July 3, 1934. W. E. GARITY 1,964,909

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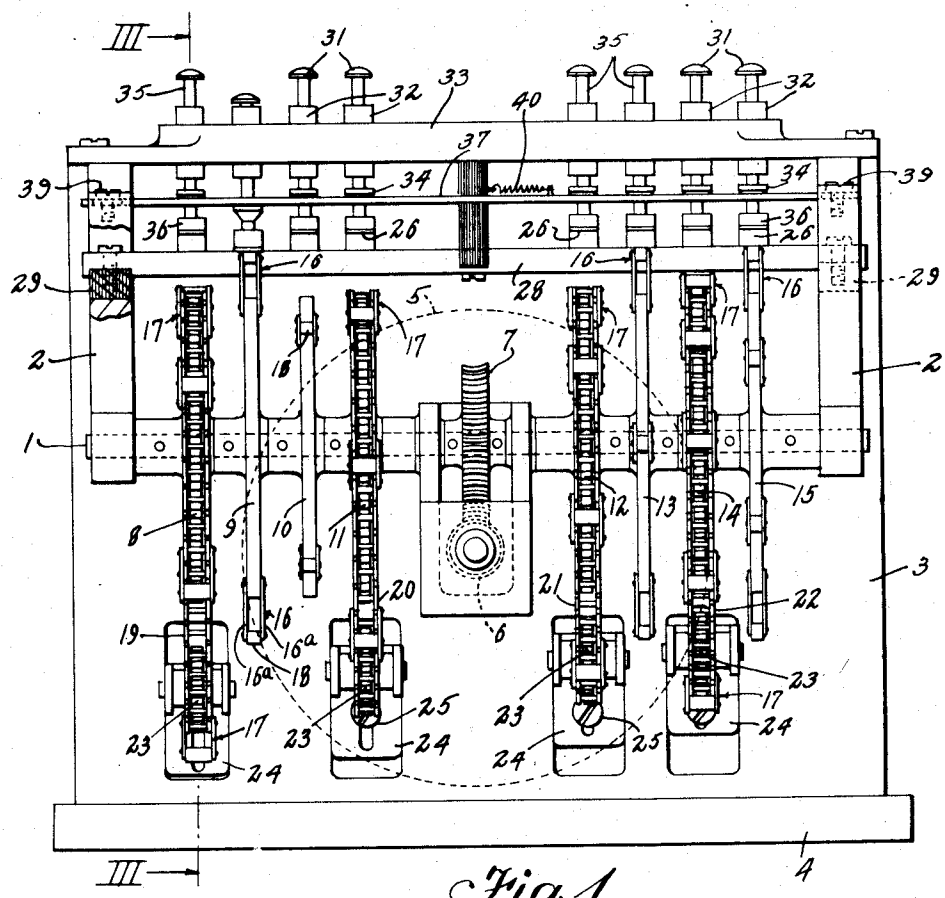


Fig. 1.

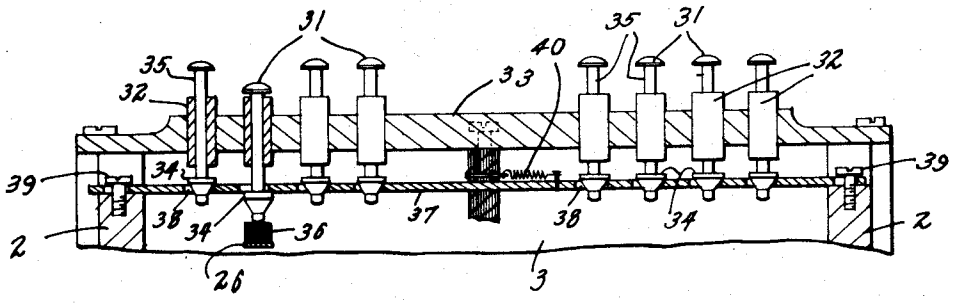


Fig. 2.

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Fig. 3.

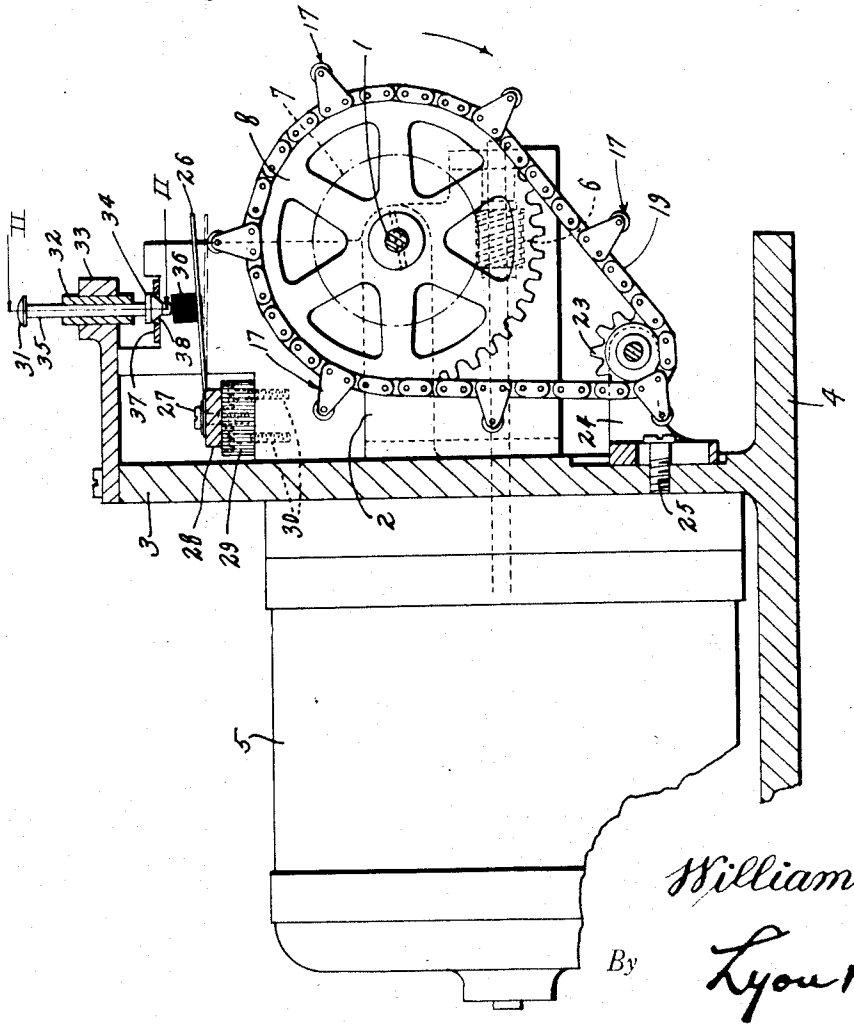
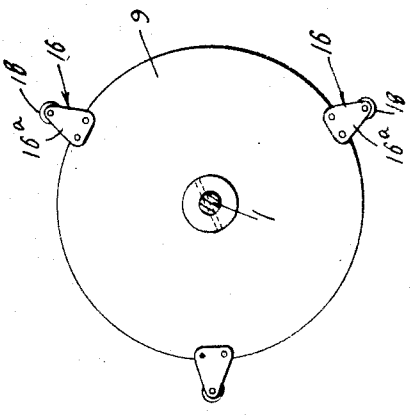


Fig. 4.



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UNITED STATES PATENT OFFICE

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Application July 14, 1933, Serial No. 680,493

3 Claims. (Cl. 161—1)

This invention relates broadly to timing devices and particularly to devices of the metronome type which produce accurately spaced marks or beats at desired intervals.

An object of the invention is to produce a recurring indication at any one of a plurality of frequencies, all of which are different but bear a fixed ratio to each other.

A feature of the invention is a machine employing as its main driving and time controlling element a rotating shaft, with a simple, rugged and accurate mechanism for producing, in response to rotation of the shaft, a series of uniformly spaced impulses, the intervals between which are shorter than the time of rotation of the shaft and yet are not submultiples of the time of rotation of the shaft.

Other objects and features of the invention will be apparent from the detailed description with reference to the drawings which follows.

Although the invention may be used for other purposes, it is intended particularly for synchronizing sounds to motion picture films and has wide application in the production of animated cartoons having synchronized sound effects. It has been found desirable in synchronizing sound effects to animated cartoon films to have a device capable of producing beats or signals at various intervals relative to the time elapsing between the projection of successive frames on the film. The producer may desire a timing device which will produce an impulse every fifth or sixth or seventh frame, etc., or he may even find it desirable to have impulses at odd intervals such as at the rate of three impulses per twenty frames.

In accordance with the present invention, a machine is provided which is capable of producing impulses at any one of several desired rates, each of which bears a fixed ratio to the others. Furthermore, the machine may be driven either by a constant-speed motor so as to yield accurately timed pulses or it may be mechanically coupled to the film projector so as to deliver pulses at intervals bearing a constant ratio to the rate of projection of the successive frames on the film regardless of the speed of the projector.

A specific embodiment of the invention is disclosed in the drawings in which

Figure 1 is a front elevational view of the machine;

Figure 2 is a vertical sectional view in the plane II—II of Figure 3;

Figure 3 is a sectional elevational view in the plane III—III of Figure 1; and

Figure 4 is a detail elevational view of one of the contact wheels of the machine.

Referring to the drawings, the machine comprises a shaft 1 journalled for rotation in bearings in arms 2 projecting forwardly from a vertical frame plate 3 which is supported on a base 4. The shaft 1 is rotated by a constant-speed electric motor 5, secured to the rear side of the vertical plate 3, through a worm drive comprising a worm 6 on the motor shaft (the shaft being projected through the frame plate 3) and a worm wheel 7 keyed to the center of shaft 1.

A plurality of wheels 8, 9, 10, 11, 12, 13, 14 and 15, respectively, are keyed to shaft 1 for rotation therewith. Some of these wheels, namely, wheels 9, 10, 13 and 15, are provided with radially projecting arms 16 uniformly spaced circumferentially thereon (Figure 4), different wheels having different numbers of arms but all the arms being of the same radial length and all the wheels being of substantially the same diameter. Each arm 16 comprises a pair of plates 16a riveted to opposite sides of the wheel on which it is mounted with a roller 18 supported on a pin joining the outer extremities of the plates.

The remaining wheels 8, 11, 12 and 14 do not have projecting arms secured directly thereto but are provided with sprocket teeth for engaging and supporting endless chains 19, 20, 21 and 22, respectively, which in turn have attached thereto projecting arms 17 similar to the arms 16 on wheels 9, 10, 13 and 15. The chains are of various lengths for reasons which will be explained later and are maintained in taut condition by small idler sprocket wheels 23 adjustably mounted below the wheels 8, 11, 12 and 14, respectively. Thus, each idler sprocket wheel 23 is rotatably supported on a slotted frame member 24 which is secured to the vertical frame plate 3 by a screw 25 passing through the slot in the frame member 24. By loosening the screws 25, members 24 may be adjusted up or down to tension the chains.

To produce indications at desired intervals in response to rotation of the shaft 1, there are positioned above the respective wheels 8 to 15, inclusive, springs 26 which may be extended into the paths of the arms 16 and 17 on the wheels or chains adjacent thereto. Each spring 26 is secured at its rear end by a screw 27 to a bar 28 which extends transversely across the machine and is insulatingly supported from the frame by blocks of insulating material 29, the blocks 29 being in turn secured to the frame by screws 30, as shown in Figure 3.

Each spring 26 extends forwardly to a position substantially above or slightly in front of the shaft 1 and just out of contact with the arms 16 or 17 associated with the adjacent wheel on shaft 1.

To selectively force any one of the springs 26 downwardly into the path of the arms associated with the adjacent wheel, a series of push buttons 31 are mounted above the respective springs 26. Thus, each button 31, referring to Figure 2, comprises a plunger 35 journalled in a bushing 32 pressed into a cross member 33 on the frame of the machine. Each plunger 35 has a shoulder 34 on the lower end thereof which is flat on its upper side but conical on its lower side. The lower end of each plunger 35 rests upon a block of insulating material 36 secured to the associated spring 26.

To automatically release any plunger 35 which has been previously depressed and at the same time lock the last depressed plunger in lowermost position, a lock plate 37 is slidably mounted below the bushings 32 and in the path of the plungers 35. Plate 37 is supported for sliding movement by screws 39 passing through slots in the ends thereof and is normally maintained in extreme left position by a spiral spring 40. The operation of this locking mechanism will be readily apparent from inspection of Figure 2, in which the second plunger from the left is shown in depressed condition. Thus, it will be observed that the shoulder 34 extends below the edge of the aperture in the plate 37, thereby preventing upward movement of the plunger. However, if any other button is depressed, the tapered lower face of the shoulder 34 on the associated plunger will force the lock plate 37 to the right against the tension of spring 40 until the apertures 38 in plate 37 are in registration with the shoulders 34 on the plungers, whereupon the second button is restored to upper normal position by the tension of spring 26 against which it bears. Further movement of the last depressed button forces the plunger 35 associated with that button completely below the lock plate 37, thereby permitting the lock plate to be moved again to the left by the spring 40 into position to lock the last depressed button in lowermost position.

When the shaft 1 is being rotated and one of the buttons 31 is in depressed position, the associated spring 26 is forced into the path of movement of the rollers 18 on the arms 16 or 17 associated with the adjacent wheel. Therefore, the successive rollers associated with that wheel will successively engage with and release the associated spring 26 at intervals depending upon the speed of rotation of the shaft 1 and the spacing between the arms. The springs 26 may be designed to give a distinctive twang as they are released, thereby directly giving a time sound indication or, as preferably employed, they are caused to successively close and open an electric circuit including a sound producing device. Thus, each time one of the rollers 18 contacts with one of the springs 26, a circuit is closed between the frame of the machine and the insulatingly-supporting bars 38 to which the springs 26 are attached and, by including the frame of the machine and the bar 28 in an electrical circuit of any sound producing device, the device will be actuated at intervals depending upon the spacing and speed of the rollers 18. Since electrical devices for producing sound are old and well known they are not disclosed in the drawings. However, such device may comprise an electrical oscillator producing tones within the audible range or it may be a vibrating device such as a buzzer or it may merely be a telephone receiver or loud speaker connected with a suitable source of actuating current. If an oscillator or buzzer is employed, a short note will be produced during each contact of an arm 16 or 17 with its associated spring 26. If a telephone receiver or loud speaker in series with a source of direct current such as a battery is employed, a click will be produced at each make and break of one of the arms 16 or 17 with its associated spring 26.

It is standard practice today to operate sound motion picture apparatus at the speed of twenty-four frames per second. If the shaft 1 is rotated at forty revolutions per minute (by properly proportioning the worm 6 and worm wheel 7 relative to the speed of motor 5) the shaft will complete a revolution in one and one-half seconds and if the sprocket wheels 8, 11, 12 and 14 are each provided with thirty-six teeth, as shown in the drawings, twenty-four teeth on each wheel will move past a given point in one second. In other words, the number of teeth moving past the springs 26 in a second will be the same as the number of frames of film projected in a second. It follows that by interspacing the arms 16 and 17 on the different wheels and chains by distances which are different multiples of the pitch distance of the sprocket wheels and chains, successive arms on the different wheels and chains may be made to intercept their associated springs 26 at time intervals which are various multiples of the time interval between exposure of successive frames of the motion picture film.

If impulses are desired at time intervals which are submultiples of the time required for the shaft 1 to complete a revolution (in other words, if the required spacing of the arms 16 to give a desired time interval is a submultiple of the circumference of the wheel) the impulses may be obtained by means of the arms 16 on one of the wheels 9, 10, 13 and 14. Thus, in Fig. 1 wheel 9 is shown provided with two diametrically opposite arms spaced a distance apart equivalent to eighteen sprocket teeth and moving past the associated spring 26 every eighteenth frame on the film. Obviously, if the button associated with this wheel is depressed, an impulse will be produced every eighteenth frame of film.

Wheel 10 is provided with three arms 16 spaced a distance apart equivalent to twelve sprocket teeth and moving past the associated spring 26 every twelfth frame on the film.

Wheel 13 is provided with four arms spaced a distance apart equivalent to nine sprocket teeth and moving past the associated spring 26 every ninth frame on the film.

Wheel 15 is provided with six arms spaced a distance apart equivalent to six sprocket teeth and moving past the associated spring 26 every sixth frame on the film.

It will be observed that the spacing between arms of each of wheels 9, 10, 13 and 15, namely, 18, 12, 9 and 6 (in terms of sprocket teeth), respectively, is in each instance a submultiple of the circumference of the wheel (thirty-six in terms of sprocket teeth). Obviously, any other interval which (in terms of sprocket teeth) is a submultiple of thirty-six, may be obtained by using the proper number of arms on a wheel. Thus, a wheel having nine arms would give impulses at intervals of four frames, a wheel having

twelve arms would give impulses at intervals of three frames, a wheel having eighteen arms would give impulses at intervals of two frames, and a wheel having thirty-six arms would give an impulse for each frame.

However, impulses at intervals of five, seven, eight, ten or any other number of frames that is not a submultiple of thirty-six cannot be obtained from arms spaced directly on the wheels and it is to obtain impulses at such intervals that the sprocket wheels bearing chains 19, 20, 21 and 22 are provided. With these chains other desired intervals between impulses may be obtained because the arms 17 on the chains may be spaced apart any desired number of links and the length of the chain varied as necessary to make its total length a multiple of the spacing between successive arms thereon.

In the machine disclosed, all four sprocket wheels 8, 11, 12 and 14 are identical, each having thirty-six teeth, and the four chains are of the same pitch but have their arms 17 spaced differently thereon, and the chains are of different lengths. Thus, chain 19 has seven arms spaced eight links apart and is fifty-six links in length. It might equally well be made forty-eight links in length and have six arms. It gives an impulse every eighth frame of film. Chain 20 has five arms spaced ten links apart and is fifty links in length; it produces an impulse every tenth frame of film. Chain 21 has seven arms spaced seven links apart and is forty-nine links in length; it produces an impulse every seventh frame of film. Chain 22 has nine arms spaced five links apart and is forty-five links in length; it produces an impulse every fifth frame of film.

The speed of rotation of the shaft 1 and the number of teeth on the sprocket wheels may be varied to give different increments of spacing if desired. Furthermore, the shaft 1 may be rotated from a motion picture projector mechanism instead of a constant speed motor, or electrically synchronized therewith, under which condition it will produce impulses of desired spacing in absolute synchronism with the film regardless of the speed of projection.

By using the device described in synchronizing sound to film, any possible tempo, beat or cue may be selected which will always be in absolute synchronism with the lineal frame speed of the film. It enables the producer to analyze the picture and arrange the sound score to be produced with the picture and record it with uncanny accuracy.

It is to be understood that numerous modifications and adaptations may be made in the construction disclosed and described without departing from the spirit of the invention and that the scope of the invention is to be limited only as set forth in the appended claims.

I claim:

1. In a device for selectively producing trains of signals at different time intervals, a shaft, means for rotating said shaft, a plurality of wheels of substantially the same diameter fixed to said shaft at longitudinally spaced intervals therealong, a plurality of contact members each positioned adjacent one of said wheels and movable toward and away from its adjacent wheel, means for selectively shifting any one of said contact members toward its associated wheel, locking it in that position and simultaneously releasing any other contact member previously locked toward its associated wheel, projecting members on each of said wheels for intercepting the contact member adjacent that wheel when and only when the contact member is moved toward the wheel, and means for producing a signal in response to contact from each contact member and the projecting members on the adjacent wheel, the different wheels having different numbers of projecting members thereon.

2. In a device for selectively producing any one of a plurality of trains of equally spaced signals in which the intervals between signals in the different trains are different but bear a fixed ratio to each other, a shaft, means for rotating said shaft, a plurality of wheels of substantially the same diameter fixed to said shaft for rotation therewith, uniformly spaced projecting members on at least one of said wheels, endless belt means looped over and in positively driven relation with another of said wheels, projecting members on said belt means uniformly spaced longitudinally therealong at intervals which are different from the intervals between the projecting member on said first mentioned wheel and are not submultiples of the circumference of said wheels, the length of said belt means being greater than the circumference of said wheels and being a multiple of the interval between the projecting members on the belt, a plurality of contact members each positioned adjacent one of said wheels but out of the path of the projecting members associated with that wheel, means for selectively shifting any one of said contact members toward its adjacent wheel whereby it intercepts the projection associated with that wheel, and means for producing a signal in response to contact between any of said contact members and the projecting members associated with the adjacent wheel.

3. In a device for selectively producing any one of a plurality of trains of equally spaced signals in which the intervals between signals in the different trains are different but bear a fixed ratio to each other, a shaft, means for rotating said shaft, a plurality of wheels of substantially the same diameter fixed to said shaft for rotation therewith, uniformly spaced projecting members on at least one of said wheels, endless belt means looped over and in positively driven relation with another of said wheels, projecting members on said belt means uniformly spaced longitudinally therealong at intervals which are different from the intervals between the projecting member on said first mentioned wheel and are not submultiples of the circumference of said wheels, the length of said belt means being greater than the circumference of said wheels and being a multiple of the interval between the projecting members on the belt, normally stationary contact means selectively shiftable to intercept the projecting members associated with any one of said wheels, whereby it intercepts the projection associated with that wheel, and means for producing a signal in response to contact between any of said contact members and the projecting members associated with the adjacent wheel.

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