

Sept. 14, 1965

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3,205,569

METHOD OF FABRICATING A PHOTOGRAPHIC APERTURE REGULATING DEVICE

Filed Jan. 10, 1964

2 Sheets-Sheet 1

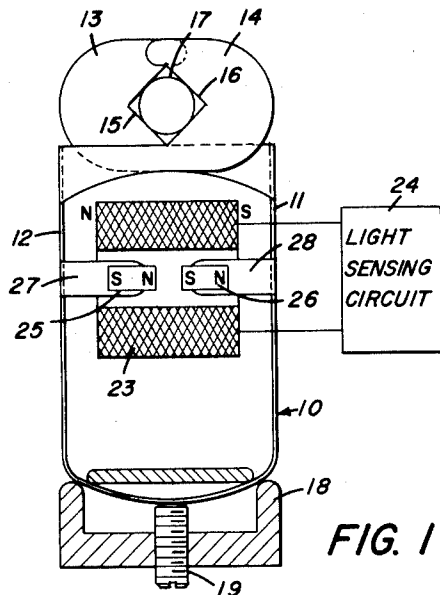


FIG. 1

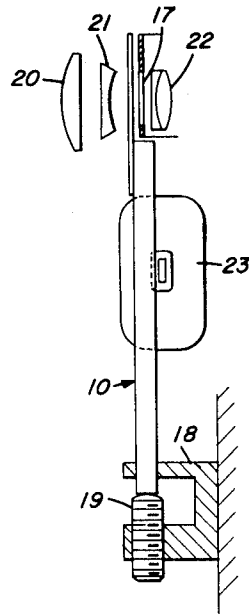


FIG. 3

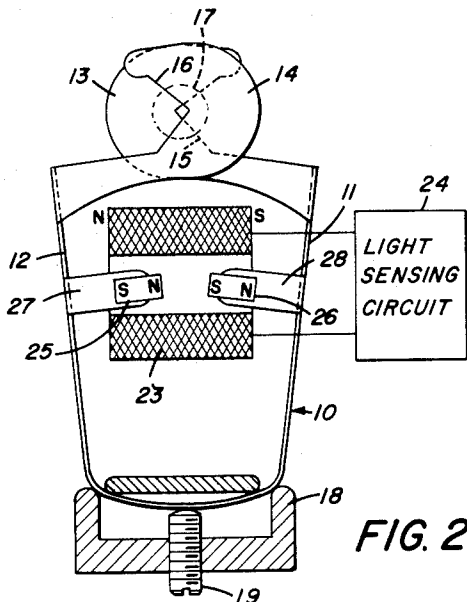


FIG. 2

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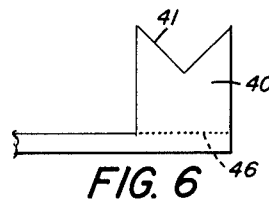
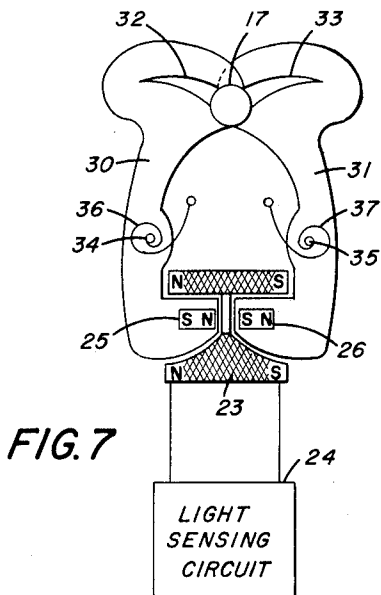
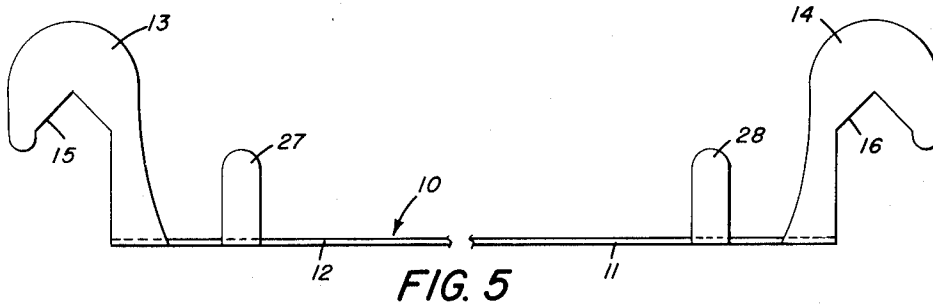
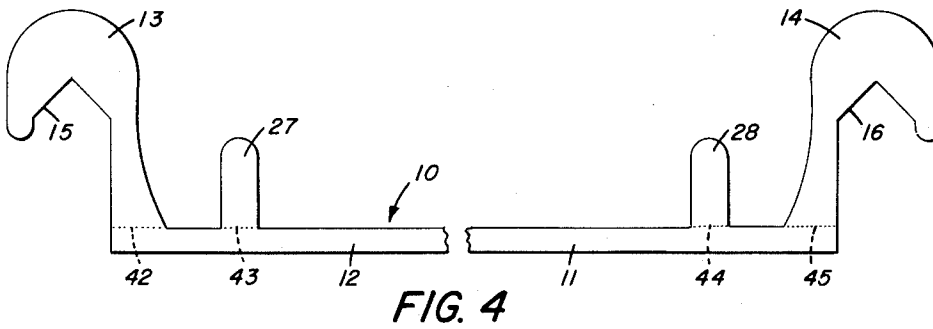
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## METHOD OF FABRICATING A PHOTOGRAPHIC APERTURE REGULATING DEVICE

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Filed Jan. 10, 1964, Ser. No. 337,031

3 Claims. (Cl. 29—407)

This invention relates to a device for regulating the effective size of a photographic aperture, and more particularly to an adjustable diaphragm vane device and method of making such a vane device that is positionable in accordance with interaction between permanent magnet means and solenoid means variably energized as a function of sensed illumination.

It is an object of this invention to regulate the effective size of a photographic aperture by means of a simple device that is electromagnetically positionable.

Another object of the invention is to reduce the manufacturing costs of a photographic aperture regulating device.

Another object of the invention is to form a diaphragm vane means from a single piece of material.

Another object of the invention is to eliminate the effects of hysteresis on an electromagnetic diaphragm vane adjusting mechanism.

Another object of the invention is to position a diaphragm vane by means of an electromagnetic actuator that is non-linear in its response to sensed illumination.

Another object of the invention is to regulate the effective size of a diaphragm aperture by means of a device that is reliable and accurate in operation, and to make such a device by a method that is simple and economical.

Another object of the invention is to eliminate the multiplicity of parts and reduce the relative movements of parts forming a diaphragm aperture size adjusting device.

These and other objects of the invention are accomplished by forming from a piece of bendable material an elongated member having longitudinally spaced notched vanes arranged so that when the member is bent into a U-shape, the notched vanes overlap and form an adjustable aperture the effective size of which varies as a function of the overlap of the vanes. Such a U-shaped or equivalent diaphragm vane device is positioned by the magnetic repulsion between solenoid or coil means variably energized as a function of sensed illumination and permanent magnet means, no other magnetic material being present within the effective magnetic field of the solenoid means. The invention will be more clearly understood by reference to the following description and the accompanying drawings wherein:

FIGS. 1 and 2 show partially schematic, partially sectioned front plan views of a diaphragm aperture adjusting device according to the invention.

FIG. 3 shows a partially schematic, partially sectioned side view of the device of FIGS. 1 and 2.

FIGS. 4 and 5 show steps in the method of fabricating the diaphragm vane illustrated in FIGS. 1-3.

FIG. 6 shows a plan view of an alternate vane configuration suitable for a single piece diaphragm vane device.

FIG. 7 shows a partially schematic, partially sectioned front plan view of a two-vane diaphragm aperture and adjusting device according to the invention.

As shown in FIGS. 1-3, a U-shaped diaphragm vane member 10 has leg portions 11 and 12 integral with vanes 13 and 14 that have respective notches 15 and 16 for regulating the effective size of photographic aperture 17 as a function of the overlap of the vanes. The overlap

of the vanes 13 and 14 is in turn regulated by the position of leg portions 11 and 12 of U-shaped member 10. U-shaped member 10 is supported in a holder 18 having an adjusting screw 19 for calibrating the overlaps of vanes 13 and 14.

To incorporate the aperture adjusting member 10 into a photographic camera, holder 18 is fixed to the camera so as to position notches 15 and 16 over a camera taking lens aperture 17 for varying its effective size. To facilitate such an arrangement, camera taking lenses 20-22 can be associated with aperture 17 as shown in FIG. 3.

For positioning vanes 13 and 14 so as to regulate the effective size of aperture 17, a coil or solenoid 23 is in circuit with schematically illustrated light-sensing circuit 24 so that solenoid 23 is variably energized as a function of sensed illumination. Many well-known photocell circuits including unassisted selenium cells, photoconductive cells with batteries, and amplified photocell outputs may be used as light-sensing circuit 24. Typically such photocells are arranged for accepting illumination from a scene to be photographed.

Interacting with the variable field of solenoid 23 are two permanent magnets 25 and 26 fixed respectively to arms 27 and 28 so as to extend into the hollow center of solenoid 23 as shown in FIG. 1 wherever solenoid 23 is unenergized. Diaphragm adjusting member 10 including legs 11 and 12 and arms 27 and 28 is preferably formed of nonmagnetic material so as not to be affected by the magnetic field of solenoid 23. Magnetic material within the effective variable field of solenoid 23 such as soft iron that is subject to the effects of hysteresis would introduce inaccuracies into the functioning of diaphragm aperture vanes 13 and 14. In other words, such magnetic material would retain some residual magnetism after a cycle of operation of coil 23 depending on previous induced magnetism and thus would start each aperture regulating cycle with variable and unknown conditions of induced magnetism. This results in inaccuracies in the positioning of vanes in response to the energization of coil 23. By eliminating from the effective magnetic field of solenoid 23 all magnetic material other than permanent magnets 25 and 26, the errors produced by hysteresis are eliminated. Permanent magnets 25 and 26 retain their fixed values of induced magnetism so as not to be subject to any variation from hysteresis effect. Once the inaccuracies from variable magnetic reactions from hysteresis are eliminated, a simple device such as illustrated in FIGS. 1-3 can function accurately to regulate the effective size of aperture 17 as a function of the illumination sensed by light-sensing circuit 24.

The interaction between the variable magnetic field of solenoid 23 and permanent magnets 25 and 26 is one of magnetic repulsion. This has the advantage of positioning vanes 13 and 14, as a function of a non-linear response to sensed illumination. Since the magnetic field strength within the hollow core of solenoid 23 for any given value of energization is uniform from the center to the edges of the coil, and is strongest throughout such a zone, magnets 25 and 26 react to the greatest repulsive forces available for the lower values of illumination and to relatively decreased repulsive forces for increases in illumination from higher values of light intensity. Thus, when sensed illumination is at low values, magnets 25 and 26 are relatively strongly repulsed toward the ends of coil 23 and for intense illumination and relatively high energization levels of solenoid 23, magnets 25 and 26 begin to withdraw from the ends of coil 23 and increased illumination produces relatively weaker increases in repulsive forces. This is desirable for approximating the

log-linear conversion of sensed light intensity to mechanical movement.

Of course, the relative positions of solenoid and permanent magnets could be interchanged. Thus, two hollow solenoids could move over the ends of a fixed permanent magnet. Also, solenoid 23 could be formed in two connected coils and arms 27 and 28 could be located in another position, for example, bent outwardly of legs 11 and 12 for interacting with separate solenoid coils. Alternatively, the solenoid could be fixed to one leg of member 10 and a permanent magnet fixed to the other leg.

In FIG. 7 is illustrated an alternative embodiment of the invention using two pivoted diaphragm vanes 30 and 31 having respective falcate or sickle-shaped openings 32 and 33 co-operating to define photographic aperture 17 that is variable as a function of the overlap of vanes 30 and 31. Vanes 30 and 31 are mounted for rotation about pivot points 34 and 35 respectively. Respective springs 36 and 37 operate to return vanes 30 and 31 from any deflected position to the position illustrated in FIG. 7 in which vane openings 32 and 33 provide maximum effective size for aperture 17. Permanent magnets 25 and 26, fixed respectively to vanes 30 and 31, interact repulsively with coil 23, and light sensing circuit 24 variably energizes coil 23—both as described above for FIGS. 1-3.

One advantage of the diaphragm aperture adjusting member 10 illustrated in FIGS. 1-3 is that it can be manufactured from a single piece of material by an advantageous method, steps of which are illustrated in FIGS. 4-6. A piece of bendable and preferably non-magnetic material should be selected, suitable materials including non-magnetic metals such as aluminum and various plastics. To make the diaphragm vane member 10 illustrated in FIGS. 1-3, the elongated member 10 illustrated in FIG. 4 is cut from a flat piece of bendable material. Such member has leg portions 11 and 12 and vanes 13 and 14 having respective notches 15 and 16. Arms 27 and 28 also extend from leg portions 12 and 11 respectively. Although arms 27 and 28, and vanes 13 and 14 may extend from either or alternate sides of member 10, it is preferred that vanes 13 and 14 extend from the same lateral side of elongated member 10 as illustrated in FIG. 4.

Alternatively, vane 40 having notch 41 as illustrated in FIG. 6 may be substituted for the vane configuration of vanes 13 and 14 as illustrated in FIGS. 4 and 5.

Right angle bends are formed at dotted lines 42-45 or 46 that are located where vanes and arms project laterally from elongated member 10. Such right angle bends are made so that vanes 13 and 14 extend from the same face of leg portions 12 and 11 respectively as illustrated in FIG. 5. In such position vanes 13 and 14 are coplanar in a plane normal to the plane of leg portions 11 and 12. Arms 27 and 28 are similarly bent at right angles so as to project from the same face of leg portions 11 and 12, but, as indicated above, arms 27 and 28 could be bent in opposite right angles so that either one or both of arms 27 and 28 extended in a direction 180 rotational degrees from the direction illustrated in FIG. 5. The determining factor for the bends of arms 27 and 28 is the desired location and number of solenoids or permanent magnets.

When the member, 10 formed as illustrated in FIG. 5, is bent into a U-shape as illustrated in FIGS. 1-3, vanes 13 and 14 overlap to define the effective size of aperture 17. With the fixing of permanent magnets 25 and 26 to

arms 27 and 28 respectively, diaphragm aperture adjusting member 10 is ready for insertion into holder 18. Adjustment of screw 19 calibrates member 10 for operation.

The advantages of the above-described vane manufacturing method include simplicity, economy of parts, elimination of assembly operations, and reduction of the possibilities for manufacturing errors, all of which contribute to economy of manufacture.

The invention has been described in detail with particular reference to preferred embodiments thereof but it will be understood that variations and modifications can be effected within the spirit and scope of the invention as described hereinabove and as defined in the appended claims.

We claim.

1. A method of fabricating a photographic aperture regulating device, comprising:

- (a) from a flat piece of bendable material, forming and elongated strip having a pair of longitudinally spaced, notched vanes extending laterally from one side of said strip adjacent the opposite ends thereof;
- (b) forming an approximately right angle blend where each of said vanes joins said elongated strip so that said vanes extend in the same general direction from said elongated strip and are approximately coplanar in a plane normal to the plane of said elongated strip; and

- (c) bending said elongated strip into a U-shape so that said vanes partially overlap and their respective notches cooperate to define an aperture that is variable in size as a function of the overlap of said vanes.

2. A method of fabricating a photographic aperture regulating device, comprising:

- (a) cutting from a flat piece of bendable material an elongated strip having near its opposite ends a pair of notched vanes extending laterally from the same side of said strip, and having two tabs extending laterally from one side of said strip at locations therealong spaced from one another and from said vanes;
- (b) forming approximately right angle bends where each of said vanes joins said elongated strip so that said vanes extend in the same general direction from said elongated strip and are approximately coplanar in a plane normal to the plane of said elongated strip;
- (c) similarly forming approximately right angle bends where each of said tabs joins said elongated strip so that said tabs also extend in a common direction from said strip; and
- (d) bending said elongated strip into a U-shape so that said tabs are in general alignment with one another and said vanes partially overlap and their respective notches cooperate to define an aperture that is variable in size as a function of the overlap of said vanes.

3. The method of claim 2 with the additional step of fixing permanent magnets to said tabs.

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