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(54) Multispeed turntable drive system

(57) A turntable multi-speed drive system using a belt drive 14 from electrical motors, the belt drive being an endless belt passing around spindles 16, 18 driven respectively by the motors (40) (Fig 2) and around the turntable platter, the spindles being of equal, and of constant diameter, and the motors being rotatable at more than one constant speed. Three or more spindles may be provided. Inhibitions of 'wow' and lateral instability effects is considered.

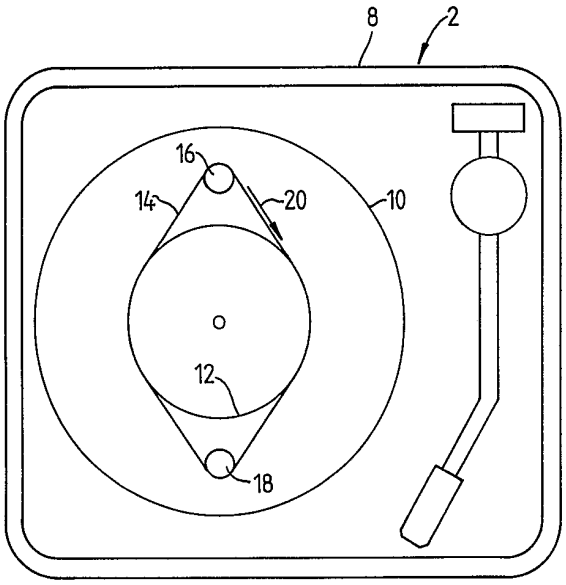

FIG 1

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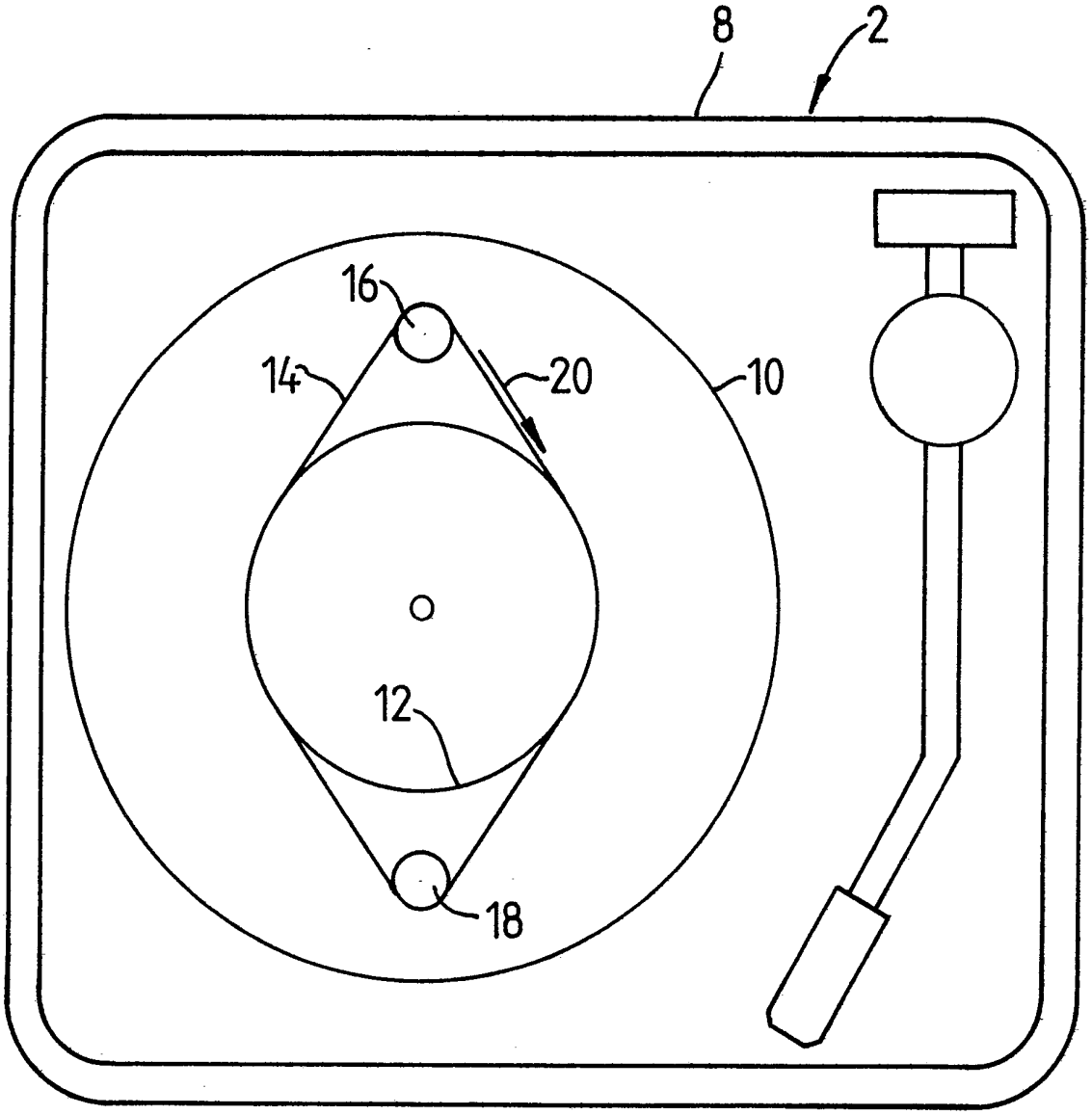

FIG 1

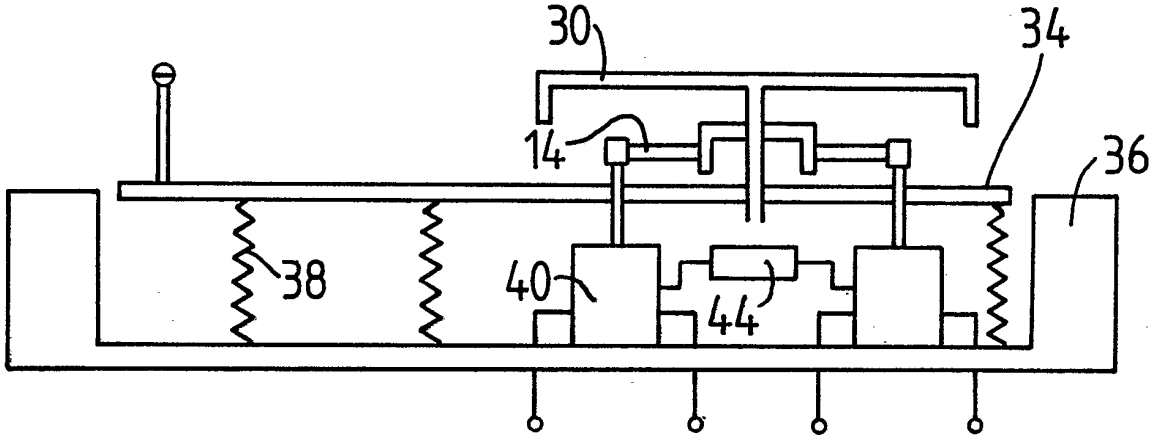

FIG 2

SPECIFICATION

Turntable drive system

The present invention relates to a drive system for a turntable for the reproduction of analogue records, and in particular to a mulit-speed drive system. Analogue records conventionally are made for rotation at 33½ RPM, 45 RPM or at 78 RPM and a multi-speed drive system will thus drive the turntable at two or more of these speeds.

There are two standard methods of driving a record turntable. One is direct drive in which an electric motor is connected directly to the turntable platter.

The other is belt drive in which an endless belt passes around a pulley attached to a motor spindle and around either a drive hub to which the platter is attached or around the outer periphery of the platter itself. The drive is transmitted from the motor to the platter via the belt.

When measured under quiescent conditions, belt drive turntables display a very high rotational stability. However, when under music drive, varying loads are created between the record and the stylus by the music transients present on the record. These varying loads create differences in the drive force requirements of the platter, the rotation of which, ideally, should be constant under all conditions, failing which, the quality of music reproduction will be impaired.

One type of instability which is well known is dynamic smearing or dynamic 'wow'. This is caused by the failure of the platter to maintain a constant speed under transient load conditions and is manifested in aberrations in the attack, sustain and decay of the musical waveform. The forces between the record and the stylus cause the platter to slow momentarily and the necessarily compliant drive belt stretches under the rotation of the motor. When the music transient has passed, the belt regains its original length.

Another instability which is less well known, is lateral instability. When the platter slows down momentarily under transient load, the tension in the run of the drive belt from the motor pulley to the platter is increased and the belt is stretched due to its compliance. The increase in tension of the belt exerts a force on the platter towards the motor and the platter moves in that direction. When the music transient has passed, the platter, under the influence of its suspension system will return towards its original position but due to its inertia will overshoot that position, again causing excess tension in the drive belt forcing the platter back towards the motor. Thus the platter will continually oscillate laterally along a line extending approximately through its centre and that of the motor pulley.

The platter and drive hub assembly is normally mounted on a spring suspended chassis and the constant oscillation of the platter due to lateral instability may cause excitation of the suspension springs which further reduces the quality of the music reproduced, and under extreme conditions may cause stylus mistracking.

One known arrangement for a phonograph turntable multi-speed drive system is that of British Patent 1 131 858, which to avoid side-pull on the floating turntable discloses two turntable drive motors spaced to each side of the turntable axis. There is no recognition on this prior patent however of the need to employ two or more turntable drive motors to reduce or overcome the transient effects of the varying loads under music drive between the record and the stylus; in fact, this prior patent discloses obtaining the two speed drive by the use of two-step pulleys whereby belt changeover (between the pulleys) to change the speed can itself cause a transient change in belt tension and turntable speed, and whereby the different attitude of the pulley drive between the first and second ratios can cause the platter to be pulled out of its first plane of rotation into a second plane of rotation with then a continuous effect on record output performance, e.g. the quality of music reproduction.

Furthermore, the mechanical belt shift can fail, and so require regular replacement, whilst as it operates it can damage the belt, giving rise to a different expansion for a given loading depending on the position of the damaged portion in relation to the drive motors and pulleys.

The present invention seeks to overcome, or at least ameliorate, the problems of lateral and dynamic instability and the problems of a mechanical speed change arrangement and provides a multi-drive system for a turntable for the reproduction of analogye records comprising a turntable platter having a rotational axis, a plurality of drive spindles spaced from the platter, a plurality of electric motors each operatively connected to one of the drive spindles, and an endless belt passing around the drive spindles and the platter, the drive spindles being of uniform external diameter and the electric motors being rotatable at more than one constant speed, whereby to drive the platter at different rotational speeds about the rotational axis. This permits the provision of a more stable rotational platform for the record than has been previously possible. A pulley may be provided on each spindle to improve the efficiency of the drive to the belt.

The two spindles may be positioned at opposite sides of the drive hub, equidistantly spaced from the hub along a diameter thereof. Alternatively, three or more spindles may be provided spaced around the drive hub. The effect of having a plurality of spindles is to create an equalisation of the forces applied to the drive hub by dynamic load conditions when the platter is under load. For example, when there are two spindles on opposite sides of the hub, slowing of the hub will cause an increase in the tension of the belt run between the hub and each spindle. The forces thus applied to the hub are in opposition and hence there is no net lateral movement of the hub about its centre of rotation.

Each spindle may be driven by a corresponding motor. Use of synchronous motors ensure that all the spindles rotate at the same speed. Alternatively d.c.

motors may be used with synchronisation achieved by a servo drive.

An embodiment of the invention will now be described in detail, by way of example, with reference to the accompanying drawings, in which:

Fig. 1 shows a schematic turntable drive system according to the present invention, in plan view; and

Fig. 2 shows a schematic side elevation of a turntable drive system.

Referring to that figure, the turntable 2 includes a turntable platter, the periphery of which is indicated at 10 has a drive hub 12 and is mounted on a suspended chassis 8. An endless resilient belt 14 passes around the drive hub 12 and around two spindles 16 and 18. Each spindle 16, 18 is preferably driven by a corresponding synchronous motor (not shown), although d.c. motors or motor common for both spindles 16, 18 may be used.

With the belt 14 moving in the direction of arrow 20 a music transient causes a load to be applied to the platter 10 and the rotation of the platter 10 and the hub 12 slows. The tension in the runs of the belt 14 from the hub 12 to each spindle 16, 18 increases and opposing forces are applied to the hub 12. These forces cancel each other out and there is no net lateral movement of the hub 12 hence the rotation of the platter 10 is more stable than with a standard drive system.

As seen in the embodiment of Fig. 2, the turntable platter 30 is driven by way of sub-platter 32 which is rotatably mounted on the chassis 34. Chassis 34 is itself mounted on platter 36 by way of resilient suspension members 38. Motors 40 are also mounted on plinth 36. The motors are energises by electric supply 42, and motor speed mounting means 44 are included. In an embodiment, motors 40 are pre-selected to have the same output speed for a given input voltage, so that the monitoring of speed output can be by suitable monitoring of the electrical input to the motors, to ensure a stabilised supply.

The use of separate motors driving the spindles 16, 18 increases the power of the drive and hence reduces the possibility of slowing of the hub 12 causing slight slowing of the motors. Hence dynamic instability is also decreased.

The spindles may be placed closer to the hub than is normal in belt drive systems so that the belt is shorter than (or at least is no longer than) the standard belt. This is advantageous as, the shorter the belt, the less will it stretch under a given load.

The present invention is not limited to the use of two spindles; more than two may be used and the geometric arrangement of hub and spindles may be varied to give suitable balancing of the forces applied to the hub.

Thus I provide spindles of equal, and constant diameter, so that my mechancial drive is not changed during speed changes, obtained by varying the electrical output speed of the prime mover, e.g. the synchronised motors driving spindles 16, 18.

CLAIMS

1. A multi-speed drive system for a turntable for the reproduction of analogue records comprising a turntable platter having a rotational axis, a plurality of drive spindles spaced from the platter, a plurality of electric motors each operatively connected to one of the drive spindles, and an endless belt passing around the drive spindles and the platter, the drive spindles being of uniform external diameter and the electric motors being rotatable at more than one constant speed, whereby to drive the platter at different rotational speeds about the rotational axis.

2. A drive system as claimed in Claim 1 in which the belt engages a drive hub to which the platter is attached.

3. A drive system as claimed in Claim 1 in which the belt engages the outer periphery of the platter.

4. A drive system as claimed in any of Claims 1 to 3 in which each spindle carries a pulley engaged by the belt.

5. A drive system as claimed in any of Claims 1 to 4 in which two spindles are provided, positioned at opposite sides of the rotational axis.

6. A drive system as claimed in any of Claims 1 to 4 in which three spindles are provided, at a constant radius from, and equi-angularly spaced about the rotational axis.

7. A drive system as claimed in any preceding claim in which the electric motors are AC synchronous motors.

8. A drive system as claimed in any of Claims 1 to 6 in which the electric motors are DC motors, with a servo drive to ensure synchronised rotational speed.

9. A drive system as claimed in Claim 7 or Claim 8 in which an ancillary circuit monitors the motor rotational speeds to ensure synchronised running.

10. A drive system constructed and arranged substantially as described with reference to the accompanying drawings.

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