Feb. 18, 1930. L. A. ELMER 1,747,866

SOUND RECORDING AND REPRODUCING MACHINE

Filed Dec. 28, 1927 3 Sheets-Sheet 1

FIG. 1

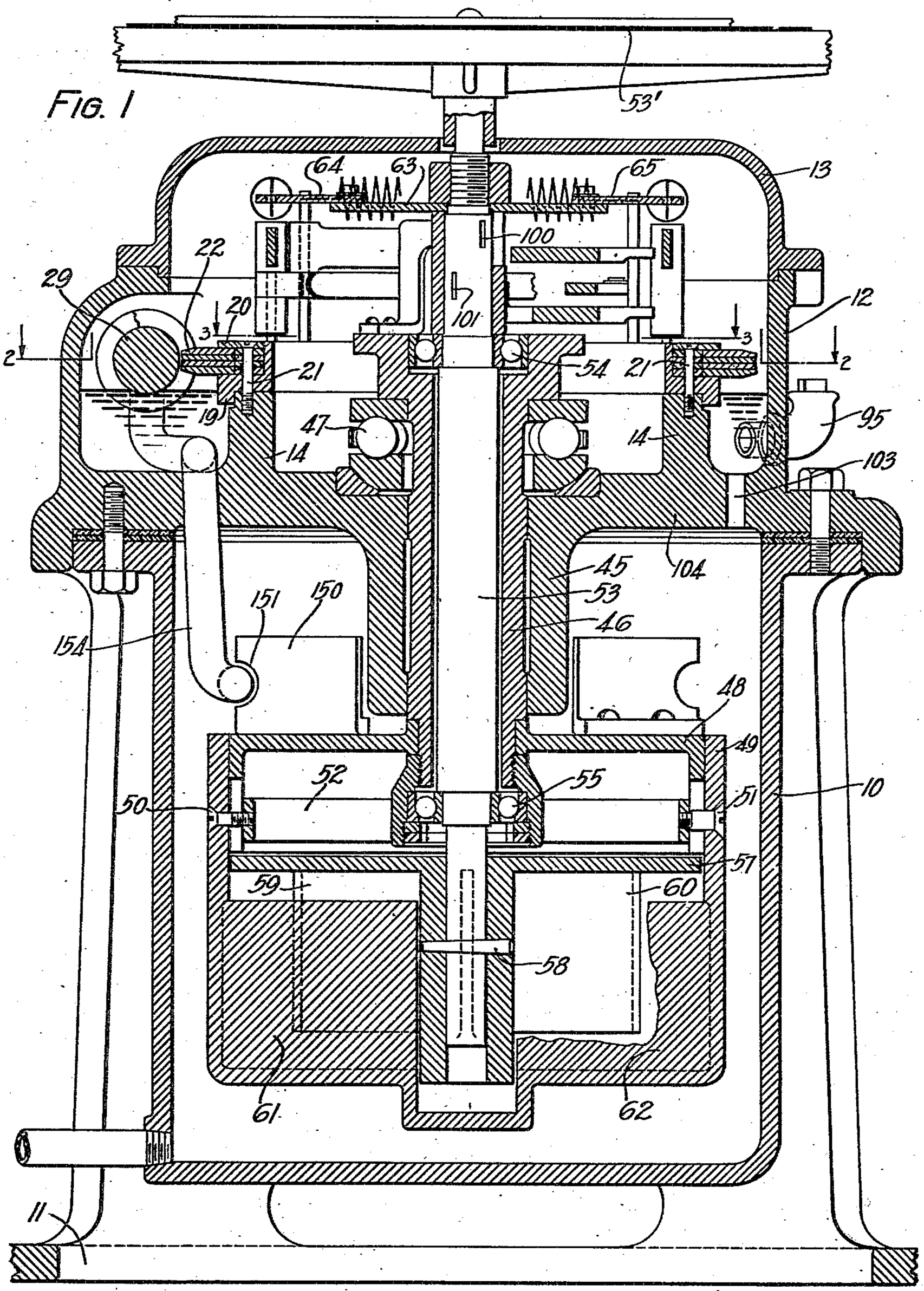


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FIG. 2

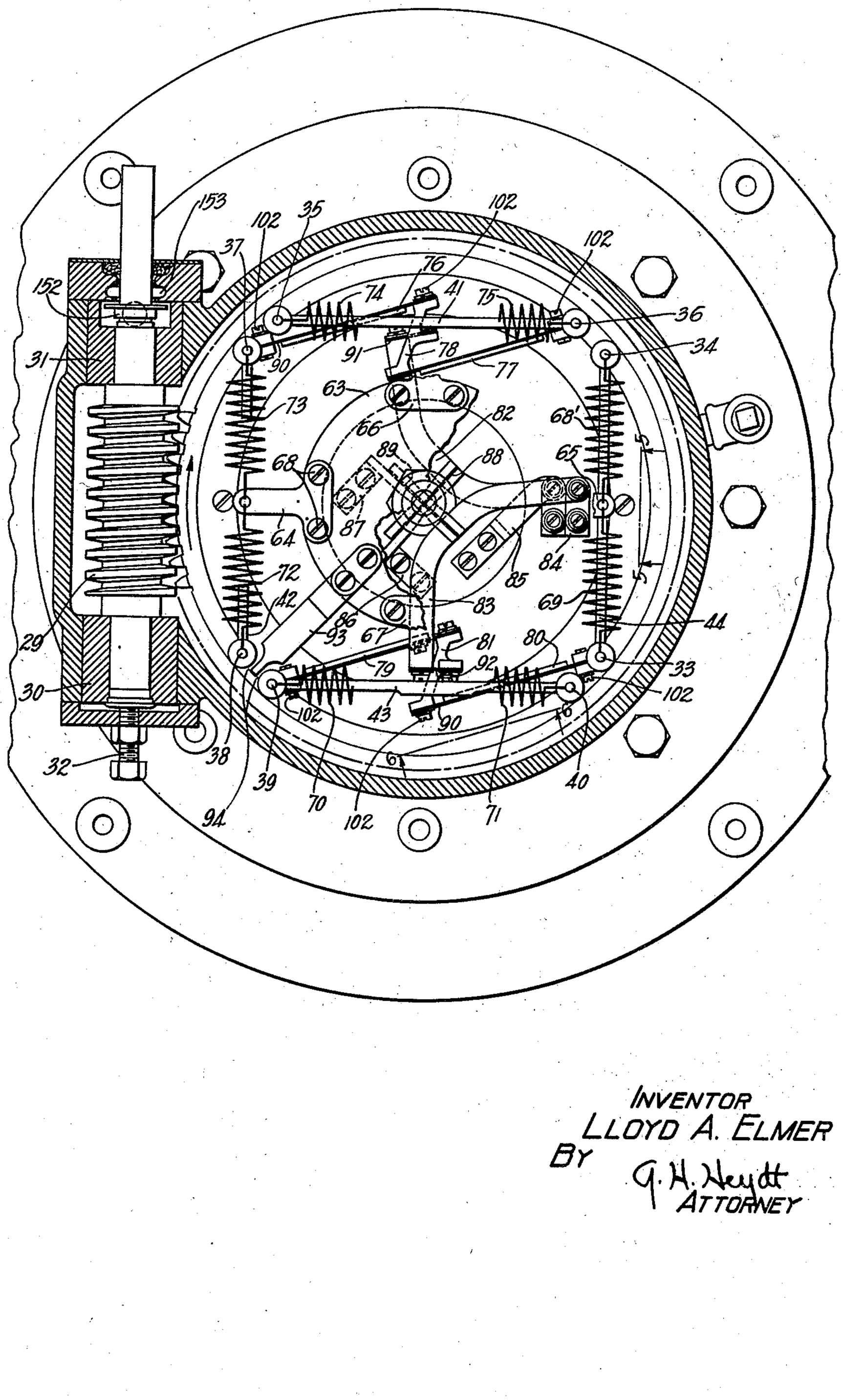


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FIG. 3

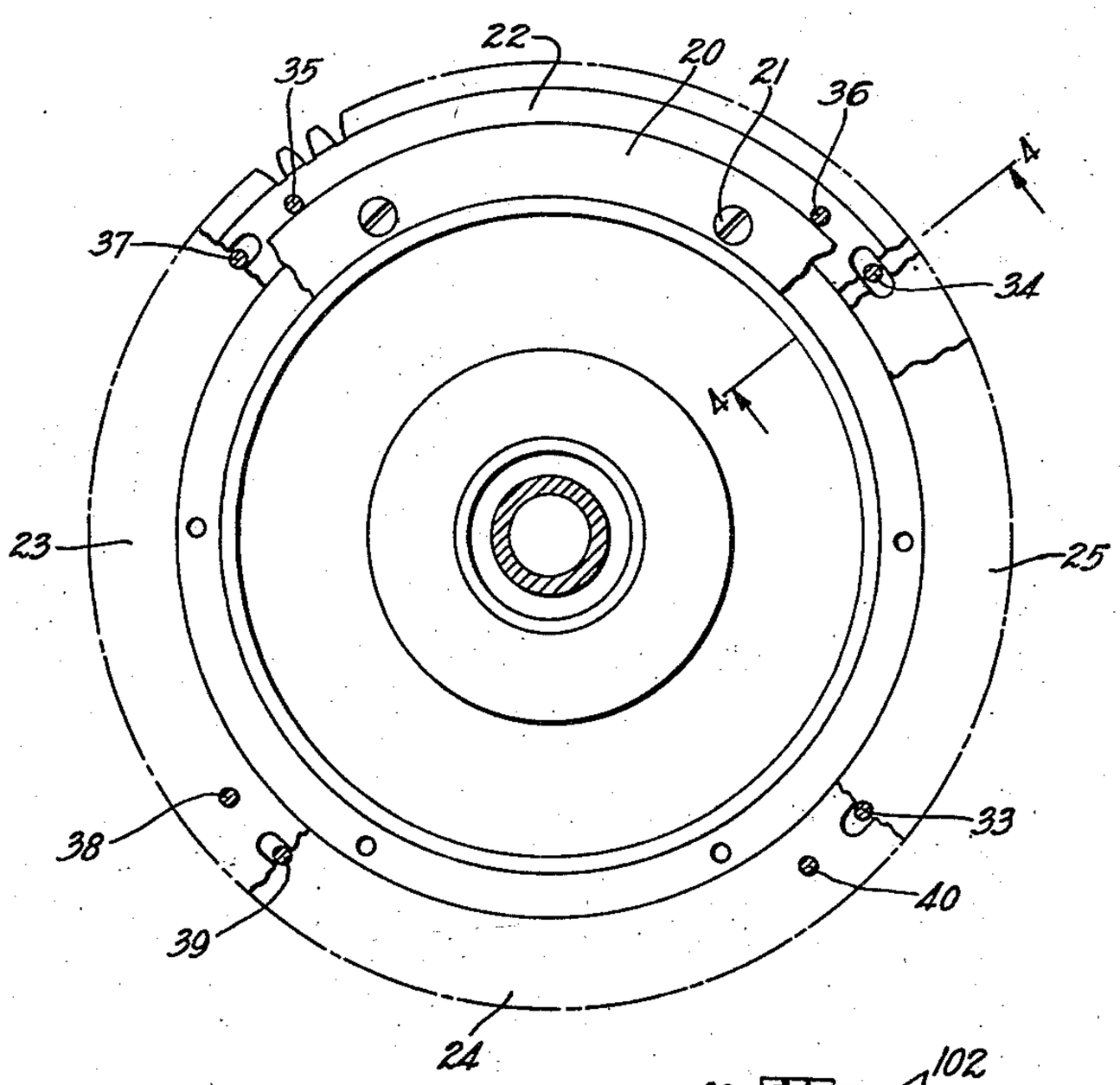



FIG. 4

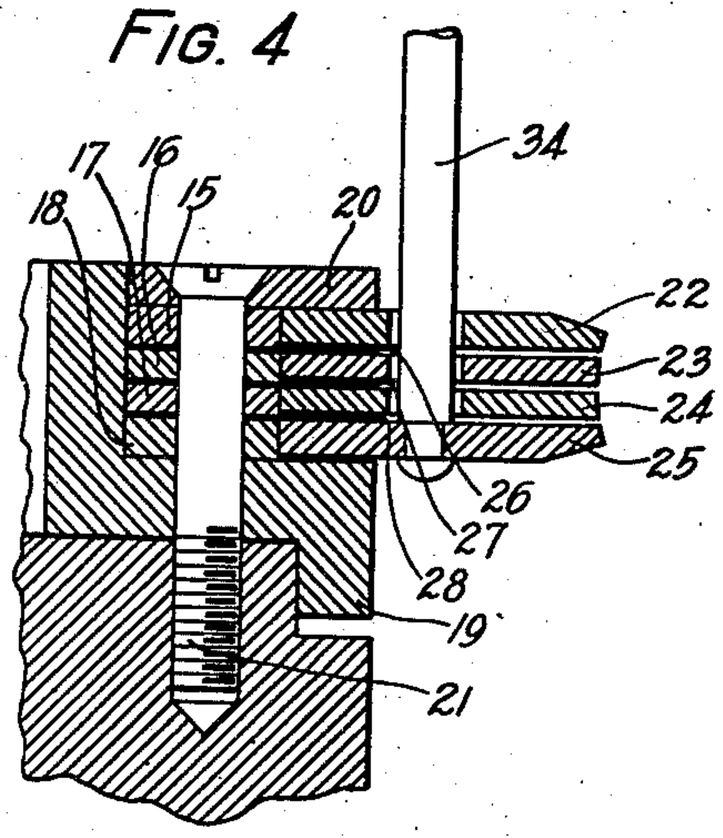



FIG. 5

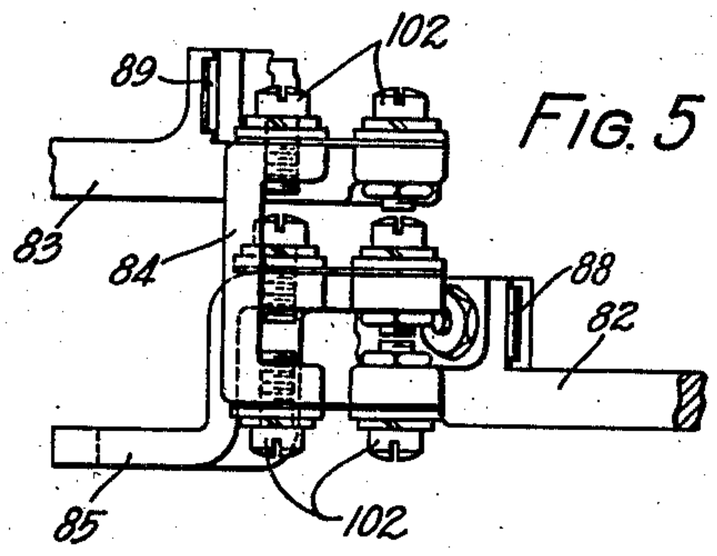
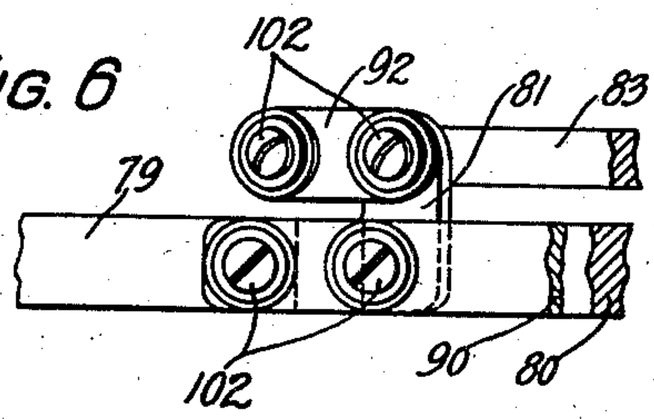



FIG. 6

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Patented Feb. 18, 1930 1,747,866

# UNITED STATES PATENT OFFICE

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## SOUND RECORDING AND REPRODUCING MACHINE

Application filed December 28, 1927. Serial No. 242,987.

This invention relates to driving mechanisms and is of a type particularly well adapted for use in driving the turntable of a sound recording or reproducing machine or the like.

It is an improvement over a turntable drive disclosed in a copending application to H. C. Harrison, Serial No. 111,707, filed May 26, 1926.

In such a system the movement of a motor is transmitted to the turntable shaft by means of a gear reduction mechanism which includes a two-layer worm gear. These layers are operatively connected to the turntable shaft by means of mechanical filters in the form of springs and two intermeshing vane wheels acting on a damping fluid cooperate with each other to damp the action of the driving springs to compensate for sudden changes in the angular velocity of the gear layers.

The object of this invention is to improve the operation of such driving mechanism, and this object is accomplished by the provision of novel means and combination of parts whereby the actions of the driving springs tending to affect the constancy of rotation of the turntable shaft are attenuated to such a degree that the turntable shaft is caused to maintain a uniform and constant speed and thereby permits the accurate recording and faithful reproduction of the sounds thus recorded.

Referring to the drawings, Fig. 1 is a vertical sectional view of the driving mechanism;

Fig. 2 is a horizontal sectional view of the casing taken approximately on line 2—2 of Fig. 1 showing a number of operating parts partially cut away and the turntable removed from its supporting shaft;

Fig. 3 is an assembly view of a four-layer gear, showing three of the layers partially cut away;

Fig. 4 is a sectional view taken on line 4—4 of Fig. 3;

Fig. 5 is a partial view of the lever system shown in Figs. 1 and 2 looking from a line perpendicular to line 5—5 of Fig. 2; and

Fig. 6 is a partial view of the lever system observed from a line perpendicular to line 6—6 of Fig. 2.

This driving mechanism consists of an uprightly disposed tank 10 which is preferably integrally formed with a base 11 and cooperates with detachable superposed covert portions 12 and 13 to form a dust proof casing for housing the turntable operating mechanism.

The casing portion 12 is provided with a circular ridge 14 on which the rings 19 and 20 and bearings 15, 16, 17 and 18 interposed therebetween are held in adjusted position by a plurality of screws, such as 21. On bearings 15, 16, 17 and 18, best seen in Fig. 4, there are rotatably mounted a corresponding number of independent gear layers 22, 23, 24 and 25, between which friction rings 26, 27 and 28 are mounted and held against rotation by screws 21.

The worm gear thus formed is disposed in engageable relation with a common worm screw 29 which as shown in Fig. 2 is journaled in bearings 30 and 31 mounted in the casing portion 12 and an adjustable end thrust bearing 32 is provided for preventing the axial movement of worm screw 29. Gear layers 22, 23, 24 and 25 are each provided with a set of upward extending studs 35—36, 37—38, 39—40 and 33—34 and the studs of each set are connected by reinforcing bars 41, 42, 43 and 44, respectively. Each of these bars is provided with a clamping device to which links of a lever mechanism, which will be hereinafter described, are attached. The casing portion 12 is provided with a downward extending hub portion 45 in which a sleeve 46 is rotatably mounted and supported by an ordinary end thrust bearing 47 as shown in Fig. 1. On the lower end portion of sleeve 46 there is mounted a cylindrical casing formed by two telescoping portions 48 and 49 which are normally held in adjusted position by a number of screws 50, 51, etc., threadedly engaging a ring 52.

In sleeve 46 there is rotatably mounted a shaft 53 which is supported therein preferably by ball bearings 54 and 55. On the upper extending end portion of this shaft is mounted the turntable 53′ and on its lower

end portion is mounted a vane wheel 57 which is held securely thereon by a pin 58. This vane wheel carries a suitable number of blades, such as 59, 60, etc. which intermesh with a corresponding number of blades 61, 62, etc. in the lower disposed casing portion 49.

On the upper end portion of shaft 53 adjacent the under side portion of casing 13 there is mounted a disc 63 to which four equally spaced arms 64, 65, 66 and 67 are mounted and held securely thereon. These arms are operatively connected to their respective gear layers 22, 23, 24 and 25 by pairs of springs, as shown in Figs. 1 and 2. Springs 68′ and 69 for example have each one of their end portions connected to their respective studs 33—34 carried by gear layer 25 and the other end portions of these springs are connected to arm 65. Similarly gear layer 24 which carries studs 39 and 40 imparts its movement to the turntable shaft through springs 70 and 71 hooked to the studs 39 and 40 and to disc arm 67, as above described in connection with springs 68 and 69. Gear layer 23 which carries studs 37 and 38 is operatively connected to disc arm 64 by springs 72 and 73 and gear layer 22 which carries studs 35 and 36 is operatively connected to the disc arm 66 by springs 74 and 75.

As shown in Fig. 2 each gear layer 22, 23, 24 and 25 is further operatively connected to sleeve 46 by the system of levers above mentioned. This lever mechanism operates in a manner similar to that of a swingle-tree and double-tree arrangement commonly used in drawing wagons. It consists of links 76 and 77 which connect reinforcing bars 42 and 41 carried by gear layers 23 and 22 to opposite end portions of a yoke member 78 and links 79 and 80 which connect reinforcing bars 43 and 44 carried by gear layers 24 and 25 to opposite end portions of a yoke member 81. Yokes 78 and 81 are connected respectively to yokes 82 and 83 which in turn are connected to opposite end portions of a common link 84, best seen in Fig. 5 and a bracket 85 which has one of its end portions attached to the middle portion of link 84 and the other to the upper end of sleeve 46 operatively connects the gear layers 22, 23, 24 and 25 with sleeve 46. Yokes 82 and 83 are each attached at their middle end portions to respective supporting brackets 86 and 87 by flat or ribbon springs 88 and 89 which cross through slots 100—101 in the shaft 53 for permitting the pivotal movement of these yokes at these points.

The connections between the different reinforcing bars 41, 42, 43 and 44 and links 76, 77, 79 and 80 to respective yokes 78 and 81 are effected by ribbon springs 90, secured to the bars by screws 102 and the yokes 78 and 81 are connected to their respective yokes 82 and 83 by ribbon springs 91 and 92, respectively.

On disc 63 there is mounted an arm 93 which cooperates with stops formed by head portions of bars 42 and 43, as shown at 94 for limiting any angular movement which may be accidentally imparted to shaft 53 with respect to the gear layers 22, 23, 24 and 25 to which it is operatively connected as above described. On the casing portion 12 there is mounted an elbow pipe 95 which registers with hole 103 in the casing partition 104 for filling the casing with a suitable damping fluid, such as oil, up to the level indicated in the casing portion 12.

On the upper surface of telescopic portion 48 there are mounted a plurality of equally spaced radial blades 150, which are each provided with a notch 151 as shown in Fig. 1. A piece of metal tubing 154 has its discharge end portion disposed to register with notches 151. The other end portion of tubing 154 extends through the partition of casing portion 12 into a recess in bearing 31 in which a disc 152 mounted on the spindle of the worm 29 is provided to prevent a too great amount of oil from reaching the stuffing box 153.

Through this arrangement the oil vortex, created by the rotation of the vane wheel thus formed, tends to draw the oil from the recess in bearing 31 back into casing portion 10 and thus cooperates with the stuffing box 153 for effectively preventing a substantial amount of oil leaking out through the stuffing box.

In operation the movement of worm screw 29, which may be driven by any source of power operating at a constant velocity is effective to rotate the gear layers 22, 23, 24 and 25, which in turn actuates shaft 53 and the turntable 53′ carried thereby through the pair of springs 72—73, 74—75, 68′—69 and 70—71 attached to their respective gear layers and to respective arms 64, 65, 66 and 67 carried by disc 63. Considering the movement of turntable shaft 53 as being in the direction indicated by the arrow in Fig. 2, the torque is transmitted to the shaft 53 by springs 73, 75, 69 and 70 held to a predetermined tension by springs 72, 74, 68′ and 71 respectively. Now assuming that the motor operates at an absolutely constant speed, that each gear layer turns on an absolutely true center and that the spacing of the teeth in each gear layer is accurate, there will be no relative movement between the gear layers and therefore the movement of the turntable will be constant and uniform. Under such condition the oil damping device, and the lever system above described have not been rendered active and perform no function. However, it has been found practically impossible to produce gears which do not have a certain amount of eccentricity and other defects in the spacing of the teeth, and while

a defect of this minor extent is not perceptible and detrimental to the operation of ordinary machinery, it has been found to interfere considerably with the operation of sound recording machines by the introduction of extraneous vibrations in the recording system and in like proportion interferes with the reproduction of sound records thus recorded.

In the device of this invention the inaccuracy of the worm gear which has been found to be the main generating source of objectionable disturbing effects in the constancy of the turntable movement has been averaged by disposing the gear layers at an angular distance of substantially 0°, 90°, 180°, and 270° with respect to each other or their common tooth cutting position. The angular relative movement of each gear layer caused by the inherent defects above mentioned with respect to the sleeve 46 and the vane wheel 57 carried thereby has been reduced to a convenient degree by the system of levers above described and for a purpose that will be hereinafter described. Considering that the gear layers 22, 23, 24 and 25 are rotated in a clockwise direction and that due to defects in the formation of the gears such as eccentricity, the layers in their cyclic movement will tend to continuously change their speed which in each case is maximum when the shorter radius passes the worm screw, minimum when the longer radius passes the worm screw and, of course, normal at the true pitch radii at distances 90° from these extreme points. The movement of gear layer 22 for example relative to gear layers 23, 24 and 25 in a clockwise direction during a half cycle is effective to impart a rocking movement to yoke 78 through the movement of link 77 against the resistance of link 76 carried by gear 23 then moving in phase with worm 29. Through the connection of main yoke 82 to the middle portion of yoke 78 and to the lower arm of yoke 84, as shown in Fig. 5, a rocking movement is imparted to yoke 84, which in turn imparts this movement to sleeve 46 in a clockwise direction. This angular movement while reduced in amplitude in the order of three-fourths less than the relative movement of gear 22 tends to momentarily increase the speed of turntable shaft 53. However, it is to be noted that during the relative movement of layer 22, layers 23 and 25 then in phase with worm 29 through their respective driving springs 69 and 73 in cooperation with the mass effect of the turntable and the damping device neutralize the tension effect of driving spring 75, and the turntable is thus caused to maintain a uniform and constant speed.

A relative movement of gear layer 22 through the other half cycle is effective to cause a retard movement to sleeve 46 with respect to turntable shaft 53. Under this condition the driving spring tensioned by the relative movement of the gear layer 24 which has been rotated through an angle of 180° with respect to layer 22 is rendered ineffective to disturb the constancy of rotation of the turntable shaft due to the resistance afforded by the compression of the fluid between the vane wheels 60, 62, etc., which neutralizes the action of the spring and permits the turntable to move at a uniform and constant speed under the action of driving springs 73 and 69 whose layers are as described in connection with the first mentioned example in phase with worm 29.

The action of the lever system on sleeve 46 and casing 49 carried thereby is similar to that above described when affected by the relative movement of gear layers 23, 24 and 25 and as in any well-known vibratory system the damping effect of the elements 57 and 49 may easily be modified or adjusted with respect to the tension of the driving springs by increasing or decreasing the effective surfaces of blades 59, 60, etc., with respect to blades 61, 62, etc. This adjustment may be accomplished by lowering or raising the casing portion 49 with respect to vane wheels 57 carried by the turntable shaft.

What is claimed is:

1. A driving mechanism comprising a plurality of independent gear layers, actuating means for said layers, a shaft resiliently connected to each of said layers, a fluid damping device including intermeshing vane wheels, one of said wheels being carried by said shaft, and a lever system operatively connecting each of said layers to the other wheel.

2. A driving mechanism comprising a plurality of gear layers, a shaft actuated thereby, resilient coupling means interconnecting the gear layers to said shaft, an oil damping device, and a system of levers actuated by the independent movement of said gear layers and cooperating with said device for controlling the operation of said shaft.

3. A driving mechanism comprising a worm wheel made up of a plurality of gear layers, a common worm screw for actuating the worm layers, a shaft, resilient means for independently connecting each gear layer to said shaft, a damping device including a vane wheel carried by said shaft, another vane wheel associated with the first mentioned wheel, and a mechanical linkage interconnecting the last mentioned vane wheel to said gear layers for damping the movement of said resilient means on said shaft.

4. A driving mechanism comprising a worm wheel made up of a plurality of gear layers, a shaft, a vane wheel on said shaft, means operatively connecting said shaft to each of said layers, another vane wheel, intermeshing with the first mentioned wheel, a system of levers arranged to attenuate the amplitude of movement of the last mentioned

vane wheel with respect to the first mentioned vane wheel, and a fluid acted upon by the relative movement of said wheels for controlling the movement of said shaft against the action of said first mentioned means.

5. In a driving mechanism, a worm gear made up of a plurality of gear layers, a shaft actuated by the conjoint movement of said gear layers, a vane wheel carried by said shaft, a sleeve mounted concentric to said shaft, a vane wheel carried by said sleeve intermeshing with the first mentioned vane wheel, a lever mechanism interconnecting each of said gears to said sleeve and a fluid acted upon by a relative movement of the vane wheels for controlling the movement of said shaft.

6. In a driving mechanism, gear layers, a worm screw common to said layers, a shaft, springs operatively connecting said shaft to each of said gear layers, and a damping device including mechanical coupling means responsive to the relative movement of each of said gear layers for damping the action of said driving springs.

7. In a driving mechanism, pairs of independent gear layers, a damping device including a pair of vane wheels, a lever mechanism operatively connecting one of said wheels to each layer in said pairs, said mechanism comprising a yoke common to each pair, other yokes attached to the first mentioned yokes, a common yoke attached to the last mentioned yokes, and a bracket attached to the last mentioned common yoke and to one of said wheels.

8. In a driving mechanism, the combination with a plurality of independent gear layers, a damping device including vane wheels, a lever mechanism operatively connecting one of said wheels to each of said layers, said mechanism comprising a pair of yokes, link members connecting said layers to said yokes, a third yoke, another pair of yokes connecting the third yoke to each of the first mentioned yokes, and a bracket connecting one of said wheels to said third yoke.

9. A driving mechanism comprising a worm wheel made up of a plurality of layers, a driven shaft, means resiliently coupling said shaft and said layers, a linkage mechanism, and a fluid damping device cooperating with said linkage mechanism to damp the action of said coupling means with respect to said shaft.

In witness whereof, I hereunto subscribe my name this 22 day of December A. D. 1927.

LLOYD A. ELMER.