

Dec. 16, 1930.

C. F. WIEBUSCH

1,784,860

SOUND RECORDER

Filed Aug. 25, 1928

FIG. 1

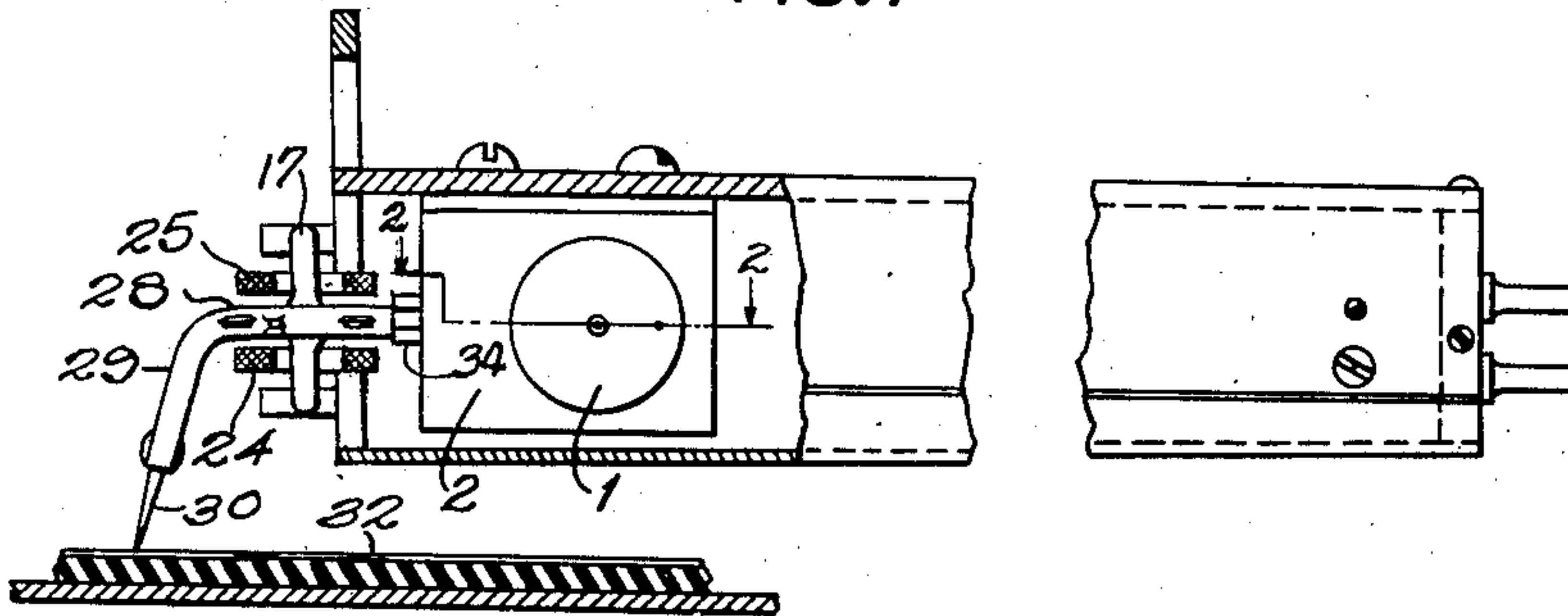


FIG. 2

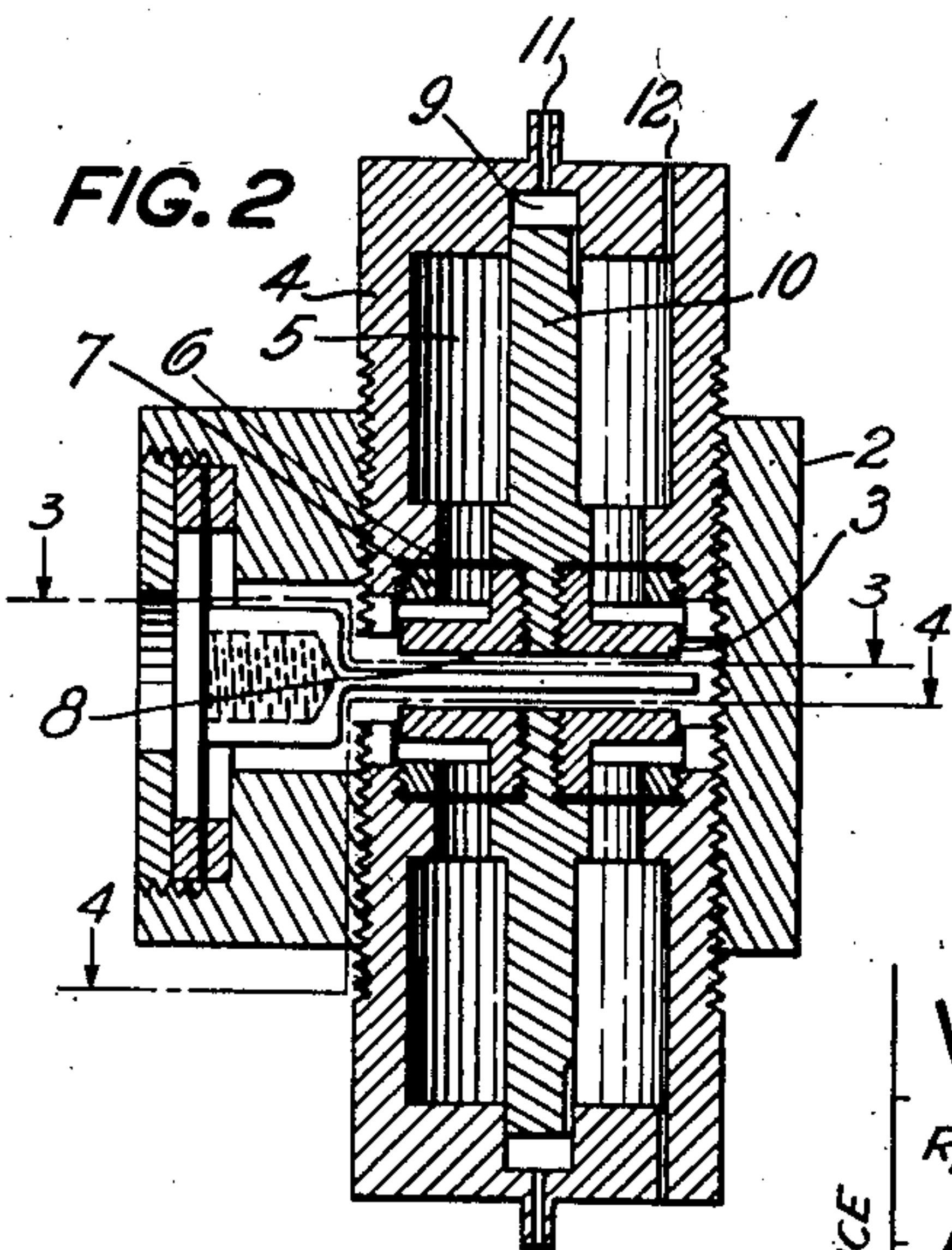


FIG. 3

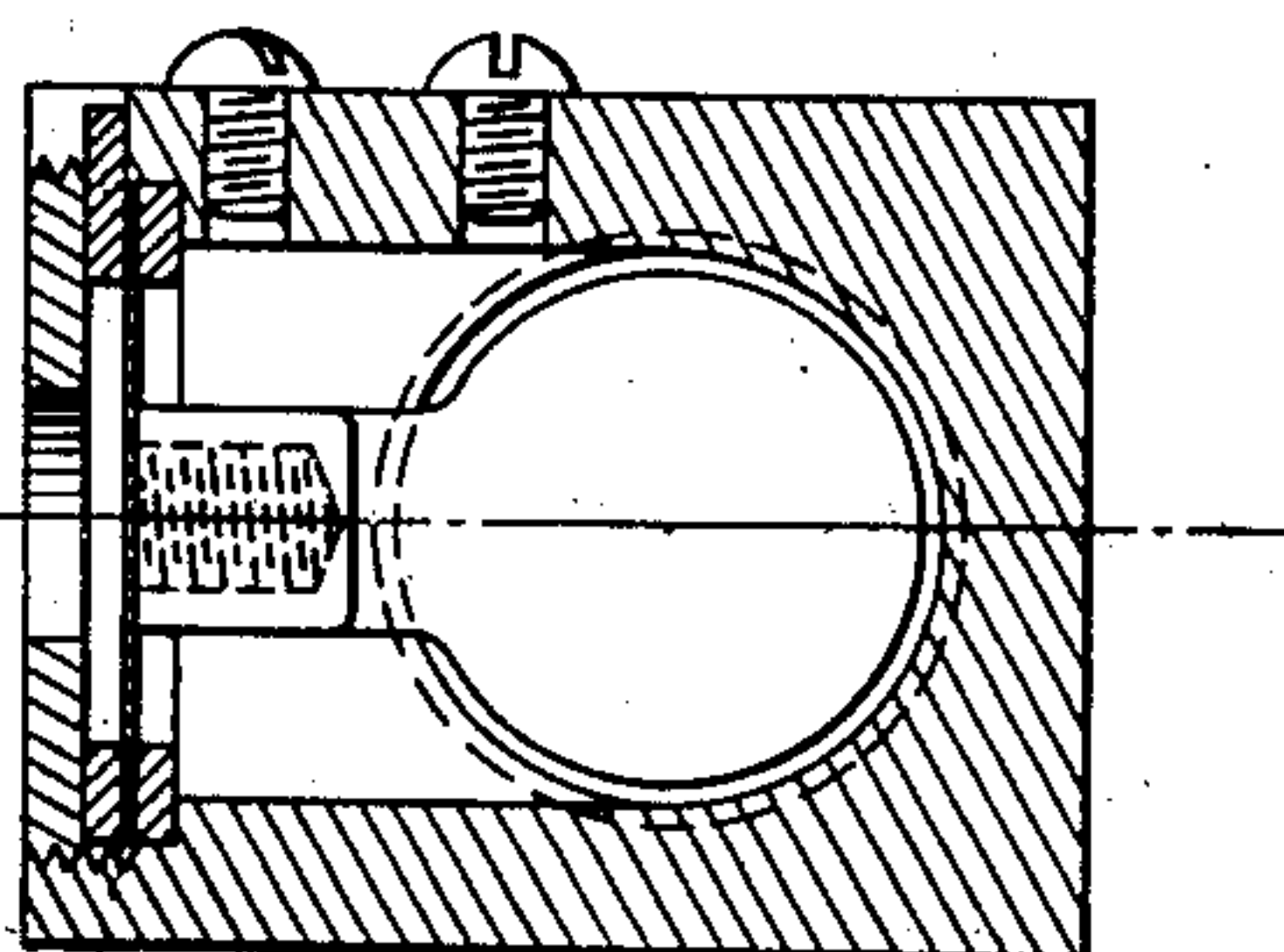


FIG. 4

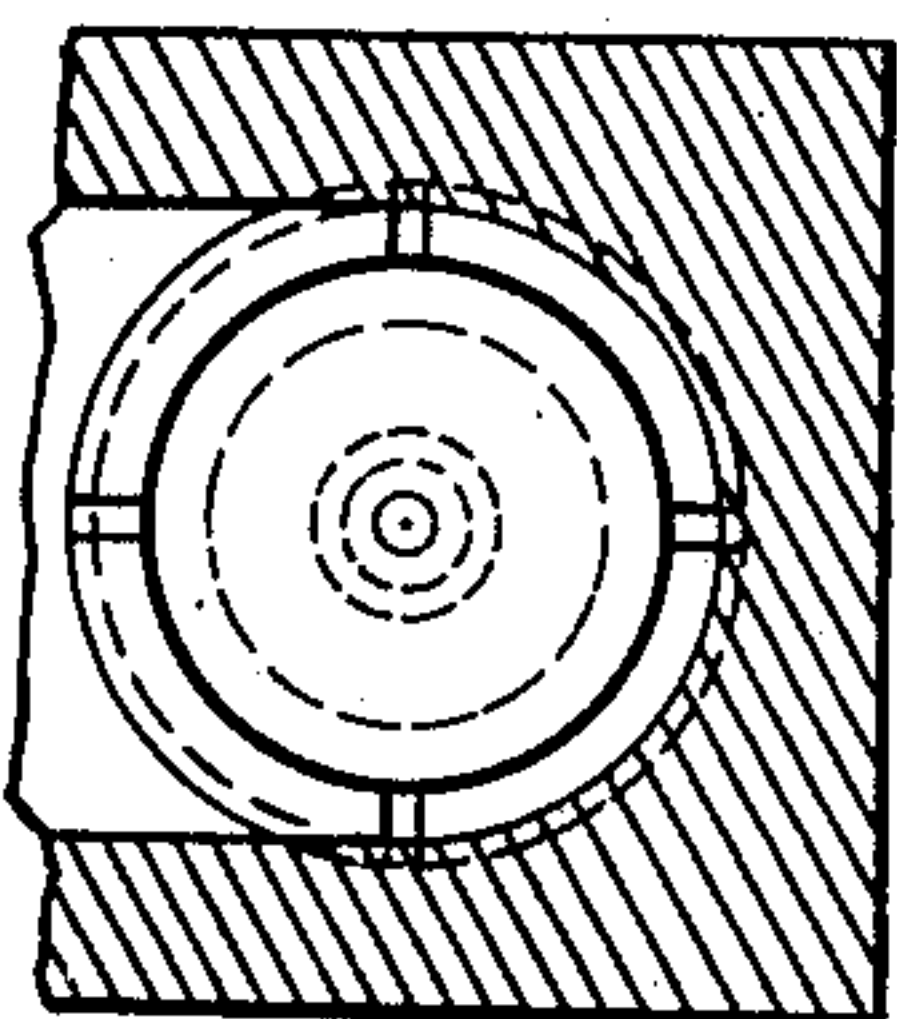
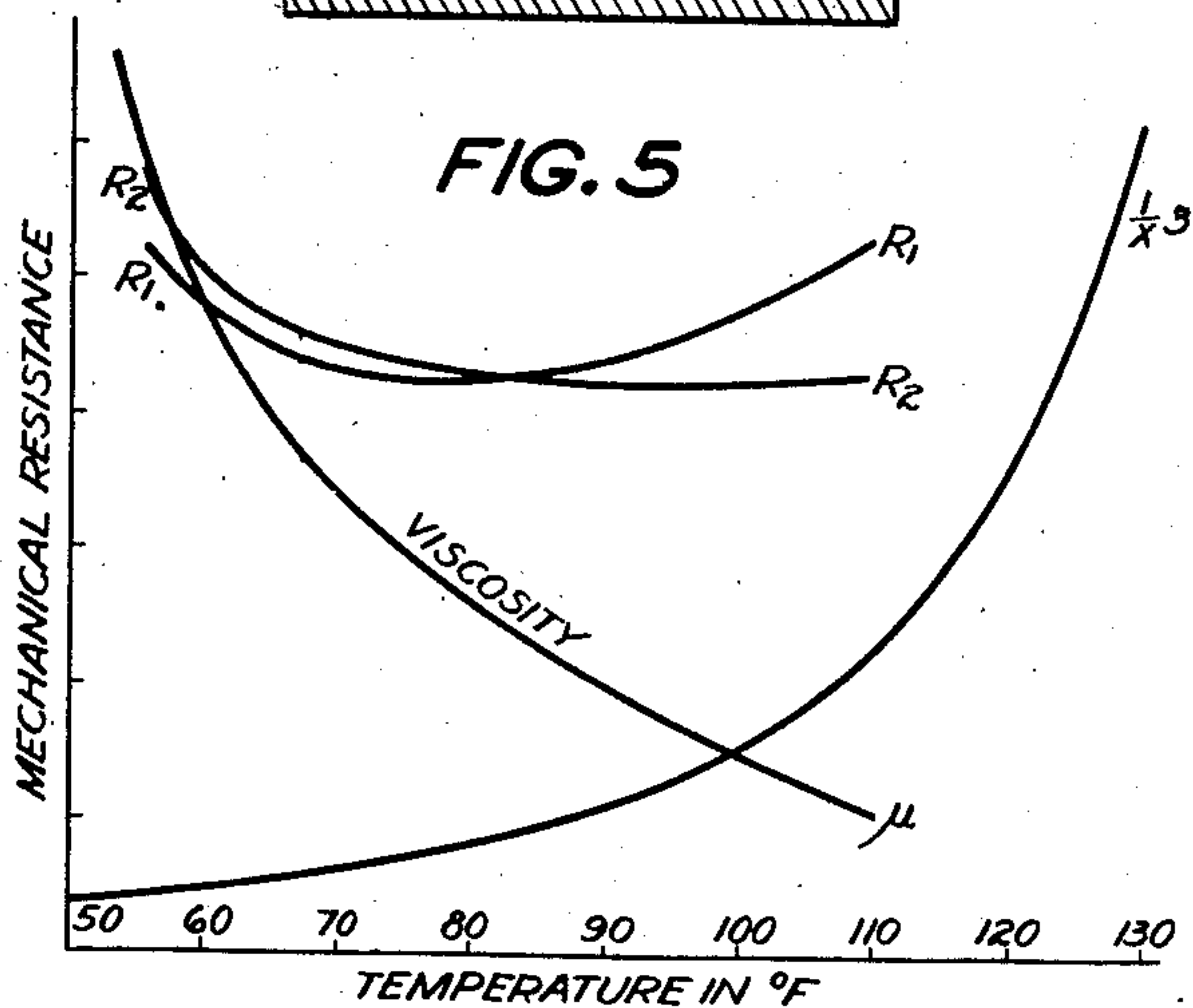


FIG. 5



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SOUND RECORDER

Application filed August 25, 1928. Serial No. 302,083.

This invention relates to vibration damping devices and more particularly to an arrangement for maintaining the damping action at a constant value in electro-magnetic devices such as sound recorders:

In Patent No. 1,663,884 to Harrison, March 29, 1928, there is disclosed a translating device in which the moving system has attached to it a mechanical terminating impedance consisting of a rubber "line" of high dissipative properties whereby substantially constant response is obtained over a wide range of frequencies. As an alternative device for this purpose it has been proposed to use an oil damping unit which consists of a wing-like member attached to the moving system of the device and adapted to vibrate in a viscous medium between two adjustable plates. In units of this sort the mechanical resistance or damping action of the wing member is proportional to the viscosity of the damping medium employed. The response of such a device therefore will vary with the temperature so that for high quality work calibration must be made at approximately the temperature at which the unit is to be used.

It is the object of the present invention to overcome this objection and to provide a damping unit which offers substantially constant resistance to motion over a wide range of both frequency and temperature.

According to the preferred embodiment of this invention variations in damping effect due to changes of viscosity of the damping medium with temperature are prevented automatically by the movement of the adjustable plates in accordance with the expansion and contraction of oil or other fluid means in secondary chambers on the other side of the plates. One or both of the plates may be regulated in this way according to the degree of accuracy required.

In the drawing, Fig. 1 is an assembly view showing how the present invention may be used with an oil-damped recording device.

Fig. 2 is a sectional view of the temperature compensating unit.

Figs. 3 and 4 are sectional views through the damping chamber as indicated, and

Fig. 5 shows a series of curves by means of

which the design of the device is facilitated.

Referring now to Fig. 1, the recorder shown is of the balanced armature type and, with respect to the arrangement of the parts for translating electrical variations in the windings 24—25 into mechanical vibrations of the recording stylus 30, is essentially the same as that disclosed in the above Harrison patent. The recording stylus 30 is carried by a stylus holder 29, the horizontal section 28 of which serves also as a supporting member for the armature 17. When the record 32 is being cut, an oscillatory motion is imparted to the armature by the interaction of the currents corresponding to the sounds to be recorded and the magnetic field of the recorder as fully described in the Harrison patent so that the stylus holder will vibrate about its horizontal axis.

It will be evident that in the present invention the damping unit 2 replaces the rubber line of the patent and that the wing member 33 engages threads on the end of member 28 and is held in proper adjustment by lock nut 34. As the member 28 oscillates in accordance with the currents in coils 24—25 the wing member 33 undergoes a similar oscillatory motion and displaces the oil in the gaps 8 and 35, thereby introducing the required damping action. The foregoing detailed explanation deals entirely with the devices of the prior art but it is a necessary prerequisite to a proper understanding of the present invention which will now be described.

The compensating unit 1, which is arranged to be screwed into the damping unit 2 in place of the adjustable plate used heretofore, consists of a piston 3 adapted for slight longitudinal movement in the casing 4 under the pressure of oil in the chamber 5. The diaphragm 6, held in place by an annular member 7, serves as an oil seal between the recorder damping gap 8 and the chamber 5 and yet flexes sufficiently to permit the piston to vary the gap in accordance with temperature changes. The casing is recessed at 9 to receive the end of piston rod 10 as indicated, and thereby maintain the piston in proper alignment. The casing is made oil-

tight by soldering around the periphery of the diaphragm and sealing off openings 11 and 12 after the unit has been filled with oil.

The exact size of the oil chamber necessary to maintain constant damping depends, of course, upon the viscosity of the oil, the ratio of the temperature coefficients of the oil and the casing material, the dimensions of the gap, the effective area of the diaphragm and whether one or two compensating units are used. In the present instance brass is used as a casing material, the gaps of the damping unit are about 15 mils each and the effective area A of the diaphragm is taken as .10 square inches. An oil which has been found satisfactory for the purposes of this invention is a mixture of 74% polymerized linseed oil and 26% kerosene.

These factors having been determined, the required volume of the compensating chamber is fixed by the distance the piston must move per degree rise in temperature to maintain the damping within permissible limits of variation. In order to obtain theoretically a first approximation of this movement, curves of μX the viscosity of the oil, and

$$\frac{1}{X^2}$$

were plotted as shown in Fig. 5. Values of X were obtained from the equation

$$X = g \left(\frac{G_0}{g} + t_0 - t \right)$$

G_0 being the oil gap at the temperature t_0 , and g being the assumed expansion per degree rise in temperature (in this case

$$g = \frac{G_0}{124}.$$

An indication of the variations in mechanical resistance or damping with temperature is obtained by plotting a curve R_1 which represents the product of the first two curves. The flatter curve R_2 was obtained by changing g arbitrarily to the value

$$\frac{G_0}{144}$$

when curve R_1 was found to be unsatisfactory.

Since variations up to 10% do not affect the response characteristic seriously, R_2 may be said to effect satisfactory compensation between 65° and 110° F. The operating temperature of the unit is generally 10° to 15° F. above room temperature so that a unit designed in accordance with curve R_2 would compensate for temperature variations from 55° to 100° F.

With a 15 mil gap on either side of the wing member 12,

$$g = \frac{15}{144} = .104 \text{ mils per degree F.}$$

The apparent coefficient of expansion d of the oil used, in a brass casing is about 35×10^{-5}

per degree F. The necessary movement of the piston per degree F. due to the expansion of the oil in chamber 5 is then represented by

$$g = \frac{V_0 d}{A}$$

from which the required volume of the compensating chamber

$$V_0 = \frac{.000104'' \times .10}{35 \times 10^{-5}} = .030 \text{ cubic inches.}$$

Since the temperature range of a studio is generally rather small, one variable gap will provide sufficient temperature compensation in many cases. Experiments along this line indicate that one unit may be designed to give satisfactory regulation over a range of about 2/3 that possible when both gaps are made variable.

While this invention has been described with reference to a particular embodiment, it is intended to be limited only by the following claims.

What is claimed is:

1. In a vibration damping device the method of preventing variations in the damping action which consists in varying the size of the damping chamber in accordance with the volume variations of fluid external to the damping chamber.

2. In a vibration damping device, a casing containing viscous matter, a damping member moving in said matter and fluid means responsive to temperature changes for preventing variations in the effectiveness of said damping device.

3. In a mechanical vibration damping device, a casing, a pair of spaced plates, a member adapted to oscillate between the plates, viscous matter in said casing to impede the oscillations of said member and means responsive to temperature changes for varying the spacing of said plates.

4. In a mechanical vibration damping device, a casing, a pair of spaced plates, a member adapted to oscillate between the plates, viscous matter in said casing to impede the oscillations of said member and fluid means cooperating with one of said plates to prevent variations in the effectiveness of said device.

In witness whereof, I hereunto subscribe my name this 21st day of August, 1928.

CHARLES F. WIEBUSCH.