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SOUND PICTURE APPARATUS

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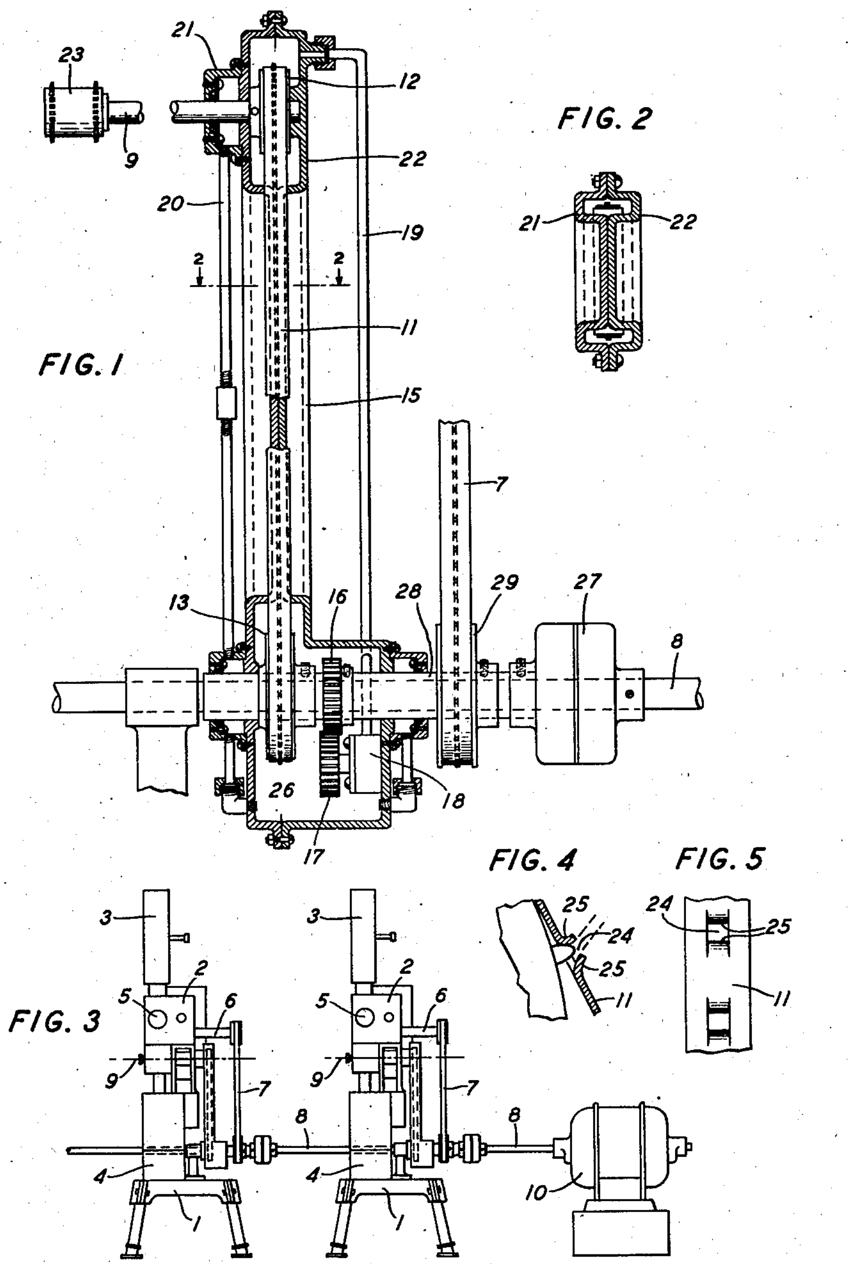

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SOUND PICTURE APPARATUS

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This invention relates to sound picture apparatus and more particularly to a driving mechanism for driving the sound reproducing or recording part of the apparatus.

A well known type of apparatus of this sort in which sound and scene are reproduced synchronously involves driving from a common source, a motion picture projector and a sound sprocket acting upon the film after it leaves the projector head. The sound sprocket serves to present an edge of the film in operative relation to an electrical reproducing or recording device for reproducing or recording the sound, the record in this case being placed on the edge of the film. In apparatus of this general character, it is important that not only the sound and picture mechanisms be operated in synchronism but that the sound record be presented to the sound reproducing device at a uniform speed since variations in speed will cause variations in the sound from that originally recorded which takes the form of a rapid variation superimposed on the sound and is commonly called a "flutter". This "flutter" is generally due to irregularities in the gear teeth which are ordinarily used to transmit motion from the main shaft or common source to the sound sprocket. It may also be due to variations in load placed on the sound sprocket by inequality in sprocket hole spacing, variations in film thickness and oil or dirt on the film.

One method which has been used to minimize this "fluttering" effect is to place a heavy flywheel on the shaft with the sound sprocket. Flywheels, in order to be effective for this purpose, must have considerable mass and consequently are of considerable size and take up considerable space. In the driving device of the present invention, the flywheel is eliminated as is the gear type drive, the advantages of the gear drive and flywheel being obtained without the disadvantages inherent in such mechanisms.

In accordance with the invention, the sound sprocket is mounted on a shaft which is driven from a parallel main shaft by means of a positive belt drive. The main shaft is rigidly connected to the armature of the driving motor and has imparted to it the inertia of the motor armature. In order that the sound sprocket may have positively imparted to it the effective inertia of the motor armature, and thus render unnecessary the use of a flywheel on the sound sprocket shaft, it is preferred to use a belt in the form of a light steel tape of the so-called "weldless" type, provided with equally spaced perforations which engage pins or teeth on the driving pulleys on the two shafts. Other smooth running positive belt drives might be used, providing they have the property of the steel tape or ribbon belt of being substantially inextensible or unyielding under the load conditions that obtain and act to establish rotational rigidity between the motor armature and the sound sprocket. In order to prevent speed fluctuations of the sound sprocket such as might result from transverse belt vibrations, a braking or retarding force is applied to the belt. In the preferred arrangement, the belt is caused to travel through a fluid, such as oil, which, due to its viscosity, has a braking or vibration damping action on the belt moving through it. A fixed and unvarying velocity ratio is thus maintained between the motor armature and the sound sprocket.

It is common practice to provide each sound and picture reproducing or recording machine with an individual motor, which arrangement has certain advantages in a machine in which the sound sprocket is gear driven. In accordance with a feature of the present invention, a common drive for a plurality of machines is utilized and results in unexpected advantages. Since a positive belt drive is used, any number of machines may be connected to the main shaft and the inertia of the common driving motor and the main shaft utilized as a steadying means for all of the machines. Where individual motors are used, the inertia of the motors is relatively small compared with the sound sprocket flywheel, but with a common drive the mass of the motor and the drive shaft is increased and has a substantial steadying influence on the sound sprocket drives.

Reference has heretofore been made to a "sound sprocket" as defining a mechanism for presenting the film in operative relation to the electric reproducing or recording equipment. While this term is commonly used to designate a toothed drive which engages perforations in the film at or near the sound reproducing equipment, it is used herein in a broader sense to define a film handling mechanism at or near the sound reproducing or recording point whether in the form of a toothed sprocket, a smooth drum, an endless belt or other similar film feeding device which is constructed to positively engage and prevent slipping of the film during a portion of its movement.

In the drawing, Fig. 1 represents a view in elevation and partly in section of the driving mechanism of the invention; Fig. 2 is a sectional view across the line 2—2 of Fig. 1; Fig. 3 is an elevation showing the driving mechanism of the invention applied to a plurality of sound picture reproducng machines; and Figs. 4 and 5 are views of a preferred form of the driving belt.

Referring particularly to Fig. 3 wherein two of the sound picture reproducing machines are shown in front elevation, the usual adjustable bases are indicated at 1, the projector head at 2, the upper film magazine at 3 and the lower film magazine at 4. The film passes from the upper film magazine 3 into the projector head 2 and behind the projecting lens 5 and is driven through the projector head with an intermittent movement through the drive shaft 6 which is positively driven by a suitable belt 7 from the main shaft 8. This mechanism, except that gear drive is used instead of belt drive, is common to the standard motion picture projector in common use. However, the belt drive of the projector mechanism is no part of my invention and the ordinary gear drive may be substituted if desired. After leaving the projecting lens 5, the film passes through a suitable number of idlers and guide pulleys to a sprocket known as the sound sprocket 23 shown in Fig. 1 which is mounted on the shaft 9. After passing this point, the film is delivered to the lower film magazine 4. The main shaft 8 is driven from a source of power 10 which may be a motor which is ordinarily provided with automatic regulating equipment to keep its speed constant with varying load and varying voltage in the supply mains. Such regulating equipment, which may be generally of the type described in the paper "Speed Control for the Sound-Picture System" by Stoller, published in "Bell Telephone Laboratories Record", November 1928, is very effective in preventing variations of speed with changing load and supply voltage. Furthermore, when the rotor of such a constant velocity motor is connected with the sound sprocket shaft by a positive transmission that does not itself introduce velocity variations, the effective inertia imparted to the sound sprocket by the mass of the rotor and its shaft is sufficient to take care of such variations as have their rise in variations in the frictional force exerted on the film by the film gate or similar irregularities. Contributing to the elimination of these irregularities, is shown in Fig. 3 a plurality of reproducing machines which are driven from a common motor and shaft, which means a heavier motor and shaft than if individual drives are used. By using such common drives, and properly proportioning the speed and power to the load, advantage is taken of the inherently greater inertia of the motor and drive shaft to suppress these small variations.

The main drive shaft is rigidly coupled with the reproducing machine when desired by means of the clutch 27 the driving member of which is keyed to the shaft 8 and the driven member of which is keyed to the sleeve 28 within which the shaft 8 rotates. This sleeve carries the driving sprocket 13 for the sound head and the driving sprocket 29 for the picture head or projector. The driving sprocket 13 is coupled with the sound sprocket shaft by means of the positive belt drive of the invention, one embodiment of which is shown in Fig. 1. It consists of a perforated steel belt or band 11 preferably of the "weldless" type passing over the peripheries of two accurately centered and accurately circular sprockets 12 and 13 carrying teeth which enter the spaced perforations in the band. In accordance with the practice customary in the movement of perforated film, the sprockets 12 and 13 are provided with strippers (not shown) to insure the smooth disengagement of the belt from the sprocket teeth. The sprockets 12 and 13 are located, as shown, in the opposite ends of the casing 15; one end of which embraces the main shaft 8 and sleeve 28, and the other end of which embraces the shaft 9. The sprockets 12 and 13, it will be understood, will have their diameters so related as to give the desired velocity ratios between the driving and driven members. This, in the case of the system described in the paper by Stoller already mentioned, is a speed reduction ratio of 20 to 6 as between the motor armature and the sound sprocket. In its preferred form the belt 11 is constructed as illustrated in Fig. 4 and Fig. 5. The longitudinal edges 24 of the perforations 25 are upset from the plane of the belt and are shaped on the contour of an involute curve to conform with the contour of the sprocket tooth. The separation between the elastic upset edges 24 is slightly less than the breadth of the sprocket tooth at the point of engagement so that the teeth and perforations will tend to be smoothly centered with respect to each other during the engaging movement. The perforations in the belt and the teeth in the sprockets are closely spaced to obtain the advantage of the constant engagement of a large number of perforations and sprocket teeth for insuring a uniform flow of velocity from the motor armature to the sound sprocket and the elimination of troublesome low frequency disturbances. Any slight tooth and perforation disturbance which may be produced will have a high frequency characteristic and therefore be readily suppressed by damping and elasticities of a known character which may be introduced in the transmission system.

If desired, the transmission between the driving motor armature and the sound sprocket may be through the medium of a flexible belt of steel or metal provided with simple substantially rectangular perforations such as are well known and commonly used in motion picture film provided the flexible belt has properties similar to the endless steel belt with respect to longitudinal rigidity of the belt. The longitudinal rigidity of an endless belt of steel ribbon or the like makes it possible to exercise a high degree of accuracy in the spacing of the perforations. A high degree of accuracy has already been obtained in the spacing and shaping of sprocket teeth such as shown for the driving and driven members. It is therefore possible to eliminate substantially all disturbance between the belt perforations and sprocket teeth and obtain in effect a positive rotary interlock between the sound sprocket and the motor armature. Thus, there is provided a fixed speed reduction means for positively coupling the sound sprocket to the effective inertia of the motor armature.

If desired, a metal belt of the character disclosed may be accurately perforated and formed by joining the two ends together by means of a dovetailed electric weld in a manner well understood in the electrical welding art. This provides substantially the same longitudinal rigidity and uniform continuity that characterizes the weldless type of belt.

The shaft 9 lies within the pivoting axis of the projector so that the projector may be adjusted at different angles without disturbing the relation of the main shaft 8 and the shaft 9. A spring pressed roller may engage the projector belt 7 to take up any slack due to pivoting adjustment of the projector.

The shaft 8 in addition to the sprocket 13, also carries a gear 16 which, through a gear 17, drives a pump 18 which drives oil from the lower part of the casing 15 through a duct or pipe 19 to the upper part of the casing from which it returns by way of the clearance space between the casing walls and the two sides of the belt. Oil in the upper part of the casing that may leak through the inner bearing of the sound sprocket shaft 9 flows by gravity to pipe 20 and returns together with any leakage through the inner bearings of drive shaft 8, to the well 26 in the bottom of the casing.

It will also be observed that the pump keeps the oil above the level of the upper end of pipe 20 so that the entire casing, including the shafts through which the belt moves, will be filled with oil. The belt 11 therefore moves in a bath of heavy oil and the high viscosity of such oil with reference to the belt serves as a brake or damper to suppress minute variations in the position of the belt.

As shown more particularly in Figs. 1 and 2 the casing for the belt of the drive may be conveniently formed of two casings 21 and 22. These two casings when assembled, form an upper and lower chamber and two channels connecting such chambers through which the belt runs with its surfaces close to the inner walls of the channels. Obviously other arrangements of cooperating guiding surfaces may be employed to constrain the belt to travel in a path of substantially unvarying length between the driving and driven sprockets. The oil circulating pump may be omitted where the movement of the belt itself through the oil in the well 26 is sufficient to provide and maintain the oil film between the belt and its cooperating surfaces. A viscosity or ohmic resistance load may, if desired, be added to the sound sprocket shaft to further reduce velocity variations by locating a stationary member or surface of the casing in close proximity to a rotating surface of the upper sprocket 12 with an intervening film of oil.

A convenient form of sound film feeding sprocket is indicated at 23 and is known as the sound sprocket because the film at or adjacent that point is presented to the sound reproducing mechanism. By virtue of the positive drive of the invention, the sound sprocket moves with the same uniform speed as the main drive shaft and the braking or damping effect of the oil on the moving parts contributes to and aids in the further elimination of any slight variation in speed due to variations of the load caused by the film.

It is obvious that the constant speed drive disclosed herein as applied to a sound picture reproducing machine is equally applicable to machines for recording sound and scene and to machines for separately recording or reproducing sound independently of scene.

What is claimed is:

1. A constant speed film driving mechanism for sound picture apparatus comprising a film driving sprocket having a pulley rigidly connected thereto, a main drive shaft having a pulley rigidly connected thereto, a belt arranged to positively engage said pulleys, a resistance filter arranged to resist forward or backward velocity variations in said driving mechanism and means whereby said belt may be directly subjected to the filtering action of said resistance.

2. A constant speed film driving mechanism for sound picture apparatus comprising a film driving sprocket having a pulley rigidly connected thereto, a main drive shaft having a pulley rigidly connected thereto, a belt arranged to positively engage said pulleys, a fluid resistance filter arranged to resist forward or backward velocity variations comprising a casing enclosing said pulleys and belt supplied with a viscous fluid whereby said belt and pulley may be directly subjected to the filtering action of said resistance.

3. A constant speed driving mechanism for sound recording or reproducing apparatus, means for feeding a record strip to a recording or reproducing instrumentality, comprising a feed sprocket to engage perforations in the record strip, a shaft for said sprocket, a drive shaft, a belt for positively driving the sprocket shaft from the drive shaft, and a resistance applied to the surfaces of said belt for imposing on said record feeding means a braking force which is large compared to the load variations imposed on said feed sprocket by said record strip said resistance being arranged to oppose forces influencing forward or backward velocity variations.

4. A constant speed driving mechanism for sound recording or reproducing apparatus including means for feeding a record surface to recording or reproducing instrumentalities, means for driving said record feeding means comprising a drive shaft, a driven shaft and a belt positively connecting said shafts, and a resistance applied to the surfaces of said belt for imposing on said driving means a braking or retarding force which is large in comparison to the load variations imposed on said drive by irregularities in the record feeding operation said resistance being arranged to oppose forces influencing forward or backward velocity variations.

5. A constant speed film driving mechanism for sound picture apparatus comprising a film driving sprocket having a pulley rigidly connected thereto, a main drive shaft having a pulley rigidly connected thereto, a belt arranged to positively engage said pulleys, a fluid resistance filter arranged to resist forward or backward velocity variations comprising a casing enclosing said pulleys and belt supplied with a viscous fluid with such positional relation between the belt and walls of said casing as to establish a large resistance to the forces influencing velocity variations.

6. A constant speed film driving mechanism for sound picture apparatus comprising a film driving sprocket having a second sprocket rigidly connected thereto, a main drive shaft having a sprocket rigidly connected thereto, an endless belt having perforations therein connected between said second sprocket and said drive shaft sprocket, a resistance filter arranged to resist forward or backward velocity variations and means whereby said belt may be directly subjected to the filtering action of said resistance.

7. A constant speed film driving mechanism for sound picture apparatus comprising a film driving sprocket having a second sprocket rigidly connected thereto, a main drive shaft having a sprocket rigidly connected thereto, an endless belt having perforations therein connected between said second sprocket and said drive shaft sprocket, a fluid resistance filter arranged to resist forward or backward velocity variations and means whereby said belt may be directly subjected to the filtering action of said fluid resistance.

8. A constant speed film driving mechanism for sound picture apparatus comprising a film

driving sprocket having a second sprocket rigidly connected thereto, a main drive shaft having a sprocket rigidly connected thereto, an endless belt having perforations therein connected between said second sprocket and said drive shaft sprocket, a resistance filter arranged to resist forward or backward velocity variations comprising a casing enclosing said belt supplied with a viscous fluid whereby said belt may be directly subjected to the filtering action of said resistance.

9. A constant speed film driving mechanism for sound picture apparatus comprising a film driving sprocket having a second sprocket rigidly connected thereto, a main drive shaft having a sprocket rigidly connected thereto, an endless metal belt having perforations therein connected between said second sprocket and said drive shaft sprocket, the edges of said perforations being shaped on the contour of an involute curve to conform with the contour of the sprocket teeth, a resistance filter arranged to resist forward or backward velocity variations comprising a casing enclosing said belt supplied with a viscous fluid with such positional relation between the belt and walls of said casing as to establish a large resistance to the forces influencing velocity variations.

10. In sound picture apparatus having a constant speed driving motor and a sound sprocket for moving the sound film, means for establishing rotational rigidity between the sound sprocket and the inertia of the motor including a toothed driving sprocket on the motor armature shaft, a toothed driven sprocket on the sound sprocket shaft, and a longitudinally unyielding metal belt with perforations in said metal shaped to conform accurately with the contour of the sprocket teeth.

11. In sound picture apparatus having a constant speed driving motor and a sound sprocket for moving the sound film, means for establishing rotational rigidity between the sound sprocket and the inertia of the motor including a toothed driving sprocket on the motor armature shaft, a toothed driven sprocket on the sound sprocket shaft, and a longitudinally unyielding metal belt with perforations in said metal with sides protruding beyond one surface of the metal of the belt shaped on an involute curve to conform accurately with the contour of the sprocket teeth.

12. In sound picture apparatus having a constant speed driving motor and a sound sprocket for moving the sound film, means for establishing rotational rigidity between the sound sprocket and the inertia of the motor including a toothed driving sprocket on the motor armature shaft, a toothed driven sprocket on the sound sprocket shaft, a longitudinally unyielding metal belt with perforations in said metal shaped to conform accurately with the contour of the sprocket teeth, and means to apply resistance to said belt for damping load variations.

13. In a sound picture apparatus having a constant speed driving motor and a sound sprocket for moving the sound film, a non-slipping belt transmission between the driving motor and the sound sprocket including a driving and a driven sprocket with teeth spaced as closely as practical, and a perforated metal ribbon belt between said driving and driven sprockets with perforations spaced and shaped to accurately match the spacing and contour of the sprocket teeth to provide a rotational rigid coupling between the driving motor and the sound sprocket.

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