Sept. 5, 1933. L. A. ELMER 1,925,690

SOUND PICTURE SYSTEM

Filed Nov. 5, 1931

FIG. 1

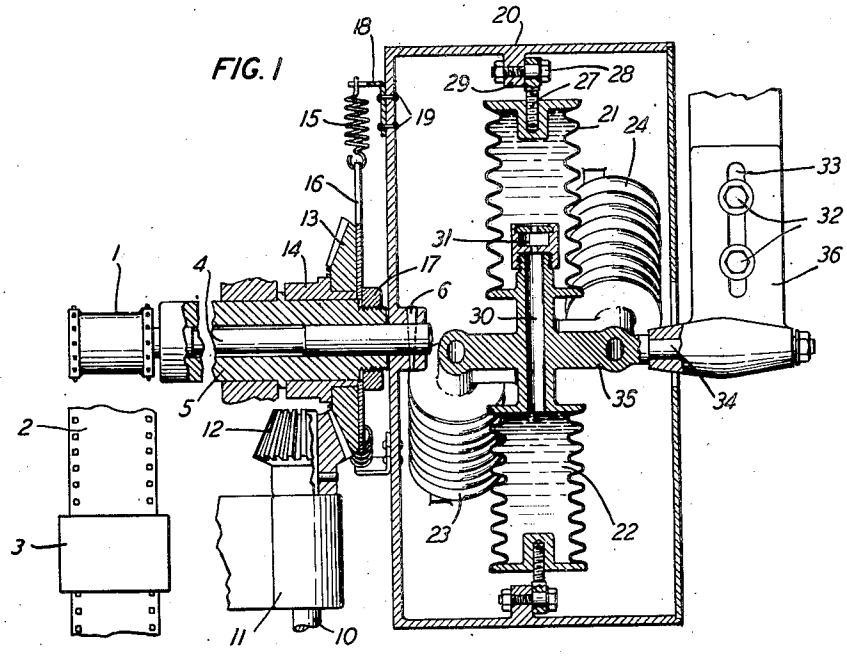


FIG. 2

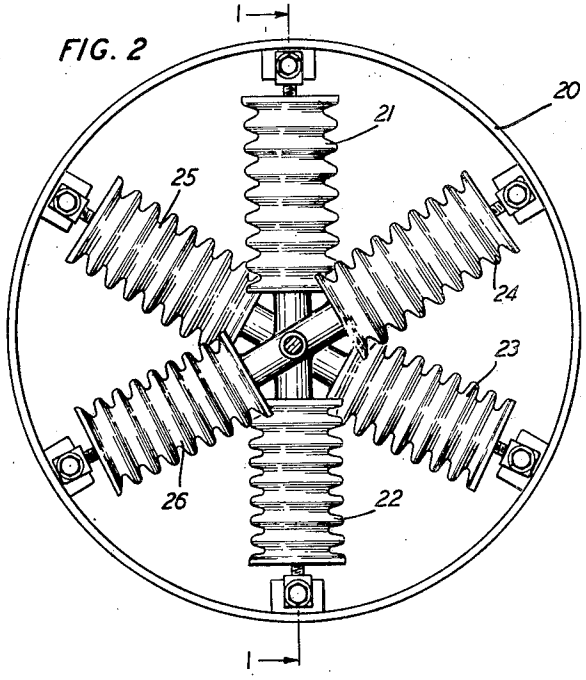
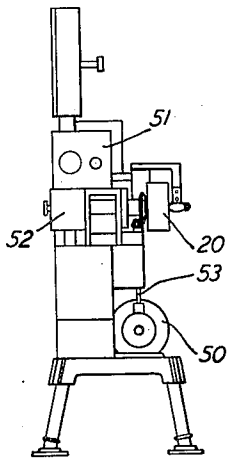


FIG. 3



INVENTOR
L. A. ELMER

BY G. H. Heydt

ATTORNEY

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SOUND PICTURE SYSTEM

Lloyd A. Elmer, West Orange, N. J., assignor to Bell Telephone Laboratories, Incorporated, New York, N. Y., a corporation of New York

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8 Claims. (Cl. 271—2.3)

This invention relates to sound picture apparatus and more particularly to a control mechanism for maintaining a film at constant velocity for sound translation.

A well known type of apparatus of this character in which sound and scene are synchronously recorded or reproduced involves driving the various mechanisms from a common source. This includes an apparatus for intermittently positioning a film before lenses for photographic exposure or projection and a cylinder or sprocket wheel for moving the film before sound translating apparatus. It is well established that the film must be moved at a uniform velocity for reproducing sound as well as for recording sound and that any velocity variations in either case that cause a pitch variation of over 0.3% will introduce noticeable sound distortion. In some cases a pitch variation of over 0.1% will introduce sound distortion. Consequently, it is a fundamental requirement that the cylinder or sprocket which is used to move the film past the sound translating apparatus be rotated at an unvarying velocity.

The intermittent motion and sprocket are ordinarily driven by gears which are connected through shafts and other gears to an electric motor. The parts for this mechanical transmission apparently cannot be produced and connected together in a manner to eliminate all irregularities of motion. Such irregularities have a tendency to produce velocity variations at the sound sprocket. Irregularities in film load also have a tendency to introduce velocity variations at the sound sprocket. The greatest variation in film load is probably produced when a film splice passes through the tension pad ordinarily used at the point of sound translation.

One method which has been used to minimize the effect of irregularities in the driving mechanism is to mount a heavy flywheel on the sound sprocket shaft. The functioning of this flywheel is to absorb or give out mechanical energy in response to fluctuations in applied torque, thereby minimizing the fluctuations. A flywheel must be of large mass to reduce the effect of these disturbances. The size, weight and momentum of the flywheel are objectionable both in recording and reproducing apparatus.

The object of this invention is, therefore, to provide in a sound picture apparatus a velocity regulator of light weight and negligible inertia arranged to dissipate energy proportional to the velocity of rotation of the film driving sprocket comprising a plurality of pressure pumps operated by a member which is driven in unison with the sprocket.

In accordance with the invention the firm driving sound sprocket is mounted on a shaft which is driven through a resilient member by a gear drive. A circular frame also mounted on this shaft is arranged to drive a plurality of bellows pumps. Three pairs of bellows are mounted within the circular frame and connected thereto. Each pair of bellows is filled with liquid and arranged in such manner that the liquid may be pumped at a given rate alternately from one bellows to the other. Each pair of bellows is a separate pumping unit connected in the center to a common supporting member which terminates in a shaft mounted eccentric to the outer circular frame. The support for this shaft is adjustable to obtain different eccentricities in order to regulate the pumping action of the bellows.

As the circular frame is rotated with the sound sprocket the bellows of each pair are alternately compressed and expanded causing a pumping action of the liquid. This pumping action produces a force whose successive instantaneous values if plotted between suitable coordinates, would generate a sine curve. This force will accordingly be referred to hereinafter as a sinusoidal force. With several pairs of bellows equally spaced angularly the resultant flow of liquid is constant for a constant velocity and an even load is thus placed upon the sound sprocket. This load is many times greater than the greatest load variation caused by film inequalities. This acts in the manner of a swamping load which minimizes the effect of the tendency of the film variations to cause velocity variations in the sound sprocket. Since the resistance to the flow of the liquid is proportional to the velocity of rotation any tendency toward a sudden increase or decrease in the velocity of rotation would be practically annulled by the resulting great increase or decrease respectively in resistance. Consequently, irregularities in velocity produced in the driving mechanism effect an action in the springs or elastic member between the final driving gear and the circular frame and do not noticeably affect the velocity of the sound sprocket.

In the drawing, Fig. 1 is a view in elevation and partly in section of the velocity regulator and film driving sprocket;

Fig. 2 is an end elevation of the bellows of the velocity regulator; and

Fig. 3 illustrates a well known projector equipped with the velocity regulator.

In the illustrated embodiment Fig. 1, the shaft 10 interconnects a gear set driven by a motor with the final driving gear 12. The intermittent motion which is also connected to this gear set, is of conventional design. The intermittent motion and other operating parts of the projector are not shown in detail since they are all of conventional design and well understood. The driving gear 12 is associated with gear 13 for driving the sound sprocket 1 and circular frame 20. The gear 13 is rigidly connected to sleeve 14 which freely rotates on housing 5. The gear 13 and sleeve 14 are rigidly connected to the circular plate 16 which is connected to a plurality of springs 15. The opposite end of spring 15 is connected to the circular frame 20 by angle pieces 18 which are rigidly connected to frame 20 by rivets 19. Frame 20 is rigidly connected to shaft 4 by pin 6. The sprocket wheel 1 is also rigidly connected to shaft 4 by a key not shown. The sprocket 1 and frame 20 are thus driven by gear 12 under the control of an elastic member shown in the form of a plurality of springs.

In the cross-sectional view of the velocity regulator Fig. 1, the bellows 21 and 22 forming one pair of bellows are shown in cross section to illustrate the internal structure. This structure is used for each pair of bellows. Bellows 23 and 24 each form one half of a second and third pair of bellows. Each bellows is connected to frame 20 by an eyebolt such as shown at 27. This eyebolt may have slight movement with relation to its fastening bolt 28. The central portion of each bellows is connected to a common supporting member 35. This supporting member terminates in shaft 34 which is mounted eccentrically with relation to the circular frame 20. It is thus apparent that as the circular frame 20 rotates each bellows is alternately compressed and expanded. Each pair of bellows is filled with liquid, preferably oil. Each pair of bellows is interconnected by a tube 30 which extends through the supporting member 35. A valve 31 permits the regulation of the rate of flow from one bellows to the other of each pair. The eccentricity of shaft 34 may be regulated by an adjustment of mounting 36.

The film 2 and film pad 3 are of conventional designs. The film 2 ordinarily has both picture and sound records thereon and is drawn by sprocket 1 past the point of sound translation after it has been carried before the picture lenses by an intermittent motion. As hereinbefore stated inequalities of the film 2 exert a varying load upon the sound sprocket 1. In order to minimize the effect of this variation in film load on the sound sprocket the resistance load exerted by the velocity regulator is made several hundred times greater than the load introduced by the greatest film variation. The bellows mounting shaft 34 may be fixed by adjustment to obtain the correct ratio between the film load and the velocity regulator load.

The arrangement proposed for the bellows 21 to 26, inclusive is best shown in Fig. 2. These bellows are arranged in such manner that all bellows are constantly operated at an even rate to dissipate energy proportional to the velocity of rotation. The operation as described with the bellows arranged as shown causes a pumping action upon the liquid that is sinusoidal for each pair of bellows, each pump delivering a sinusoidal force 120° out of phase with each other pump.

A projector has been shown in Fig. 3 illustrating the velocity regulator associated therewith. The driving motor is shown at 50 connected by shaft 53 with the apparatus of the projector. The usual projector head is shown at 51 and the sound unit at 52. The circular frame 20 is shown associated with the sound unit 52.

The velocity regulator may assume various forms other than the form shown. Various types of compression pumps may be used in place of the bellows. It is, therefore, not the intention to limit the invention to the particular form shown.

What is claimed is:

1. In a sound picture mechanism, a cylinder for imparting a uniform motion to a band of inconsiderable mass, a velocity regulator for said cylinder comprising a pumping device having a plurality of pairs of pumps, each pair arranged to deliver a sinusoidal force out of phase with respect to each other pair, and a common driving means for said cylinder and velocity regulator.

2. In a sound picture mechanism, a cylinder for imparting a uniform motion to a band of inconsiderable mass, a velocity regulator for said cylinder comprising a pumping device having a plurality of pairs of pumps, each pair arranged to deliver a sinusoidal force out of phase with respect to each other pair, a shaft for driving said cylinder and velocity regulator, and a driving means for said shaft.

3. In a sound picture mechanism, a cylinder for imparting a uniform motion to a band of inconsiderable mass, a velocity regulator arranged to dissipate energy proportional to the velocity of rotation of said cylinder comprising a pumping device having a plurality of pairs of pumps, each pair arranged to deliver a sinusoidal force out of phase with respect to each other pair and a common driving means for said cylinder and velocity regulator.

4. In a sound picture mechanism, a cylinder for imparting a uniform motion to a band of inconsiderable mass, a driving means and means to annul the effect of velocity variations of said cylinder due to irregularities of structure and load, comprising a pumping device operated by said driving means in unison with said cylinder and having a plurality of pairs of pumps, each pair arranged to deliver a sinusoidal force out of phase with respect to each other pair.

5. In a sound picture mechanism, a cylinder for imparting a uniform motion to a band of inconsiderable mass, a velocity regulator for said cylinder arranged to dissipate energy proportional to the velocity of rotation of said cylinder comprising a plurality of pairs of bellows filled with liquid, each pair being operable to alternately pump said liquid from one bellows to the other and each pair being arranged to deliver a sinusoidal force out of phase with the force delivered by each other pair of bellows and a common driving means for said cylinder and said velocity regulator.

6. In a sound picture mechanism, a cylinder for imparting a uniform motion to a band of inconsiderable mass, a velocity regulator for said cylinder for annulling velocity variations comprising a plurality of reciprocating pressure pumps, each pump arranged to deliver a sinusoidal force out of phase with respect to each other pump and a common driving means for said cylinder and velocity regulator.

7. In a sound picture mechanism, a cylinder

for imparting a uniform motion to a band of inconsiderable mass, a velocity regulator for said cylinder for annulling velocity variations comprising a plurality of reciprocating pressure pumps, each pump arranged to deliver a sinusoidal force out of phase with respect to each other pump, a circular member for operating said pumps, a shaft, means for rigidly mounting said cylinder and circular member on said shaft and a driving means for said shaft.

8. In a sound picture mechanism, a cylinder for imparting a uniform motion to a band of inconsiderable mass, a velocity regulator for said cylinder for annulling velocity variations comprising a plurality of reciprocating pressure pumps, each pump arranged to deliver a sinusoidal force out of phase with respect to each other pump, a circular member for controlling the operation of said pump, a shaft eccentrically mounted with respect to said circular member for supporting the central axis of said pumps, a second shaft, means for rigidly mounting said cylinder and circular member on said second shaft, and means for driving said second shaft for rotating said cylinder under control of said velocity regulator.

LLOYD A. ELMER.