

PATENT SPECIFICATION (11)

1 446 457

1 446 457

- (21) Application No. 49851/73 (22) Filed 25 Oct. 1973 (19)
 (31) Convention Application Nos. 2 253 000 (32) Filed 28 Oct. 1972
 2 257 608 24 Nov. 1972 in
 (33) Germany (DT)
 (44) Complete Specification published 18 Aug. 1976
 (51) INT. CL.³ G03B 7/00 F16D 63/00
 (52) Index at acceptance

G2A 401 403 455 470 473 474 481 484 488 524 527 53
 583 585 589 614 661 663 701 711 BH BK
 F2E 2E



(54) REFLEX CAMERA

(71) We, FRANKE & HEIDECHE G.m.b.H., a German Body Corporate, trading as ROLLEI-WERKE FRANKE & HEIDECHE, of 196 Salzdhumerstrasse, Braunschweig, Germany, 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 reflex camera having a photoelectric converter arranged behind the lens and serving for diaphragm setting.

Mirror-reflex cameras in which the manual setting of a diaphragm has been gradually replaced by automatically operable diaphragms are generally known. The use of interchangeable lenses and the setting of diaphragms and shutters according to the ascertaining of the setting values by TTL (Through The Lens) measurement in monocular mirror-reflex cameras have made these apparatuses into relatively fast and also convenient cameras. In the endeavour further to simplify the setting functions of such cameras and make them less problematical, by way of example exposure meters are known, the exposure measurement of which takes place in a picture-taking ray path, where the ideal diaphragm apertures thus obtained are pre-set as diaphragm stops by means of a detent setting member in conformity with a diaphragm value scale. On initiation of an exposure cycle the diaphragm then runs against this detent before the shutter opens. Apart from the fact that in the case of interchangeable lenses with different initial diaphragm apertures, precautions must be taken for adaptation to the measuring device, there still remains the disadvantage of the manual diaphragm detent setting, ascertained by a measuring operation and indicated in the viewfinder window, which is necessary before every exposure in order to arrive at correct exposure values.

Finally it is known, apart from firstly pre-

setting the exposure time in the ordinary way with an exposure time-setting member, to displace the diaphragm by means of the diaphragm detent setting member with a measuring key depressed to such an extent that a potentiometer slider coupled with the diaphragm permits a pointer deflection of a meter to adjust to a zero mark. Then the diaphragm runs against the diaphragm stop thus pre-set on release of the shutter. The zero setting of the meter pointer, which is constantly correctible by hand in the view-finder during the preparation for picture-taking, until directly before the initiation of the picture-taking cycle, permits an adjustment of the correct diaphragm aperture. This however has the considerable disadvantage that the photographer cannot concentrate completely upon the subject, but additionally must continuously perform a compensation operation of the meter.

According to the present invention there is provided a reflex camera comprising a diaphragm control circuit into which exposure factors of exposure time and film sensitivity are settable, a photo-electric converter connected in said control circuit and located to receive light through the lens diaphragm, a diaphragm actuating rod, drive means for driving the diaphragm actuating rod upon operation of a shutter release key or measuring key, and an electromagnetic stopping device for interrupting movement of the actuating rod, wherein said control circuit is arranged to energise the electromagnetic stopping device to stop the actuating rod when a diaphragm diameter determined by said exposure factors and light incident upon the photo-electric converter is reached.

Therefore there is provided a camera able to photograph rapidly moving subjects or subjects which appear unexpectedly, by means of simple handling without distraction from the observation of the subject and without loss of time in camera setting.

Therefore, there is provided a photographic camera of the initially described kind in which an exposure control system assembled with the simplest means renders

possible very rapid setting times for the diaphragm aperture.

If it is assumed that other known cameras make use of diaphragms in front of the photocell or store electrical signals, obtained by a light measurement operation, in electronic store devices before the actual release of the shutter, then the particular advantage of the idea of the invention is recognised in that these additional means can be eliminated and after the initiation of a picture-taking cycle, the light measurement in the lens ray path which determines the diaphragm aperture and the closing down of the diaphragm proceed continuously in direct mutual dependence until the correct diaphragm aperture determined by local light intensity is reached. The invention simplified in this way exploits these advantages by an independent drive for the lens diaphragm which can be liberated by means of a special measuring key or by the shutter release, and an electronic comparison circuit controlled by the photoelectric converter, which circuit on providing an output representative of the correct diaphragm aperture energises an electromagnetic stopping device to halt the diaphragm drive.

For the monitoring of the possibly varying light conditions prevailing at the picture-taking site, according to a special development of the invention check measurements can be carried out in a manner in which a check measurement which can be instigated at any time by operation of the special measurements key. Such operation serves to initiate the diaphragm setting operation and, upon reaching the diaphragm aperture for local light intensities, to fix the diaphragm such that the measured value obtained is visible as a pointer deflection in the viewfinder window. The measured value is correctible to a comparison mark on a meter, upon a change in light conditions, by variation of the shutter time.

The actuation of the special measurement key for occasionally necessary check measurements of the light conditions at the picture-taking site or the actuation of the shutter release effects the instantaneous halting of the diaphragm drive, according to an advantageous development of the invention, in that a ferromagnetic armature disc coupled with the diaphragm drive through a transmission and standing opposite to the pole shoes of an electromagnet, with a narrow gap, can be made fast on reaching the diaphragm aperture.

A diaphragm error occurring due to the time delay from initiation of the release key to the abutment of the armature disc on the magnet can advantageously be compensated by an advance of the stopping time moment. Thus an extremely short halting time of the diaphragm and thus the avoidance of such

a diaphragm error and its compensation are achieved according to a special embodiment of the invention in that the brake disc is mounted for movement towards the pole shoes.

This advantageous effect is achieved in that the armature disc is mounted on a flexible shaft end in such a way that the shaft flexes under the influence of the electromagnet and the disc contacts the pole shoes.

Finally an embodiment of an automatic diaphragm in accordance with the invention is produced by the application of the diaphragm drive to cameras with interchangeable lenses where the diaphragm is adjustable by a push rod from the camera. This embodiment is advantageous in that the automatic diaphragm in accordance with the invention readily and immediately sets itself, without alteration to accommodate interchangeable lenses of different technical forms of diaphragm blades and their diaphragm apertures, that is the maximum and minimum diaphragm aperture allocated to any desired interchangeable lens is adopted as basis for an exact setting of the correct diaphragm aperture by the automatic diaphragm system in accordance with the invention.

An embodiment of the present invention will now be described, by way of example, with reference to the accompanying drawings, wherein:—

Figure 1 shows diagrammatically an embodiment of an automatic diaphragm with a brake electromagnet acting on the periphery of a disc;

Figure 2 shows an arrangement with a brake electromagnet acting in an axial direction on a disc;

Figure 3 shows a diagram relating to a diaphragm setting with compensation of diaphragm error by adjustment of a time delay;

Figure 4 shows a circuit diagram for the control of the automatic diaphragm;

Figure 5 shows a modified embodiment of a circuit diagram according to Figure 4;

Figure 6 shows a block circuit diagram of another embodiment;

Figure 7 shows a variant of an automatic diaphragm drive, represented diagrammatically; and

Figure 8 shows a further diagrammatic illustration of an embodiment of a diaphragm drive.

Referring now to the drawings in more detail a diaphragm setting operation is initiated by a measuring key or by a shutter release of a camera (not shown). An operating rack 57 of Figure 1 with a cam 58 for a diaphragm actuating rod 59 is actuated by an electro-magnet 60 in the manner of a linear motor. A pinion 62 and an armature disc 63 are mounted on a shaft 66, the disc

63 being of ferromagnetic material, for example soft iron. The pinion 62 is in engagement with teeth 61 of the rack 57. Poles 64 of an electromagnet 65 acting as a brake and having a winding 56 are located adjacent the periphery of the armature disc, with a small air gap. If this electro-magnet 65 is actuated, that is to say if the electro-magnet 65 is energised on bridge balancing, it prevents rotation of the armature disc 63 and thus halts the diaphragm drive via actuating rod 59. This effect can be further reinforced by the fact that the armature disc 63 is seated on the outer end of the thin and therefore easily flexible shaft 66, so that the electro-magnet poles 64 on energisation of the electro-magnet 65 attract the armature disc 63 causing bending of the shaft 66 until contact of the poles with the disc periphery takes place and mechanically instantaneously halts the disc.

In an embodiment according to Figure 2, in which similar components have the same reference numerals as in Figure 1, the poles of the magnet 65 lie parallel with the shaft 66 of the armature disc 63. The armature disc 63 is axially movably guided with its hub 67 on the shaft 66, but is not rotatable relative to the shaft 66. It is held by a spring 68 in abutment with a shaft collar 69. In this embodiment the electro-magnet 65 on energisation axially moves the armature disc so that the latter engages the poles 64 and remains firmly adhering thereto, whereupon it is immediately halted.

It is expedient to provide a biasing spring arrangement 70, that is a certain initial tension which suffices to bring the drive system into abutment with the diaphragm actuating rod 59 of the lens without initially actuating the diaphragm. The force necessary for the actuation of the lens diaphragm actuating rod lies in the order of magnitude of 200 grams, so that thus with an initial tension of about 50 grams no diaphragm displacement takes place, but a play-free abutment of the cam 58 on the diaphragm actuating rod 59 is brought about.

A diaphragm error occurs due to the time difference which elapses between the switching on of the electro-magnet 65 and the halting of the armature disc 63. This error is slight at the beginning of the push rod movement and reaches an approximately constant value after a certain time. By the use of a suitably dimensioned pulse control stage in the electronic circuit, the electro-magnet is operated in advance of the above described time by a time interval which corresponds approximately to the otherwise occurring error and largely compensates the latter.

In Figure 3 these conditions are represented in graph form. The occurring diaphragm error without the advance time inter-

val is practically one diaphragm stop value or a part of a diaphragm stop value and relatively constant, so that it can be compensated by advancement of the moment of stopping. If the advance time interval is made dependent upon the rate at which the measured light varies, then at the same time the influence of different speeds of running off of the diaphragm drive are also compensated.

In Figure 4 upon closing switch 6 the circuit is connected with a battery 8. Under the influence of incident light a current occurs in photoelectric converter 1 which causes a voltage drop U_1 across resistor 2. A voltage U_2 occurs across a potentiometer 3, which voltage U_2 represents a correct value of the illumination intensity as determined by exposure time and film sensitivity. The voltage U_1 corresponds to a measured actual value of the illumination intensity. The difference between the two voltages is indicated by an instrument 4. The diaphragm value can be read off on this instrument by an appropriate scale. The voltages U_1 and U_2 are applied to the inputs of a comparator 5. This measurement takes place with the diaphragm fully open. Under ordinary light conditions and with setting of the potentiometer 3 according to an ideal value of light intensity, the voltage U_1 is greater than the voltage U_2 .

Upon releasing the camera shutter switch 7 is closed, whereby the electromagnet 65 is connected with the battery 8. As long as the voltage U_1 exceeds the voltage U_2 , this electromagnet remains de-energised; the simultaneously liberated diaphragm drive, which is further described hereinafter, closes the diaphragm, whereby the photoelectric current and thus the voltage U_1 drop. At the moment when the voltages U_1 and U_2 become equal, the comparator 5 energises the electro-magnet 65 which then halts the diaphragm drive, in that it interrupts movement of the actuating rod.

A modified form of the circuit arrangement is represented in Figure 5 in which similar components have the same reference numerals as in Figure 4. The functions of the indicator instrument 4 and of the comparator 5 are the same as described in Figure 1. The current of the photoelectric converter 1 is converted by an operational amplifier 20 which is connected with a resistor 21 in a known manner as a current voltage amplifier, into a voltage level at the output of the operational amplifier 20. Resistors 22 and 23 form the reference level for the positive input of the operational amplifier 20. The potentiometer 3 serves for the introduction of the exposure time and film sensitivity into the circuit. The switches 6, 7, the electro-magnet 65 and the battery 8 are connected in the same

12/18

operational manner as Figure 4. The advantage over the embodiment according to Figure 4 consists above all in that the photoelectric converter 1 is operated almost exactly in short circuit and that the current through the indicator instrument does not load the photo-electric current.

Both embodiments are directed to diaphragm drives which are freed on actuation of the camera release. Accordingly, they operate automatically and are stopped by an electro-magnetically actuated catch or brake when the correct diaphragm value is reached.

If the diaphragm setting drive does not take place mechanically, for example by a drive spring tensioned in the cocking of the shutter or by winding of the film, but is effected electromagnetically or by an electric motor, the switch 7 can be actuated by a measuring key so that for a check measurement the correct diaphragm is set (dark measurement), which permits a direct assessment of the depth of focus of the camera.

Finally the arrangement can also be made such that on pressing of a measuring key only the switch 6 is closed, so that a light measurement is enabled while pressure is applied to the release up to a particular pressure point so that on pressing of the release as far as the pressure point the switch 7 is closed and a dark measurement results. If the release is operated beyond the pressure point, then the actual shutter release and exposure of the film take place directly upon the diaphragm setting.

Referring to Figures 6, 7 and 8 there are illustrated different embodiments of the manner in which a rack 27 and 37 or gearwheel 27¹ are driven. The stopping of the respective rack or gearwheel is not specifically described but is effected by an electromagnetic stopping device in a manner according to the invention.

In Figure 6 there is illustrated a block circuit diagram of an embodiment which operates according to the invention, and in which when the correct value of the diaphragm is reached the drive is switched off. In the circuit illustrated in Figure 6 a photoelectric cell 11 is connected via a bridge 28 to a zero voltage discriminator 29 which switches on a timing signal pulse generator 24 and switches it off upon balancing of the bridge. The timing signal generator is effective to actuate a stepping motor 25 which operates a rack 27 by means of a pawl 26, which rack in turn effects the push rod drive of the diaphragm.

In Figure 7 a variation of Figure 6 is illustrated in which a linear motor 25¹ operates a stepping gearwheel 27¹ by means of a pawl 26¹, from which the actuating rod drive is derived, for example, through a spiral cam (not shown).

In Figure 8 a further rack drive is illustrated. A rack 37 which is moved in a stepped manner by stepping pawl 36, possesses an oblique face 38 which displaces diaphragm adjusting push rod 39. A return spring 40 is thereby tensioned. The stopping of the rack 37 is effected by an electromagnetic stopping device according to the present invention. The system is held in position by a detent pawl 41. On release of the measuring or release key, the drive motor or operating magnet 42 is de-energised, so that the spring 40 draws the rack 37 back again into the rest position when the detent pawl 41 is disengaged from the rack 37. It is obvious that the rack 37 and the rectilinear oblique surface 38 are in the form of a rotating cam in the case of a rotatable system such as in Figure 7.

WHAT WE CLAIM IS:—

1. A reflex camera comprising a diaphragm control circuit into which exposure factors of exposure time and film sensitivity are settable, a photo-electric converter connected in said control circuit and located to receive light through the lens diaphragm, a diaphragm actuating rod, drive means for driving the diaphragm actuating rod upon operation of a shutter release key or measuring key, and an electromagnetic stopping device for interrupting movement of the actuating rod, wherein said control circuit is arranged to energise the electromagnetic stopping device to stop the actuating rod when a diaphragm diameter determined by said exposure factors and light incident upon the photo-electric converter is reached.

2. A camera as claimed in claim 1, wherein a check measurement is available by actuation of the measuring key to initiate the diaphragm setting operation and, upon reaching the required diaphragm aperture, to fix the diaphragm aperture so that the measured value obtained is visible as a pointer deflection in a viewfinder window, which measured value is correctible to a comparison mark in the event of changing light conditions on the measuring mechanism by variation of the shutter time.

3. A camera as claimed in claim 1 or 2, wherein a ferromagnetic armature disc is coupled with the diaphragm drive by a transmission and is located opposite to pole shoes of an electromagnet with an air gap comprising the electromagnetic stopping device, which armature disc is made fast when the correct diaphragm aperture is reached.

4. A camera as claimed in claim 3, wherein the armature disc is mounted for yieldable movements towards the pole shoes.

5. A camera as claimed in claim 3 or 4, wherein the armature disc is mounted on a flexible shaft end in such a way that it flexes under the influence of the electro-

operational manner as Figure 4. The advantage over the embodiment according to Figure 4 consists above all in that the photoelectric converter 1 is operated almost exactly in short circuit and that the current through the indicator instrument does not load the photo-electric current.

Both embodiments are directed to diaphragm drives which are freed on actuation of the camera release. Accordingly, they operate automatically and are stopped by an electro-magnetically actuated catch or brake when the correct diaphragm value is reached.

If the diaphragm setting drive does not take place mechanically, for example by a drive spring tensioned in the cocking of the shutter or by winding of the film, but is effected electromagnetically or by an electric motor, the switch 7 can be actuated by a measuring key so that for a check measurement the correct diaphragm is set (dark measurement), which permits a direct assessment of the depth of focus of the camera.

Finally the arrangement can also be made such that on pressing of a measuring key only the switch 6 is closed, so that a light measurement is enabled while pressure is applied to the release up to a particular pressure point so that on pressing of the release as far as the pressure point the switch 7 is closed and a dark measurement results. If the release is operated beyond the pressure point, then the actual shutter release and exposure of the film take place directly upon the diaphragm setting.

Referring to Figures 6, 7 and 8 there are illustrated different embodiments of the manner in which a rack 27 and 37 or gearwheel 27¹ are driven. The stopping of the respective rack or gearwheel is not specifically described but is effected by an electromagnetic stopping device in a manner according to the invention.

In Figure 6 there is illustrated a block circuit diagram of an embodiment which operates according to the invention, and in which when the correct value of the diaphragm is reached the drive is switched off. In the circuit illustrated in Figure 6 a photoelectric cell 11 is connected via a bridge 28 to a zero voltage discriminator 29 which switches on a timing signal pulse generator 24 and switches it off upon balancing of the bridge. The timing signal generator is effective to actuate a stepping motor 25 which operates a rack 27 by means of a pawl 26, which rack in turn effects the push rod drive of the diaphragm.

In Figure 7 a variation of Figure 6 is illustrated in which a linear motor 25¹ operates a stepping gearwheel 27¹ by means of a pawl 26¹, from which the actuating rod drive is derived, for example, through a spiral cam (not shown).

In Figure 8 a further rack drive is illustrated. A rack 37 which is moved in a stepped manner by stepping pawl 36, possesses an oblique face 38 which displaces diaphragm adjusting push rod 39. A return spring 40 is thereby tensioned. The stopping of the rack 37 is effected by an electromagnetic stopping device according to the present invention. The system is held in position by a detent pawl 41. On release of the measuring or release key, the drive motor or operating magnet 42 is de-energised, so that the spring 40 draws the rack 37 back again into the rest position when the detent pawl 41 is disengaged from the rack 37. It is obvious that the rack 37 and the rectilinear oblique surface 38 are in the form of a rotating cam in the case of a rotatable system such as in Figure 7.

WHAT WE CLAIM IS:—

1. A reflex camera comprising a diaphragm control circuit into which exposure factors of exposure time and film sensitivity are settable, a photo-electric converter connected in said control circuit and located to receive light through the lens diaphragm, a diaphragm actuating rod, drive means for driving the diaphragm actuating rod upon operation of a shutter release key or measuring key, and an electromagnetic stopping device for interrupting movement of the actuating rod, wherein said control circuit is arranged to energise the electromagnetic stopping device to stop the actuating rod when a diaphragm diameter determined by said exposure factors and light incident upon the photo-electric converter is reached.

2. A camera as claimed in claim 1, wherein a check measurement is available by actuation of the measuring key to initiate the diaphragm setting operation and, upon reaching the required diaphragm aperture, to fix the diaphragm aperture so that the measured value obtained is visible as a pointer deflection in a viewfinder window, which measured value is correctible to a comparison mark in the event of changing light conditions on the measuring mechanism by variation of the shutter time.

3. A camera as claimed in claim 1 or 2, wherein a ferromagnetic armature disc is coupled with the diaphragm drive by a transmission and is located opposite to pole shoes of an electromagnet with an air gap comprising the electromagnetic stopping device, which armature disc is made fast when the correct diaphragm aperture is reached.

4. A camera as claimed in claim 3, wherein the armature disc is mounted for yieldable movements towards the pole shoes.

5. A camera as claimed in claim 3 or 4, wherein the armature disc is mounted on a flexible shaft end in such a way that it flexes under the influence of the electro-



18/19
5

magnet stopping device into contact with the pole shoes.

- 5 6. A camera as claimed in any of the preceding claims, wherein the camera is adapted to receive interchangeable lenses, the diaphragms of which are adjustable via the diaphragm actuator rod.

7. A reflex camera substantially as des-

cribed herein with reference to and as illustrated by the accompanying drawing. 10

For the Applicants:
MATTHEWS, HADDAN & CO.,
Chartered Patent Agents,
33 Elmfield Road,
Bromley, Kent.

Printed for Her Majesty's Stationery Office by Burgess & Son (Abingdon), Ltd.—1976.
Published at The Patent Office, 25 Southampton Buildings, London, WC2A 1AY
from which copies may be obtained.

