

MACRO-FOCUSSING REAR CONVERTER LENS ASSEMBLY

This invention relates to a macro-focussing rear converter lens assembly for insertion between a camera body and a master lens.

When the function of a macro lens is given to a camera, it is known that the photographic equipment is fitted with an extension tube or a special rear converter lens. Since the whole lens is made to shift without changing the interval between the rear and front mount of the converter in these kinds of known rear converter lenses, the lens will approach nearer to the surface of a film as a magnification of the lens is made higher. Consequently, the lens back must be made very long and the total length of the converter lens becomes longer, resulting in it being difficult to carry. To shorten the total length of the converter lens, the total length of lens formation must be made shorter, and the number of lenses must be made smaller and so good correcting aberrations become difficult. Further, in such a known type where the whole lens is made to move, photographing with magnification from 1:00 to 1 : 1 cannot be effected.

Among known cameras, there are those in which for transmitting the F number at open aperture of the photographing lens (the master lens) to the camera body,

a signal pin having a height corresponding to the F number at open aperture is projectingly provided on the rear portion of the lens, and this pin is made to abut on a receiving piece on the side of camera body.

5 Therefore, in the rear converter lens assembly used for these kinds of cameras, an interconnecting rod communicating from the side of the master lens to the side of the camera body is provided with a length equal to the interval between the rear and front mount.

10 The signal pin provided on the master lens is made to abut on one end of the interconnecting rod, the other end of which is made to project on the side of the camera body by the same amount with the height of the signal pin. Thereby the F number at open aperture of

15 the master lens is transmitted to the side of the camera body. Thus, in the rear converter lens assembly in which the interval between the rear and front mount is varied, such an interconnecting system as mentioned above cannot be used.

20 The object of embodiments of this invention is to provide a macro-focussing rear converter lens assembly wherein the total length of the converter lens can be made shorter in carriage; good correcting aberrations can be effected by increasing the number of lenses; and photo-

25 graphing with magnification from 1 : 00 to 1 : 1 can be continuously effected.

Another object of an embodiment of the invention is to provide a rear converter lens assembly which can reliably transmit the F number at open aperture of a master lens to the side of camera body, even though the function of macro-lens is added as mentioned above.

According to the invention there is provided a macro-focussing rear converter lens assembly for insertion between a camera body and a master lens, comprising a tube fitted within a main body having a converter lens system fixed therein, said tube being movable along the optical axis of said lens system and the interval between the camera body and the master lens being variable according to the movement of said tube.

The macro-focussing rear converter lens assembly may comprise a cam means to be moved in the direction of optical axis by a signal pin provided on the master lens and to convert its movement into rotary motion around the optical axis, an interconnecting plate to be rotated by the cam means, and another cam means to convert the rotary motion of the interconnecting plate into the movement in the direction of optical axis.

Preferred embodiments of the invention are described below, by example only, with reference to the accompanying drawings, wherein:

Fig. 1 is a sectional view of a rear converter

lens according to this invention, wherein the lens housing assembly is not sectioned and cam means the like for transmitting F number at open aperture are not provided; and

5 Fig. 2 is a sectional view of a rear converter lens according to this invention, showing another embodiment in which the lens housing assembly is omitted.

 In the rear converter lens shown in Fig. 1, the converter lens system is provided in a lens housing
10 assembly 1, which is fixed by means of screws (not shown) to the main body 3 having rear mount assembly 2 to be mounted on the side of camera body. The main body is fitted with a tube 4, which is movably provided along the optical axis. In the lens shown in Fig. 1, the tube
15 is provided on the side of master lens and a front mount 5 for mounting the master lens is formed on the end portion thereof. If desired, it is possible that the tube is provided on the side of camera body to be expanded and contracted, and the main body is provided
20 on the side of master lens to fix the lens housing assembly to the main body (not shown).

 As an expansion and contraction mechanism of the tube in the direction of optical axis, known mechanisms such as a straight advance system by means of key and
25 key way and the like may be adopted. However, an expansion and contraction mechanism by means of helicoid is

utilized in the drawing. Namely, a revolving ring assembly 6 is fitted between the tube 4 and the main body 3 and by means of screws 7a, 7b provided on the outer face of the revolving ring assembly 6 and the inner face of the main body 3, the revolving ring assembly 6 being rotatably mounted on the main body. Further, on the inner face of the revolving ring 6 and on the outer face of the tube 4, helicoid screws 8a, 8b with reversing threads relative to screws are provided to mount the revolving ring assembly and the tube rotatably. A key 10 fixed to the main body 3 and extended in the direction of optical axis is slidably engaged. With a key way 9 provided on the inner face of the tube. When an indication of magnification is marked on an outer periphery 6a of the revolving ring assembly 6 and a fixed indication is marked on an outer periphery 3a, a desired magnification will be easily obtained.

Further, when the rear mount assembly 2 is engaged with the camera body (not shown) and the master lens (not shown) is engaged with the front mount assembly 5, the flange face 11 of the rear mount assembly will closely contact onto the flange face of the camera body and the flange face of the master lens will closely contact onto the flange face 12 of the front mount

assembly. 5. In the state as shown in Fig. 1, the master lens may be used with its focal length being elongated due to the function as an ordinary rear converter lens. In the next place, with close-up photography, when the revolving ring assembly is turned to set the desired indication of magnification, the tube will not rotate but will expand or contract in the direction of the optical axis (in the drawing move to the right or to the left) because the rotation of tube is regulated by means of the key 10 and the key way 9. Thus, the interval between the rear and front mount will be varied. Hereupon, since the lens housing assembly does not move, the distance between the lens housing assembly and the film face will not be changed. However, the distance between the lens housing assembly and the master lens will become longer or shorter, and thus the close-up photography may be continuously effected with a magnification of from $1 : \infty$ to $1 : 1$.

In Fig. 2, there is shown a converter lens preferably used in a camera of which master lens is projectingly provided with a signal pin to show the F number at open aperture. In this drawing, the lens housing assembly is omitted. Further, although the shapes are different, the main body, the tube, the revolving ring assembly and the mount assemblies are not essentially different from those of the above

embodiment. In Fig. 2, when the master lens is engaged with the front mount assembly 5, an interconnecting pin 13 is inserted into a guide cylinder 15 of a plate 14 mounted on the tube 4, preferably urged by a spring 16, and thus the interconnecting pin is movable in the direction of the optical axis so as to be abutted by a signal pin (not shown) of the master lens. On the other hand, when the rear mount assembly is engaged with the camera body, an interconnecting pin 17 is provided on the main body 3 so as to abut on a signal receiving pin (not shown), preferably urged by a spring 18, enabling the pin to move in the direction of the optical axis. Further, the tube 4 and the main body 3 are provided with cam means which will convert the movement in the direction of the optical axis or the movement in the peripheral direction into the movement in the peripheral direction (rotary motion around the optical axis) or the movement in the direction of the optical axis. In the embodiment shown in the drawing, substantially L-shaped cam plates 19, 20 are pivoted at 21, 22 to be rocked. The cam plates have, on one end, contact points 23, 24 projectingly formed so as to abut against the inner end side of the respective interconnecting pin, and on their other end projections 26, 27 are provided for connecting with an interconnecting plate 25 to be described later.

The interconnecting plate 25 is made to bend cylindrically along the inner periphery of the tube and is provided so as to rotate in a peripheral direction (around the optical axis). In the drawing, the interconnecting plate is fixed by screws 31 to flanges 29, 30 which are formed by inwardly folding a portion of a mounting plate 28 rotatably provided on the tube. If desired the mounting plate may be rotatably mounted on the side of the main body and the interconnecting plate may be fixed to the mounting plate. Although omitted in the drawing, ball bearings may be preferably provided on rotary portions. On the interconnecting plate, engaging grooves 32, 33 are formed along the direction of the optical axis, which grooves are slidably fitted with the projections 26, 27 of the cam plates respectively. In the drawing, the interconnecting plate is mounted on the side of the tube, so that the engaging groove 33, into which is fitted the projection 27 of the cam plate 20, is formed longer corresponding to the amount of movement of the tube and the connecting portion between the cam plate and the interconnecting plate is formed shiftably in the direction of the optical axis. When the interconnecting plate is mounted on the side of the main body, the engaging groove 32 into which is fitted the projection 26 of other cam plate 19 may be formed longer corresponding to the amount of movement. Further,

the projections may be provided on the interconnecting plate reversely to those shown in the drawing and the engaging grooves may be provided on the cam plates. The distance between the contact point 23 and the pivotal portion 21 of the cam plate 19 and the distance between the pivotal portion 21 and the projection 26 are respectively formed equally to the distance between the contact point 24 and the pivotal portion 22 of the cam plate 20 and the distance between the pivotal portion 22 and the projection 27. Thereby, when the contact point of one cam plate is moved in the direction of the optical axis via the interconnecting plate, the contact point of another cam plate will move with an equal amount in the direction of the optical axis. Thus, when the rear mount assembly is engaged with the camera body and the master lens is engaged with the front mount assembly, the signal pin of the master lens will abut against the interconnecting pin 13 and the interconnecting pin 13 will move in the direction of the optical axis corresponding to the height of the signal pin. Thereby, the cam plate 19 rocks in the peripheral direction via the contact point 23 and the interconnecting plate 25 rotates via the projection 26 and the engaging groove 32. The rotation of the interconnecting plate is transmitted to the cam plate 20 as a rocking motion via the

engaging groove 33 and the projection 27; thus the
interconnecting pin 17 is moved in the direction of
optical axis via the contact point 24 of the cam plate.
The signal receiving pin of the camera body is pressed
5 by the interconnecting pin by the amount corresponding
to the height of the signal pin of the master lens,
and the F number at open aperture of the master lens
is transmitted to the camera body.

For the purpose of close-up photography, when
10 the tube is expanded and contracted as mentioned
above and shown in the drawing, the cam plate, the
interconnecting plate and the like connected with the
tube will move in the direction of optical axis together
with the tube, but the connecting portion (projection
15 and engaging groove) of the cam plate and the inter-
connecting plate provided on the main body is shiftably
formed in the direction of optical axis, so that the F
number at open aperture of the master lens can be trans-
mitted to the camera body similarly as in the above
20 description. As cam means, suitable mechanisms other
than those shown in the drawing may be used.

CLAIMS

1. A macro-focussing rear converter lens assembly for insertion between a camera body and a master lens, comprising a tube fitted within a main body having a converter lens system fixed therein, said tube being
5 movable along the optical axis of said lens system, and the interval between the camera body and the master lens being variable according to the movement of said tube.
2. An assembly according to Claim 1, comprising a cylindrical main body having a converter lens system
10 and a mount assembly for mounting on the camera body; a tube having a mount assembly for mounting the master lens and being fitted within said main body movably along the optical axis of said lens system; a revolving ring assembly inserted between said main body and said tube;
15 wherein screws are provided on an inner face of said main body and on an outer face of said revolving ring assembly and on an inner face of said revolving ring assembly and on an outer face of said tube, and said tube can be moved according to the turning of said
20 revolving ring assembly.
3. An assembly according to Claim 1, wherein cam means for converting the movement in the direction of optical axis into the movement in a peripheral direction is respectively provided on said main body and on said tube;
25 the movement of the cam means on the side of the tube is



transmitted to the cam means on the main body by means of an interconnecting plate turning in the peripheral direction; and a connecting portion between said cam means and said interconnecting plate is formed shiftably in the direction of the optical axis.

4. An assembly according to Claim 3, wherein the cam means are L-shaped cam plates respectively pivoted to the main body and the tube; said cam plates carry on one end a contact point operated by a signal pin of the master lens or operate a signal receiving pin on the side of the camera body, and have a projection on another end; said interconnecting plate has two engaging grooves extending in the direction of the optical axis; and said engaging grooves are slidably engaged with the projections of said cam plates.

5. A macro-focussing converter lens assembly for insertion between a camera body and a master lens, substantially as herein described and as illustrated in either Fig. 1 or 2 of the accompanying drawings.

