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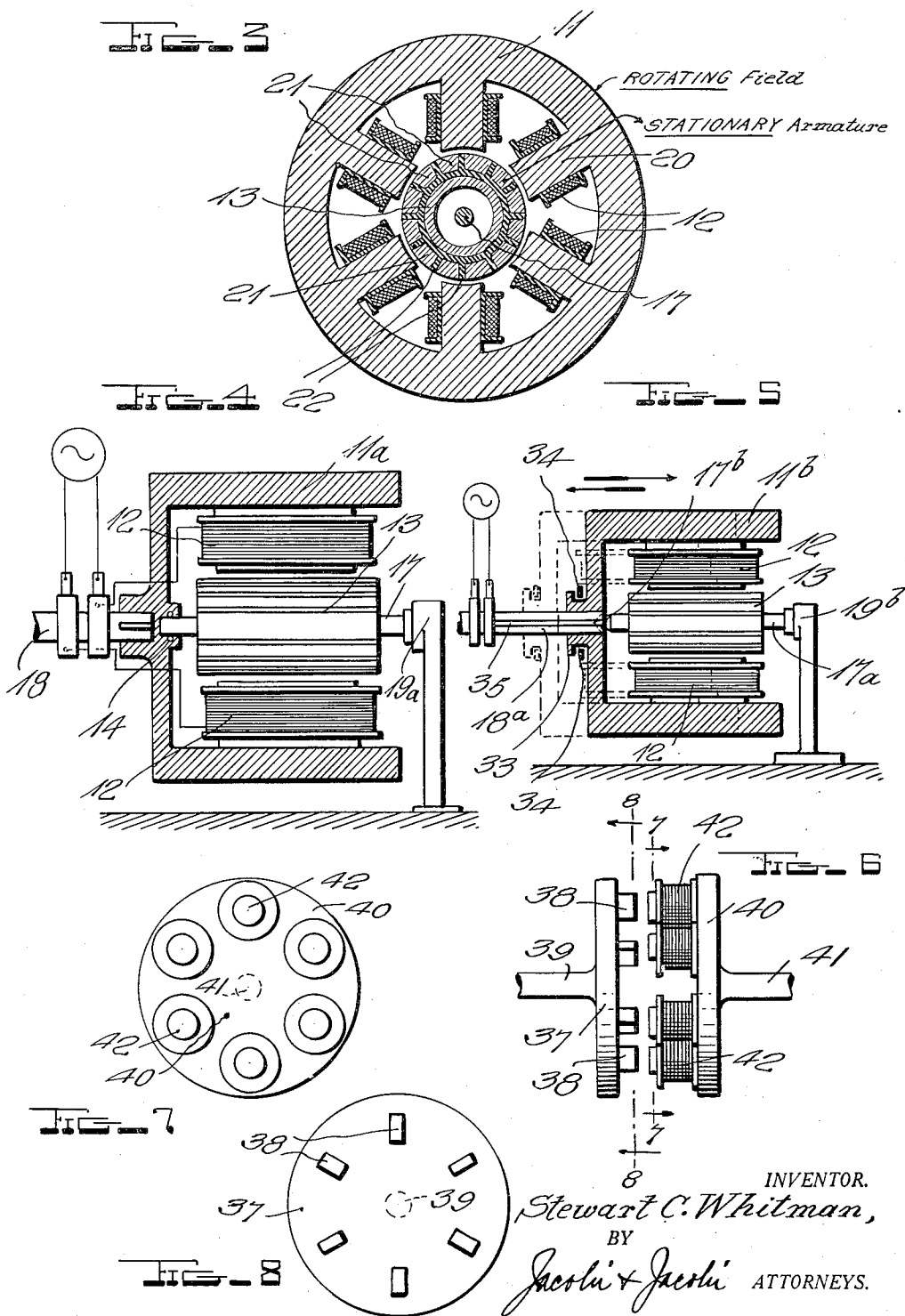
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ELECTRODYNAMIC RECORDING AND REPRODUCING DRIVING UNIT

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ELECTRODYNAMIC RECORDING AND RE-
PRODUCING DRIVING UNIT

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3 Claims. (Cl. 271—2.3)

My invention relates broadly to systems for recording and reproducing sound on film, and in particular to means for driving the film at an invariable speed and for eliminating hunting and all other irregularities or variations in speed such as may be due to the mechanical properties of the system. In the recording and reproduction of sound on film, it is highly important to drive the film at a uniform determined speed in both recording and reproduction to avoid irregular sound effects. In arrangements heretofore known, various devices such as loose mechanical couplings have been used to provide flexibility in the mechanical system, but in themselves have not been satisfactory.

In the film driving arrangement of my invention, I provide an electromagnetic or electrodynamic system for applying driving power to the film. In preference, I employ a synchronous motor suitably mounted, to which current of commercial frequency is supplied. Preferably, the central salient pole structure element is fixed in position and the magnets which are supplied with alternating current revolve around this armature. This rotor element may advantageously be made rugged and massive.

Under conditions of serious tendencies to vary speed, it may be desirable, in addition to the driving means which I describe, to also employ a resilient or elastic coupling means between the driving unit and the driven unit, such as a spring or a leather coupling.

In the usual type of synchronous motor, the rotor element is centrally disposed, and the surrounding frame is stationary. I find that for the purposes here in view, the construction which I describe, with the central salient pole structure element stationary and the surrounding magnet structure rotating, is more satisfactory. The synchronous motor unit of the type which I describe provides not only motive power for driving the film but also a flexible electromagnetic coupling, and eliminates the necessity of damping devices provided in arrangements heretofore employed.

An object of my invention is, therefore, to provide an electrodynamic driving unit for driving the film in sound recording and reproduction on film, at an invariable speed, and to provide means for eliminating all irregularities in driving the film.

A further object of my invention is to provide a flexible electromagnetic coupling means for coupling the driving power to the film actuating members.

Still another object of the invention resides in providing an apparatus which is simple and durable in construction, inexpensive to manufacture and one which will be very efficient in operation.

With these and numerous other objects in view, my invention consists in the novel features of construction, combination and arrangement of parts as will be hereinafter referred to and more particularly pointed out in the specification and 10 claims.

In the accompanying drawings forming a part of this application:

Figure 1 is a general schematic view showing diagrammatically the sound recording camera 15 with film driving unit of my invention, the driving part of the apparatus being shown in longitudinal section;

Figure 2 is a general schematic view showing diagrammatically the unit for reproducing sound 20 from film with the film driving unit of my invention, the driving part of the apparatus being shown in longitudinal section;

Figure 3 is a cross sectional view of the stationary salient pole structure element and rotating magnets of the motor which I provide, taken on the line 2—3 of Figure 1;

Figure 4 shows in longitudinal section a modified form of the driving portion of the apparatus, the rotating magnet frame being supported at 30 only one end and being open or free at the other end;

Figure 5 shows still another modification of the driving portion of the apparatus, wherein the rotating magnet structure is slidably mounted on 35 a shaft to which it is keyed, so that the degree of electromagnetic coupling between the magnets and the salient pole structure element can be varied and the torque transmitted can be adjusted;

Figure 6 shows another form of the driving part of the apparatus employing parallel concentric discs whereon the magnets and studs in register therewith are mounted;

Figure 7 shows a detailed sectional view of the 45 magnets of the form shown in Figure 6; taken on the line 7—7 of Figure 6; and

Figure 8 shows a sectional view of the stud members which register with the magnet of the form shown in Figure 6, taken on the line 8—8 50 of Figure 6.

Referring to the drawings in detail, in Figure 1, the numeral 1 is a sound recording camera through which the film 2 provided with the sound track is driven from a suitable loading reel to a 55

suitable takeoff reel. The electrical sound recording unit 3 receives the electrical current of sound frequency from the microphone input unit 4 and a source of light 5. In this figure, the driving unit is shown considerably enlarged in comparison with the size of the camera, as compared with the relative sizes of these parts of the apparatus as they would be actually employed in practice.

The shaft for driving the film through the camera 1 is carried on the bearing 6. Alternating current of commercial frequency for actuating the driving motor is supplied from a suitable source of commercial frequency through a power line 7a and 7b. As before stated, under conditions of serious tendencies to vary speed, it may be desirable to employ in addition to the driving means described, a resilient or elastic coupling means, which is here shown at 8 mounted between the driving part of the apparatus and the driven part; this coupling means 8 may be a spring mounted between concentric discs, or a leather coupling, or other elastic or resilient means familiar in the art.

The alternating current is supplied to the driving motor through the slip rings 9 and 10. The synchronous motor comprises the magnets mounted on a cylindrical rotatable frame which is shown at 11. The windings of the magnet are shown at 12. The fixed salient pole structure element 13 is mounted centrally inside of the magnets. The magnet frame is carried on suitable bearings 14 and 15 on the shaft members 16 and 17 which support the armature. The driving shaft 18 is keyed to the rotor element of the synchronous motor and is mounted on the bearing 6 to drive the film actuator in the camera 1. The shaft member 17 of the armature is supported on a suitable bearing 19. The magnets are provided with cores 20 mounted on the frame 11 and projecting through windings 12. The armature 13 is provided with teeth 21 which are of the same number as the magnets or a multiple thereof, and register with the magnet cores. The field magnet windings 12 are connected by suitable wiring to the slip rings 9 and 10. The salient pole structure element 13 may advantageously be constructed as shown in Figure 3 with the teeth 21 separated by insulating partitions 22 from the adjacent teeth and the central shaft.

The rotor frame 11 is, therefore, mounted to freely rotate about the fixed armature 13, and when alternating current of suitable frequency is applied to slip rings 9 and 11, the rotor 11 is caused to rotate about the central shaft. The synchronous motor comprising the magnets and the salient pole structure element should be so designed as to number of teeth and magnets and as to their relative relations to operate as a synchronous motor at the frequency which is supplied to supply line 7a-7b, in accordance with the elementary principles of synchronous motor design which are known in the art. As has been stated, the rotor element may advantageously be made rugged and massive. In Figure 1, a single row of magnets with long pole pieces 20 has been shown extending substantially the full length of the outer stator frame, but it may be desirable instead to employ two or more parallel rows of magnets arranged in parallel. The armature element 13 is constructed of laminated stampings in the usual manner.

The motor required for this purpose is in size approximately one-tenth to one-fourth horsepower. The smaller sizes can be started by hand,

and the larger sizes can be started by a crank geared up with a suitable ratio such as ten to one.

Figure 2 shows schematically the general arrangement of the elements of my system for reproducing sound from a sound track on film. The reproducing unit 23 includes the source of light 24 and the condensing lens 25 which sends a beam of light through the film 26 carrying the sound track and mounted on suitable loading and takeoff reels. The light from source 24 after passing through the sound track on film 26 passes through the optical system 27 and actuates light-sensitive cell 28, which is connected through plate amplifier 30 to the loud speaker or reproducer 31. The film may carry picture frames as well as the sound track in which case light from source 32 will pass through film 26 and projecting lens 29 to project the picture. The driving part of the apparatus for reproducing the sound as shown in Figure 2 is substantially the same as the driving part of the apparatus shown for recording Figure 1 and will produce the same unvariable speed at which the film 26 is driven through reproducing unit 23 to reproduce the sound from the sound track faithfully and without distortion. The detailed structure of the stationary salient pole structure element and the rotating magnet structure can be clearly seen in the cross sectional view of Figure 3 including the teeth 21 and insulating partitions 22.

In the modification shown in Figure 4 of the driving unit, the frame 11a of the revolving magnets is open at one end so that the frame is supported only at one end. This type of structure has the advantage of simplicity in construction and accessibility for adjustments. In other respects the structure of the modification of Figure 4 is essentially the same as that of Figure 1.

In the modification shown in Figure 5, the magnet frame 11b is mounted to slide axially over the salient pole structure element 13, in order to vary the electromagnetic coupling therebetween and thereby controllably adjust the transmitted torque and the driving tension applied to the film. For this purpose, the shaft 17a-17b has a conical terminal portion which is carried in the conical bearing surface provided in the end of the driving shaft 18a and inset into the central bore 35 thereof. The magnet frame 11b is provided with the recessed hub portion 33, and a suitable fork member 34 engages the recesses in this hub for the purpose of applying slidable motion thereto, in the manner commonly employed in transmission structures. The shaft 17a of the armature is carried by the bearing member 19b. By actuating the fork 34, the portion of the surface of the pole pieces of the magnets 12 which are in close electromagnetic relation to the teeth of salient pole structure element 13 may be varied, and thereby the electromagnetic torque applied to the shaft 18a and to the film driving mechanism may be varied. In other essential respects, the modification shown in Figure 5 is similar to that shown in Figure 4, and in the details other than the open end structure, similar to that of Figure 1.

In Figure 6, there is shown a simple type of synchronous motor wherein a plurality of magnets are provided carried on one side of the disc member 40 and mounted circumferentially thereon. These magnets should be evenly spaced and should be of number which in accordance with the principles of synchronous motor design will cause the motor to operate at the desired speed

when supplied with the commercial frequency available. The disc 40 is mounted on shaft 41 and the windings of magnets 42 are connected to the source of alternating current of commercial frequency. The companion disc member 37 is provided with stud members 38 mounted circumferentially on one side thereof and corresponding in number to the magnets. The disc 37 is mounted on the shaft 39. One of the shafts is connected to the film driving mechanism, and the other is fixedly mounted, in a manner similar to that shown in Figures 1 and 2. The detailed structure and arrangement of the magnets 42 on the disc 40 is shown in Figure 7 in cross sectional view, and the detailed structure and arrangement of stud members 38 on disc member 37 is shown in cross sectional view in Figure 8.

The synchronous form of electric motor will in itself operate at a very uniform speed but the particular form of synchronous motor which I have described will maintain unusually exact and constant speed, being practically absolutely invariable. In operation, the alternating current of commercial frequency is supplied by wires 1a-1b to the driving part of the apparatus and the magnets 12, and causes the magnet structure to revolve in synchronism with the frequency of the source of alternating current supply, and thereby drives the shaft 18 and the rotating member of camera 1 which the film carrying the sound track engages. This film feeding means therefore causes the film to be fed past the electro-optical actuating apparatus at a very uniform speed. This produces an extremely even and unvarying torque applied to the driving system and, therefore, a very even speed. The system which I describe avoids the considerable time required to get the feeding mechanism up to rated speed such as ninety revolutions per minute in the type of systems often used which possess very large mechanical inertia. There is also avoided the extreme looseness of mechanical coupling which is employed in some systems, which involves uncertain performance. The flexibility of the electro-magnetic coupling which I provide smooths out irregularities in the performance of the driving members, and thereby avoids distortion and non-uniformity in reproduction.

I have provided a sound-on-film system where-
in the film is driven at an absolutely constant and

unvarying speed, free from speed variations and hunting, which will give much better sound records and reproduction than those produced by the apparatus heretofore produced.

From the foregoing description of the construction of my improved driving unit, the operation thereof and the method of applying the same to use will be readily understood. It will be seen that I have provided a simple, inexpensive and efficient means for carrying out the objects of the invention and while I have particularly described the elements best adapted to perform the functions set forth, it is obvious that various changes in form, proportion and in the minor details of construction may be resorted to, without departing from the spirit or sacrificing any of the principles of the invention.

Having thus described the invention, what is claimed is:

1. In a film feeding apparatus, feeder means for feeding a film and synchronous means for driving said feeder means at substantially unvarying speed, said synchronous driving means comprising adjustable tension means for controllably adjusting the driving tension applied to said film through said feeder means.

2. In a film feeding apparatus, feeder means for feeding a film, and synchronous means for driving said feeder means at substantially unvarying speed, said synchronous driving means comprising as its principal source of motive power a synchronous motor having a rotor mounted for driving said feeder means, said synchronous motor comprising variable torque means for controllably adjusting the driving torque applied to said feeder means.

3. In a film feeding apparatus, feeder means for feeding a film, and synchronous means for driving said feeder means at substantially unvarying speed, said synchronous driving means comprising a synchronous motor having a rotor element and a stator element, said rotor element being mounted for slidable controlled movement of said rotor element over the surface of said stator element in the direction of the axis of rotation of said rotor element, for varying the driving tension applied to said film through said feeder means.

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