its edge to traverse said valve disc and said orifices, said orifices being dispersed over the surface of said disc in directions spaced both along the edge of said flow-obstructing member and the path of movement of said edge, said orifices being small enough to be completely traversed by said edge within relatively small portions of its path of movement, said orifices and said edge being constructed and arranged to cause different portions of said edge to lie in different dispositions relative to said orifices, and the means which movably mounts said flow-obstructing member causing said different portions to successively traverse said orifices for precisely varying the flow of air through said disc in small increments.

2. An exposure regulating device as set forth in claim 1 wherein said portions of said edge and said orifices are arranged to cause said portions to traverse one of said orifices at a time.

3. An exposure regulating device as set forth in claim 1 wherein said orifices are arranged in groups, and said groups of orifices and said edge being constructed and arranged in a manner to cause said edge to successively traverse each of said groups of orifices.

4. A device as set forth in claim 1 wherein said orifices are arranged upon curves which incline ahead of lines perpendicular to the direction of movement of said portions of the edge of said flow-obstructing member.

5. A device as set forth in claim 4 wherein said orifices are disposed upon several of said curves, and said orifices and said edge of said flow-obstructing member are constructed and arranged to permit orifices on separate curves to be successively traversed by said edge of said flow-obstructing member.

6. A device as set forth in claim 5 wherein the edges of said portions of the edge of said flow-obstructing member are disposed substantially perpendicular to the direction of movement of said portions, and said orifices are disposed within the areas which are traversed by said edge portions during the course of the exposure regulating movement of said flow-obstructing member.

7. An exposure regulating device as set forth in claim 6 wherein said edge portions are constructed and arranged in a saw-toothed configuration.

8. An exposure regulating device as set forth in claim 7 wherein said flow-obstructing member rotates about an axis, and the covering and uncovering edges of said saw-toothed portions are constructed and arranged to have extensions thereof intersect said axis of rotation.

9. An exposure regulating device as set forth in claim 8 wherein said flow-obstructing member is constructed and arranged in a substantially elliptical shape with its outer surface disposed substantially within the confines of said

valve plate during the course of its flow-regulating movement including both limits of said movement.

10. A device as set forth in claim 1 wherein an additional orifice is incorporated in said valve plate in a position to maintain it uncovered by said flow-obstructing member when all the rest of said orifices are covered to precisely regulate the flow of air through said device when all of said rest of said orifices are covered.

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