

April 16, 1929.

N. P. RASHEVSKY
OPTICAL SIGNALING DEVICE

1,709,809

Filed Oct. 28, 1926

Fig. 1.

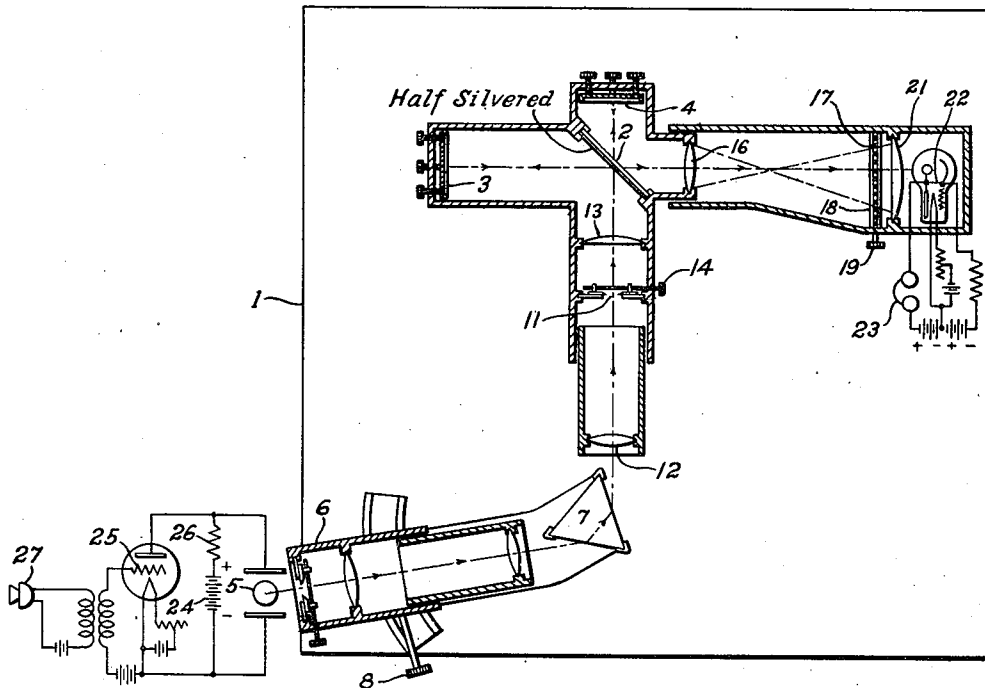


Fig. 2.

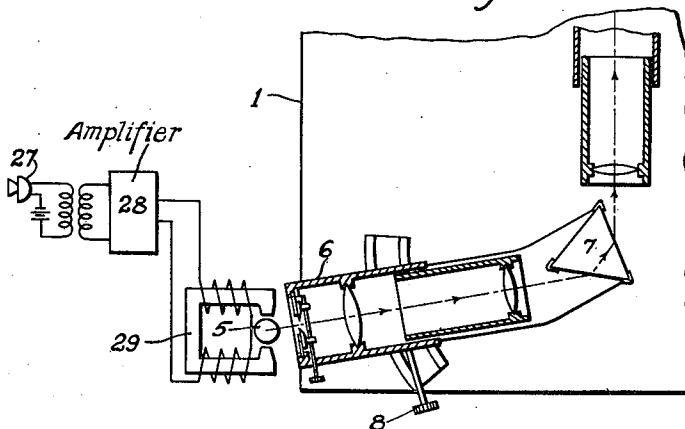
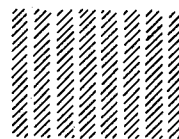


Fig. 3.



Fig. 4.



WITNESSES:

E. J. Veller.

H. A. Blum.

INVENTOR

Nicolas P. Rashevsky

BY

Charles E. ...
ATTORNEY.

UNITED STATES PATENT OFFICE.

NICOLAS P. RASHEVSKY, OF WILKINSBURG, PENNSYLVANIA, ASSIGNOR TO WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY, A CORPORATION OF PENNSYLVANIA.

OPTICAL SIGNALING DEVICE.

Application filed October 28, 1926. Serial No. 144,809.

This invention relates to signaling and television systems.

It is an object of this invention to produce a signal-responsive device which shall be quicker in its response to the signaling energy than the devices heretofore known.

It is a further object of this invention to produce a signal-controlled illuminating means which shall be more rapid in its response to the signal energy than devices heretofore known.

It is a further object of this invention to produce a varying illumination device which shall be sufficiently rapid in its variations to serve the needs of television systems, ultrarapid telegraph systems and similar systems requiring rapid changes.

It is a further object of this invention to produce a combination of a mask and an optical instrument producing fringes, in which the width of the fringes shall be made to vary and the amount of light passing through the mask be controlled by such variation.

The most rapid response to impressed energy known in nature is the change in the character of the light emitted from certain glowing bodies when they are subjected to electric or magnetic fields. This effect may be noticed most readily in connection with glowing bodies which give a spectrum consisting of sharp lines.

The spectrum of such glowing bodies contains lines which even under very searching examination show only a single wave-length, provided the glowing body is in normal condition. If, however, such a glowing body be subjected to an electric field or to a magnetic field, the same lines are found to consist of several nearly equal wave-lengths.

These phenomena, known as the Stark effect and as the Zeeman effect, have been known as laboratory curiosities, but, heretofore, no practical use has been made of them. In my invention, I employ the Zeeman effect or the Stark effect to cause a change in the width of fringes produced by an interferometer. When such fringes are narrow, they may be completely hidden by a mask of appropriate pattern. When the electric field or the magnetic field, acting upon the source of light, causes the fringes to become wide or to merge into one continuous path of light, such mask will no longer obstruct the light

but will permit a greater or less portion of it to pass.

The variation in the character of the fringes is produced in a small fraction of a micro-second after the field is impressed upon the source of light, and the fringes return to their normal character just as promptly when the field is removed. No other action controlled by any form of energy suitable for signaling is known which is as rapid as this. The changes in the amount of light which passes the mask may thus be made sufficiently rapid for even the most exacting demands of television systems or other ultrarapid communication methods.

The invention will be better understood and additional objects of it will be apparent from the following detailed description and the accompanying drawing, in which,

Fig. 1 is a view, partly in section and partly diagrammatic, of the apparatus as a whole;

Fig. 2 is a similar view of a portion of the apparatus, showing a modification.

Fig. 3 illustrates the kind of fringes produced when the light source is normal;

Fig. 4 illustrates the fringes when the light source is subjected to an electric or a magnetic field.

The apparatus includes an interferometer mounted upon a base 1. The interferometer includes the usual half-silvered mirror 2 and cooperating mirrors 3 and 4. The distance from the mirror 2 to the mirror 3 is greater than the distance from the mirror 2 to the mirror 4. The difference in these distances is made as great as it can be without rendering the production of fringes impossible. With certain light sources, this difference may be as great as ten meters. If the desired distance between the mirrors 2 and 3 is so great as to make the apparatus unwieldly, the optical path may be increased without requiring the physical dimensions of the instrument to be large. This may be done most readily by the use of supplemental mirrors, causing the light to travel over the distance 2—3 a plurality of times.

Light is supplied to the interferometer from a light source 5. Preferably, this light source is of a kind that will yield a spectrum having very sharp lines. The cadmium arc, which, as is well known, gives a very sharp red line, is suitable for this purpose. At

room temperature and atmospheric pressure, the wave-length of this line is

$$6438.47 \times 10^{-8} \text{ cm.}$$

5 Light from the light source 5 passes through the usual collimator telescope 6 to a prism 7, by means of which the spectrum is produced. The collimator and the prism may be rotated about the center of the prism as an axis by means of an adjustment controlled by the
10 milled head 8. This adjustment brings the selected line of the spectrum upon the slit 11 of the interferometer. Preferably, the light is concentrated upon the slit 11, by means
15 of a lens 12, and the light from the slit is rendered parallel by means of another lens 13. Provision is made for adjusting the width of the slit 11 and this adjustment is controlled by the milled head 14.

20 After passing through the mirror system of the interferometer, the light passes through a lens 16, and the fringes are produced at the focal plane of the lens 16. Positioned in the focal plane of the lens 16 is a
25 mask 17, mounted in guides 18 and adjusted by means controlled by the milled head 19. The mask consists of alternate transparent and opaque portions extending in the same direction as the fringes. The opaque portions
30 may be strips of metal or pigment or ruled lines upon the surface of a glass plate, or they may be bars of opaque metal. In the latter case, the transparent portions are merely the empty spaces between the bars.

35 On the other side of the mask 17 from the lens 16, a condensing lens 21 is provided. In the specific application of my invention chosen for illustration, the light is condensed upon a photo-electric cell 22, which controls
40 a translating device, illustrated as a telephone 23.

In the form of my invention illustrated in Fig. 1, the light source 5 is controlled by means of an electric field. The field is produced by a battery 24 and controlled by means
45 of a vacuum tube 25, acting through a high resistance 26. The telephone 27 which may be at any desired distance, is employed, in the illustration, to indicate any incoming
50 signal. The signal need not be telephonic.

In the form of my invention illustrated, in Fig. 2, the incoming signal, represented by the telephone 27, after being amplified at 28, has the form of a varying current in the coils
55 of an electromagnet 29, the poles of which are closely adjacent to the light source 5.

In the operation of my device, the incoming signal controls the output of the amplifier 25 in Fig. 1, or the amplifier 28 in Fig. 2, and
60 thereby controls the field of force acting upon the light source 5. In Fig. 1, the field of force is an electric field but, in Fig. 2, it is a magnetic field.

The light given out by the light source 5
65 may consist of many wave-lengths, but, if a

proper kind of light source has been chosen, one of the wave-lengths will be well separated from the other wave-lengths in the light from said source. Consequently, it is easy to so
70 adjust the collimator 6 and prism 7 that only light of the selected wave-length enters the interferometer through the slit 11. When a field of force acts upon the light source, the light entering the slit 11, instead of being
75 of a single wave-length, will be of several nearly equal wave-lengths.

The interferometer produces fringes at the mask. When the light is of a single wave-length, the fringes will be sharp, clean cut,
80 narrow bands of light separated by dark spaces. The mask will be so adjusted that an opaque portion coincides with each fringe. The light which comes through the lens 16 will thus be completely stopped by the mask
85 17, and no light will enter the lens 21.

When a field of force acts upon the light source 5, the light entering the slit 11 is no longer homogeneous, but consists of different wave-lengths. Several sets of fringes would,
90 theoretically, be created, but, actually, because the several wave-lengths are nearly equal, instead of several sets of fringes, the fringes are only broadened. The result is illustrated in Fig. 4. The difference between
95 this figure and Fig. 3 is an attempt to show the different appearance which the fringes will have when the field is present. The increase in width of the fringes will be in accordance with the intensity of the field at the
100 light source.

When the fringes have the form illustrated in Fig. 4, light will pass through the mask 17 because the opaque portions of the mask are
105 no longer of sufficient width to completely cover the fringes. Light will, therefore, pass through the lens 21 and be concentrated upon the photo-electric cell 22. The translating device 23 will respond to this change in the
110 light.

An interferometer will not produce fringes
115 if the difference in length of the two optical paths is too great. When the difference in length is nearly so great that fringes fail to be produced, it is essential that the light be very homogeneous. Fringes will not appear
120 if even a very small variation in the wave-length is present in the light. Consequently, if the interferometer be built with the difference between the distance 2—3 and the distance 2—4 merely great enough to prevent
125 the formation of fringes, a very feeble field will be sufficient to change the fringes into one continuous band of light. This is true even when the magnetic field is used, instead of the electric field.

Heretofore, in investigations of the Zeeman effect, very strong magnetic fields have been
130 necessary, but, with the interferometer, designed as just described, the change from fringes to a continuous band of light may be

produced by even very feeble magnetic fields. Under these circumstances, the magnet 29 need not be of very great inductance and will not hinder rapid signaling.

5 On the other hand, when the difference in length of the two optical paths is very near the limit at which fringes are just possible, the change from fringes to a continuous band of light is abrupt, or nearly abrupt, and correspondence between the impressed field and the width of the fringes is lost. With the two optical paths more nearly equal, this correspondence is readily obtained, but then the electric field is preferable to the magnetic field.

15 The changes in the light which emerges from the lens 21 are very rapid. The changes in the field impressed upon the light source 5 may be very rapid. The system, therefore, is applicable to signaling methods which require rapid changes. The system may be employed, for example, for telegraphic communication, in which the dots and dashes are sent at a very much higher speed than has heretofore been practicable, or it may be employed for controlling the illumination from point to point of the reproduced picture in a television system. The changes in light may be made with sufficient rapidity to correspond to a complete covering of the whole picture in a much smaller time than the $\frac{1}{18}$ of a second heretofore regarded as desirable, but unattainable, in such systems.

25 It will be evident to those skilled in the art that many modifications of this invention are possible without departing from the spirit thereof. I, therefore, do not intend the specific illustrations and description given herein to be construed as limitations.

40 I claim as my invention:

1. In a device for producing changing illumination, a source of light normally having a sharp-line spectrum, means for subjecting said light-source to a field of force, whereby the lines in the spectrum will be less sharp, and means for producing a change in illumination corresponding to said change in sharpness.

50 2. A source of varying illumination, comprising a light source, remotely-controlled means for subjecting said light source to a varying field of force, spectroscopic means for obtaining monochromatic light from said source, an interferometer for producing fringes from said monochromatic light, and

a mask comprising a series of alternating opaque portions and transparent portions, said portions corresponding in spacing and position to the fringes, whereby the variations in the field cause corresponding variations in the amount of light passing said mask. 60

3. A source of varying illumination, comprising a light source, remotely-controlled means for subjecting said light source to a varying field of force, spectroscopic means for obtaining monochromatic light from said source, an interferometer for producing fringes from said monochromatic light, and a mask comprising a series of alternating opaque portions and transparent portions, said opaque portions being narrower than the greatest width of the fringes and corresponding in spacing and position to the fringes, whereby variations in the field cause corresponding variations in the amount of light passing said mask. 70

4. In a device for producing varying illumination, a source of light, means for producing optical fringes therefrom, means acting on said source to vary the width of the fringes and a mask comprising a series of alternating opaque portions and transparent portions, said opaque portions being narrower than the greatest width of the fringes and corresponding in spacing and position to the fringes, whereby the variations in the field cause corresponding variations in the amount of light passing said mask. 85

5. In a device for producing changing illumination, a mask comprising a series of opaque strips and intervening transparent strips, a source of light, means to cause light from said source to produce fringes in position to be obscured by said opaque strips and means acting upon the source of light to so change the character of the light that a portion thereof will pass through the transparent strips. 95

6. In a signal translating system, a source of light, means controlled by the signal for impressing a field of force on said source, means for producing optical fringes from said source, means for ensuring that changes in the width of said fringes will result in changes in illumination and a translating device controlled by the illumination. 100

In testimony whereof, I have hereunto subscribed my name this 21st day of October, 1926.

NICOLAS P. RASHEVSKY. 105