

SYSTEM FOR TRANSMITTING INFORMATION FROM
AN INTERCHANGEABLE LENS TO A PHOTOGRAPHIC
CAMERA

This invention relates to a system for transmitting information from an interchangeable lens to a photographic camera, and is concerned to reduce the number of signal lines necessary for transmission of this information.

5 In a photographic camera provided with an automatic exposure control mechanism of the preset shutter speed type, it is necessary to transmit information on the maximum aperture and information on the minimum aperture of the objective being used to said automatic exposure control
10 mechanism. Assuming that a suitable type of film has been selected and a shutter speed has been set by the photographer, an appropriate exposure is sometimes impossible depending on the brightness of the object to be photographed, within the effective aperture range of this objective. In such
15 a case, the photographer must be warned of this situation, or exposure must be prevented, for example, by locking the shutter release. Especially when it is desired to provide a single-lens reflex camera, usually used with a group of various interchangeable lenses with an automatic exposure
20 control mechanism of shutter speed preset type, said transmission of information on the maximum aperture and information on the minimum aperture is essential. With an automatic exposure control mechanism of diaphragm preset

type, it is necessary for a diaphragm value preset by the photographer to be transmitted to said automatic exposure control mechanism and such transmission of said diaphragm value information is preferably done in an electric manner in view of the fact that the essential part of said automatic exposure control mechanism comprises an electronic circuit and the camera itself is extremely compact. From the viewpoint as mentioned above, a plurality of signal lines are required for transmission of information on the objective diaphragm to the camera body and, preferably, the number of these signal lines should be as small as possible.

In the transmission of information on the maximum aperture of an individual objective from the objective to the camera body, it may be required to transmit one of ten diaphragm values, i.e. F values of 1.2, 1.4, 1.7, 2, 2.5, 2.8, 3.5, 4, 4.5, and 5.6 for the commercially available group of interchangeable lens having different fully opened aperture values. Digital transmission of this information on the maximum aperture from the objective to the camera body requires four signal lines shown by Table 1 below, in which C_3 , C_2 , C_1 and C_0 designate the binary codes of signals related to actual maximum aperture corresponding to the respective maximum apertures in F-values (these signals will be referred hereinafter as the actual maximum aperture signals). For the information related to the minimum aperture, on the other hand, the minimum aperture in F-value which is the largest one of the minimum aperture values of usually used interchangeable lenses is used as a

reference minimum aperture and the minimum aperture in F-value of the actually used objective relative to said reference minimum aperture in F-value is transmitted to the camera body. The electric signal related to the difference
5 between this reference minimum aperture and the minimum aperture of the actually used objective is hereby defined as the minimum aperture difference signal. Table 2 below shows such minimum aperture difference signals in the case where the reference minimum aperture in F-value is 22 and
10 the other minimum aperture which can be selected is only 32 in F-value.

It will be understood from the foregoing explanation that, when a conception of the minimum aperture difference signal is introduced, at least five signal lines
15 are necessary for transmission of information on the maximum aperture and information on the minimum aperture.

The present invention is defined in the appended claims, to which reference should now be made.

The invention will be described in more detail, by way of example, with reference to the drawing, in which:
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Fig. 1 is a circuit diagram illustrating a logic circuit for obtaining the actual maximum aperture signal when the minimum aperture difference signal is represented by a single bit; and

25 Fig. 2 is a circuit diagram illustrating a logic circuit for obtaining the actual maximum aperture signal when the minimum aperture difference signal is represented by two bits.

Based on two findings, in Table 1, that three signal lines are sufficient for eight maximum apertures and that the maximum aperture in F-value corresponding to the minimum aperture in F-value higher than a predetermined value takes a relatively high value, in accordance with this invention the signal to be transmitted from the objective to the camera body as the maximum aperture signal is expressed by:

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$$\begin{array}{l} \text{maximum aperture} \\ \text{signal} \end{array} = \begin{array}{l} \text{actual maximum} \\ \text{aperture signal} \end{array} - \begin{array}{l} \text{minimum aperture} \\ \text{difference signal} \end{array} \quad (1)$$

This maximum aperture signal is regenerated as:

$$\begin{array}{l} \text{actual maximum} \\ \text{aperture signal} \end{array} = \begin{array}{l} \text{maximum aperture} \\ \text{signal} \end{array} + \begin{array}{l} \text{minimum aperture} \\ \text{differences signal} \end{array} \quad (2)$$

The minimum aperture difference signal b_1 is such that $b_1 = 0$ when the minimum aperture in F-value is 22 and $b_1 = 1$ when the minimum aperture in F-value is 32. Thus, the notional digit b_0 is always equal to zero in arithmetic operation of formulae (1) and (2). When the maximum aperture signal expressed by formula (1) is applied from the objective to the camera body, arithmetic operation of formula (2) occurs in the camera body to reproduce the actual maximum aperture signal C_3, C_2, C_1 and C_0 . The arithmetic operation for $b_1 = 0$ is shown by Table 3 and the arithmetic operation for $b_1 = 1$ is shown by Table 4.

25 For example, the objective with the maximum aperture 2.8 in F-value and the minimum aperture 32 in F-value corresponding to the case of $b_1 = 1$ as seen in Table 2 outputs the maximum aperture signal 011. In the camera body, a binary arithmetic operation $011 (a_2 a_1 a_0) + 010 (b_2 b_1 b_0)$ occurs and
30 therefrom the actual maximum aperture signal 101 is

reproduced. As will be understood from Table 1, this objective has its maximum aperture 2.8 in F-value. Then, the objective with the maximum aperture 2.8 in F-value and the minimum aperture 22 in F-value corresponding to the case of $b_1 = 0$ as seen in Table 2 outputs the maximum aperture signal 101. In the camera body, a binary arithmetic operation $101 (a_2 a_1 a_0) + 000 (b_2 b_1 b_0)$ takes place and therefrom the actual maximum aperture signal 101 is reproduced. Table 1 indicates that this objective has its maximum aperture 2.8 in F-value. The coding system used in transmission of the maximum aperture signal is thus seen to be varied in dependance upon the minimum aperture value.

It will be seen from the foregoing description in reference with the examples shown by Tables 1 and 2 that three signal lines suffice for transmission of information related to the maximum aperture. Namely, even when the signal line for transmission of information related to the minimum aperture is included, the necessary number of signal lines for this purpose can be reduced by one, to four.

Although the system has been described hereinabove with the minimum aperture being represented by a single bit, it is also possible to represent the minimum aperture by two bits - for example, 00($b_1 b_0$) for F-value 22, 01($b_1 b_0$) for F-value 32 and 11($b_1 b_0$) for F-value 45 - so that the number of the minimum apertures which can be selected may be increased to four while the number of signal lines for transmission of information related to the actual maximum aperture remains three. However, such two-bit representation

17 results in the same effect as achieved by the single bit representation of the minimum aperture, in so far as the total number of signal lines necessary for transmission can be reduced by one.

5 Fig. 1 is a logic circuit diagram of a logic circuit constructed to execute the arithmetic operation of formula (2) when the minimum aperture difference signal is represented by a single bit. Reference numerals 1 and 2 designate exclusive OR gates and reference numerals 3 and 4
10 designate AND gates. Fig. 2 is a logic circuit diagram of an embodiment of logic circuit to execute the arithmetic operation of the formula (2) when the minimum aperture difference signal is represented by two bits. Reference numerals 5 to 8 designate exclusive OR gates, reference
15 numerals 9 to 12 designate AND gates and reference numeral 13 designates an OR gate. It should be understood that the logic circuits as illustrated by Figs. 1 and 2 are not limitative and these logic circuit arrangements may be variously modified in view of the versatility peculiar to
20 logic circuit arrangements in general.

The arithmetic operation to be executed by the logic circuit of Fig. 1 is given by a following logical expression:

$$C_0 = a_0$$

$$C_1 = a_1 \oplus b_1$$

25 $C_2 = a_2 \oplus a_1 \cdot b_1$

$$C_3 = a_2 \cdot a_1 \cdot b_1$$

where $\oplus$ and $\cdot$ designate exclusive OR and AND, respectively.

The corresponding expression for Fig. 2 can be derived from

inspection thereof.

It will be understood from the foregoing description that the present system permits the number of signal lines for transmission of information related to the maximum aperture to be reduced by utilizing information related to the minimum aperture to be transmitted from the objective to the camera body. Although the system has been described with respect to the transmission in the digital mode, similar transmission may be achieved in the analog mode.

Table 1: Relationship between maximum aperture in F-value
and actual maximum aperture signal

Maximum aperture in F-value	Actual maximum aperture signal			
	C_3	C_2	C_1	C_0
1.2	0	0	0	0
1.4	0	0	0	1
1.7	0	0	1	0
2	0	0	1	1
2.5	0	1	0	0
2.8	0	1	0	1
3.5	0	1	1	0
4	0	1	1	1
4.5	1	0	0	0
5.6	1	0	0	1

Table 2: Relationship between minimum aperture in F-value
and minimum aperture difference signal

Minimum aperture in F-value	Minimum aperture difference signal b_1
22	0
32	1

Table 3: Case of $b_1 = 0$ (minimum aperture 22 in F-value)

Maximum aperture signal a_2 a_1 a_0			Actual maximum aperture signal C_3 C_2 C_1 C_0				Maximum aperture in F-value
0	0	0	0	0	0	0	1.2
0	0	1	0	0	0	1	1.4
0	1	0	0	0	1	0	1.7
0	1	1	0	0	1	1	2
1	0	0	0	1	0	0	2.5
1	0	1	0	1	0	1	2.8
1	1	0	0	1	1	0	3.5
1	1	1	0	1	1	1	4

Table 4: Case of $b_1 = 1$ (minimum aperture 32 in F-value)

Maximum aperture signal a_2 a_1 a_0			Actual maximum aperture signal C_3 C_2 C_1 C_0				Maximum aperture in F-value
0	0	0	0	0	1	0	1.7
0	0	1	0	0	1	1	2
0	1	0	0	1	0	0	2.5
0	1	1	0	1	0	1	2.8
1	0	0	0	1	1	0	3.5
1	0	1	0	1	1	1	4
1	1	0	1	0	0	0	4.5
1	1	1	1	0	0	1	5.6

C L A I M S:

1. A system for transmitting information from an interchangeable lens to a photographic camera, in which each lens is provided with means for transmitting information on its maximum aperture and information on its minimum aperture, and the coding used for transmission of the maximum aperture value varies in dependence upon the actual minimum aperture value.

2. A system according to claim 1, in which the transmitted maximum aperture information is generated as a coded maximum aperture value which is equal to the actual maximum aperture value and a minimum aperture difference value as hereinbefore defined.

3. A system for transmitting information from an interchangeable lens to a photographic camera, substantially as herein described with reference to the drawing.

