March 23, 1937. C. L. FARRAND 2,074,686

PLURAL MOTOR INTERLOCK SYSTEM

Filed April 18, 1935 2 Sheets-Sheet 1

FIG_1

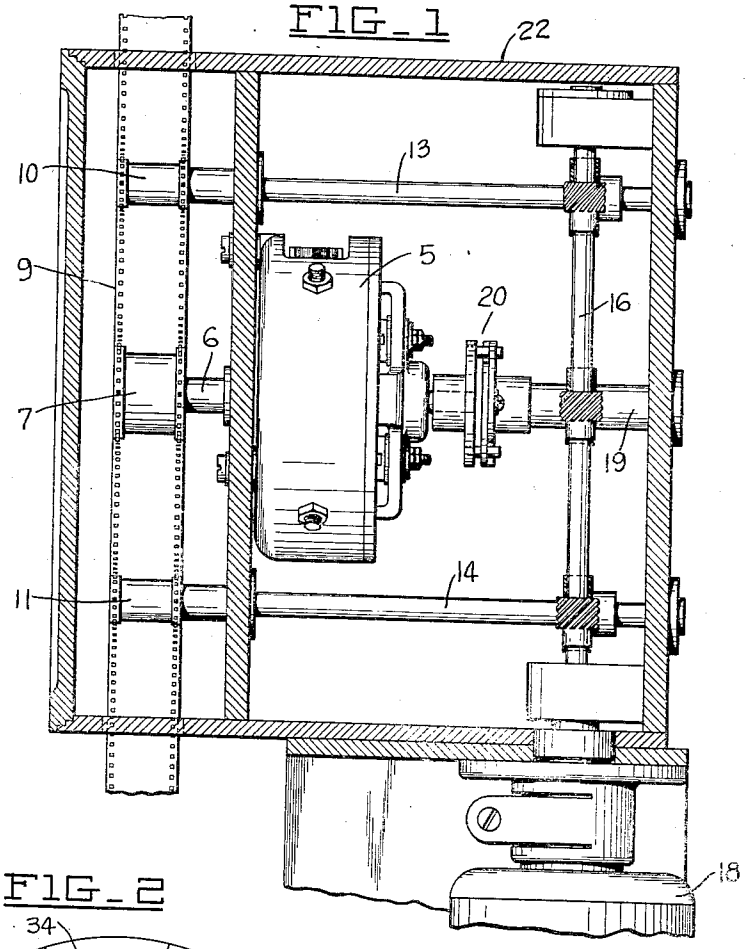



FIG_2

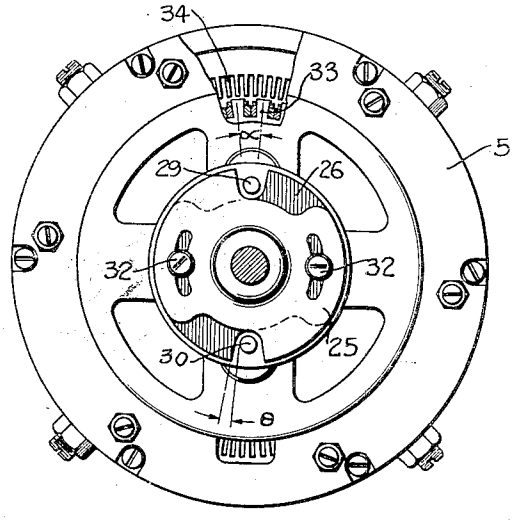
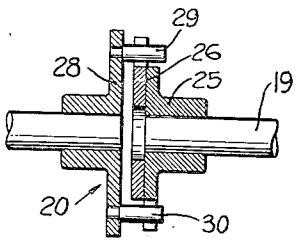



FIG_3



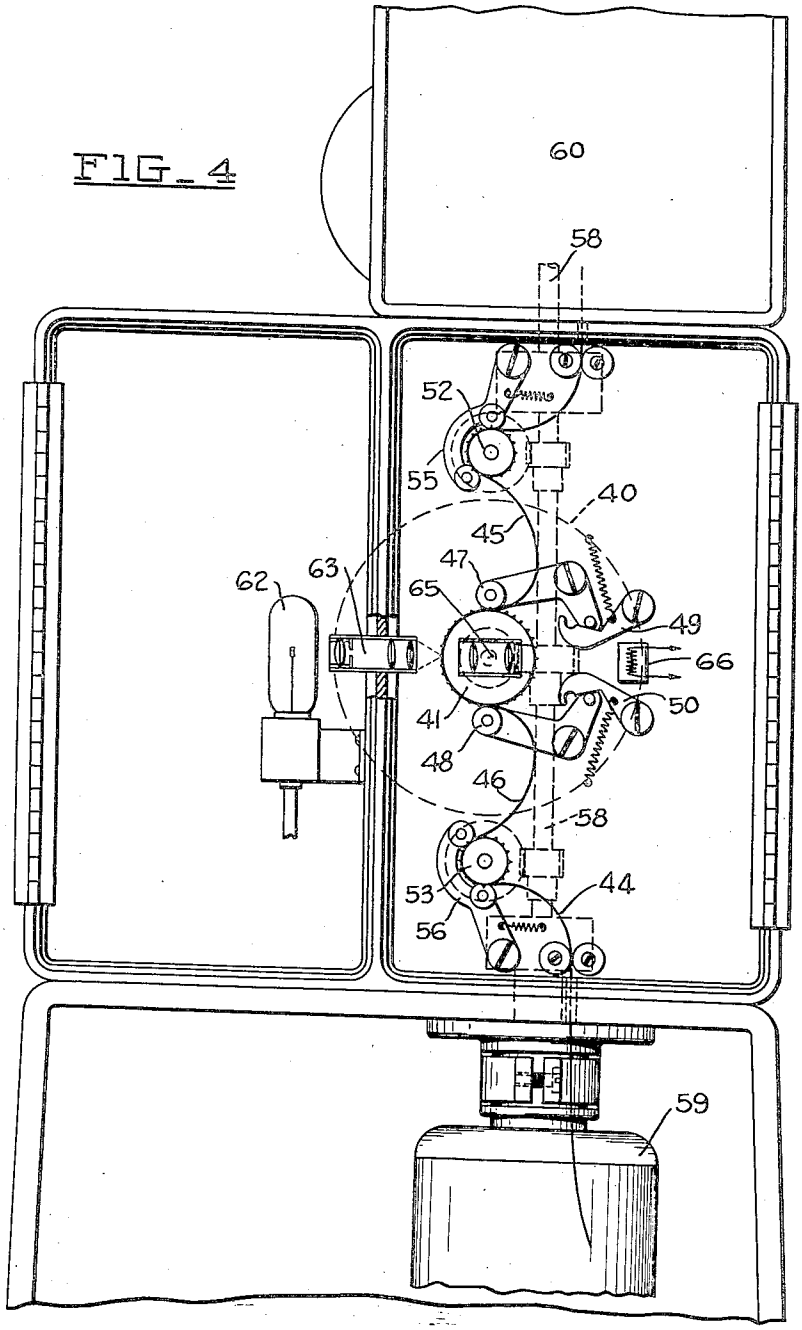

INVENTOR
Clair L. Farrand
BY Orl R. Goslaw
ATTORNEY

March 23, 1937. C. L. FARRAND 2,074,686

PLURAL MOTOR INTERLOCK SYSTEM

Filed April 18, 1935 2 Sheets-Sheet 2

FIG. 4




INVENTOR
Clair L. Farrand
BY
Ira M. Goslaw
ATTORNEY

Patented Mar. 23, 1937

2,074,686

# UNITED STATES PATENT OFFICE

2,074,686

## PLURAL MOTOR INTERLOCK SYSTEM

Clair L. Farrand, Larchmont, N. Y., assignor to United Research Corporation, Long Island City, N. Y., a corporation of Delaware

Application April 18, 1935, Serial No. 17,098

7 Claims. (Cl. 271—2.3)

This invention relates to constant speed driving systems and particularly to driving systems for progressing linear carriers of photographic sound records. It is well known in the art of recording and reproduction of sound waves that perfect recording and reproduction can only be obtained by maintaining a constant linear velocity for the record carrier since sound is made up of one or more frequencies having a definite wave form and relationship to one another, both as to amplitude and phase. Any disturbance of that relationship during the translation from acoustic to electrical energy, or vice versa, produces distortion, one of the chief causes being variation in speed of the driving means. An object of the invention, therefore, is to efficiently progress a linear carrier of sound waves at constant speed.

Where the record carrier is a film and recording is accomplished by the projection thereon of modulated light while reproduction is accomplished by the projection thereon of constant intensity light, the apparatus required employs a plurality of driving sprockets, supply and take-up reels. In addition, since it is customary to have on the diapositive, pictures of concomitant sound sources the projection of which is accomplished simultaneously with reproduction of the sound, there is considerable apparatus being simultaneously operated, this apparatus producing variations in load on the driving means which are generally electrical motors of the synchronous type. A further cause of speed variations where motor power is used is the variation in the motor supply energy. Another object, therefore, of this invention is to drive a talking motion picture film past a sound translation point at a constant speed regardless of variations in speed of other moving parts.

The present invention contemplates the use of separate motors for driving different parts of the system. In brief, a constant speed synchronous motor of special construction is employed for progressing the film past the translation point while the usual type of synchronous motor may be employed for driving the sprockets feeding the film to and from the translation point, the supply and take-up reels, and, when reproducing, the picture projecting mechanism. In accordance with this invention these separate motors, which would if operated separately require different times to reach synchronous speed, are arranged to operate independently when in synchronism within certain predetermined limits, thus permitting one motor to vary in speed without disturbing the other within these limits, but are so arranged that they will start and stop together and thereby retain their synchronous relationship at all times. The special constant speed synchronous motor is directly connected to the drive sprocket which controls the speed of the film past the translation point, while the other motor may be coupled by gears, chains, belts, or the like, to the other moving parts. A "back lash" coupling or interlock provides the synchronous independence of the motors but does not permit them to slip an entire pole. The coupling device itself is of the mechanical type which may be adjusted to provide for different pole pitches of different motors.

The invention will be better understood from the following description read in conjunction with the accompanying drawings in which:

Fig. 1 is a partial elevational view of a sound recording unit showing the two motors in their connected relationship to one another.

Fig. 2 is an end view of the motor showing the relationship between the coupling device and the motor stator and rotor.

Fig. 3 is a cross-sectional view of the mechanical interlock; and

Fig. 4 is a partial view of a projection system showing certain details of the sound reproduction system.

Referring specifically to Fig. 1, a motor 5 is shown directly coupled by shaft 6 to a drive sprocket 7. The translation point may be directly on the sprocket in the case of sound recording, or this sprocket may drive a film past an immediately adjacent sound slit in any well known manner. A film 9 is being shown over the sprocket 7 and also on sprockets 10 and 11. Sprockets 10 and 11 are on shafts 13 and 14, respectively, these shafts being connected through worm and pinion gears to a shaft 16, the shaft 16 being driven directly by a motor 18. The shaft 16 is also geared to a shaft 19 which carries one portion of a mechanical interlocking device 20, shown in cross-section in Fig. 3, and in front elevation in Fig. 2. A frame 22 supports the mechanism just described which may constitute the essential elements of the driving mechanism for a sound recording system. Since the light source, optics and associate apparatus, are not directly involved, they have not been shown.

The motor 5 is specially designed and constructed to provide as nearly constant a speed as can be obtained with a synchronous motor, the motor itself being disclosed and claimed in my co-pending application Serial No. 17,097 filed

April 18, 1935. It has a large capacity relative to its load which is solely the moving of the film between the loops on either side of the sprocket 7. The motor 18 may be either of the same type or of the usual commercial type, as long as it has sufficient power to drive the apparatus at normal load.

Referring now to Figs. 2 and 3, the coupling device 20 comprises two concentric plates 25 and 26 on shaft 19 adjustable with respect to one another, and a disc or plate 28 having pin extensions 29 and 30 diametrically opposite one another on the plate 28. The plates 25 and 26 are maintained in their adjusted position by means of screws 32. The desired adjustment is such that the variation between the shaft 19 and the shaft of motor 5 is just less than one pole pitch of the motor 5. As described in the above-mentioned co-pending application, the motor has 40 poles, as shown at 33, and 120 armature teeth as shown at 34. In Fig. 2 the pole pitch is represented by the angle alpha and this angle should be greater than twice the angle theta or the angle formed between the pin 30 and plates 25 and 26, assuming pin 30 to be in a central position. This adjustment of the plates 25 and 26 will prevent any variation in speed between the two motors greater than one pole pitch and the eventual slippage of either motor out of synchronism, while permitting relative variations in speed therebetween within these limits. This provides a system wherein the motor 5 is not subjected to speed variations of motor 18 caused by variations in load on the other moving parts of the mechanism and therefore isolates the sprocket 7 driven by motor 5.

Referring now to Fig. 4, the drive system has been applied to a talking motion film projecting system wherein the special constant speed motor is represented by the dotted line 40. This motor is connected directly to the sprocket 41 for driving or controlling the speed of the film 44 between loops 45 and 46. The film is maintained on the sprocket by pad rollers 47 and 48 with a releasing mechanism 49 and 50. The feed sprockets 52 and 53 with their respective pad rollers 55 and 56 are driven from a shaft 58 to which they are geared, the shaft 58 being directly connected to a synchronous motor 59. The space 60 above the mechanism just described may house the picture projecting mechanism which can be driven from shaft 58 in any well known manner. As this system is for reproduction, a lamp 62 of constant intensity provides light which is optically reduced to a slit by optical system 63. The emergent light from the sound track portion of the film 44 is gathered by an optical system 65 and projected upon a light sensitive device 66 which may be a selenium or photoelectric cell.

In this system the translation point is on the sprocket 41 at which point the film should have a constant velocity. This constant velocity is provided by the special constant speed motor 40 corresponding to motor 5 in Fig. 1, while the remaining apparatus is driven by motor 59 corresponding to motor 18 in Fig. 1. Any variations in speed of the motor 59 caused by variations in load at any point in the moving mechanism directly connected to motor 59 will not be transferred to the motor 40 within the limits of adjustment of the mechanical coupler shown in Figs. 2 and 3 which interconnects the motors.

As stated above, this combination of two driving motors for different portions of film driving apparatus in combination with the "back lash" coupling prevents load variations from affecting the velocity of the record carrier at the translation point. There is another cause, however, of speed variations which may affect both motors and that is a variation in the electrical energy supplied thereto. A system for reducing to a minimum the effect of the supply voltage on the speed of the motor which drives the film past the translation point is disclosed and claimed in my co-pending application Serial No. 17,099 filed April 18, 1935.

The scope of the present invention is defined by the appended claims.

What is claimed is:

1. In a system for obtaining constant linear velocity of a record carrier, the combination of a plurality of rotating means for progressing said record carrier between two points, a synchronous motor for driving certain of said plurality of means, said plurality being subjected to variations in load, a second synchronous motor directly connected to a certain one of said rotating means, and means interconnecting said motors for permitting said motors to run independently of one another when in synchronism and to be positively connected during running conditions when the differential variation in speed reaches a predetermined amount.

2. A system in accordance with claim 1 in which the predetermined amount of differential variation in speed between said motors is less than the pole pitch of one of said motors.

3. In a system for progressing talking motion picture film past a translation point, the combination of a synchronous motor directly connected to a driving sprocket at or adjacent said transmission point, said sprocket lying on one side of said motor, sprockets for progressing said film to and from said first sprocket, a second motor geared to said second mentioned sprockets, and mechanical coupling means lying on the side opposite said sprocket on said synchronous motor and interconnecting said motors for adjusting the slippage therebetween during running conditions to a value less than the pole pitch of one of said motors.

4. In a system for permitting independent operation of synchronous motors within predetermined limits comprising a load mounted on the rotor shaft of one of said motors, a second load coupled by gears to the second of said motors, and a mechanical interlocking device providing a back lash between said rotor shaft and the shaft of said second motor, said interlocking device having a pair of adjustable discs for predetermining the back lash therebetween.

5. In a sound reproducing system, means for progressing a record carrier past a translation point, means for feeding said record carrier to and from said first mentioned sprocket, a synchronous motor having said first mentioned means mounted on the shaft thereof, said motor having a high degree of speed constancy, a second synchronous motor having said feeding means geared thereto, said motor being subject to variations in load and consequent variations in speed, and means coupling said motors for permitting their independent operation within one pole pitch of said first motor.

6. In a sound reproducing and picture projecting system, a plurality of sprockets for progressing a record carrier through said picture projecting mechanism, a plurality of sprockets for progressing said carrier through said sound re-

producing mechanism, a synchronous motor with a high degree of speed constancy having one of said last-mentioned sprockets mounted on the shaft thereof, a second synchronous motor connected to the other sprockets in said picture projecting mechanism and said sound reproducing mechanism, and a mechanical interlock between said motors for maintaining synchronism therebetween at all times, said interlock permitting independent operation of said motors within certain limits.

7. A system in accordance with claim 6 in which said certain limits of independent operation is an angular variation less than one pole pitch of one of said motors.

CLAIR L. FARRAND.

CERTIFICATE OF CORRECTION.

Patent No. 2,074,686.

March 23, 1937.

CLAIR L. FARRAND.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 2, second column, lines 36 and 37, claim 3, for the word "transmission" read translation; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 11th day of May, A. D. 1937.

(Seal)

Henry Van Arsdale
Acting Commissioner of Patents.

CERTIFICATE OF CORRECTION.

Patent No. 2,074,686.

March 23, 1937.

CLAIR L. FARRAND.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 2, second column, lines 36 and 37, claim 3, for the word "transmission" read translation; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 11th day of May, A. D. 1937.

(Seal)

Henry Van Arsdale
Acting Commissioner of Patents.