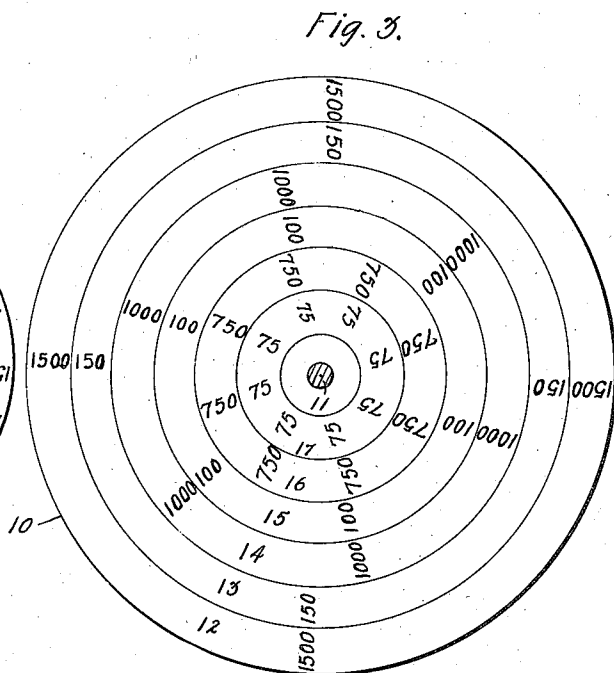
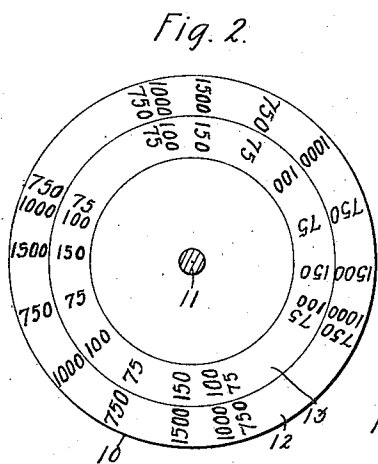
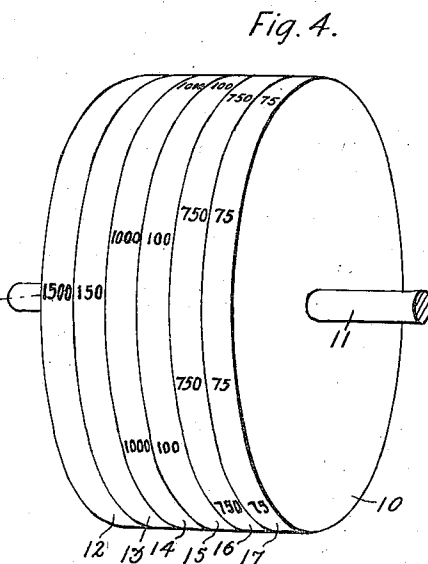
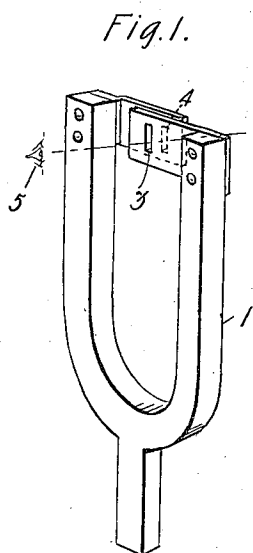


R. E. COLLIS.
STROBOSCOPIC SYSTEM.
APPLICATION FILED FEB. 14, 1918.

1,387,240.

Patented Aug. 9, 1921.



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UNITED STATES PATENT OFFICE.

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STROBOSCOPIC SYSTEM.

1,387,240.

Specification of Letters Patent.

Patented Aug. 9, 1921.

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To all whom it may concern:

Be it known that I, RAYMOND E. COLLIS, a citizen of the United States, residing at East Orange, in the county of Essex, State of New Jersey, have invented certain new and useful Improvements in Stroboscopic Systems, of which the following is a full, clear, concise, and exact description.

This invention relates to systems for determining the rate or cyclic frequency of periodic motion, and more particularly to stroboscopic systems for observing vibratory or rotatory motion.

The present invention is applicable in relatively any situation where it may be desirable or required to make determinations as to the speed or working rate of devices or systems characterized by some form of periodic motion. In the embodiment chosen for illustrating the system, however, service in connection with multiplex telegraphic working will, for convenience of description, be more particularly referred to, and following an understanding of such use, other applications of the invention will be readily apparent, thereby rendering specific reference to such applications unnecessary.

The stroboscope, as commonly understood, comprises an arrangement for rendering a moving body visible only at certain points of its path, as by throwing light upon it at intervals or by observing it through moving apertures. In connection with such an arrangement, the present invention contemplates the use of characters or other markings placed at one or more points on a moving body in such a manner that the characters or markings may, during certain predetermined speed relations with respect to moving apertures and the moving body, become intelligible to an observer.

This invention is illustrated diagrammatically in the accompanying drawing in which only so much of a stroboscopic system is shown as will be necessary to a clear understanding of the present invention.

In the drawing, Figure 1, is shown a vibrating means suitable for alternately obscuring and clearing an observing or sighting range. In Fig. 2 is shown a revoluble disk on which characters are placed in a manner to illustrate one embodiment of the invention, while in Figs. 3 and 4 are shown respectively alternate arrangements which

may be substituted for the disk shown in Fig. 2.

In describing this invention, a tuned fork, indicated by the reference character 1 (Fig. 1), is provided with a slitted diaphragm on each of its prongs, and when vibrating the slits 3 and 4 register, one with the other, once during a complete vibratory cycle of the prongs. The fork may either be fixed to a suitable support or held in the grasp of an observer in such a position that observation taken from a point indicated by the vision symbol 5, as directed through the openings or slits 3 and 4, will range or aline within a limited area or scope on the surface of a body 10 shown in each of the Figs. 2, 3 and 4, respectively. It will be understood that either one of the bodies 10 may be rotated on its axis 11 (by means not shown), and it will be apparent that during such rotation the numbers present in the circular paths 12 and 13 on the body Fig. 1 and the paths 12 to 17, Figs. 3 and 4, would be unintelligible or entirely obliterated with respect to unaided or non-controlled visualizing of the disk. On peering or gazing in alinement with the registering position of the openings 3 and 4, after first setting the fork 1 in vibration, certain respective speed relations between a body 10 and the fork 1 will render corresponding ones of the figures clear and intelligible to an observer.

Although tuned forks employed for stroboscopic observations may be arranged in such a manner that the slits in the overlapping flanges or diaphragms may register, one with the other, more than once during each complete vibration of the fork, a visualizing ratio on the basis of a single opening of the sighting range for each vibration of the fork will, for convenience of description, first be considered. The speed relation between such single acting fork and any combination of single or plural markings on the revolving bodies 10, together with the speed at which the body may be rotating, will perhaps be more readily understood from a statement of this relation in the form of an equation. Accordingly, let T represent the time in seconds for an interval of one minute; R, the rate or number of vibrations per second of the tuned fork 1; N, the number of different equidistant points at which a certain marking or character may appear on

a body 10; while X represents the number of revolutions per minute at which such body 10 must be revolving in order that the marking or character may be rendered visibly intelligible. Then,

$$\frac{T \times R}{N} = X$$

Substituting values, for purpose of example

$$\frac{60 \times 100}{8} = \frac{6000}{8} = 750$$

In this instance the fork would be operating at a frequency of one-hundred vibrations per second, while the character to be visualized would be present at eight different equidistant points on a body 10. Referring more particularly to Fig. 1 of the drawing, it will be noted that the number 750 appears at eight different points in a path 12 on the disk 10; therefore, it follows that during the time the disk may be rotating at the rate of 750 revolutions per minute, this number will be rendered visible through the slits of the fork device eight times per revolution or six-thousand times during 750 revolutions, when that number of revolutions correspond with a time interval of one minute. As well understood in connection with stroboscopic determinations, the described condition of periodic motion, with respect to the fork 1 and the disk 10, will render the number 750 clearly intelligible to an observer.

For the purpose of a second illustration, let it now be assumed that with the same fork it is desired to discern a marking which appears at six different equidistant points around the disk 10. Accordingly,

$$\frac{60 \times 100}{6} = \frac{6000}{6} = 1000$$

It will be seen that the number 1000 appears at six different points on the disk 10, therefore, this number will be visible to an observer six times per revolution of the disk or 6000 times during 1000 revolutions, when the revolutions take place in the time of one minute. An observer may therefore clearly read this number, which will indicate that the disk is being operated at the rate of 1000 revolutions per minute.

As a further example, let it be assumed that it is desired to employ the same fork for making determinations with respect to markings which appear at four different equidistant points on the disk 10. By means of the same formulae,

$$\frac{60 \times 100}{4} = \frac{6000}{4} = 1500$$

The number 1500 is present at four different points on the disk and will, therefore, become intelligible to an observer four times

during each revolution of the disk or six thousand times during 1000 revolutions, when the revolutions take place evenly during a period of one minute.

From the foregoing description, it will be clear that if the disk 10 be started from a condition of rest and rotated at an accelerating rate and the tuned fork 1 set into vibration, in any convenient manner, observation taken through the range permitted by the slits 3 and 4 will first become aware of the speed 750, followed successively by an indication of the speeds 1000 and 1500, respectively. In a converse manner if negative acceleration or decrease of speed is now applied to the disk, the speeds 1500, 1000 and 750 would successively become visible to an observer. It will, therefore, be obvious that with the present system the fact that the rate of a periodic motion may be read directly without the necessity of keeping in mind the ratio or factor by which determinations taken from arbitrary markings must be translated, renders the present method efficient, reliable and convenient.

In connection with systems of motion, it is frequently more desirable to directly determine the working factor or the output rate of a machine or mechanism rather than to ascertain the speed rate of any of its moving parts, in order to avoid the process of translating such speed rate into the actual working or output capacity of the system.

For convenience in illustrating such an application of this invention, let it be assumed that the disk 10 is connected to be driven in a suitable ratio with respect to the moving parts of a current distributor which may be of any well-known type as commonly employed with multiplexed telegraph systems, particularly in connection with printing telegraphs. In systems of this character it is well known that for any given arrangement, the speed or rate of message transmission is directly proportional to the speed of the distributors employed. On the assumption that the telegraphic equipment for the present assumed case would be capable of properly responding to various speeds which the distributors may attain, it will be considered that an average of ten revolutions of the distributor part, which may be driving the disk 10, represents a transmission rate of one word. Therefore, at a speed of 750 revolutions per minute, the rate of transmission would be 75 words per minute, for 1000 revolutions per minute, 100 words per minute would be transmitted, and for a speed of 1500 revolutions per minute 150 words per minute would be handled.

In keeping with such transmission rates, the second circular path 13 on the disk 10

is provided with eight markings for the 75-word speed, six markings for the 100-word speed and four markings which correspond with the 150 words per minute speed. In bringing the distributors at remote telegraphic stations into synchronism, one with another, it is therefore only necessary that the attendants have information as to the number of words per minute which it will be necessary to adhere to in order that unison of operation may be arrived at and maintained. To this end observations as may be taken by way of the sighting slits in the fork 1 may be directed onto the path 13 of the disk 10, and a speed controlling means (not shown) suitably adjusted to maintain the speed of the distributor at any desired one of the word transmission rates,—the number 75 being rendered readable when the speed is 750 revolutions per minute which corresponds with the 75 words per minute rate of sending, and in a similar manner the number indicating 100 words per minute would be readable at the corresponding speed of 1000 revolutions per minute, while the number signifying 150 words per minute would be readable for the corresponding speed of 1500 revolutions per minute. In regulating the operation of the distributors on the basis of the rate of the telegraphic transmission, as described, the markings in the path 12, which correspond with the revolutions per minute of the distributors, would not ordinarily be required and therefore could be dispensed with in the handling of such service.

It will be pointed out that during the time the speed of 1500 revolutions per minute would be readable, as described, the number 750 would also be readable, this phenomenon being due to the fact that the number of points at which each of these sets of numbers appear on the disk are in the ratio of an even multiple, one with the other. In the case of the different speed indicating numbers employed for purpose of illustrating the principle of the system, a lower number would be disregarded when readable with a higher number, as the latter number would be the true speed. In practice, the speed rates would not ordinarily extend over such a wide range, and are more likely to be in the relation of a five point, a six point and a seven point series of groupings on the disk 10. For such combinations no double readings would be likely to result, as the ratio between the different groups would be fractional and not in the proportion of even multiples. In order to avoid a more involved description which would have been necessitated by employing speeds which would work out fractionally, the present, even multiple speeds were used since they are equally applicable in conveying a clear understanding of the features of the system.

It may also be mentioned that in situations where a plurality of speed group numbers may be in such ratio, one group with another, that if in laying out the necessary number of equidistant points on the body it would result that one point would be common to two different number groups, a number may be omitted from one group. Under such condition it has been found that for a group of numbers from which one point or occurrence has been omitted, a slightly grayish flashing will occur during the time the speed of the system is such that the numbers of this group are otherwise distinctly readable.

Referring to the matter of the frequency of the tuned fork 1, it will be understood that if the apertures 3 and 4 are arranged to register, one with the other, more than once during a complete vibration of the fork, that such additional frequency in clearing the sighting range with respect to the disk 10 would require that they be used as multipliers in arriving at the speed observed. For example, a fork operating at the rate of 50 vibrations per second and clearing the sighting range twice per vibration, would give the same result as that attained by the fork 1 operating at 100 vibrations per second and clearing the sighting range only once during each vibration.

The disk shown in Fig. 3 of the drawing may be considered to be the same as the disk 10 (Fig. 2) except that the several groups of speed and working-rate numbers are arranged in respectively different circular paths 12 to 17, lying at different respective radial distances from the center of the disk. By this arrangement no double readings can possibly occur, as already described, and it is also more convenient in certain situations to lay out the numbers or characters with respect to their size without resorting to crowding as may otherwise be necessary in placing the figures on the proper equidistant points.

In Fig. 4 a revoluble drum or cylinder is shown which may be substituted for the disk shown in either Fig. 2 or Fig. 3, numbers corresponding with different speeds or the working rate of a system of motion being spaced at equidistant points in paths 12 to 17 which lie around the face of the drum as indicated.

Although numerals have, for convenience of description, been employed in marking the stroboscopic disks, it will be understood that letters, words or any other type of characters or markings may be employed in substitution of the numerals without departing from the spirit of this invention, and also that a character may be shown at only one point on the moving body instead of a plurality of points as shown for convenience of description.

What is claimed is:

1. A stroboscopic system comprising a moving body carrying a plurality of sets of numerals, the numerals of each set being
5 equally spaced and of the same value, the numerals of the respective sets being spaced at different distances apart and of different values, and means for rendering any of the numerals of any of the sets legible during
10 the rotation of said body when the speed thereof corresponds to the value of the numerals in one of such sets.

2. A stroboscopic system comprising a moving body carrying a plurality of sets of
15 numerals, the numerals of each set being equally spaced and of the same value, the numerals of the respective sets being spaced at different distances apart and of different values, and a vibrating member for render-
20 ing any of the numerals of any of the sets legible during the movement of said body when the speed thereof corresponds to the value of the numerals in one of the sets.

3. A stroboscopic system comprising a
25 moving body carrying a plurality of sets of numerals, the numerals of each set being equally spaced and of the same value, the numerals of the respective sets being spaced at different distances apart and of different
30 values, a vibrating member having an aperture, and means for opening and closing

said aperture in response to the vibration of said member, whereby the numerals in any of said sets are rendered legible when the rate of speed of said body corresponds to the
35 value of the numerals in one of the sets.

4. A stroboscopic system comprising a moving body carrying a plurality of sets of numerals, the numerals of each set being
40 equally spaced and of the same value, the numerals of the respective sets being spaced at different distances apart and of different values, and means for detecting the relation between the spacing and the value of the numerals, whereby the speed of rotation of
45 said body is indicated automatically.

5. A stroboscopic system comprising a moving body carrying a plurality of sets of numerals, the numerals of each set being
50 equally spaced and of the same value, the numerals of the respective sets being spaced at different distances apart and of different values, and a vibrating member for detecting the relation between the spacing and the value of the numerals, whereby the speed
55 of rotation of said body is indicated automatically.

In witness whereof, I hereunto subscribe my name this 6th day of February, A. D. 1918.

RAYMOND E. COLLIS.