Exposure and focus system for a zoom lens camera
Belichtungs- und Fokussierungssystem für eine Kamera mit Zoomobjektiv
Système d’exposition et de mise au point pour un appareil photographique muni d’un objectif à focale variable
DESCRIPTION

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates generally to photographic zoom cameras and, more particularly, to passive automatic focus/automatic exposure systems for cameras.

2. Description of the Related Art

Cameras that require no adjustments from users before taking photographs are very inexpensive and easy to use, and therefore are quite popular with consumers. These cameras often have a fixed lens focus distance, shutter speed, and aperture diameter. For improved picture-taking with no loss in convenience, consumers typically purchase flash-equipped cameras with variable focus, shutter, and aperture mechanisms and automatic exposure and automatic focus systems. Automatic exposure systems detect the amount of ambient light in the photographic scene and adjust one or more exposure parameters such as shutter speed, aperture opening, and flash setting to obtain optimal exposures for the detected light level. Automatic focus systems typically include ranging systems that determine the distance from the camera to a subject and automatically set the focus of the camera objective lens in accordance with the determined distance. Generally, the distance to the subject can be measured by a light- or sound-emitting system, comprising an active system, or the distance can be measured by the ambient light received from the photographic scene, comprising a passive, split-image rangefinder system.

Active ranging systems generally provide good accuracy, but require relatively expensive components, including an emitter that produces a beam of energy directed into a photographic scene, a beam receiver that detects the reflected beam from a subject in the scene, and a control system that provides power to the emitter and processes information from the beam receiver to determine the distance to the subject. These systems add cost and increase the difficulty of packaging the camera components into a compact camera size. Passive split-image rangefinder systems can require complex data manipulation and correlation functions to make the calculations necessary to convert received ambient light levels into object distances. Sophisticated cameras that provide both automatic lens focus and exposure control features are very convenient to use and provide good results, but can be rather complex and expensive. See, for example, U.S. Patent No. 4,345,825 to Matteen and U.S. Patent No. 5,017,955 to Kotani disclosing a camera in which a flash unit, a shutter/aperture combination exposure system and an autofocus system are automatically actuated by a controller including a data table memory for taking pictures while the depth of field is optimized.

Cameras that provide the benefits of automatic exposure and automatic focus without the complexity and expense of more sophisticated ranging systems are desirable. For example, U.S. Patent No. 4,710,013 to Wong assigned to W. Haking Enterprises of Hong Kong describes a camera with a relatively simple passive automatic focus and automatic exposure capability in which the ambient light level is detected as being one of two levels and limited camera adjustments are made accordingly. A detected lower light level places the camera in a flash mode in which a flash unit is activated and lens focus distance is set to a minimum setting with maximum aperture, and a higher light level places the camera in a daylight mode in which the flash unit is turned off and the lens focus distance is set to a maximum setting with minimum aperture.

Although an automatic lens focus and automatic exposure control system such as described in the Haking patent is not excessively complex and expensive and also generally provides satisfactory photographs, it would be desirable to provide greater adjustment capability without the relatively great complexity and expense of the other systems described above. For example, with only two light levels from which to index camera adjustments, somewhat incorrectly exposed exposures can be produced, especially in high contrast situations. Greater exposure parameter adjustment would help provide exposures that are more evenly illuminated.

From the discussion above, it should be apparent that there is a need for a relatively simple and inexpensive automatic lens focus and automatic exposure control system that provides quick, relatively accurate lens focus distance setting and improved exposure under a variety of lighting conditions. The present invention fulfills this need.

SUMMARY OF THE INVENTION

The present invention provides a zoom camera as defined in Claim 1. Essentially, the camera for taking photographs of a scene includes a flash unit operable in a flash on or flash off status, an objective lens with means for focus distance adjustment having means for selecting, by a user, one of a limited number of predetermined focal lengths, and a shutter/aperture combination adapted for adjustment through a range of exposure settings comprising shutter times and aperture diameters to produce an exposure, the system comprising:

- a light level detecting system that receives ambient light from the scene and produces a light signal representative of the amount of received light;
- a controller that receives the light signal and determines a lens focus distance, flash unit status, and exposure setting in accordance with the received light signal value and controls the focus distance of the objective lens, the flash unit status, and the set-
tuning of the shutter/aperture combination in accordance with such determinations; and
a program table memory providing data to the controller and having data elements addressed by light
signal value, each data element storing lens focus distance data for setting the lens focus distance at
one of a plurality of distance zones, flash unit status data for setting the flash unit status, aperture data
for setting the aperture size, and shutter time data for setting the shutter open time, such that the flash
unit status is changed from off to on at a predetermined light signal value without a corresponding
change in lens focus distance.

The light level at which the flash unit is turned on
and the lens focus distance is held unchanged is select-
ed such that the flash unit provides lighting to eliminate
shadows without changing the overall exposure. In this
way, for example, the flash unit can be activated at a
subject distance under conditions where it can provide
a more pleasing exposure under high contrast condi-
tions. That is, the flash unit can be activated before nec-
essary to prevent underexposure and at a subject dis-
tance greater than is conventional, improving the result-
ing exposure. The use of a program table memory helps
reduce the cost of achieving such improvements.

In another aspect of the invention, the system in-
cludes a user-operable flash selection switch operable
between a flash setting and a no-flash setting, and the
table memory data includes data elements addressed
by light signal level for setting the exposure at different
values depending on the setting of the flash selection
switch. With the flash selection switch set to the flash
setting, the flash unit status is set in accordance with
the table memory so the flash unit is automatically acti-
vated. When the flash selection switch is set to the no-
flash setting, the data elements selected from the table
memory are such that the flash unit status is always set
to off and the flash unit is never activated. In addition,
the selected data elements increase the shutter open
times as compared to the data elements where the flash
unit would otherwise have been activated. This provides
a simplified automatic focus/automatic exposure control
system that produces optimal exposures when flash is
not desired.

Other features and advantages of the present in-
tention should be apparent from the following descrip-
tion of the preferred embodiments, which illustrate, by
way of example, the principles of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a perspective view of a camera constructed
in accordance with the present invention.

Fig. 2 is a block diagram of the automatic focus/au-
tomatic exposure system of the camera illustrated in Fig.
1.

Fig. 3 is a chart showing the values entered in the
first program memory table illustrated in Fig. 2.

Fig. 4 is a chart showing the values entered in the
second program memory table illustrated in Fig. 2.

DESCRIPTION OF THE PREFERRED EMBODIMENT

With reference to Fig. 1, a camera 10 constructed
in accordance with the present invention includes an
objective lens 12 that directs light from an ambient scene
to a photographic film plane (not illustrated) in the cam-
ера to expose an image onto photographic film. The
camera also includes a viewfinder 14 through which a
camera user views the ambient scene and frames the
exposure to be produced. A shutter button 16 is operat-
ed by the camera user to initiate production of an ex-
posure. A light-detecting sensor 18 detects the camera-
received ambient light level in the scene. A flash unit 20
provides auxiliary lighting under certain conditions and
a flash selection switch 22 is operable between a flash
setting and a no-flash setting to control the flash lighting.
The lens 12 is a zoom lens that can be set to one of five
focal lengths, which are selected by the camera user
with a zoom switch 24. The camera includes a light level,
automatic zone focus and automatic exposure system
that detects light level through the sensor 18 and selects
parameters for flash unit status, lens focus distance, and
exposure setting based on the light level detected by the
sensor. The light level transition at which the flash unit
status is changed from off to on is different from the light
level transition at which the lens focus distance is
changed, which permits better tailoring of exposure pa-
rameters. In this way, the flash unit can be activated at
a light level and focus distance greater than necessary
to prevent underexposure but sufficient to eliminate
shadows in high contrast lighting conditions, thereby
producing better quality exposures, while making use of
a simplified, light-level-type automatic focus and auto-
matic exposure system.

Fig. 2 is a block diagram of the automatic focus/au-
tomatic exposure system 30 of the camera 10. The light-
detecting sensor 18 detects the ambient light level re-
ceived by the camera, as noted above, and produces a
light signal that is representative of the amount of re-
ceived light. The light signal is provided to a controller
32 over a signal line 33. When the shutter button 16 is
pressed, the controller adjusts the focus distance of the
objective lens 12 through a lens-positioning system 34,
controls the flash unit 20 to automatically provide flash
illumination when set to an "on" status, and sends an
exposure setting signal to a shutter/aperture combina-
tion 36.

The controller 32 obtains the lens focus distance
data, flash unit status data, and exposure setting data
from a first program memory table 38 having data ele-
ments addressed by light signal level. The exposure set-
ting data, for example, includes information such as
shutter open time data and aperture diameter setting da-
ta. The memory table comprises a digital memory de-
vice and therefore provides digital data to the controller
32. In contrast, the remaining components such as the
light detecting sensor 18, lens positioning system 34,
and shutter/aperture combination 36 can be analog de-
vices. The controller therefore is provided with pulses
from a system clock 39 to extract the digital data from
the table. Storing the exposure parameters as entries in
a table permits selection of optimal combinations of set-
ing at relatively low cost.

Fig. 3 illustrates the entries of the program memory
table 38 of the preferred embodiment. The program
memory table is indexed by a plurality of light level in-
tervals. Each light level interval has corresponding en-
tries for lens focus distance, flash status, shutter open
time, and aperture diameter. In the preferred embod-
iment, the table 38 is provided with five turning points,
or transitions, that define six light level intervals.

As can be seen from the table of Fig. 3, the control-
ner 32 controls the lens positioning system 34 to set the
lens 12 at one of five focal lengths selected by the cam-
era user. At each focal length, the controller selects pic-
ture-taking parameters in accordance with the light level
detected by the sensor 18. In particular, the controller
selects an aperture opening for the shutter/aperture
combination 36 corresponding to an f-stop number, se-
lects a flash status for the flash unit 20, selects a focus
distance for the lens 12, and selects a shutter open time
for the shutter/aperture combination 36. As can be seen
from the table, the five light level turning points are
indicated as TP1 through TP5. For example, when the
light level detected by the light-detecting sensor 18 in-
creases from a light level signal value less than TP1 to
a value greater than TP1, then the f-stop is changed
from f/8 to f/10.6. Similarly, at the same turning point,
the focus distance for the lens 12 is changed from 7.5
feet (2.3 meters) to 11.5 feet (3.5 meters).

In general, the system 30 assumes that a greater
light level corresponds to an outdoor scene, implying
greater distances, and assumes that a lower light level
corresponds to an indoor scene, implying shorter cam-
era-to-subject distances. Thus, greater light level values
are associated with greater focus distances and lesser
light level values are associated with lesser focus dis-
tances. Exposure setting and flash status are changed
accordingly, as well.

With respect to at least one pair of adjacent light
level intervals, the program memory table 38 has table
entries such that the flash status is changed while the
lens focus distance is held constant. In particular, the
lens focus distance is set to one of two distances for any
focal length selected by a user and the flash unit 20 sta-
tus is changed from off to on at a light signal turning point
different from that used to change the focus distance.
For example, at a user-selected lens focal length of 26.0
mm in the table of Fig. 3, the flash unit status is changed
from off to on when the light signal value changes from
greater than TP2 to less than TP2, but lens focus dis-
tance remains constant at 11.5 feet (3.5 meters). Shutter
open time and aperture stop also remain constant at
10.0 msec and f/10.6, respectively. Lens focus distance
is not changed until the light signal value drops below
TP1. At a user-selected focal length of 48.0 mm, the
flash unit 20 status is changed from off to on when the
light signal value changes from greater than TP4 to less
than TP4 but lens focus distance remains constant until
the light signal value drops below TP3.

Conventional passive light-level, zone automatic fo-
cus/automatic exposure systems such as the related art
discussed above change lens focus distance and flash
status simultaneously at a light level where the change
is necessary to prevent underexposure. The present in-
vention, however, changes flash unit status to provide
flash at a light level greater than that necessary to pre-
vent underexposure, and changes focus distance at a
different light level, to eliminate shadows under daylight
photographic conditions using a typical ISO 100 photo-
graphic film. Such flash illumination provides what is
commonly referred to as a fill flash function. Compara-
tively sophisticated control systems can provide such
a function, but typically do so with much greater com-
plexity and expense. See, for example, the related art
discussed above. The present invention provides such a
function with a relatively simple automatic focus and au-
tomatic exposure system that operates solely on the ba-
sis of detected ambient light level.

To further simplify the system 30, only four aperture
diameters are possible. The aperture diameters are in-
dicated in the table as either 1, 2, 3, or 4 enclosed within
parenthesis following the f-stop number. These aperture
diameters correspond to approximately 4.3 mm, 3.8
mm, 3.2 mm, and 2.5 mm, respectively. Thus, the con-
troller 32 selects the aperture diameter for the shutter/
aperture combination 36 from a predetermined number
of diameters. Restricting the number of diameters at
which the shutter/aperture combination can be set sim-
plifies the construction of the combination and therefore
reduces cost. The table of Fig. 3 also shows that each
aperture diameter has associated with it only one expo-
sure time. For example, aperture diameter numbers 1
and 2 are associated with an exposure time of 13.0
msec while aperture diameter numbers 3 and 4 are as-
sociated with exposure times of 10.0 msec. Permitting
only one exposure time per aperture diameter reduces
cost as compared with a system that permits multiple
times for each aperture diameter.

In another aspect of the invention, the automatic fo-
cus/automatic exposure system 30 includes a second
program memory table that also is indexed by a plurality
of light levels. A preferred embodiment of a second pro-
gram memory table 40 in accordance with the invention
is illustrated in Fig. 4. The second memory table 40 is
similar to the first program memory table 38 except that
the controller 32 selects entries from the second table
only when the flash selection switch 22 is placed in the
"no-flash" position. With the flash selection switch set to
the "no-flash" setting, the flash unit 20 is never activated.
and the data elements in the second table are arranged such that the shutter open time is increased where the flash unit status otherwise would have been changed to "on". This is illustrated in the Fig. 4 table.

By implementing the second program memory table 40, the automatic focus/automatic exposure system 30 provides optimal exposures in a simplified automatic focus system when flash illumination is not desired. Thus, the system still utilizes the light level signals as produced by the light-detecting sensor 18. For example, at a focal length of 26.0 mm, the entries in the second table 40 are arranged such that the shutter open time is changed from 10.0 msec to 20.0 msec when the light level detected by the light-detecting sensor 18 changes from greater than TP2 to less than TP2 but lens focus distance remains constant. This change in light level corresponds to the level at which entries in the first data table 38 indicated that the flash unit 20 status should be changed to on so the flash unit would be activated. In the second table 40 illustrated in Fig. 4, for a user-selected focal length of 46.0 mm, the shutter open time is changed from 10.0 msec to 20.0 msec when the light level changes from greater than TP4 to less than TP4 but lens focus distance remains constant until the light signal value drops below TP3. The second program memory table provides additional exposure flexibility with little increase in cost and complexity.

Thus, operation of the system 30 using the second table 40 of Fig. 4 is analogous to operation using the first table 38 of Fig. 3 except that, rather than turning on the flash unit 20, the system operates with the second table such that flash unit status remains off and the shutter open time is increased to permit increased light to fall on the photographic film when producing an exposure. Again, the increased shutter open time and light occur at a level greater than would be necessary to prevent underexposure but sufficient to provide a more pleasing exposure.

The preferred embodiment includes a shutter/aperture combination 36 comprising a separate shutter blade and aperture diaphragm construction. Those skilled in the art, however, will recognize that other constructions can be used without departing from the teachings of the present invention. For example, a shutter/aperture combination referred to as a programmed shutter can be used, in which shutter blades are opened up to a maximum opening size, remain open for a predetermined time, and then are closed to provide an equivalent shutter open time and f-stop that otherwise would be provided by a separate shutter and aperture diaphragm construction. The diameter of the programmed shutter and the time during which it is open do not necessarily equal the diameter and time of the equivalent f-stop and shutter open time of an independent shutter and diaphragm. In addition, table entries might be modified as a function of the rated light sensitivity, or film speed, of the photographic film loaded in the camera 10. Therefore, the system 30 can include a film speed sensor 42 that is either set manually by the camera user or automatically reads a code on a film cartridge that indicates film speed.

The following elements and their corresponding reference numerals are used in the drawings:
camera 10
objective lens 12
viewfinder 14
shutter button 16
light-detecting sensor 18
flash unit 20
flash selection switch 22
zoom switch 24
automatic focus/automatic exposure system 30
controller 32
signal line 33
lens-positioning system 34
shutter/aperture combination 36
first program memory table 38
system clock 39
second program memory table 40
film speed sensor 42

Claims

1. A zoom camera for taking photographs of a scene, the camera comprising:

- a variable focal length objective lens unit (12) with means for focus distance adjustment;
- means (24) for selecting, by a user, one of a limited number of predetermined focal lengths of the objective lens;
- a shutter/aperture combination (36) operable to provide a range of exposure settings comprising shutter open times and aperture diameters to produce a photographic exposure;
- a light level detecting system (18) that receives ambient light from the scene and produces a light signal representative of the amount of received light;
- a flash unit (20) that provides flash illumination to the photographic scene;
- a program table memory (38, 40) having data elements addressed by the selected focal length and by a predetermined number of light level intervals of the light signal value, each data element storing lens focus distance data, flash unit status on/off data, aperture data, and shutter time data; and
- a controller (32) that receives the detected light signal from the light level detecting system (18) and, based on the light level interval of the light signal value and the selected focal length, selects lens focus distance data, shutter time data, aperture data and flash unit status on/off da-
ta from the program table memory and, based on the selected data from the program table memory, controls the corresponding camera settings, wherein the program table memory is such that the flash unit status is changed from off to on at a predetermined light signal value different from the value at which the lens focus distance is changed.

2. The zoom camera as defined in claim 1, wherein the program table memory contains data elements such that only one predetermined shutter time is possible for each aperture selected from the table memory.

3. The zoom camera as defined in claim 1, wherein the camera further comprises a manual flash selector (22) switch that can be switched in a non-flash setting such that the controller increases the shutter time for data elements that otherwise would have a flash unit status data from the memory table with an on setting.

4. The zoom camera as defined in claim 1, wherein the shutter/aperture combination (36) comprises a separate shutter mechanism and aperture mechanism.

5. The zoom camera as defined in claims 1, 2 or 4, wherein the controller controls the shutter/aperture combination such that the shutter aperture diameter is selected from a predetermined number of diameters.

6. The zoom camera as defined in claim 5, wherein the shutter aperture diameters comprise four predetermined diameters.

7. The zoom camera as defined in claim 5, wherein the controller controls the shutter/aperture combination such that the controller selects only one predetermined shutter time for each aperture diameter regardless of changes in light level.

Patentansprüche

1. Kamera mit Zoom-Objektiv zum Aufnehmen einer Szene, wobei die Kamera folgende Komponenten aufweist:
   - ein Objektiv (12) mit veränderlicher Brennweite und einem Mittel zur Entfernungseinstellung;
   - ein Mittel (24) zum Auswählen durch den Benutzer einer aus einer begrenzten Anzahl von vorbestimmten Brennweiten des Objektivs;
   - eine Verschluß/Blende-Kombination (36), die eine Reihe von Belichtungseinstellungen mit

Verschlußöffnungszeiten und Blendendurchmessern bietet, um eine fotografische Belichtung zu erzeugen;

- ein Lichtintensität-Erfassungssystem (18), das Umgebungslicht vom Aufnahmegegenstand empfängt und ein die empfangene Lichtmenge kennzeichnendes Licht-Signal erzeugt;

- eine Blitzeinheit (20) für die Blitzbeleuchtung des Aufnahmegegenstands;

- eine Programmspeichertabelle (38, 40) mit Datenelementen, die durch die ausgewählte Brennweite und eine vorbestimmte Anzahl von Lichtstärkeintervallen des Licht-Signalwerts adressierbar sind, wobei jedes Datenelement Daten über Objektiv-Scharfeinstellung, Ein/Aus-Zustand der Blitzeinheit, Blende und Verschlußzeit speichert; und

- ein Steuerelement (32), welches das detektierte Licht-Signal vom Lichtintensität-Erfassungssystem (18) empfängt und basierend auf dem Lichtstärkeintervall des Licht-Signalwerts und der gewählten Brennweite Daten über Objektiv-Scharfeinstellung, Verschlußzeit, Blende und Ein/Aus-Zustand der Blitzeinheit aus der Programmspeichertabelle auswählt und basierend auf den ausgewählten Daten aus der Programmspeichertabelle die entsprechenden Kamereinstellungen steuert, wobei die Programmspeichertabelle so ausgelegt ist, daß der Zustand der Blitzeinheit bei einem vorbestimmten Licht-Signalwert von AUS nach EIN verändert wird, der sich von dem Wert, bei dem die Objektiv-Scharfeinstellung verändert wird, unterscheidet.

2. Kamera nach Anspruch 1, dadurch gekennzeichnet, daß die Programmspeichertabelle Datenelemente enthält, so daß für jeden aus der Speichertabelle ausgewählten Blendewert nur eine vorbestimmte Verschlußzeit möglich ist.

3. Kamera nach Anspruch 1, dadurch gekennzeichnet, daß die Kamera einen manuellen Blitzwahl-Schalter (22) aufweist, der in eine Stellung "Kein Blitz* schaltbar ist, so daß das Steuerelement die Verschlußzeit für Datenelemente vergrößert, für die sonst in der Speichertabelle der Zustandswert der Blitzeinheit auf EIN stehen würde.

4. Kamera nach Anspruch 1, dadurch gekennzeichnet, daß die Verschluß/Blende-Kombination (36) einen getrennten Verschluß- und Blendeneinrichtung aufweist.

5. Kamera nach Anspruch 1, 2 oder 4, dadurch gekennzeichnet, daß das Steuerelement die Verschluß/Blende-Kombination so steuert, daß der Verschlußöffnungsdurchmesser aus einer vorbe-

7. Kamera nach Anspruch 5, dadurch gekennzeichnet, daß das Steuerelement die Verschluß/Blende-Kombination so steuert, daß das Steuerelement für jeden Blendendurchmesser, ungeachtet etwaiger Veränderungen der Lichtintensität, nur eine vorbestimmte Verschlüßeinschneidungsdurchmesser zur Auswahl steht.

Revendications

1. Appareil photographique à focale variable destiné à prendre des photographies d'une scène, l'appareil photographique comprenant :

   une unité de lentille d'objectif à distance focale variable (12) muni d'un moyen pour le réglage de la distance de mise au point,
   un moyen (24) destiné à la sélection, par le utilisateur, d'une distance parmi un nombre limité de distances focales prédéterminées de la lentille d'objectif,
   une combinaison obturateur/ouverture (36) pouvant être mise en œuvre pour fournir une plage de réglages d'exposition comprenant des temps d'ouverture d'obturateur et des diamètres d'ouverture afin de produire une exposition photographique,
   un système de détection de niveau de lumière (18) qui reçoit la lumière ambiante provenant de la scène et produit un signal de lumière représentatif de la quantité de lumière reçue,
   une unité de flash (20) qui permet une illumination du flash de la scène photographique,
   une mémoire de table de programme (38, 40) comportant des éléments de données adressés par la distance focale sélectionnée et par un nombre prédéterminé d'intervalle de niveaux de lumière de la valeur de signal de lumière, chaque élément de données mémorisant des données de distance de mise au point de lentille, des données de marche/arrêt d'état de l'unité de flash, des données d'ouverture, et des données de temps de l'obturateur, et un contrôleur (32) qui reçoit le signal de lumière détecté depuis le système de détection de niveau de lumière (18) et, sur la base de l'intervalle de niveau de lumière de la valeur du signal de lumière et de la distance focale sélectionnée, sélectionne des données de distance de mise au point de lentille, des données d'ouverture et des données de marche/arrêt d'état de l'unité de flash d'après la mémoire de table de programme et, sur la base des données sélectionnées à partir de la mémoire de table de programme, commande les réglages correspondants de l'appareil photographique, dans lequel la mémoire de table de programme est telle que l'état de l'unité de flash passe d'arrêt à marche pour une valeur de signal de lumière prédéterminée différente de la valeur à laquelle la distance de mise au point de lentille est modifiée.

2. Appareil photographique à focale variable selon la revendication 1, dans lequel la mémoire de table de programme contient des éléments de données tels que seul un temps prédéterminé de l'obturateur soit possible pour chaque ouverture sélectionnée d'après la mémoire de table.

3. Appareil photographique à focale variable selon la revendication 1, dans lequel l'appareil photographique comprend en outre un commutateur de sélection manuelle de flash (22) qui peut être basculé sur un réglage sans flash de façon à ce que le contrôleur augmente le temps de l'obturateur pour des éléments de données qui obtiendraient sinon des données d'état d'unité de flash à partir de la table en mémoire avec un réglage en marche.

4. Appareil photographique à focale variable selon la revendication 1, dans lequel la combinaison obturateur/ouverture (36) comprend un mécanisme d'obturateur et un mécanisme d'ouverture séparés.

5. Appareil photographique à focale variable selon les revendications 1, 2 ou 4, dans lequel le contrôleur commande la combinaison obturateur/ouverture de façon à ce que le diamètre d'ouverture de l'obturateur soit sélectionné à partir d'un nombre prédéterminé de diamètres.

6. Appareil photographique à focale variable selon la revendication 5, dans lequel les diamètres d'ouverture de l'obturateur comprennent quatre diamètres prédéterminés.

7. Appareil photographique à focale variable selon la revendication 5, dans lequel le contrôleur commande la combinaison obturateur/ouverture de façon à ce que le contrôleur sélectionne uniquement un temps d'obturateur prédéterminé pour chaque diamètre d'ouverture indépendamment des variations du niveau de lumière.
<table>
<thead>
<tr>
<th>FOCAL LENGTH (mm)</th>
<th>PARAMETER</th>
<th>LESS THAN TP1</th>
<th>FROM TP1 TO TP2</th>
<th>FROM TP2 TO TP3</th>
<th>FROM TP3 TO TP4</th>
<th>FROM TP4 TO TP5</th>
<th>GREATER THAN TP5</th>
</tr>
</thead>
<tbody>
<tr>
<td>26.0</td>
<td>f/4 (APERTURE #)</td>
<td>8.0(3)</td>
<td>10.0(4)</td>
<td>10.0(4)</td>
<td>10.0(4)</td>
<td>10.0(4)</td>
<td>10.0(4)</td>
</tr>
<tr>
<td></td>
<td>FLASH ON/OFF</td>
<td>ON</td>
<td>ON</td>
<td>OFF</td>
<td>OFF</td>
<td>OFF</td>
<td>OFF</td>
</tr>
<tr>
<td></td>
<td>FOCUS DISTANCE - ft</td>
<td>7.5</td>
<td>11.5</td>
<td>11.5</td>
<td>11.5</td>
<td>11.5</td>
<td>11.5</td>
</tr>
<tr>
<td></td>
<td>SHUTTER TIME - ms</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
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**FIG. 3**
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**FIG. 4**