

No. 862,501.

PATENTED AUG. 6, 1907.

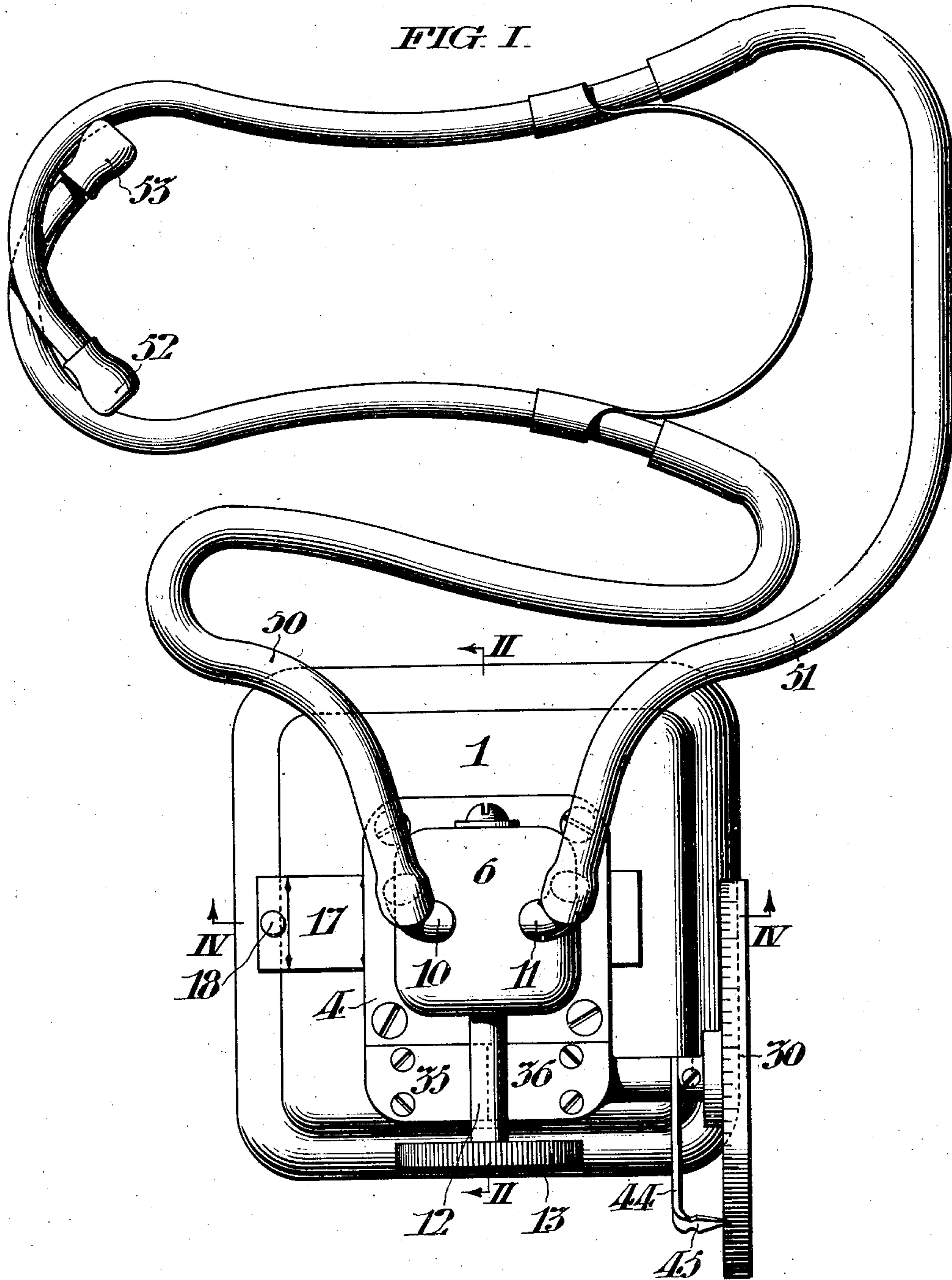
J. M. McCALLIE.

AUDIOMETER.

APPLICATION FILED MAR. 7, 1907.

4 SHEETS—SHEET 1.

FIG. I.



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4 SHEETS—SHEET 2.

FIG. II.

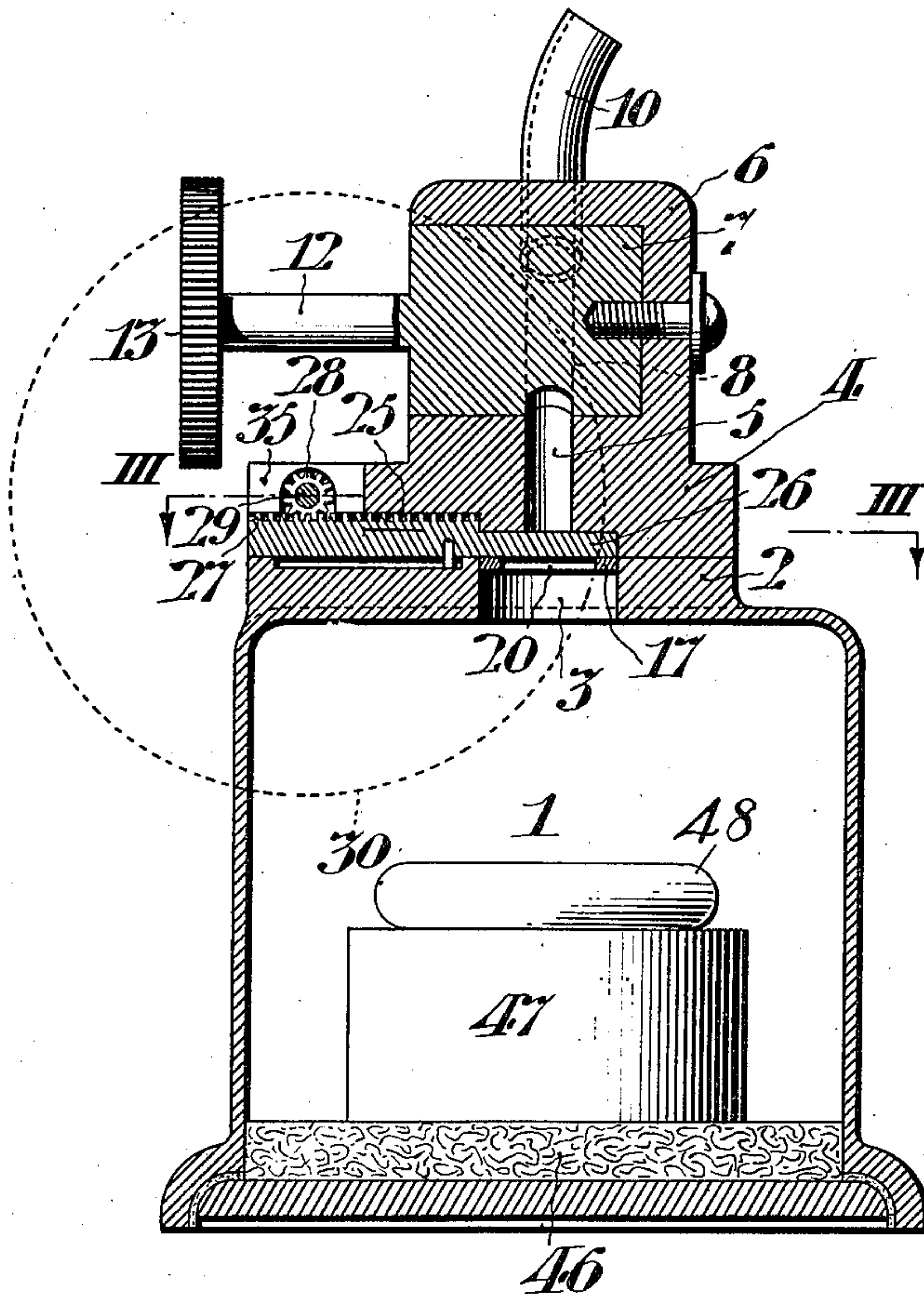
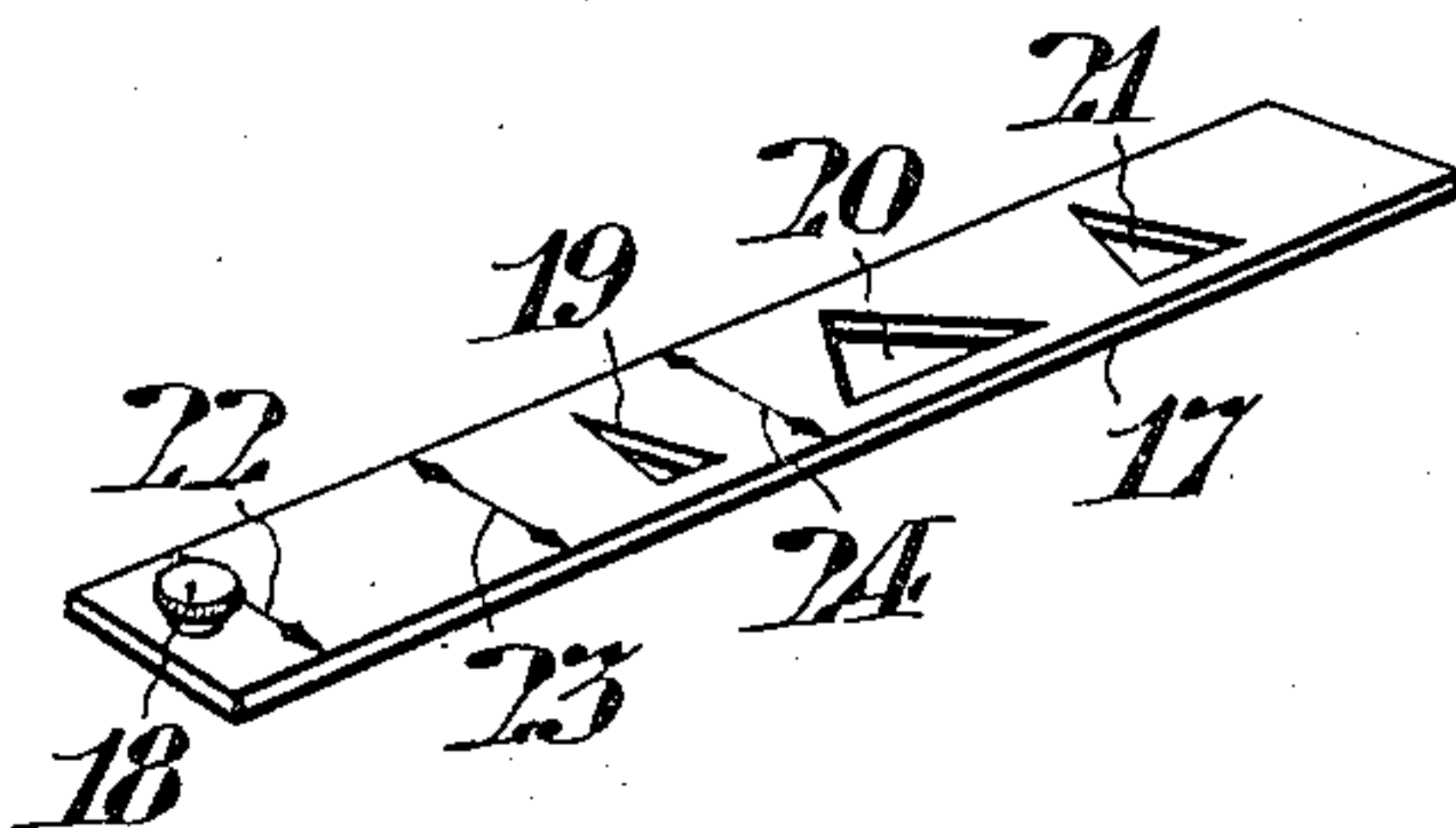


FIG. VI.



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4 SHEETS—SHEET 3.

FIG. III

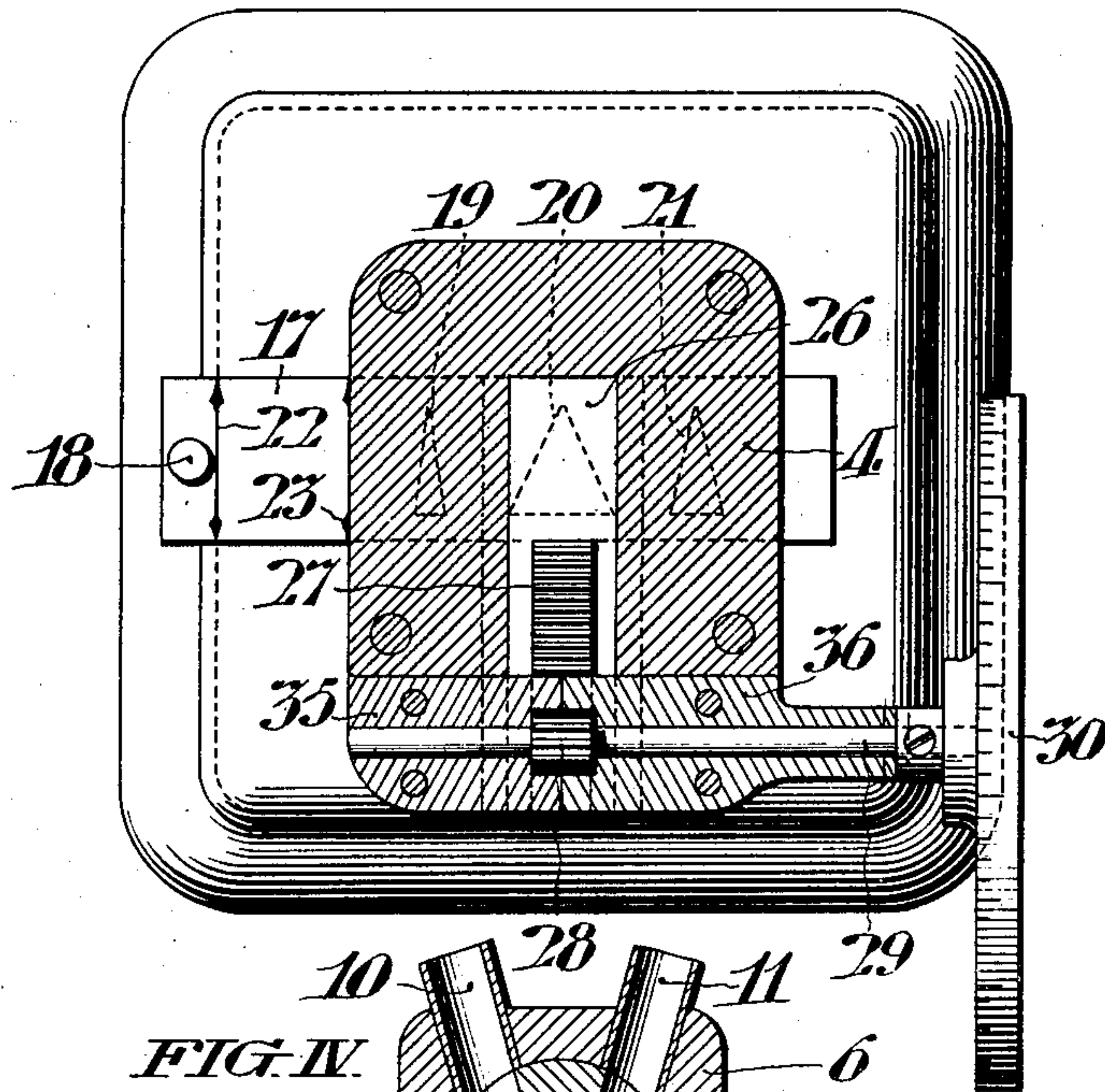
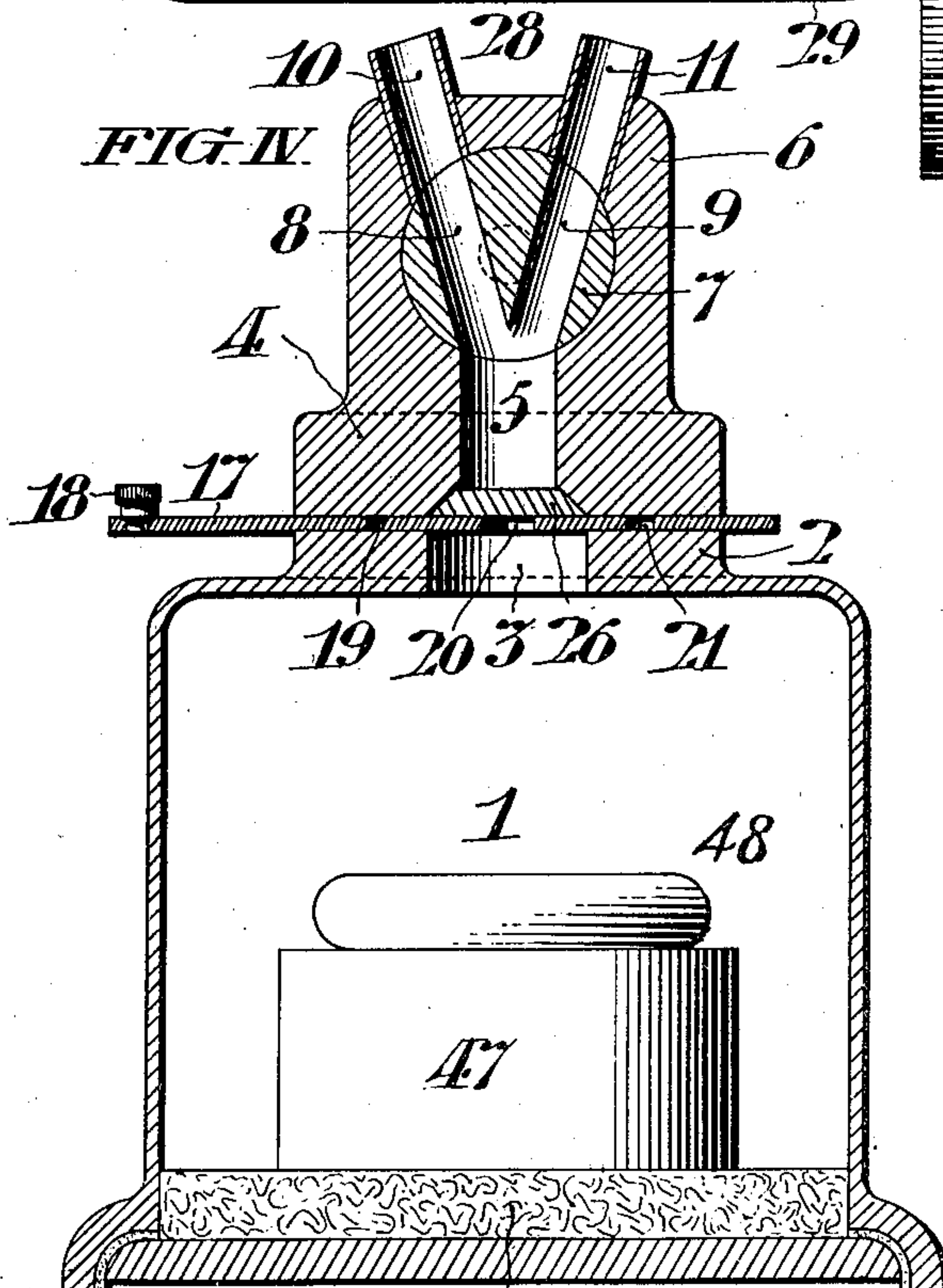


FIG. IV



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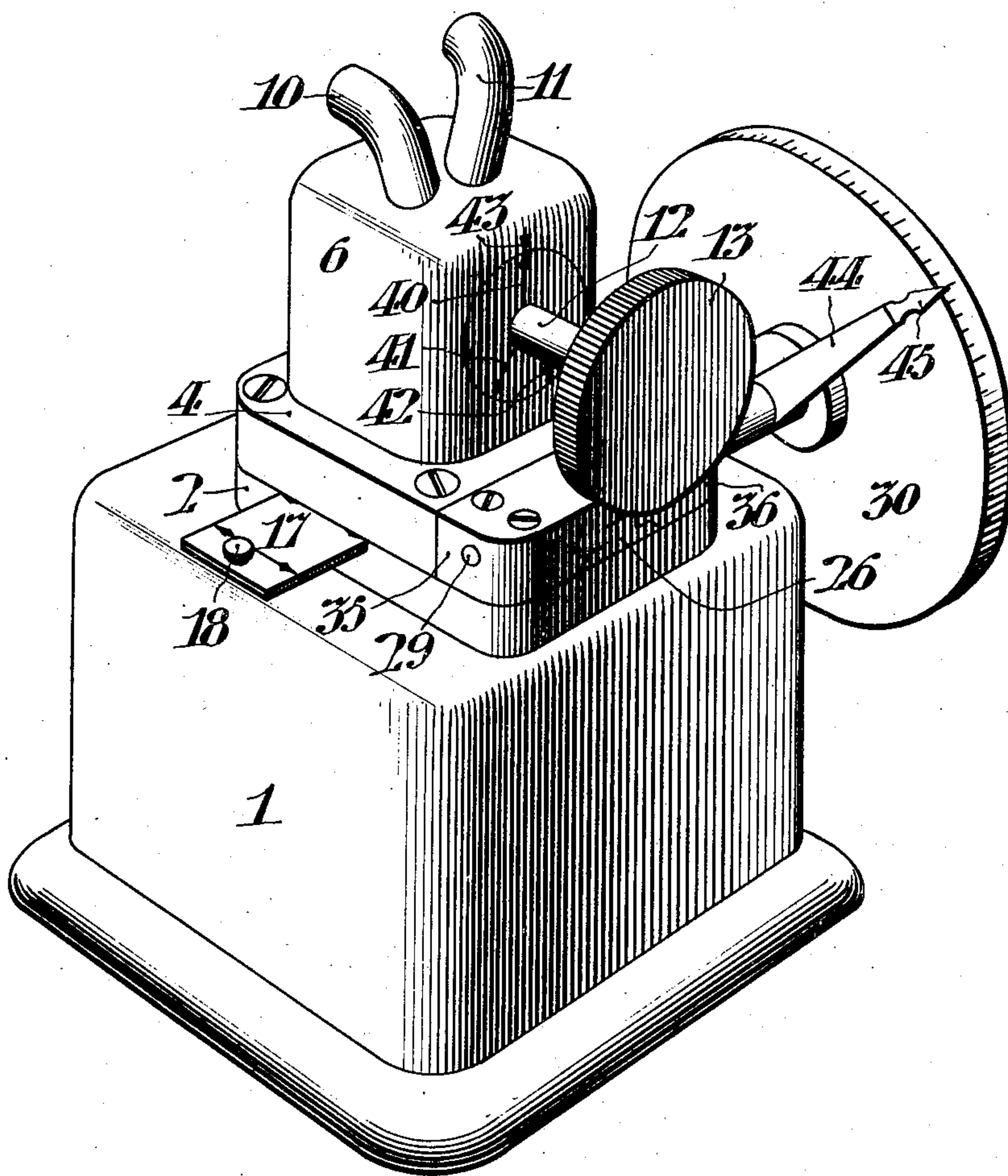
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4 SHEETS—SHEET 4.

FIG. V.



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UNITED STATES PATENT OFFICE.

JOSEPH M. McCALLIE, OF TRENTON, NEW JERSEY.

AUDIOMETER.

No. 862,501.

Specification of Letters Patent.

Patented Aug. 6, 1907.

Application filed March 7, 1907. Serial No. 361,033.

To all whom it may concern:

Be it known that I, JOSEPH M. McCALLIE, of Trenton, in the county of Mercer and State of New Jersey, have invented a certain new and useful Audiometer, of which the following is a specification, reference being had to the accompanying drawings.

My invention relates to an instrument which is adapted to test the acuteness of human hearing, and, in its most complete embodiment, to enable comparison of the results in individual cases with a predetermined standard.

An ordinary method of testing hearing of individuals is to employ a sound emitting device, such as a watch, which is successively placed at more and more remote distances from the person subjected to the test, until the sound ceases to be audible, application being made of the familiar rule that the sound impressions upon the ear diminish in accordance with the square of the distance.

The object of my invention is to furnish a compact apparatus not requiring adjustment of the sound emitting device at different distances from the person subjected to the test and the consequent ascertainment of such distances by measurement, but which, nevertheless, permits the employment of the same general principle as to the diminution of audibility and presents the results of a given test immediately and directly to the observer.

In the accompanying drawings, Figure I, represents a plan view of an apparatus embodying my invention and provided with the flexible tubes, of the same general character as ordinary stethoscope tubes, which I prefer to employ in connection therewith. Fig. II, is a vertical section on a plane of the line II, II, of Fig. I. Fig. III, is a horizontal sectional view on the two planes indicated by the lines III, III, of Fig. II. Fig. IV, is a vertical section at right angles to that of Fig. III, and on the plane of the line IV, IV, of Fig. I. Fig. V, is a perspective view of the apparatus. Fig. VI, is a perspective view of the adjustable slide for affording sound openings of different fixed area, the purpose of which will be explained hereafter. In Figs. II, IV, and V, the flexible tubes are omitted for purpose of convenience.

Generally speaking, my invention in its fullest embodiment comprises a receptacle adapted to so inclose a sound emitting object as to prevent the transmission of sound audible to the human ear, except through an aperture provided for that purpose; means for progressively varying the area of said aperture and for indicating the extent thereof at a given movement; means for employing openings of selected areas for the purpose of such subsequent variation; and means

whereby either or both ears of the person undergoing the test may be placed in communication with the source of sound.

Referring to the drawings, 1, indicates the closed receptacle, preferably of metal, which is conveniently made of the approximate cubical form shown. Upon a portion of the top of the receptacle 1, and preferably integral therewith, is a raised bed plate 2, through which a vertical passage 3, of circular cross section, extends. This bed plate may extend laterally as shown, to one edge of the receptacle, and supports a casing 4, whose upper portion 6, is somewhat reduced in size, as indicated.

The upper portion of the casing contains a cylindrical valve 7, adapted to turn upon a horizontal axis and provided with a shaft 12, and hand wheel 13. This valve is provided with two passages 8, and 9, respectively, which merge into an oblong opening at one extremity, but diverge from one another so as to be capable of simultaneous registration respectively with the opening of the outlet nozzles 10, and 11.

A vertical passage 5, is formed through the lower portion of the casing in proper position to communicate with the passage 3, leading from the receptacle 1. In cross section the passage 5, is oval, its two diametrical dimensions being indicated respectively in Figs. II, and IV, and its greatest diameter being such as to register with the approximately oval opening in the valve 7, at the region where the passages 8, and 9, merge together.

Intermediate between the passage 5, and the passage 3, are two independent controlling elements, which in this instance, are arranged to move at right angles to one another. The lower of these elements is the slide 17, shown in perspective in Fig. VI, and which may conveniently be termed the outlet-slide. This outlet-slide moves freely in a horizontal channel formed in the bed plate 2, the width of the slide being such as to completely cover the upper end of the passage 3. This outlet-slide is provided with a stud 18, so that it may be shifted by hand into any desired position and in this instance, it contains three triangular openings 19, 20, and 21, the altitude of the three triangles being the same, but the base lines varying, so that the area of the triangle 19, is one-half that of the triangle 21, the area of the latter one-half that of the triangle 20. When the outlet slide is adjusted with any one of these three triangles symmetrically over the center of the passage 3, the effective area of the outlet of said passage is of course reduced to the area of the particular triangle so located. Transverse lines 22, 23, and 24, are so marked upon the outlet-slide as to register with the exterior face of the

casing 4, when the respective triangles are in the proper position with reference to the passage, so that the operator may correctly adjust the slide.

Immediately above the outlet-slide 17, and preferably at right angles thereto is a second slide 26, which may conveniently be termed the cut-off slide. This cut-off slide moves freely in an undercut recess 25, formed in the lower portion of the casing 4, and is provided with a laterally projecting rack 27, which extends out through the casing 4, and is mounted within a removable housing comprising the pieces 35, and 36, which are secured to the laterally extending part of the bed plate 2, at that region. Said housing affords bearings for the shaft 29, upon which a pinion 28, is mounted in engagement with the rack 27, the shaft 29, being provided with an external hand wheel 30, whose periphery is marked with graduations as indicated. The cut-off slide 26, is of such dimensions and its range of movement of such extent, as to permit the complete covering of any given opening through the outlet-slide 17, or the complete exposure of said opening when arranged in communication with the passage 3. The inner end of the cut-off slide 26, is in this instance, rectangular with relation to its sides, in order that it may be symmetrical with relation to the configuration of the openings in the outlet-slide 17, so that as the cut-off slide 26, is progressively advanced or withdrawn across that opening which is then beneath it, a definite and regular reduction or increase in the area of the opening shall be effected.

A radial arm 44, having an index 45, arranged to overhang the periphery of the hand wheel 30, is mounted in a convenient position for observation from what may be termed the front of the instrument, that is to say, the side which in Fig. I, is shown at the bottom of the sheet. The exterior face of the valve 7, is also marked as indicated in Fig. V, with the radial lines 40, 41, and 42, which correspond with the three required positions of said valve, a mark 43, upon the exterior of the casing being properly located for registration with said lines respectively in the several rotative positions of the valve 7, within the casing 4.

A pedestal 47, may be provided for the sound emitting object 48, which may be a watch, and said pedestal may conveniently rest upon a mat of felt 46, or other substance which is not a good conductor of sound, so as to deaden the vibrations which might otherwise be directly communicated to the base of the instrument.

Referring to Fig. I, a pair of stethoscope tubes 50, and 51, are shown as connected respectively with the nozzles 10, and 11, said tubes being provided with the usual tips 52, and 53, for insertion into the cavity of the external ear.

The operation of the device is as follows:—The outlet-slide 17, is arranged with either one of its openings over the center of the passage way 3. In the instance shown, the largest opening 20, is thus indicated. The cut-off slide 26, is withdrawn, so as to completely expose the area of said opening, the position when the withdrawal is just complete being indicated by some predetermined mark, of the graduated scale upon the hand wheel 30. The valve 7, is adjusted by means of the hand wheel 13, into the desired position. In the instance shown in Fig. IV, this position is one in which

the passages 8, and 9, are both in communication with the passage 5, and respectively in communication with the nozzles 10, and 11, and stethoscope tubes 50, and 51. The tips of the tubes 50, and 51, are placed in the ears of the person subjected to the test and the hand wheel 30, is then turned so as to shift the cut-off slide 26, progressively across the opening 20, thus symmetrically reducing the area of said opening, the movement being continued until the sound just ceases to be audible by such person. The extent of rotative movement of the hand wheel 30, is then noted by means of the graduated scale, and the acuteness of simultaneous hearing by both ears may thus be recorded. By reverse movement of the hand wheel the cut-off slide may be actuated from an alternative position, when the opening is closed, so as to gradually increase the area of the opening until sound is just perceptible.

The valve 7, may be turned into such a position that only one of the openings 8, or 9, shall be in communication with the passage 5, and as the sound will then only be transmitted through the stethoscope tube which is in communication with the passage 5, the hearing of one ear may be tested independently of the other ear, the reduction of the area of the opening 20, by means of the cut-off slide 26, being effected as above. If for any reason it is desired to employ an opening of less area than the opening 20, for the purpose of comparative test, either of the openings 19, or 20, may be substituted for said opening by merely shifting the outlet-slide 17, into one of its positions of proper registration. In such case the symmetrical reduction or increase of the size of the opening can be effected by means of the cut-off slide 26, as before.

Any predetermined standard may be adopted as the basis for the comparisons indicated by the graduated scale of the hand wheel 30, since of course, the functions of the instrument itself are not dependent upon the nature of the method by which they may be ultimately utilized.

It is of course obvious that the structural details above described may be varied without affecting the underlying principle of construction and operation, and also that while the complete embodiment above set forth is desirable, certain features may be omitted without losing the broader or more general advantages. I therefore wish it to be understood that I do not limit my claims to said structural details nor to the inclusion of all the operative features as a whole.

I claim:—

1. In an audiometer, the combination with a receptacle provided with an aperture; of a sound emitting object inclosed in said receptacle; and means for progressively and definitely varying the area of said aperture for testing the acuteness of human hearing.

2. In an audiometer, the combination of a receptacle adapted to inclose a sound emitting object, said receptacle being provided with an aperture; and means for progressively and definitely varying the area of said aperture and for indicating the extent thereof at a given movement.

3. In an audiometer, the combination of a receptacle adapted to inclose a sound emitting object; means for providing said receptacle with apertures of selected area; and means for progressively varying the area of one of said apertures and for indicating the extent thereof at a given movement.

4. In an audiometer, the combination of a receptacle adapted to inclose a sound emitting object; an outlet slide

provided with an aperture; and means for progressively varying the area of said aperture.

5 In an audiometer, the combination of a receptacle adapted to inclose a sound emitting object; an outlet slide provided with a series of apertures of selected area and adapted to be progressed to present one of said apertures as an outlet for sound from said receptacle; and means for progressively varying the area of said presented aperture and for indicating the extent thereof at a given movement.

10 6. In an audiometer, the combination of a receptacle adapted to inclose a sound emitting object; said receptacle being provided with an aperture; a cut-off slide for progressively varying the area of said aperture; and means whereby either or both ears of a person undergoing the test may be placed in communication with the source of sound.

15 7. In an audiometer, the combination of a receptacle adapted to inclose a sound emitting object, said receptacle being provided with an aperture; a cut-off slide for progressively varying the area of said aperture; means for indicating the extent of movement of said slide; tubes for application to the ears of the person undergoing the test; and a valve for establishing communication between said aperture and either or both of said tubes.

20 8. In an audiometer, the combination of a receptacle adapted to inclose a sound emitting object, said receptacle being provided with an aperture; a cut-off slide for progressively varying the area of said aperture; a casing secured to said receptacle; a pair of nozzles attached to said casing; a passage in said casing; and a valve for placing said passage in communication with either or both of said nozzles.

25 9. In an audiometer, the combination of a receptacle adapted to inclose a sound emitting object; an outlet slide provided with an aperture; a casing attached to said receptacle and having a passage adapted to be placed in com-

munication with the interior of said receptacle; a pair of nozzles in said casing; and a valve in said casing whereby either or both of said nozzles may be placed in communication with said passage.

30 10. In an audiometer, the combination of a receptacle adapted to inclose a sound emitting object, said receptacle being provided with an aperture; a casing having a passage adapted to be placed in communication with said aperture; a cut-off slide for varying the extent of said aperture; a rack upon said slide; a shaft; a pinion upon said shaft and adapted to mesh with said rack; means for turning said shaft; a pair of nozzles in said casing; and a valve for placing said passage in communication with either or both of said nozzles.

35 11. In an audiometer, the combination with a receptacle; of an object which creates sound waves inclosed within said receptacle; means for transmitting a definite portion of said sound waves to the ear; and means for progressively varying the extent of the portion of the sound waves thus transmitted, for testing the acuteness of human hearing.

40 12. The combination with means for creating sound waves; of an inclosure containing an aperture for transmitting a definite portion of said sound waves to the ear; and means for definitely varying the extent of the transmitted sound waves by uniformly progressive modifications of the area of said aperture, whereby the acuteness of human hearing may be tested.

45 In testimony whereof, I have hereunto signed my name, at Philadelphia, Pennsylvania, this twenty-third day of February, 1907.

JOSEPH M. McCALLIE.

Witnesses:

JAMES H. BELL,

E. L. FULLERTON.