

PATENT SPECIFICATION

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(54) ZOOM LENS

(71) We, KARL VOCKENHUBER, of 118 Pötzleinsdorferstrasse, Vienna, 18, Austria and RAIMUND HAUSER, of 2, Goldegasse, Vienna 4, Austria, both Austrian Citizens, 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:—

This invention relates to a zoom lens assembly having an optical axis, two spaced lens elements movable along the axis, and a control tube mechanism rotatable about said axis to produce simultaneous movement of both lens elements accompanied by a change in the spacing between them.

It has been proposed to provide a zoom lens assembly with an adjustment for focussing on close up or macro objects in addition to the zoom control for objects in the normal range. However, such proposals have not provided a way for allowing the normal range zoom control also to be used in the macro range.

According to the present invention, there is provided a zoom lens assembly comprising a first and a second lens element displaceable along an optical axis; a control mechanism including a first and a second rotatable cylinder of like radius centred on said optical axis and provided with first and second camming formations engaged by said first and second lens elements, respectively, for axially displacing the lens elements upon rotation of said cylinders, said cylinders having adjacent ends provided with coupling means linking the cylinders for joint rotation while enabling their relative axial displacement; and actuating means coupled with said first cylinder for axially displacing same independently of said second cylinder to preset said first lens element to a selected starting position relative to said second lens element.

The invention will now be described further, by way of example, with reference to the accompanying drawing which is a diagrammatic cross-section through a zoom lens assembly.

A zoom lens 1 comprises four lens elements 2, 3, 4 and 5, which are each indicated for convenience by a single lens and of which

the front lens 2 is adapted to slide in a tube 8 along the optical axis 6 by screwing an associated socket part 7. The rear lens 5 is stationary and not slidable. The associated retaining parts for the rear lens 5 are of known construction and are therefore not shown in detail. The two middle lens 3, 4 on the other hand are axially slidable according to two different laws of motion and are controlled to this end by respective curved camming slots 9, 10.

The camming slots 9, 10 are cut into a control tube mechanism which rotates about the optical axis 6 or about an axis that is parallel thereto. The slots 9, 10 are respectively disposed in two separate coaxially arranged cylinders 11, 12 which have intermeshing coupling fingers 13, 14. The two guide cylinders 11, 12 are rotationally coupled by the fingers 13, 14 but are axially slidable with respect to each other. A gear rim 17 of the guide cylinder 12 is arranged to be driven by a motor 15 via a pinion 16 and the intermeshing fingers 13, 14 ensure that the cylinder 11 co-rotates so as to provide the desired change of focal length by simultaneous axial movement of both lens 3 and 4. The guide cylinder 11 is retained against axial movement by a collar 18 rotatably trapped between the tube member 8 and a surrounding tube 19. The guide cylinder 12 is however slidable with respect to the cylinder 11 as is explained below. In order to compensate for tolerances and to ensure that the two camming slots 9, 10 are always accurately co-ordinated with each other the two guide cylinders 11, 12 are provided with lugs 20 or 21 respectively which extend along the edges of each of their coupling fingers 13 or 14 and are bent radially inwards towards the optical axis 6. The lug 20 is provided with leaf springs 22 which bear upon the lug 21 and thus retain the coupling fingers 13, 14 in a defined angular spacing. Tolerances of the coupling fingers are thus compensated.

An eccentric 23 controlled by a hand lever 24 is provided for the axial displacement of the guide cylinder 12. The eccentric 23 is pivotable about a stationary axis 25 and exerts a thrust on a flange which is associated

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with the guide cylinder 12 and supports the rim 17. One end of a diaphragm spring 26 bears on the other side of the flange, the other end of the diaphragm spring bearing on the tube 19. The diaphragm spring 26 therefore thrusts the guide cylinder 12 towards one limiting position which is defined by a stop abutment 27 that is fixed with respect to the apparatus when the eccentric 23 is in an in-operative position, the stop abutment cooperating with a ball cage 28 which is mounted on the guide cylinder 12.

If the handle 24 is rotated about the axis 25 in the clockwise direction the external surface of the eccentric 23 displaces the said guide cylinder to the right against the action of the diaphragm spring 26. Any readjustment by the thrust of the diaphragm spring 26 after the hand lever 24 is released is not possible because the eccentric 23 is substantially self-arresting. Nevertheless, the focal length adjusting motor 15 can be operated in any desired position of the eccentric 23 so that an adjustment of the focal length is possible with any setting of the lens 4. The hand lever 24 functions as a macro range focussing adjustment.

WHAT WE CLAIM IS:—

1. A zoom lens assembly comprising a first and a second lens element displaceable along an optical axis; a control mechanism including a first and a second rotatable cylinder of like

radius centred on said optical axis and provided with first and second camming formations engaged by said first and second lens elements, respectively, for axially displacing the lens elements upon rotation of said cylinders, said cylinders having adjacent ends provided with coupling means linking the cylinders for joint rotation while enabling their relative axial displacement; and actuating means coupled with said first cylinder for axially displacing same independently of said second cylinder to preset said first lens element to a selected starting position relative to said second lens element.

2. A zoom lens as claimed in claim 1, wherein the coupling means comprise intermeshing fingers on adjoining ends of said cylinders.

3. A zoom lens as claimed in claim 2, wherein peripherally effective resilient means are interposed between adjacent fingers for eliminating angular play between the two cylinders.

4. A zoom lens assembly substantially as hereinbefore particularly described with reference to and as illustrated in the accompanying drawing.

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