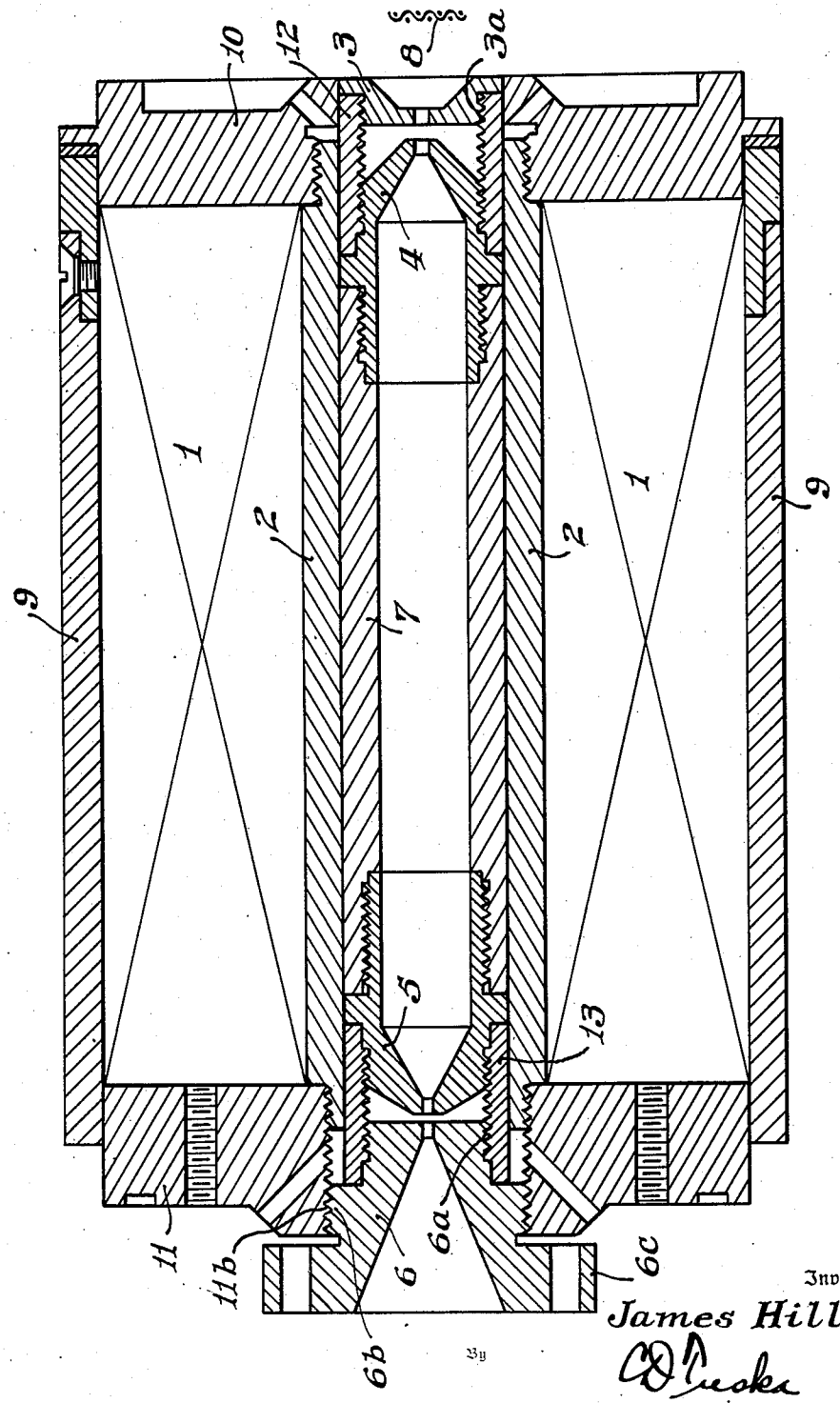
Feb. 20, 1945. J. HILLIER 2,369,782

ELECTRON LENS SYSTEM

Filed April 1, 1943



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Patented Feb. 20, 1945 2,369,782

UNITED STATES PATENT OFFICE

2,369,782

ELECTRON LENS SYSTEM

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Application April 1, 1943, Serial No. 481,399

5 Claims. (Cl. 250—161)

This invention relates to electron lens systems and particularly to improvements in magnetically energized lenses for use in electron microscopes and analogous instruments.

In a conventional transmission type electron microscope employing two or more pairs of lens elements or pole pieces it is customary to employ a separate source of magnetic energy for actuating each pair of pole pieces. This is a costly practice particularly when the system comprises a plurality of electro-magnets since, in such case, separate current regulating systems must be provided in the circuit to each coil.

Accordingly, the principal object of the present invention is to provide an improved magnetically actuated electron lens system and one characterized by the economy of its parts, the simplicity of its structure, and by its trouble-free performance.

Another and important object of the present invention is to achieve the foregoing in an electron lens system capable of variable magnification.

In the embodiment of the invention which has been selected for purposes of illustration, a single electro-magnet comprising a coil 1 wound upon a hollow cylinder 2 which is constituted of a non-magnetic material (e. g., brass) serves to actuate two pairs of apertured lens elements or pole pieces 3—4 and 5—6. These separate pairs of pole pieces 3—4 and 5—6 may comprise the objective and projection lenses, respectively, of an electron microscope or similar instrument. They are constituted of a magnetically permeable material (e. g., soft iron) and are supported, in a manner later described, upon a hollow magnetic structure 7 which has a sliding fit within the bore of the non-magnetic cylinder 2 so that the magnification of the instrument may be varied by moving the entire lens assembly axially within the said cylinder and with respect to an externally mounted specimen holder 8. The coil or magnet 1 is coupled, magnetically, to the outer pole pieces 3 and 6 by a soft iron shell comprising an outer cylinder 9 and a pair of apertured end plates 10 and 11, respectively. Thus, the magnetic flux which is applied to the outer pole piece 3 through the end plate 10 permeates the space between the objective lens elements 3 and 4. The magnetic circuit back to the source 1 from the inner pole piece 4 is completed through a path which includes the slidable magnetic structure 7, the projection lens elements 5 and 6, the opposite end plate 11, and the outer cylinder 9.

The electron lens system of the present invention is so constructed that it may be easily assembled and disassembled, e. g., for purposes of inspection and adjustment. To this end, each of the outer pole pieces is threaded, as indicated at 3*a*, 6*a*, throughout at least a portion of its length and is attached to the slidable magnetic structure 7 by means of complementarily threaded non-magnetic sleeve or nipple 12 or 13, respectively. One of the outer pole pieces, in this case the piece 6, is provided with a threaded hub portion 6*b*, and this hub has a knob 6*c* thereon. The knob 6*c*, when turned, serves to advance or to retract the entire pole piece assembly with respect to the fixed specimen holder 8. Access may be had to the interior of the central magnetic member 7 by unscrewing the inner pole pieces 4 and 5 which are threaded on the opposite ends of the said member.

From the foregoing it is apparent that the present invention provides an improved magnetically actuated electron-lens system capable of variable magnification, and one characterized by the economy of its parts, the simplicity of its structure, and by its trouble-free performance.

What is claimed is:

1. A magnetically actuated electron lens system including, in combination, a hollow cylinder constituted of a non-magnetic material, means mounted adjacent to the outer surface of said cylinder for creating a magnetic field about said cylinder, a plurality of pairs of pole pieces mounted in spaced axial alignment within the magnetic field about said cylinder, means for magnetically coupling one pole piece of each pair to said field creating means, and means within said cylinder for completing the magnetic circuit between said field creating means and the other pole piece of each pair.

2. The invention as set forth in claim 1 and wherein said means for creating said magnetic field comprises a single electro-magnet.

3. A magnetically actuated electron lens system including, in combination, a hollow cylinder constituted of a non-magnetic material, a single coil for establishing a magnetic field mounted adjacent to the outer surface of said cylinder, a magnetic structure comprising an outer cylinder and a pair of oppositely located apertured end-plates mounted about said coil with the apertures in said end-plates in alignment with the bore of said inner cylinder, a plurality of pairs of spaced apart pole pieces mounted along a common axis within said magnetic cylinder with the outer pole pieces of each pair in contact, respectively, with one of said apertured end plates, a magnetic member mounted for axial movement within said non-

magnetic cylinder and upon which said pole pieces are supported, and means for moving said magnetic member and, hence, said pole pieces simultaneously along said axis with said outer pole pieces in contact with said end-plates.

4. The invention as set forth in claim 3 and wherein the inner pole piece of each pair is removably affixed to said magnetic member and the outer pole piece of each pair is removably affixed to its adjacent inner pole piece by means of a non-magnetic element.

5. A magnetically actuated lens system comprising a plurality of pairs of apertured pole pieces mounted in spaced array along a common axis, a single magnet in the form of a cylinder disposed about said axis in the space between said pole pieces for subjecting said pole pieces to a magnetic field, and means for relatively moving said pole pieces along said axis within said magnetic field and with respect to said magnet, whereby to vary the magnification of said lens system.

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