L. JANSSENS.

SYNCHRONIZING APPARATUS.

APPLICATION FILED APR. 10, 1913.

1,210,323.

Patented Dec. 26, 1916.

2 SHEETS—SHEET 1.

Fig. 2.

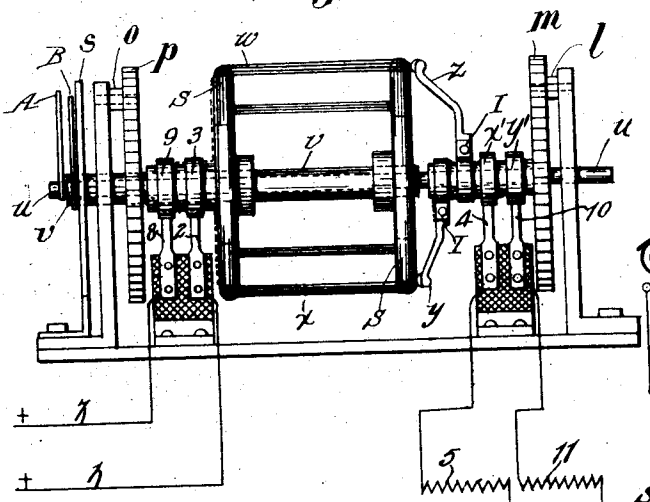


Fig. 1.

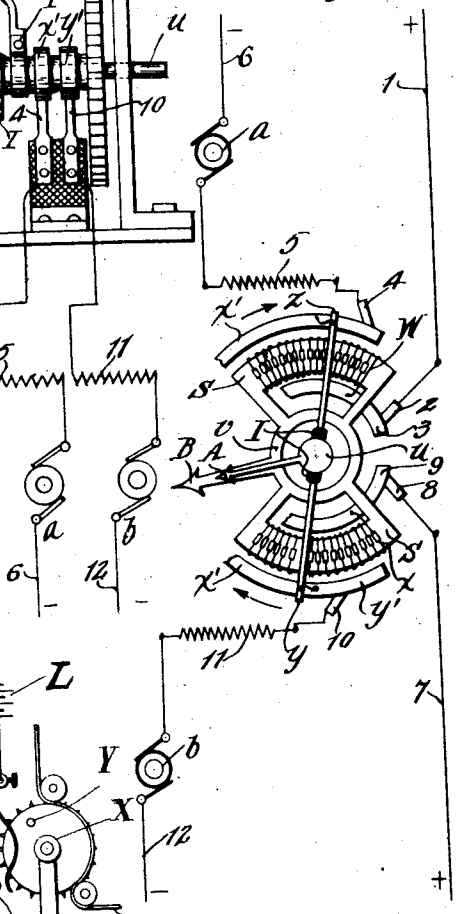
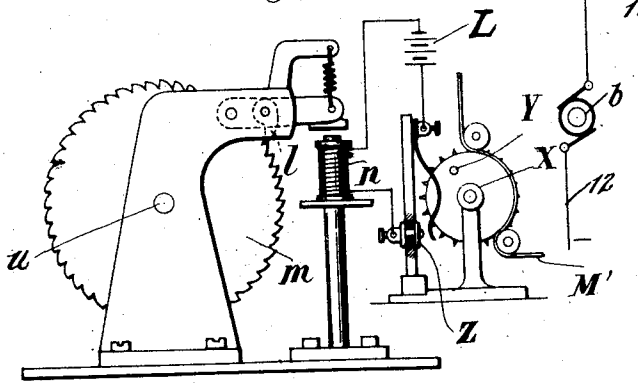


Fig. 3.



Witnesses:
M. A. Kelling
H. C. Hardwood

Inventor:
Louis Janssens
by C. Finger Atty

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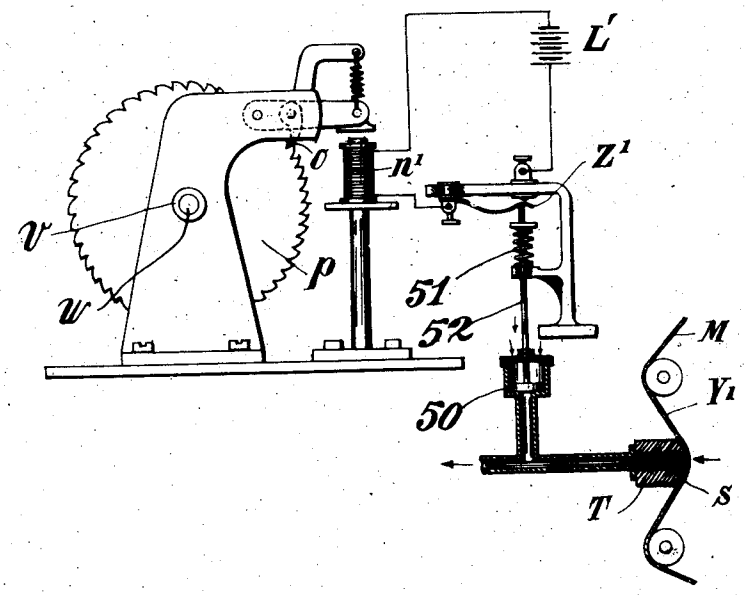
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2 SHEETS—SHEET 2.

Fig. 4.



Witnesses:
H. A. Hoffing
H. P. Hazelwood

Inventor:
Louis Janssens
by B. Singer Atty.

UNITED STATES PATENT OFFICE.

LOUIS JANSSENS, OF BRUSSELS, BELGIUM.

SYNCHRONIZING APPARATUS.

1,210,323. Specification of Letters Patent. Patented Dec. 26, 1916.

Application filed April 10, 1913. Serial No. 760,281.

To all whom it may concern:

Be it known that I, LOUIS JANSSENS, a subject of the King of Belgium, residing at Brussels, Belgium, have invented new and useful Improvements in and Connected with the Synchronizing Apparatus.

This invention relates to a method of and arrangements for obtaining, first, the synchronous registering of a musical composition adapted to a cinematograph film during the production of this film, and afterward to permit an automatic reproduction of the composition thus registered in absolute agreement with the projection of the film representing the scene.

The object of the invention is to provide for each film an appropriate musical accompaniment which, at each stage of the projection, is in perfect harmony with the scene projected.

In the method of operation in accordance with the invention a musical composition or improvisation appropriate to all the different phases of the cinematograph picture in question is performed by a performer well acquainted with the picture upon a key-board or bow instrument during the projection of the film. This instrument is combined in known manner with an apparatus which registers the musical performance by marks or perforations on a strip, which strip is drawn forward with a regular movement either by the cinematograph motor which unwinds the film strip, or by a motor turning approximately synchronously with the cinematograph motor so that the said strip thus registered can be utilized in a suitable instrument for the subsequent reproduction of the musical performance. Such registering and reproducing instruments with key-boards or bows are already known and used in practice and accordingly need not be described here.

For the sake of clearness it will be assumed in the following description that the musical instrument used for the performance and reproduction is a piano, that the music record strip is registered by perforations and that the motor which effects the perforation of the music strip serves at the same time to drive forward the film strip of the cinematograph, which may, however, be driven also by an independent motor.

It is well known that at each revolution of the toothed drum the film is always moved forward a uniform amount without any chance of slipping because the film is always perforated to engage the teeth of the drum. Hence by using this drum for recording the perforations, I can insure an exact relationship between the perforations and the film. Hence a music record strip is first obtained which has a series of perforations corresponding to similar perforations on a cinematograph film and the musical composition which is contained between each perforation exactly corresponds to the succession of cinematograph pictures by which the film has traveled forward during this rotation. By this means is obtained on this music strip a succession of synchronism perforations such that the part of the musical composition registered between adjacent synchronism perforations is in exact agreement with the series of cinematograph scenes on the portion of the film strip which passes before the projecting lens during the corresponding rotation of the toothed drum in question. By assuming that this portion of the film strip is comprised between two perforations which correspond exactly with two successive perforations marked on the music strip, the registration of the latter can be obtained. This feature of the invention permits the utilization in an automatic reproducing piano of the music band thus registered, in order to automatically reproduce the piece of music corresponding to a given film during the projection of this film and in absolute agreement with the successive scenes thereon.

The synchronizing arrangement consists of two movable members provided with needles or pointers, one of which members is displaced to a certain extent on the passage of a perforation on the music strip, while the other is displaced to a similar extent after a similar movement of the film, each one of these members being provided with a variable electric resistance one of which is in circuit with the motor driving the music strip and the other of which is in circuit with the motor driving the film, and the arrangement is such that the tensions of said resistances effective in the circuits of the motors is increased or diminished according as one member leads or lags relatively to the other. Thereby the current supply to the motors is modified so as to speed up the one which is lagging and to damp the motion of the one which is leading.

In order to play a musical record in absolute synchronism with the film it is sufficient to arrange the film strip at the point of starting in the cinematograph apparatus and to arrange the music strip at the point of starting in the reproducing piano, that is to say, in such a position that the first perforation of the music strip is in front of the tracker board. Then the cinematograph and the piano are simultaneously set in operation, taking care to regulate the speed of the two apparatus, so that at the moment of making each contact by the toothed drum of the cinematograph mechanism the synchronism perforation in the music strip corresponding to this perforation passes in front of the tracker board.

The electrical mechanical apparatus hereinafter described is used for automatically synchronizing the movements of the music strip over the tracker board, and the cinematograph film in front of the cinematograph apparatus. This apparatus is illustrated in the accompanying drawings, in which:—

Figure 1 is a diagram showing the synchronizing apparatus. Fig. 2 is a diagrammatic form of construction of the apparatus as an example. Fig. 3 illustrates a detail of the synchronizing device. Fig. 4 illustrates diagrammatically by way of example, a method of recording the perforations by an electro-mechanical device.

In the drawing, *a* indicates the driving motor of the music strip in the reproducing piano and *b* indicates the driving motor of the cinematograph film. *u* indicates a shaft, the extremity of which carries two diametrically opposite arms *y* and *z* which are insulated from the shaft, for instance, as at I. *v* indicates a hollow shaft disposed around the shaft *u*. This second shaft *v* carries two sectors S arranged diametrically opposite to each other and wound with the coils of two resistances *w* and *x*. A variable portion of the resistance *w* can be inserted in or cut out of the circuit of the motor *a* by the displacement of the arm *z* (which forms a sliding connection with the coils of this resistance) when the shaft *u* turns relative to the hollow shaft *v*. At the same time a portion of the resistance *x*, variable in the opposite sense to the portion of the resistance *w* is cut out of or inserted in the circuit of the motor *b*.

The circuit for the motor *a* may be placed on Fig. 1 so the positive lead 1 to the brush 2 through the rings 3 to the resistance *w*, through the pointer *z* to the rings *x'* through the brush 4 and the corresponding lead to a permanent resistance 5 and then through the motor *a* through the negative lead 6. A similar circuit for the motor *b* is established from the positive lead 7 to the brush 8 to the ring 9, through the resistance *x* to the pointer *y* through the ring *y'* to the brush 10 to the permanent resistance 11, through the motor *b* to the negative lead 12. It will be seen that the fixed or permanent resistances 5 need not be used unless desired, but in practice it would not usually be necessary to wind the motors *a* and *b* for the full 110 volts of the ordinary distribution circuit. Consequently the movement of the shaft *u* relative to the shaft *v* produces the acceleration of the motor *a* driving the music strip M and at the same time produces the slowing down of the motor *b* driving the film or vice versa.

Referring to Figs. 2 and 3 the shaft *u* receives an intermittent rotary movement by means of a pawl *l* acting upon the tooth of a ratchet wheel mounted on the said shaft. This pawl is actuated by an electro-magnet *n*, that is to say, at the moment of the closing of an electric contact *z* at the end of each revolution of the special drum shaft *x* in the cinematograph apparatus by means of a pin Y carried by one end of the drum.

The shaft *v* receives an intermittent movement by means of a pawl *o* acting upon a ratchet wheel *p* carried by this shaft. This pawl is actuated each time that one of the special synchronism perforations in the music strip passes before the aperture S in the tracker board T of the reproducing piano. The movement of this second pawl is preferably produced by the pneumatic action resulting from the passage of the said perforations in front of the special aperture in the tracker board.

When the perforation registers with the aperture, air is admitted under piston 50 which thereupon is lifted by spring 51 so that the piston 52 closes the contact Z^1 of electromagnet *n'*. It will be seen that magnets *n* and *n'* are supplied with current from batteries L and L', respectively.

The ratchet wheels, the pawls, the special shaft establishing the electric contact, the music strip and the tracker board, and also the electric and pneumatic connections, are not shown in the drawing since such member and arrangements are well known in current practice.

The operation of the apparatus above described takes place as follows: At each passage of an imaginary reference mark on the film in front of the objective of the cinematograph projector, that is to say, at each electrical contact made by the special shaft X above mentioned, the shaft *u* will turn through a certain angle under the action of the pawl which makes the ratchet wheel *m* advance through a distance of one tooth. When passing over the tracker board the perforation in the music strip corresponding to this imaginary reference mark on the film will cause the second pawl to be moved and consequently will make the ratchet wheel *o* on the shaft *v* advance one tooth. If the

passage of the imaginary reference mark on the film and the corresponding perforation in the music strip takes place at the same time the agreement between the music and the cinematograph is correct. The two shafts u and v turn through the same angle at each passage and accordingly the portions of the resistances w and x in the circuits do not change, that is to say, the speeds of the motors a and b remain the same. If the imaginary reference mark on the film passes prior to the corresponding perforation in the music strip, that is to say, if the film strip is in advance of the music strip, the shaft v will advance through a certain angle relative to the shaft u and the arms y and z will be displaced on the resistances x and w respectively in the sense indicated by the arrows in Fig. 1. Consequently the portion of the resistance w inserted in the circuit of the motor a will decrease and the portion of the resistance x in the circuit of the motor b will increase. In view of this, the movement of the motor a, that is to say, the movement of the music strip, will accelerate, while the movement of the motor b, that is, the movement of the film strip, will slow down. In this manner the agreement between the movement of the two strips tends constantly to reëstablish itself in an entirely automatic manner.

The shaft u receives an intermittent rotation by means of a pawl l, which acts on a ratchet wheel m mounted on the shaft u, Fig. 3. This pawl is actuated by an electromagnet n and the circuit of magnet n is closed by means of a contact Z at the end of each revolution of the shaft X in the cinematograph apparatus which shaft carries the toothed drum for moving the film M′, the drum having a pin Y for closing the contact. The shaft v receives an intermittent rotation by means of a pawl O, which at each passage of a synchronous perforation Y^1 of the music strip M in front of the opening S in the tracker board T of the piano acts on a ratchet wheel p mounted on this shaft by means of a vacuum controlled plunger which closes the contact Z′ in the circuit of magnet n, the circuit having a source of current such as B.

The apparatus described works as follows:—At each electrical contact made due to the forward movement of the cinematograph film the shaft u is turned through a certain angle by the pawl l engaging the ratchet wheel m and the latter being thus moved forward by one tooth. In passing the tracker board the perforation Y^1 in the music strip M moves a second pawl o, and in this way turns by one tooth a ratchet wheel p provided on the shaft v. When the synchronism of the music and the pictures is complete the two shafts u and v move to the same extent for corresponding movements of the music strip and of the film, and the resistances w and x inserted in the circuits do not alter, that is to say the speeds of the motors a and b remain constant. If for any reason the music and the pictures are not in synchronism then the shaft u will either be in advance of, or lag behind, the shaft v. Assuming that the shaft u is leading on the shaft v, this will cause the resistance w in the circuit of the motor a to decrease and thus the speed of the motor a will increase. Similarly the portion x of the resistance in the circuit of the motor b will increase and hence the speed of the motor b will decrease, and hence in this manner both the motors will tend toward synchronism. It will be understood that the action of the synchronizing apparatus will be similarly effected toward synchronism when the shaft u lags behind the shaft v, that is the motor b lags behind the motor a.

In practice the length of the music strip always varies to a small extent according to the temperature and the hygrometric state of the atmosphere. At the same time the size of the driving rollers of this strip is influenced by the same circumstances, and in addition this strip is liable to slip on its rollers, resulting in the retardation of its movement. The displacement of the imaginary reference marks of the film strip, which does not slip, is then, as previously stated, always proportional to the speed of the motor which drives it in known manner, while the displacement of the synchronism perforations of the music strip is not proportional to the speed of the motor which drives it, since the length of the band M between two successive perforations may become greater or smaller according to the hygrometric state of the atmosphere, and besides the band may slip while being driven.

In order to obtain automatically the synchronization of the music and cinematograph, it is not sufficient (as might have been supposed) to maintain a constant relation between the lengths of the film strip and the music strip which are driven forward during the same period of time. In other words, it is not sufficient to maintain here a rigorously constant relation between the speeds of movement of the mechanism driving the film and the mechanism driving the music strip. The synchronization or bringing into agreement of the music and cinematograph by the employment of reproducing instruments with music strips is not then comparable with the synchronization of a phonograph and cinematograph, since, in the latter case, it is sufficient to maintain a constant relation between the movements of the phonographic and cinematographic mechanisms. The means of realization of synchronism in the two cases cannot, therefore, be compared.

It is obvious that, in practice, for operation of the musical instrument of the cinematograph apparatus either electric motors or any other suitable motors, hydraulic, pneumatic, etc., may be employed without departing from the scope of the invention. Evidently the means for regulating the speed of these motors must be suited in each case to the motors.

In order to render continually visible the times of the passage of the reference marks on the music strip and the corresponding marks on the film strip, it suffices to mount at the extremity of the shaft *u* and at the extremity of the shaft *v* two needles A and B after the manner of the hands of a watch, and to cause these needles to be displaced in front of a dial. If, for instance, the needle A is in advance of the needle B, the shaft *u* has received an angular displacement before the shaft *v*, and vice versa. If, on the other hand, the needles A and B are located one above the other, the agreement between the music and cinematograph is absolute. The means of realization of synchronism in the two cases cannot therefore, be compared.

It has been assumed in the preceding description that the projection of the film would be accompanied by means of a single registering instrument or a single reproducing instrument, this instrument being a registering or reproducing piano.

It is quite evident that all that has been said is applicable to any instrument of which the sounds and musical tone variations can be registered on a strip and reproduced by employing this strip.

The initial projection of a film could be accompanied simultaneously by means of several registering instruments with keyboards and with strings, for instance, piano, organ, harmonium, violin, violoncello, double bass, harp, that is to say, by a complete orchestra, so that the synchronism perforations can be marked at the same time on the music strips registered by each instrument. Such an orchestral musical accompaniment of the film will then be able to be reproduced automatically in absolute agreement for each subsequent projection of this film by means of corresponding reproducing instruments.

Having now fully described and ascertained my said invention and the manner in which it is to be performed, I declare that what I claim is:—

1. An arrangement for maintaining synchronism between the music sheet of a tracker-board musical instrument and a cinematograph film comprising motors for driving the sheet and the film, a synchronizing apparatus acting automatically to maintain the continuous agreement of the passage of the reference marks of the music strip with the passage of the points of the film, which apparatus is characterized by a mechanism having two movable members, each provided with an indicator, means for giving one of said members a certain displacement at each passage of a reference mark on the music strip, and the other of said members an equal displacement in the same direction at each passage of a corresponding point of the film; this mechanism being combined with two electric resistances carried by one of the two members and two electric contacts carried by the other member and capable of being displaced over the resistance in one direction or the other according as the displacement of one member is in advance of or behind, the displacement of the other; the circuits of the motors which actuate respectively, the music strip and the film strip, each including one of said sliding contacts and a portion of the above mentioned resistances whereby said portion varies with the position of the contact on the resistance, substantially as described.

2. In apparatus of the class described in combination, two members, means giving each member the same displacement at each passage of a reference mark on the music strip and for giving the other member an equal displacement in the same direction upon the passage of a corresponding point on the film strip, said members comprising two concentric shafts mounted after the manner of the shafts of the hands of a watch, the outer shaft carrying two diametrically opposite sectors on each of which are wound the coils of a resistance, so arranged that a variable portion may be inserted in the circuit of one of the two motors driving the strips, while the inner shaft carries two diametrical insulated arms forming contacts sliding over the coils of the two resistances, which arms serve as connections between the resistances and the motors, in such a manner that if one shaft turns in advance of the other the displacement of the arms upon the coils produces simultaneous and inverse variations in the said resistances so as to slow down the motor driving the strip which is in advance, and to accelerate the motor driving the strip which is behind, substantially as described.

In testimony whereof I affix my signature in presence of two witnesses.

LOUIS JANSSENS.

Witnesses:
BARTON MAEZ,
CHAS. ROY NASMITH.