DRIVE FOR SEWING MACHINE OR THE LIKE USING MAGNETIC FORCE TRANSMISSION

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ABSTRACT

A drive for a sewing machine or the like has a first body which is linearly displaceable in a linear guide adjacent the orbit of a second rotatable body. At least one of the bodies is magnetized and the other is magnetically entrainable so that, as the second body is rotated adjacent the first body, this first body is linearly displaced. A spring or the like can be provided to return the first body whereby the rotary motion of the second body is converted into linear reciprocation of the first body. Both bodies can be magnetic and the first body can be part of or carried by a needle bar, with the second body carried by a motor shaft.

9 Claims, 6 Drawing Figures
DRIVE FOR SEWING MACHINE OR THE LIKE USING MAGNETIC FORCE TRANSMISSION

FIELD OF THE INVENTION

The present invention relates to a drive mechanism and, more particularly, to a magnetic drive for a sewing machine or other similar apparatus wherein linear displacement of some working part is necessary. The invention relates, more generally, to a mechanism for transforming angular displacement into translatory motion without direct shock-transmitting relationships between the driving and driven members.

BACKGROUND OF THE INVENTION

Sewing machines and similar devices often require some sort of linear displacement, often linear recirculation in their operation. At the same time, these devices are powered by rotary motors so that a complicated and highly wear-prone transmission or motion converter must be provided between the motor and the linearly reciprocable part.

Similarly, a sewing machine particularly should have some leeway in its drive so that if an obstruction is met the needle does not break, the needle bar simply will stop. Also, during sewing in large-scale installations, it is advantageous to be able to immobilize the needle bar for rethreading without shutting down the drive.

Several types of motion-conversion mechanisms have been employed heretofore in the above and other systems for transforming angular displacement into linear motion. In a rack-and-pinion mechanism, the rotary member is provided with a pinion meshing with the rack connected to the linearly guided member. In this arrangement, unless a yielding coupling is provided between the rack and the linearly guided member or a slip clutch is provided between the drive shaft or pinion, immobilization of the linearly guided member will stall the drive, cause breakage of the meshing region or damage the driving and/or driven members. Additionally, such systems are not satisfactory where reciprocation of the linearly guided member is required but reversal of the drive is not feasible.

In cam and cam-follower arrangements, the linearly reciprocable member may have a cam follower riding upon a heart-shaped or similarly functioning cam. In such devices, especially where the cam is of the external type, the linearly guided member may be temporarily immobilized without strain upon the drive. However, considerable wear is a characteristic of these systems and the cam friction generally requires larger-dimensioned motors than is desirable.

OBJECTS OF THE INVENTION

It is therefore an object of the present invention to provide an improved mechanism for driving a linear member, especially the needle bar of a sewing machine, whereby the aforementioned disadvantages are avoided.

Another object of the invention is the provision of an improved rotary to linear-motion converter.

Yet another object of my invention is to provide a drive mechanism interposed between a power source and a load and which allows slippage without appreciable wear.

SUMMARY OF THE INVENTION

I attain the above objects with a linear-output drive wherein a driven body has a portion that is rotated around in an orbit and a driven body has a portion linearly displaceable along an axis adjacent the orbit of the drive body. One of the bodies at least is magnetized and the other is magnetically permeable so that as the driven body travels in its orbit, which lies in a plane parallel to or in the same plane as the axis of displacement of the driven body, it entrains the driven body.

In accordance with another feature of this invention, the driven body is a portion of the needle bar of the sewing machine which is in turn linked to the work feed so that, should the needle become immobilized, as for instance when it hits a button, the machine stops sewing and will remain stopped, without wear of the parts, until the blockage is cleared. Similarly, the needle can be immobilized, as for instance by hand, for retreading or unfouling without necessarily shutting down the drive.

The drive mechanism, according to the present invention, has many possible uses. Feeding of a workpiece, for example, or biasing of same against against a grinding wheel can easily be accomplished when the workpiece is magnetically entrainable by rotating a magnet adjacent this workpiece in an orbit such that the workpiece displacement axis lies parallel to a tangent of the orbit, but not on a diameter thereof.

In any system based on the principles of my invention friction in the motion- translating mechanism is almost wholly eliminated in that the magnetic field acts as the coupling. Heat buildup, bearing wear, lubrication and many similar problems are simultaneously obviated.

DESCRIPTION OF THE INVENTION

The above and other objects, features and advantages will become more readily apparent from the following description, reference being made to the accompanying drawings in which:

FIG. 1 is a perspective view of a portion of a sewing machine having a drive according to the present invention;

FIG. 2 is an end view of the embodiment of the present invention shown in FIG. 1; and

FIGS. 3, 4, 5 and 6 show further embodiments of the present invention.

SPECIFIC DESCRIPTION

As shown in FIGS. 1 and 2, a sewing machine 1 has an electric drive motor 2 whose horizontal drive shaft 3 has a rotation axis A' and carries at its end an orthogonally transverse bar magnet 4 which, when rotated, describes an orbit 0. A vertical sewing needle 5 is fixed in the lower end of a needle bar 6 vertically reciprocable along an axis A orthogonally transverse to but not intersecting axis A'. The bar 6 is slidably received in two fixed guides 7 and 8 and is laterally connected via a rod 21 to the work feed (not shown). The needle 5 is biased upwardly by a compression spring 9 which surrounds the upper end of the rod 5 and is braced between the upper guide 8 and a small iron block 10 which constitutes the uppermost portion of the needle-carrying body 6. The axis A here lies in the same plane as the orbit 0 of the magnet 4, with the body 10 lying normally slightly above the center of rotation of this magnet 4.
Each time one of the poles of the magnet 4 passes the body 10 on counterclockwise rotation of the magnet 4, its field permeates this body and entrains it downwardly. The spring 10 is, however, sufficiently strong to overcome the magnet attraction between either pole and the body 10 so that, as seen in FIG. 2, once the pole reaches around seven o'clock the spring 10 drives the needle bar 6 up again. In this manner, the body 10 will be in the up position when the other magnetic pole approaches so that the needle 5 will descend twice for each rotation of the shaft 3.

In order to vary the degree of coupling between the magnet 4 and body 10 the shaft 3 is formed of two telescoping portions 3a and 3b. A small screw 13 serves to lock the two portions 3a and 3b relative to each other. For maximum coupling the magnet is displaced so that its orbit 0 lies in a plane including the axis A.

Clearly, should the movement of the needle 5 become blocked, the motor 2 will continue to turn with no undue loading. Similarly, should the machine require retreading or replacement of the work or bobbin, one need only manually stop the needle bar 6 to carry this out, the motor 2 does not have to be shut off. For this reason, one motor 2 can serve to rotate the magnets for a plurality of machines without all of the machines having to be stopped to repair the blockage at one machine. Neither need any complicated and troublesome clutches be provided.

In FIG. 3 I show a magnet 12 which rotates adjacent an elongated rod 11. Once again the axis A and A' lie normal to each other. Such an arrangement is useful in feeding a workpiece into a screw-making machine, for example.

In FIG. 4 a rod 12 is shown around which is wound a coil 13 connected through a potentiometer 14 to a battery 15. A bar magnet 16, rotatable about an axis A', has an orbit with the projection of which the axis A of the rod 12 forms a chord. Adjustment of the resistance 14 varies the field strength in rod 12 and, therefore, the extend of magnetic coupling between the magnet 16 and the electromagnet 12, 13. Rotation of the magnet 16 about its axis A' in a clockwise direction will displace the magnet 12, 13 to the right, with the poles of magnet 16 alternately pushing and pulling the magnet along. Such a system is particularly useful to provide a constant bias wherein the rod 12 is intended to bear with a constant force against some object and the potentiometer 14 serves to adjust this biasing force. Rotation of both poles of the magnet 16 past the rod 12 would prevent magnetization of the rod 12 to a large extent, as in FIG. 3.

FIG. 5 shows a first body 17 displaceable along axis A defined by guides 18 and bearing at one end a small transverse bar magnet 19. A rod 21 having a pair of ferrous end pieces 20 is rotated about an axis A' perpendicular to axis A with the bodies 20 approaching the south pole of the magnet 19 on each revolution. Since the rod 21 is rotated in the clockwise direction, each passage of one of the magnetically permeable bodies 20 will lift the rod 17 against the force of gravity.

The arrangement shown in FIG. 6 has a vertical body 22 received in vertically spaced guides 24 and carrying a crosspiece 23. A pair of in-line springs 26 and 27 serve to hold the crosspiece 23 in a normal position generally in line with the pivot axis A' of a nonmagnetic disk 28 in which is mounted a magnet 25 whose field is in line with the axis A'. Rotation of the disk 28 will pull the crosspiece 23 down against the force of spring 26 and then up against the force of spring 27 for reciprocal movement of the rod 22 up and down. The magnetic force effective on the crosspiece must be greater than the spring force of either spring so that the crosspiece can readily follow the magnet 25.

It should be clear from the above the either of the bodies (4 and 10 in FIG. 1, 11 and 12 in FIG. 3, 16 and 12 in FIG. 4, 19 and 20 in FIG. 5, and 23 and 25 in FIG. 6) can generate its own magnetic field, or either one can be merely magnetically attractive with the other body being electrically or permanently magnetized. The magnetic interplay can be effective up or down or from side to side against or even with a spring force, and like magnetic poles can be used for repulsion instead of attraction. The two axes should be generally normal to each other, and may intersect, or the plane of the rotary body's orbit can be parallel to or include the axis of the linearly displaceable body; juxtaposition of this axis with the orbit is all that is necessary, so long as the axis is generally parallel to the plane of the orbit. The magnetized body may be polarized, in the case when it is the orbiting body, either parallel to or transverse to its rotation direction or, when it is the linearly displaceable body, either parallel or transverse to its displacement direction.

1. A linear-output drive comprising:
   a. a guide defining a linear path having an axis;
   b. a linearly displaceable first body riding in said guide along said path and connected to a load linearly shifting same;
   c. an orbitally displaceable second body and means guiding same for movement in a plane parallel to said path and said axis; and
   d. means for rotating said second body through an orbit in said plane adjacent said axis about an orbit axis generally transverse to the axis of said path, one of said bodies having a magnetized portion spaced juxtaposable with said entrainable portion for linear displacement of said first body along said path on rotation of said second body.

2. The drive defined in claim 1 wherein said second body is a permanent magnet and said first body is iron.

3. The drive defined in claim 2 wherein said means is an electric motor.

4. The drive defined in claim 3, further comprising a spring biasing said first body in a first direction along said axis of said path, said electric motor rotating said second body in a sense such that said second body passes said first body in a direction opposite said first direction.

5. The drive defined in claim 4 for a sewing machine, said motor and guide being carried by said machine, said load including a needle operatively connected to said first body.

6. The drive defined in claim 5 wherein said needle is mounted on a vertical needle bar forming said first body, said spring urging said needle bar upwardly.

7. The drive defined in claim 1 wherein said second body is connected to an electric motor and is magnetic, and said first body is magnetically attachable and lies adjacent said orbit for movement along a line parallel to a tangent to said orbit.

8. The drive defined in claim 7 wherein said first body is coplanar with said orbit.

9. The drive defined in claim 7 wherein said first body lies in a plane parallel to and flanking said orbit and is displaceable along a chord thereof.