June 14, 1932. W. OTTEN 1,862,800

GRAMOPHONE

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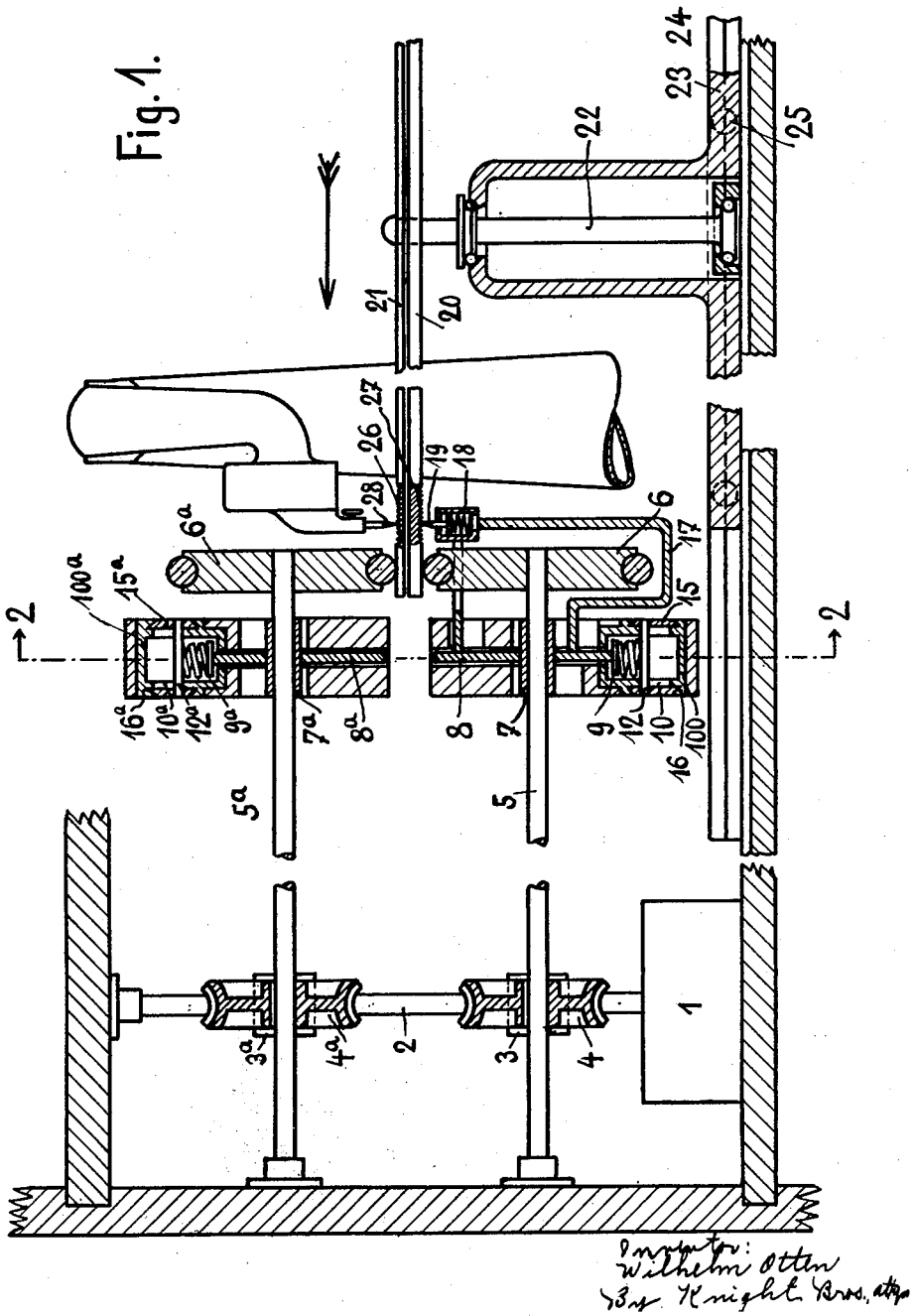
Fig. 1.



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GRAMOPHONE

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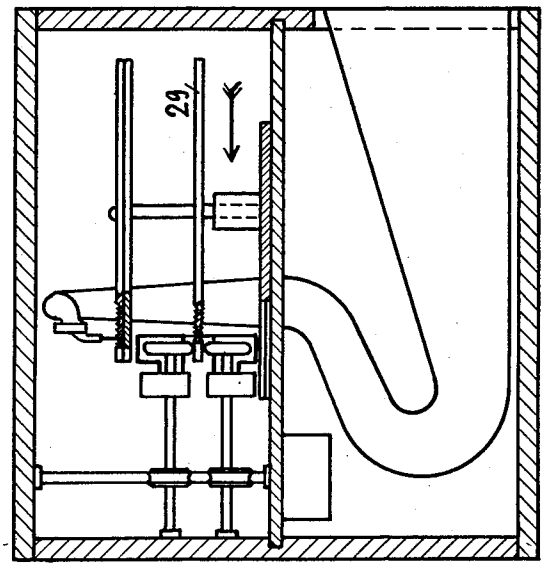
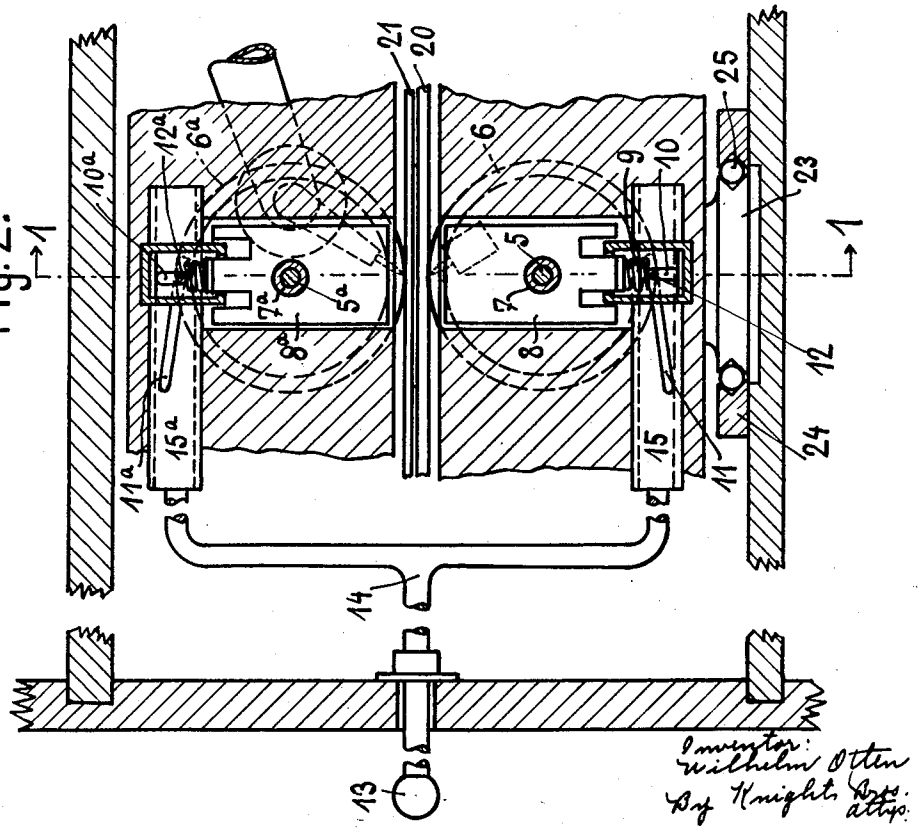


Fig. 3.

Fig. 2.



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GRAMOPHONE

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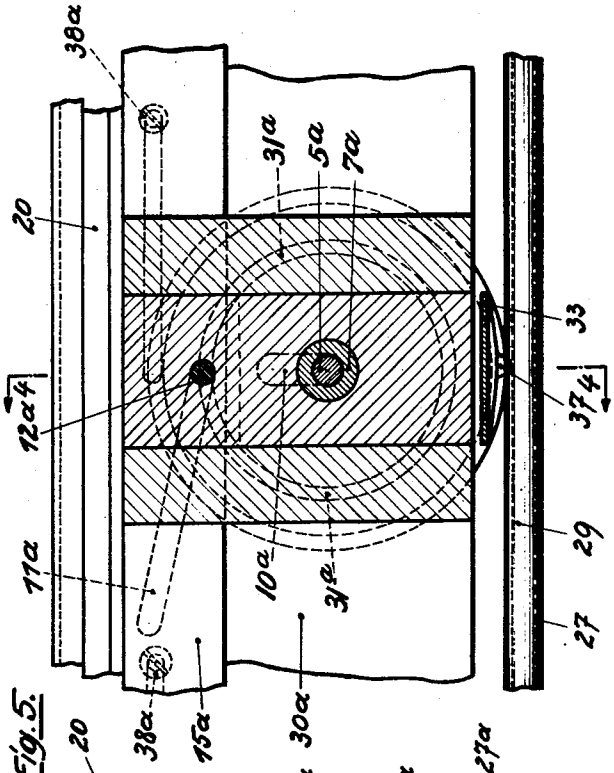

Fig. 5.

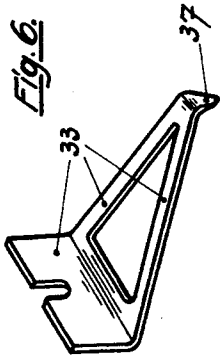

Fig. 6.

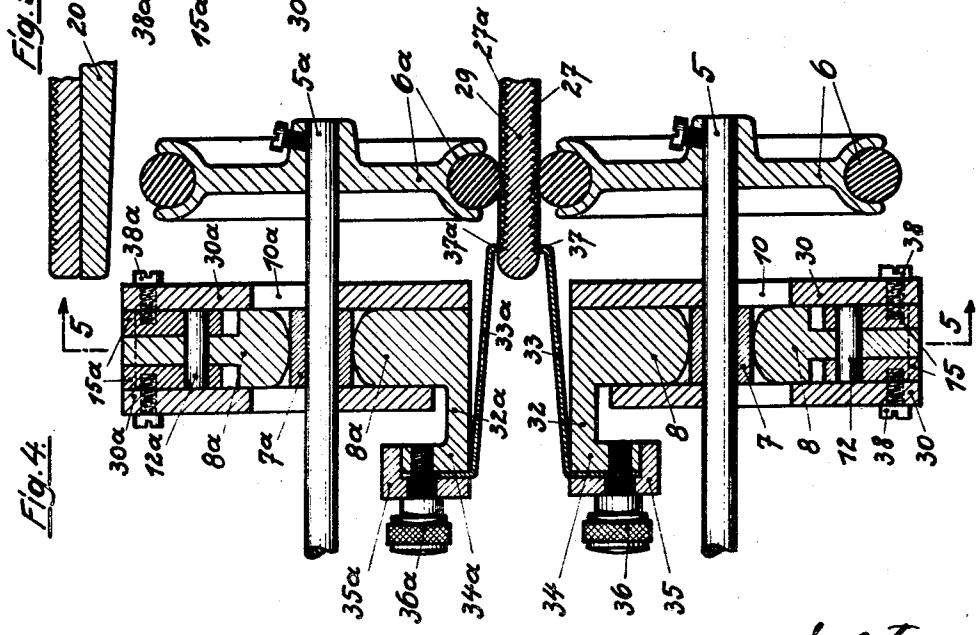

Fig. 4.

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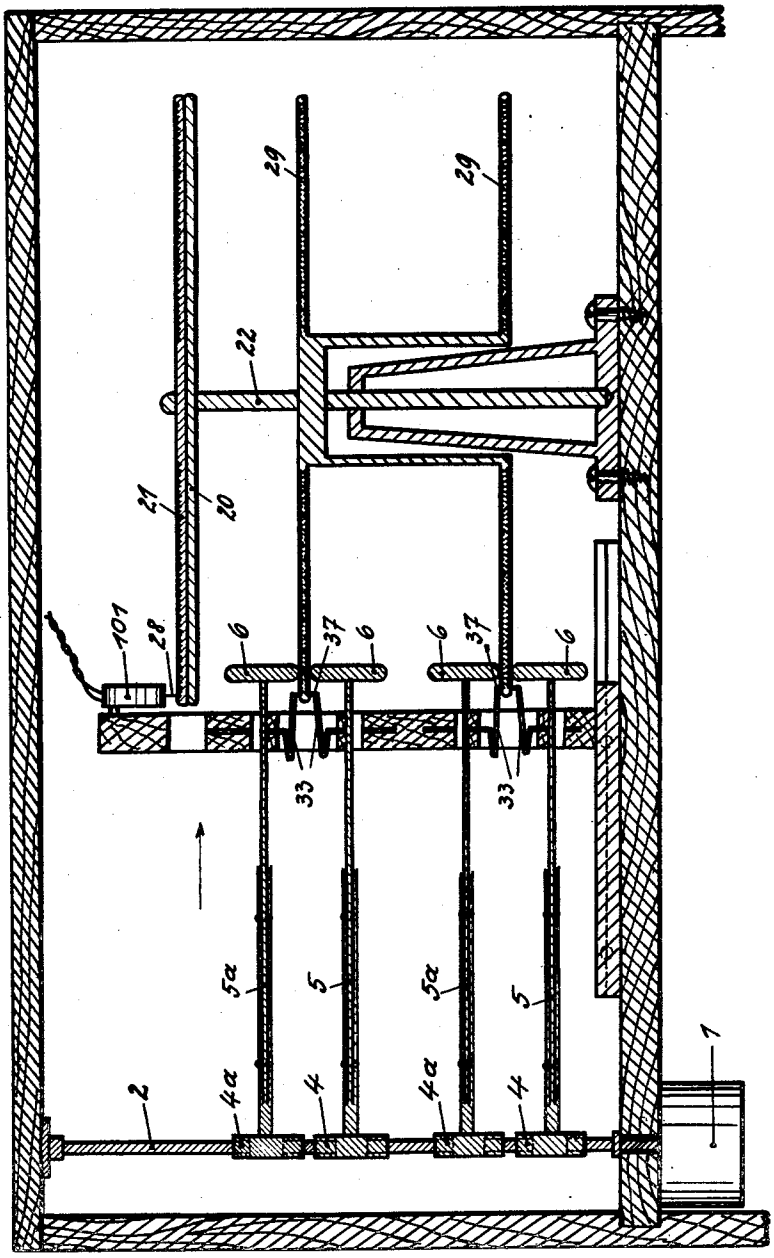
Fig. 7.



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UNITED STATES PATENT OFFICE

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GRAMOPHONE

Application filed May 20, 1930, Serial No. 454,154, and in Germany May 25, 1929.

In the reproduction of long musical compositions, speeches, etc. by gramophones heretofore on the market, the interruption caused by turning or exchanging the records is very disturbing, particularly in symphonic works, for instance, when the interruption on account of the small recording capacity of the record has to occur at an unsuitable place, so that the intention of the composer based upon an uninterrupted reproduction of a complete movement cannot be followed. Ordinarily, gramophones having a constant angular velocity of the records do not permit an uninterrupted, uniformly good reproduction of a piece which takes more than about four minutes to play. Acoustical-technical considerations stand in the way of an extension of the diameter of the records beyond the thirty centimeters customary heretofore, unless the rotational speed is made slower; and a greater utilization of the middle of the plate also results in a distortion of the sounds reproduced, due to the shortness of the extent of sound groove passing under the needle in a given time. A contraction of the sound grooves into a small space causes technical difficulties and tonal deficiencies. The previous attempts to remove the difficulties described by record changing and similar devices as well as constructions in which, as in the present invention, the record groove moves under the needle at a constant speed, in order to thereby increase the time of playing, have not given good results, from technical and acoustical-æsthetic standpoints.

The present invention has for its object to obtain by simple means a substantially uniform speed of the sound groove past the needle, or at least a speed which is exactly the same for producing and reproducing the record, and thereby not only to extend considerably the time of playing for records of the size heretofore used, but particularly to make possible the use of large records for reproducing uninterruptedly whole symphony movements or whole acts of opera, or the like. This object is obtained by means of a driving system consisting of two oppositely arranged friction rollers having rigidly connected with them one or more guide points adapted to engage in special guide grooves congruent to the grooves of the record, whereby the contact points of the friction rollers of the driving system are forced to follow the course of the spiral guide grooves, as well as the record grooves. Then with the friction rollers rotating at a constant speed, the sound grooves always move in producing and reproducing at exactlly the same uniform speed with respect to the recording stylus or the reproducing needle. According to the bulk of the masses to be moved, for example with very large records, the pairs of friction rollers can be used in multiple, working upon several coaxial rigidly connected plates, or with small records they can be used singly. Likewise and for the same reasons, one or more guide needles can be arranged in corresponding relation, or in playing small records, particularly when using especially hard record materials and deep record grooves capable of guiding, a special driving plate and guide needle can be entirely omitted and the record carrier driven directly by the friction rollers, while the driving mechanism can be made to approach or recede from the middle of the record simply by the movement of the sound grooves along the needle. Since the diameter of the record can be enlarged at will, the present invention is not bound to the pitch of the sound groove spirals used heretofore; on the contrary, the pitch can be increased with a view to improving the tone or making more positive the action of the shifting mechanism, consisting of the guide needle and guide grooves corresponding to the sound grooves. Another feature important for the commercial salability of gramophones made according to the invention is that by disconnecting the guide needle and fixing the carriage bearing the plate carrier, or any other form of shifting device, a uniform angular speed of the record carrier can also be obtained, so that the gramophones can be used equally well for long-playing records according to the invention, or for records made by previous producing processes, without difficulty and without the use of further apparatus.

Several embodiments of the invention are shown by way of example in the drawings.

Fig. 1 is a vertical section of a portion of a gramophone embodying the invention, taken on the line 1—1 of Fig. 2.

Fig. 2 is a vertical section taken on the line 2—2 of Fig. 1.

Fig. 3 is a diagrammatic vertical section of another form of the invention.

Fig. 4 is a vertical section of the driving and shifting mechanism of still another form of the invention.

Fig. 5 is a vertical section on the line 5—5 of Fig. 4.

Fig. 6 is a perspective view of one of the spring guide points shown in Fig. 4.

Fig. 7 is a diagrammatic vertical section of still another form of the invention.

Referring first to Figs. 1 and 2, a motor 1 adapted to rotate at a constant speed delivers its power through its shaft 2, worms 3 and 3*a*, and worm wheels 4 and 4*a* to two shafts 5 and 5*a*. On the end of shaft 5 is a friction roller 6 which rotates in clockwise direction, while the end of shaft 5*a* bears a similar friction roller 6*a* rotating in the opposite direction. The shafts 5 and 5*a* are journaled in bearings 7 and 7*a* mounted on guide plates 8 and 8*a*. The guide plates are pressed toward one another by springs 9 and 9*a*, the outer ends of which rest against pins 12. The ends of these pins rest in vertical slots 10 and 10*a* of a stationary box 100, 100*a*, and in inclined slots 11, 11*a* of slides 15, 15*a*, which are mounted to slide horizontally in dovetailed grooves 16, 16*a* of the boxes 100, 100*a*. By moving the slides 15, 15*a* the pins 12, 12*a* can be adjusted vertically to change the pressure of springs 9, 9*a*. For shifting the slides 15, 15*a* there is fixed to them a fork 14, the stem of which projects through the case of the gramophone and has on its end an adjusting nob 13. To the guide plate 8 is fixed a projection 17 which extends around the roller 6 and has at its outer side a cylinder 18 in which is mounted a lightly spring-influenced guide needle 19, the end of which projects out of the cylinder 18. According to whether the adjusting nob 13 is pulled out more or less, the friction rollers and guide needle 19 are pressed more or less strongly against the record carrier 20 and record 21, through the influence of springs 9 and 9*a* controlled by the adjustment of pins 12 and 12*a* in slots 10, 10*a* and 11, 11*a*. The friction rollers and guide needle can even be entirely removed from the record carrier and record and the latter being mounted on a shaft 22 supported by a carriage 23 which is slidably mounted on tracks 24 by ball bearings 25, the record carrier and record can be freely moved in the direction of the arrow in Fig. 1 and in the reverse direction.

Now when the friction rollers 6 and 6*a* are pressed against the record 21 and record carrier 20, the guide-needle 19, which is inclined in accordance with the direction of rotation of the record carrier, automatically engages in the spiral guide grooves 27 embedded in the record carrier. These guide grooves correspond exactly with sound record grooves 26 of the record, except that they do not have the sound records. Accordingly, when the motor is thrown in and the record and record carrier are set in rotation at a speed which, at the point of contact of the friction rollers corresponds to the peripheral speed of said rollers, the movable record carrier will be drawn into the pincher-like roller driving mechanism at a speed corresponding to that at which the spiral grooves approach the center of the record. The constant speed to be observed at the point of contact of the friction rollers with the record and record carrier also occurs at the point of contact of the guide needle 19 and the corresponding diaphragm needle running in the sound record grooves, and this is more nearly so the nearer the needles run to the rollers. The very slight difference between the distances covered by the friction rollers and the needles in a unit of time has practically no effect upon the uniform reproduction of sound, just as is the case with gramophones heretofore known having the much greater difference of linear speed at the edge of the record and at the middle of the record. The important thing is to have the linear speeds under the friction rollers and under the needles exactly alike in the production and the reproduction. This condition is fulfilled if the distance between the needles of the friction rollers is the same for production and reproduction, which is the case with the guide needle in the form of the invention described or any other suitable form, and with regard to the diaphragm needle can be easily accomplished by careful setting of the needle on the record, if necessary, with the help of a simple setting device.

Since the record matrix is made of material which can be easily injured at the time of production, and so might be damaged by the pressure of the friction rollers, it is necessary for production to use two coaxial plates, one for holding the record disk, the other serving as a driving disk 29. For making large records of considerable weight it is advisable to provide both sides of the driving plate with spiral guide grooves congruent with those of the record, in which guide grooves run two guide needles. This form of the invention is shown diagrammatically in Fig. 3, and can naturally be used as well for the reproduction. With unusually large record diameters there may be used two or more coaxial driving disks, each with a pair of driving rollers and guide needles. (Fig. 7.) Furthermore, instead of making the record carrier displaceable it may be rigidly mounted and the shifting mechanism

consisting essentially of pairs of rollers and a guide needle or guide needles, to which the pick-up is attached, made slidable. In this case the driving motor can either be arranged to move with the shifting mechanism, or, to reduce the weight to be moved, can be made stationary and coupled to the driving rollers by easily extensible shafts comprising balls and guide grooves. (Fig. 7.)

In another form of the invention the springs 9, which served in the previously described embodiments to keep an equal pressure of the friction rollers 6 on the record 21 and record carrier 20, are omitted. In the form shown in Figs. 4, 5 and 6 the bearings 7, 7*a* for the drive shafts 5, 5*a* are fixedly mounted in the guide plates 8, 8*a*, which are here constructed as relatively strong guide bodies, which slide vertically between plates 30, 30*a* and guide fillets 31, 31*a*. At the end of the guide bodies 8 adjacent the driving disk 29, lugs 32, 32*a* project parallel to the driving plate. Guide members in the form of spring leaves 33, 33*a* are secured to flanges 34, 34*a* of lugs 32, 32*a* by means of clamping plates 35, 35*a* and screws 36, 36*a*. The ends of the leaves 33, 33*a* are bent to a vertical direction to form guide points 37, 37*a* adapted to engage in the spiral guide grooves 27, 27*a* of the record 21 or the driving plate 29. This arrangement has the advantage that the springs can be easily exchanged as they become worn. In order to prevent the wearing of the guide points 37, 37*a* as far as possible they are made like slides, which also increases their guiding capacity. The length and elasticity of the spring leaves 33 and also the measurements of the lugs 32 are to be so chosen that with the friction rollers 6 raised the guide points are raised to about the same extent and with the friction rollers pressed close there is enough pressure of the guide points in the guide grooves to prevent them from springing out. The spring leaves are furthermore so formed that the part by which they are fastened by the clamping devices 34, 35 and 34*a*, 35*a* are broad and the points 37, 37*a* running in the guide grooves are narrow (Fig. 6).

The slides 15, 15*a* are mounted between plates 30, 30*a* and are held against vertical displacement by screws 38, 38*a*. When they are moved horizontally, the slots 11, 11*a* having the form of inclined planes, carry the pins 12, 12*a* and the guide plates 8, 8*a* to which they are secured in a vertical direction, whereby the friction rollers 6, 6*a* are pressed against or removed from the record or driving plate. As the guide plates move vertically, the shafts 5, 5*a* slide in slots 10, 10*a* in plate 30, 30*a*.

Having described my invention, I claim:

1. In a gramophone, a rotatable record carrier adapted to support a disk record thereon having spiral sound grooves, a driving system comprising a pair of rollers adapted to engage from opposite sides the record and record carrier and a guide point substantially fixed with respect to said rollers, means whereby said driving system and record carrier are mounted so as to be relatively displaceable in a radial direction with respect to said record carrier, said record carrier having a spiral guide groove therein congruent to the sound groove of the record and adapted to receive said guide point to cause the relative displacement of said driving system and record carrier as the latter rotates.

2. In a gramophone, a plurality of coaxial, rotatably mounted plates, one of said plates being adapted to carry a disk record, a driving mechanism comprising a pair of rollers arranged at opposite sides of one of said plates and a guide point substantially fixed with respect to said rollers, means for adjusting said rollers toward and from the plate with which they are associated, means whereby said plates and said driving mechanism are mounted so as to be relatively displaceable in a radial direction with respect to said plates, a spiral guide groove in one of said plates congruent to the sound groove of the record and adapted to be engaged by said guide point to cause the relative displacement of said driving mechanism and plates as the latter rotate.

3. In a gramophone, a rotatable plate containing a spiral guide groove congruent to the groove of a record to be played on said gramophone, a driving mechanism comprising a pair of rollers arranged on opposite sides of said plate and a guide point adapted to run in said guide groove, means whereby said driving mechanism and plate are mounted so as to be relatively displaceable in a radial direction with respect to said plate, and means for adjusting said rollers and said guide point in a direction perpendicular to said plate.

4. A gramophone as described in claim 3 in which the means for adjusting the rollers and guide point in a direction perpendicular to the plate comprises guide members on which the rollers and guide point are mounted, slides adjacent said guide members having inclined planes thereon, and means on said guide members adapted to engage said inclined planes.

5. A gramophone as described in claim 3 in which one of said rollers and said guide point are mounted on the common support movable substantially perpendicular to said plate, and means for moving said support to simultaneously engage said roller and said guide point.

6. A gramophone as described in claim 3 in which the means for adjusting the rollers in a direction perpendicular to the plate comprises resilient connections whereby said

rollers are held with a yielding pressure against said plate.

7. A gramophone as described in claim 3 in which said guide point is in the form of a resilient member adapted to yield in a direction perpendicular to said plate.

8. In a gramophone, a rotatable plate containing a spiral groove congruent to the groove of a record to be played on said gramophone, a driving mechanism comprising a pair of guide members adjustable in a direction perpendicular to said plate, a pair of rollers mounted one on each of said guide members and arranged on opposite sides of said plate, and a guide point mounted in a readily detachable manner on one of said guide members and adapted to run in said guide groove, and means whereby said driving mechanism and plate are mounted so as to be relatively displaceable in a radial direction with respect to said plate.

9. A gramophone as described in claim 3 in which said plate is mounted to rotate on a stationary axis, and means whereby said driving mechanism is mounted so as to slide as a whole in a radial direction with respect to said plate.

10. A gramophone as described in claim 3 in combination with a stationary driving motor, connections between said motor and said rollers comprising extensible shafts, and means whereby said rollers and guide point are mounted so as to be slidable in a radial direction with respect to said plate.

The foregoing specification signed at Stuttgart this 8th day of May, 1930.

WILHELM OTTEN.