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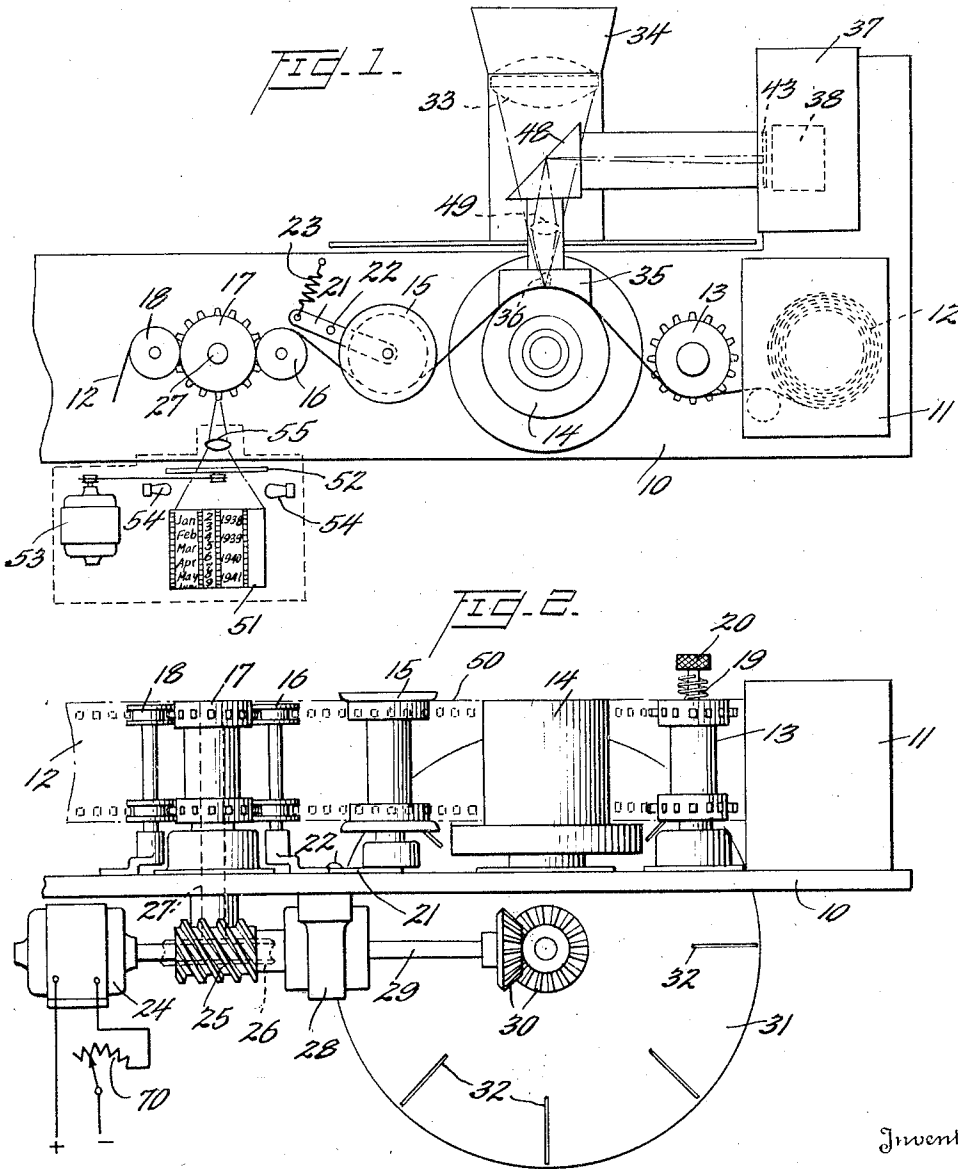
H. D. BELOCK

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METHOD AND APPARATUS FOR PRODUCING CONTINUOUS PHOTOGRAPHIC STRIPS

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2 Sheets-Sheet 1



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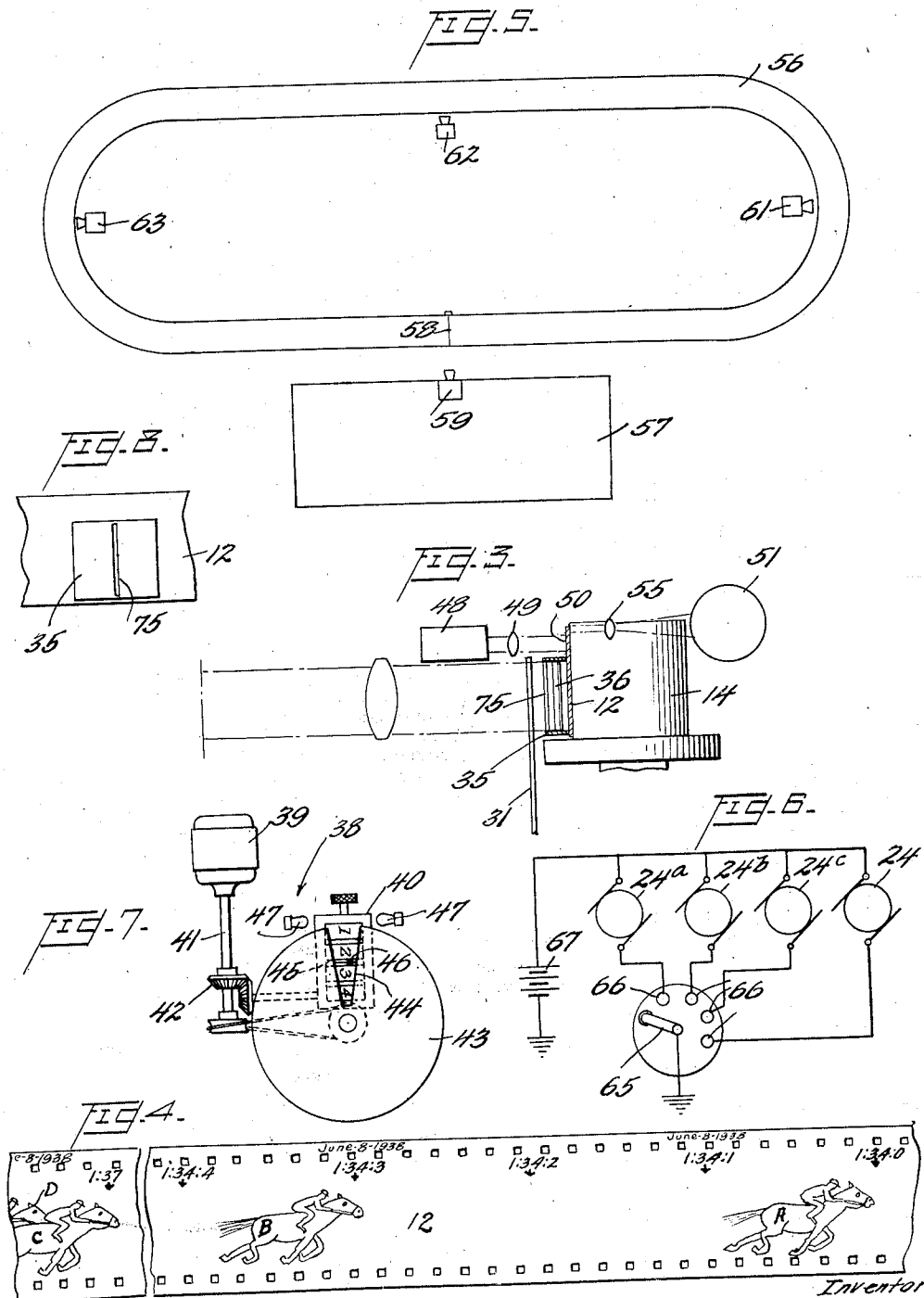
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METHOD AND APPARATUS FOR PRODUCING
CONTINUOUS PHOTOGRAPHIC STRIPSHarry D. Belock, Richmond Hill, N. Y., assignor
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7 Claims. (Cl. 95—11)

Under some conditions it becomes desirable to obtain a record of the sequence of events that transpire at a locality. Hitherto such a record had been customarily obtained by a motion picture camera, the record consisting of a film or strip upon which appears a series of framed photographs of the locality. Such a record, however, is inadequate for many purposes because to appreciate the exact sequence of events it becomes necessary to project the film onto a screen by the conventional motion picture projector. It is the aim of the present invention to provide a method and apparatus for producing a photographic record strip of such a sequence of events, on which the record appears continuously and uninterruptedly, with the result that a mere inspection of the strip immediately presents an accurate visualization of the sequence of events at the particular locality.

The present invention is particularly applicable for obtaining a permanent and accurate record of the finish of races such as horse races, automobile races or foot races or the like. For this purpose the present method and apparatus may be employed in such a manner that a continuous photographic record is obtained of events that transpire in the immediate vicinity of the finish line and the present invention may be so employed that the record is limited merely to the space within a foot or two of the finish line and if desired it may even be limited to a space within a few inches of the finish line.

By means of the present invention the photographic record may also have on it a time indication which will show the time of arrival of each contestant at the finish line. This time indication and the apparatus employed for effecting such a record and indication upon the film bearing a continuous record of the events is preferably so employed that the time indication on the photographic record or film shows the lapse of time from the beginning of the race to the finish of the race by each contestant. For this purpose a clock mechanism is started into operation from its zero position at the start of the race and when the record is made of the events at the finish of the race the time indications will be projected onto the photographic film simultaneously therewith. While the record obtained by means of the present invention is of particular value in determining the winner in a race which has been run too close for the human eye to select the first who crossed the finish line, the invention is highly

useful under all conditions for the purpose of obtaining a reliable record of the time taken by all contestants. The present invention may also be employed to time the entire field in the race being run by installing such apparatus not only at the finish line but also at other points along the track. The present invention, therefore, produces a photographic time chart of events that transpired at a selected locality.

In the method employed herein the light transmitted by the moving objects such as horses, automobiles or other contestants is modulated at predetermined frequencies and the image is projected onto a continuously moving sensitive film such as 35 millimeter motion picture film. The rate of travel of the film is determined by the speed of travel of the moving object, the focal length of the lens employed and the distance of the lens from the moving object. The ratio between the rates of travel of the object and the film should be substantially equal to the ratio between the distance of the lens from the object to its focal length. This "stops" the motion of the moving object or may be said to bring about conditions of relative fixity of film and object.

The film is masked by an opaque mask having a narrow slit such as an eighth or a tenth of an inch in width. Thus only a very narrow portion of the film is exposed at a time; the width of the slit in the mask may be varied as desired so as to permit the variation of the distance on either side of the finish line covered by each exposure. Thus in an installation having a lens with a focal length of 5 inches, the camera being installed about 150 feet from the finish line, a slit of 0.1 inch will cover approximately 18 inches on each side of the finish line. This is satisfactory for almost all purposes. But it will be understood that with a narrower slit this distance is reduced and vice versa. The width of the slit in the mask is also partly dependent on the focal length of the lens. With longer focal length a wider slit may be employed with the same accuracy.

The modulation of the light transmitted by the object is obtained by the aid of any suitable scanning device. In the present invention the scanning device preferably takes the form of a rotating disc having a series of radial slits, the disc being so disposed that a portion of it is always interposed between the lens and the film, and during this rotation the slits successively expose adjacent portions of the moving

film to the light transmitted by the moving object.

The modulating frequency employed in the present method is determined by the rate of movement of the film and the width of the slit in the mask. Thus with an installation employing a camera having a focal length of 5 inches installed about 150 feet away from the finish line, the object traveling at substantially 30 miles per hour the film should move uniformly at the rate of 1.46 inches per second, or about 1.5 inches per second. Therefore with a mask having a slit one-tenth of an inch in width the modulating frequency will be 15 per second. The width of the slits in the scanning disk should preferably be the same as the width of the slit in the mask. Such width may, however, be varied so as to vary the exposure of each section of film.

In the present method, therefore, a continuously and substantially uniformly moving film is exposed in successive portions lengthwise of the film, the portions being adjacent to each other, each portion being of a small dimension lengthwise of the film and preferably extending the full width of the film.

The present invention will be more clearly understood from the accompanying drawings in which:

Figure 1 is a top view of the apparatus employed in the present invention.

Figure 2 is a back view of the apparatus shown in Figure 1.

Figure 3 is a side view taken from the left end of Figure 1.

Figure 4 is an enlarged and schematic showing of the record obtained by the present method and apparatus.

Figure 5 shows the employment of the present method and apparatus at a number of selected points on a course.

Figure 6 is a diagrammatical showing of the electrical system.

Figure 7 illustrates the construction of the clock employed in the present device.

Figure 8 is a plan view of the mask showing its relation to the film.

In the apparatus shown herein 10 is a base which supports a chamber 11 carrying a supply of film 12. The film coming out of the chamber 11 first passes in engagement with the hold back sprocket 13 and then passes in front of the mechanical filter wheel 14, then in back of tension roller 15 over guide roller 16 driving sprocket 17 and guide roller 18. The hold back sprocket 13 is employed to prevent excessive feed of film 12 and for this purpose its rotation may be somewhat impeded by the spring 19 whose tension may be adjusted by means of the knurled nut 20. The mechanical filter wheel 14 over which the film 12 is flexed in such a manner that a substantial portion of the film is in contact with the cylindrical surface of the wheel is in the nature of a flywheel and serves to maintain the speed of the film 12 substantially uniform. The tension roller 15 rotates freely on the bracket 21 which is pivoted at 22, the roller 15 being maintained in a floating condition by the spring 23. The driving sprocket 17 governs the speed of the film and is driven by the motor 24, the motion being transmitted thereto by means of the worm 25 and the worm gear 26 in engagement therewith the worm gear being carried by shaft 27 of the sprocket wheel 17.

The driving shaft 28 of the motor 24 passes through the bracket 28 and by means of the be-

veled gears 30 its motion is transmitted to the scanning disc 31, the latter having a segmental portion overlying the filter wheel 14 and the film 12 traveling thereon. The scanning disc 31 is provided with a series of radial slits 32, which may be of any suitable width depending upon the conditions under which the apparatus is employed and generally may be said to be approximately one-eighth or one-tenth of an inch in width. The width of the slits may be varied over a wide range and may under some conditions be one-thirtieth of an inch if desired. The lens 33 together with its shadow box 34 are disposed as shown.

A mask 35, having a slit 75 is disposed over the filter wheel 14. The mask is held by the frame which also carries the cylindrical lens 38 which serves to sharpen the image cast by the slit 75.

The gears 30 and the worm and gear transmission 25, 26 are so related that the desired ratio of rotation of the scanning disc and driving sprocket 17 is had. The ratio is such that the revolutions per second of the disc multiplied by the number of slits in the disc will equal the ratio of the travel of the film per second to the width of slit 75 in the mask thus assuring one and only one exposure for each successive portion of the film as it passes under the slit 75. Thus the ratio of gears 30 will depend upon the number of slits in the disc. The number of slits in the scanning disc determines the speed at which the scanning slit passes over the exposed portion of the film. Thus the number of slits depends upon the exposure desired.

With the apparatus once organized as shown the speed of the motor 24 may be adjusted by means of the rheostat 70 in correspondence with the speed of the object. The film, to stay in step with the travel of the object, travels in a direction opposite to that of the moving object and the operating portion of the scanning disc travels in the same direction with the film. The rate of linear travel of the slits is of course greater than the speed of the film. The disc 31 with its slits therefore acts as a high speed shutter and approximates the action of the customary focal plane shutter.

While it is preferred that the width of the slits 32 be approximately the same as the slit in the mask over the film it will be understood that the present method and apparatus is not limited to this size of slit for smaller and larger slits may also be employed depending upon the factors already considered and also upon additional factors such as speed of the lens, the speed and sensitivity of the film and other properties of the optical system employed.

The plate 10 also carries chamber 37 in which is mounted the clock mechanism 38. This clock mechanism is shown in Figure 7 and comprises a synchronous motor 39 operated at 300 revolutions per minute and a four-wheel counter 40 shown in Figure 7 as indicating one minute twenty-three and four-fifths seconds. The rotation of the driving shaft 41 is transmitted by the gear 42 to the last wheel in the counter which indicates fifths of a second. The wheels of the counter are associated so as to transfer properly to indicate minutes, tens of seconds, seconds and fifths of seconds. The shaft 41 also rotates the disc 43 which is provided with a cut out portion 44. The disc 43 is rotated 300 revolutions per minute or one revolution every fifth of a second. The spacer 45 interposed between one pair of

adjacent counting wheels is provided with a painted arrow 46.

The clock mechanism shown in Figure 7 together with its lamps 47 are mounted in chamber 37. It will now be understood that the indication of this clock will be transmitted every fifth of a second through the prism 48 and thence through the lens 49 onto the edge of the film. With the time indication of the clock will also be photographed the arrow 46. The clock and its optical system are so disposed that the clock indication is projected onto the edge 50 of the film which is beyond the portion covered by the scanning disc. Thus one edge of the film will bear spaced indications of the time every fifth of a second.

If desired an apparatus may also be set up which will project onto the film the date of the events that are being recorded. For this purpose the date rollers 51 are suitably mounted with an apertured disc 52 disposed immediately in front of the same, the latter being rotated by the motor 53. 54 indicates the lamps which illuminate the date rollers 51. By means of the lens 55 and the rotating disc 52 the date is periodically projected onto an edge of the film 12 as it passes over the driving sprocket 17.

Figure 5 is a schematic illustration of a race track 56, grandstand 57 and finish line 58. The apparatus disclosed herewith is mounted on top of the grandstand as shown at 59. In mounting this apparatus it is lined up by means of a transit with the finish line 58 and is then bolted in position and preferably locked and sealed in position so that it may not be disturbed from this position by unauthorized persons. Similar apparatus 61, 62 and 63 are disposed at several other points along the track.

The clocks in each of the apparatus 59, 61, 62 and 63 are started simultaneously with the start of the race. This may either be done manually merely by closing a switch which controls the supply of current to the motors 39 of each of these clocks 38; or if desired they may all be started automatically by means of suitable apparatus in response to the start of the race. Shortly before the leader of the race reaches the point at which the apparatus is installed, current is supplied to the motor 24 of the corresponding apparatus. The motor 24 is then operated for a time long enough to permit all the participants in the race to pass that particular point and sometime shortly after that the motor of the apparatus at the next succeeding point is energized. These operations may be performed either manually by an operator stationed at each point or else they may be performed from a central station located at the apparatus 59 at the grandstand. Figure 6 shows diagrammatically a system which may be employed for this purpose. In this Figure 24a, 24b, 24c and 24 are diagrammatical showings of the motors associated with the apparatus 61, 62, 63 and 59 respectively. The switch arm 65 may be moved along the contacts 66 so as to complete the circuit from the source of current 67 through each of these motors as described.

Figure 4 shows an enlarged view of the photographic time chart obtained by the present method and apparatus. The strip 12 has photographs of the contestants as they reach the finish line, in the order of their arrival at the finish line, together with indications of the time elapsed from the start of the race. Thus it will be seen that contestant A completed the race and reached

the finish line in one minute thirty-four seconds; contestant B in one minute thirty-four and three-fifths seconds; and contestant C in one minute thirty-seven seconds, while contestant D reached the line immediately after that.

The photographs of the moving objects A, B, C, D appearing in the strip are each taken piecemeal as its successive portions appeared within view of the camera at the finish line. Thus the photographic record clearly indicates the sequence of events or the order in which the participants crossed the finish line merely by the order in which such objects appear on the strip and without the aid of the time indication. The time indication, however, is desirable to indicate the time different between the arrival of each of the participants and also to indicate the time of the race for each participant.

While as described the present apparatus is to be employed under conditions where the camera is stationary and the objects being photographed are in motion, it will be understood that the present method and apparatus are employable under all conditions where there is relative movement between the camera and the objects. Thus it may be employed for photographing stationary objects from a moving vehicle such as an automobile or an aeroplane or the like. It may also be employed where both the camera and the objects are in motion, one moving at a greater rate than the other.

The photographic record is being claimed in another application copending herewith.

I claim:

1. The method of forming a continuous uninterrupted and undivided photographic record of race participants crossing the finish line of a race course, comprising the steps of focusing a camera on the finish line of the course, moving a continuous strip of film in the camera at a rate having the same ratio to the approximate speed of the participants that the focal length of the camera bears to the distance of the camera from the finish line thereby obtaining substantial fixity of the film relative to moving image of the participants crossing the finish line, and passing a slitted element over said film in the direction of movement of the film and at a speed greater than the speed of the film, the size of the slit and the speeds of the slitted element and the film being so related that every portion lengthwise of the film is exposed, thereby obtaining a still continuous photograph containing only one photograph of each participant and indicating at a glance the order in which the participants crossed the finish line of the course.

2. The method of obtaining a continuous photographic time record of race participants crossing the finish line of a race course comprising the steps of focusing a camera on the finish line of the course, starting a timer normally at zero with the start of the race, maintaining the camera in its normally inoperative condition until the race participants approach the finish line, then starting the camera and moving a continuous strip of film in the camera at a rate having the same ratio to the approximate speed of the participants that the focal length of the camera bears to the distance of the camera from the finish line thereby obtaining substantial fixity of the film relative to moving image of the participants crossing the finish line, and passing a slitted element over said film in the direction of movement of the film and at a speed greater than the speed of the film, the size of the slit and the speeds

of the slitted element and the film being so related that every portion lengthwise of the film is exposed, and simultaneously periodically exposing a marginal portion of the film to the timer, thereby obtaining a still continuous photograph containing only one photograph of each participant and indicating at a glance the order in which the participants crossed the finish line of the course and the time made by each participant.

3. A photographic apparatus for obtaining a continuous uninterrupted and undivided elongated photographic still of race contestants crossing the finish line, said apparatus comprising a lens, a continuous film strip, having at least a part of it disposed in the focal plane of the lens, masking means for said film strip having a slit transversely of the film, a rotatable disc having radial slots so mounted that the slotted marginal portion of the disc is disposed over the mask, a motor, means for translating the rotation of the motor into uniform linear motion of the film strip, means for varying the speed of the motor to impart to the film a speed having approximately the same ratio to the speed of the race participants as the ratio of the focal length of the lens to the distance of the camera from the finish line, and means for transmitting the rotation of the motor to the disc, the said transmission means being such that a slot in said disc will pass over said mask during the travel by the film of a distance equal to the width of the slot, the linear speed of the marginal portion of the disc being greater than the speed of the film and in the same direction as the film.

4. A photographic apparatus for obtaining a continuous uninterrupted and undivided elongated photographic still of race contestants crossing the finish line, said apparatus comprising a lens, a continuous film strip, having at least a part of it disposed in the focal plane of the lens, masking means for said film strip having a slit transversely of the film, a slotted element disposed over the mask, a motor, means for translating the rotation of the motor into uniform linear motion of the film strip, means for varying the speed of the motor to impart to the film a speed having approximately the same ratio to the speed of the race participants as the ratio of the focal length of the lens to the distance of the camera from the finish line, and means for transmitting the rotation of the motor to the slotted element, the said transmission means being such that a slot in said element will pass over said mask during the travel by the film of a distance equal to the width of the slit, the linear speed of the slotted portion of the element being greater than the speed of the film.

5. A photographic apparatus for obtaining a single continuous uninterrupted and undivided elongated photographic still of race contestants crossing the finish line, said apparatus comprising a lens, a continuous film strip, having at least a part of it disposed in the focal plane of the lens, a rotatable disc having radial slots so mounted that the slotted marginal portion of the disc is disposed over the film, a motor, means for translating the rotation of the motor into uniform linear motion of the film strip, means for varying the speed of the motor to impart to the film a speed having approximately the same ratio to the speed of the race participants as the

ratio of the focal length of the lens to the distance of the camera from the finish line, and means for transmitting the rotation of the motor to the disc, the said transmission means being such that a slot in said disc will pass over said film during the time of travel by the film of a distance equal to the width of the slot, the linear speed of the marginal portion of the disc being greater than the speed of the film and in the same direction as the film.

6. A photographic apparatus for obtaining a single continuous uninterrupted and undivided elongated photographic still of race contestants crossing the finish line, said apparatus comprising a camera box, a lens, a continuous film strip disposed behind the lens, a relatively large roll disposed behind the lens and having a portion of its cylindrical surface disposed in the focal plane of the lens, a continuous strip of film flexed over and in frictional contact with a substantial portion of the cylindrical surface of the roll and including the portion thereof disposed in the focal plane of the lens, a feed sprocket spaced from said roll and in engagement with said film, a tension roller in engagement with the film between the feed sprocket and the roll, a hold back sprocket in engagement with the film on the other side of the roll, a motor for driving the feed sprocket and a radially slitted disc having a peripheral portion disposed between the roll and the lens and means for transmitting the rotation of said motor to the disc to rotate the disc at a speed greater than the speed of the film so that all portions of the film are exposed, and means for varying the speed of the motor.

7. A photographic apparatus for obtaining a single continuous uninterrupted and undivided elongated photographic still of race contestants crossing the finish line, said apparatus comprising a camera box, a lens, a continuous film strip, having at least a part of it disposed in the focal plane of the lens, masking means for said film strip having a slit transversely of the film, a rotatable disc having radial slots so mounted that the slotted marginal portion of the disc is disposed over the mask, a motor, means for translating the rotation of the motor into uniform linear motion of the film, strip, means for varying the speed of the motor to impart to the film a speed having approximately the same ratio to the speed of the race participants as the ratio of the focal length of the lens to the distance of the camera from the finish line, means for transmitting the rotation of the motor to the disc, the said transmission means being such that a slot in said disc will pass over said mask during the time of travel by the film of a distance equal to the width of the slit, the linear speed of the marginal portion of the disc being greater than the speed of the film and in the same direction as the film, a time indicator carried by said camera box, a slotted rotating disc disposed in front of said time indicator to expose the same every fifth of a second, and means for projecting an image of said time indicator to the marginal portion of the film in substantial alignment with said slit, thereby obtaining a time indication in registry with every portion of the film, to indicate at a glance the time of arrival of each participant.

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