

Jan. 30, 1945.

F. P. MASON
FACSIMILE SIGNALING SYSTEM

2,368,369

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3 Sheets-Sheet 1

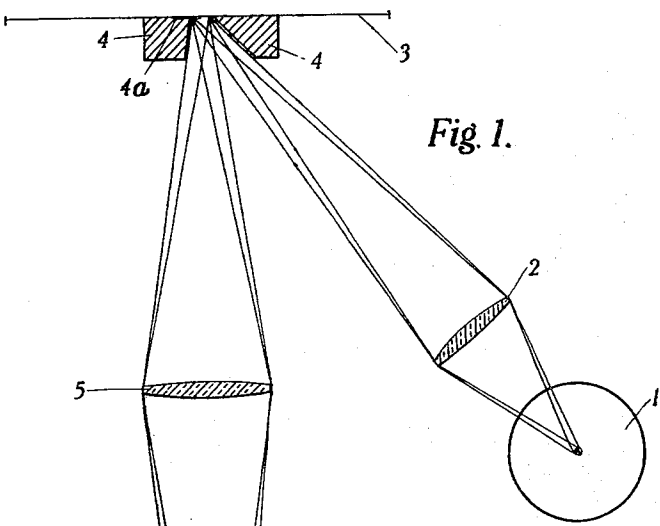


Fig. 1.

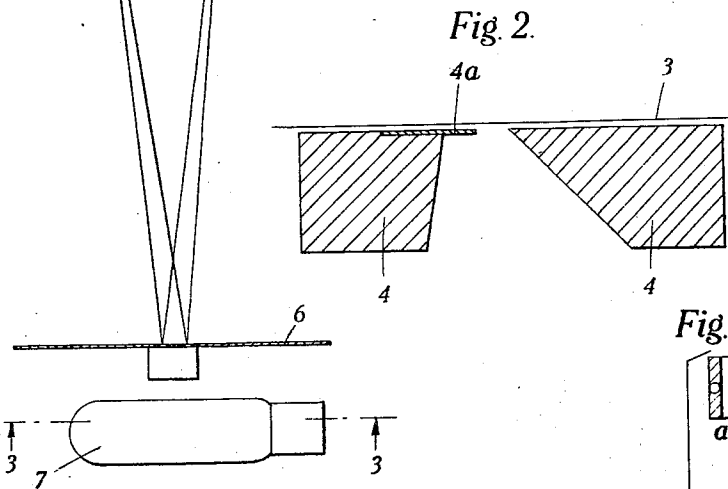


Fig. 2.

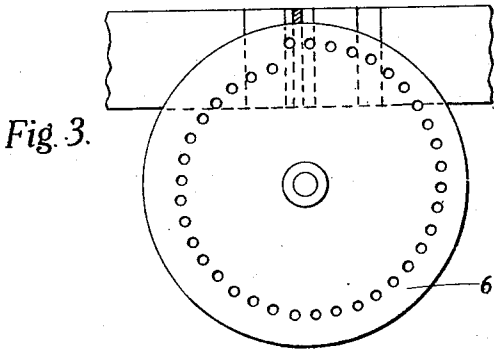
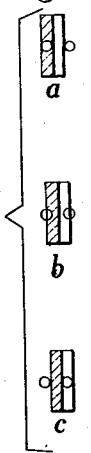


Fig. 3.

Fig. 4.



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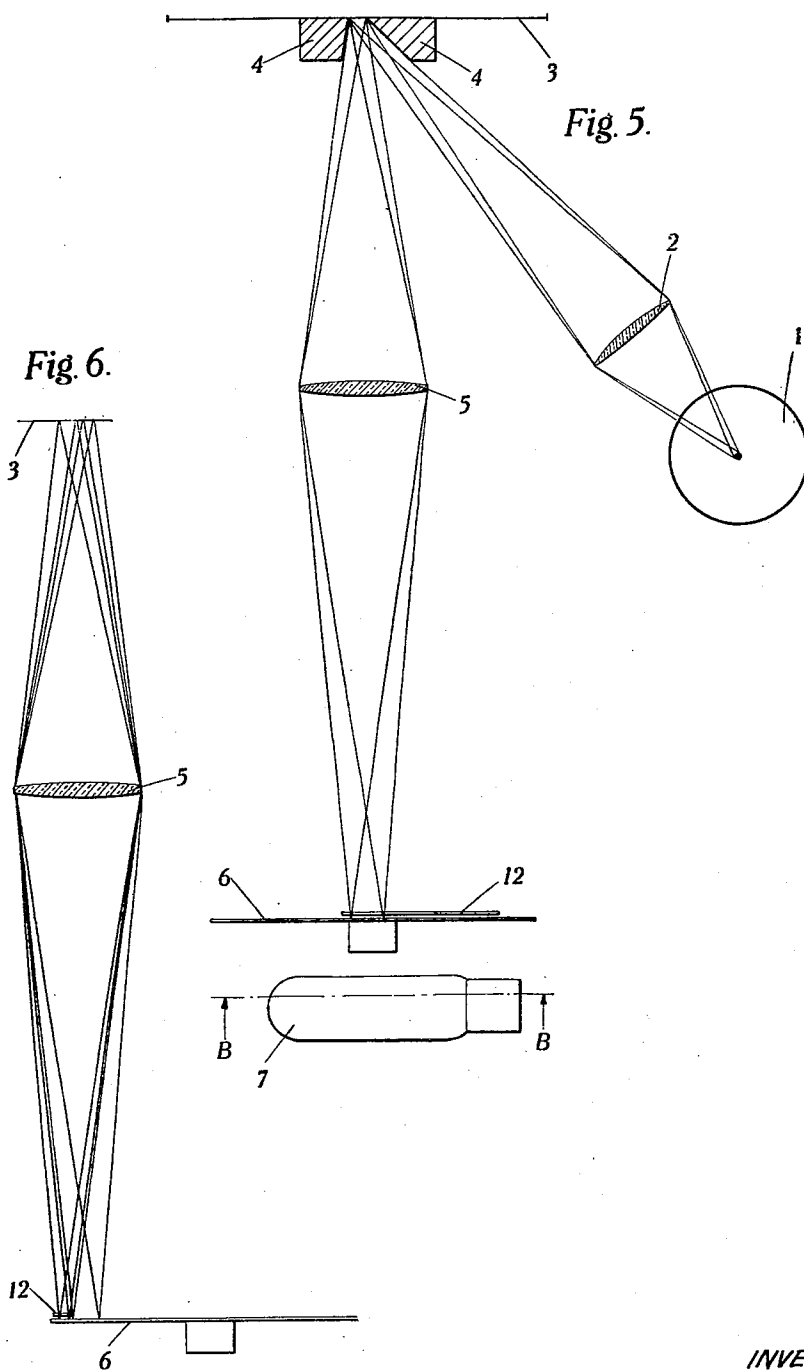
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3 Sheets-Sheet 2



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Fig. 7

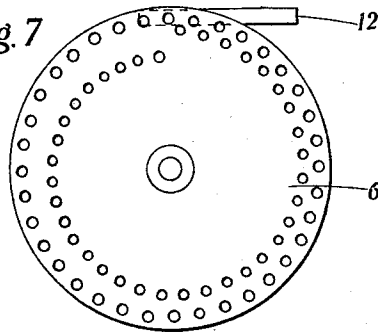
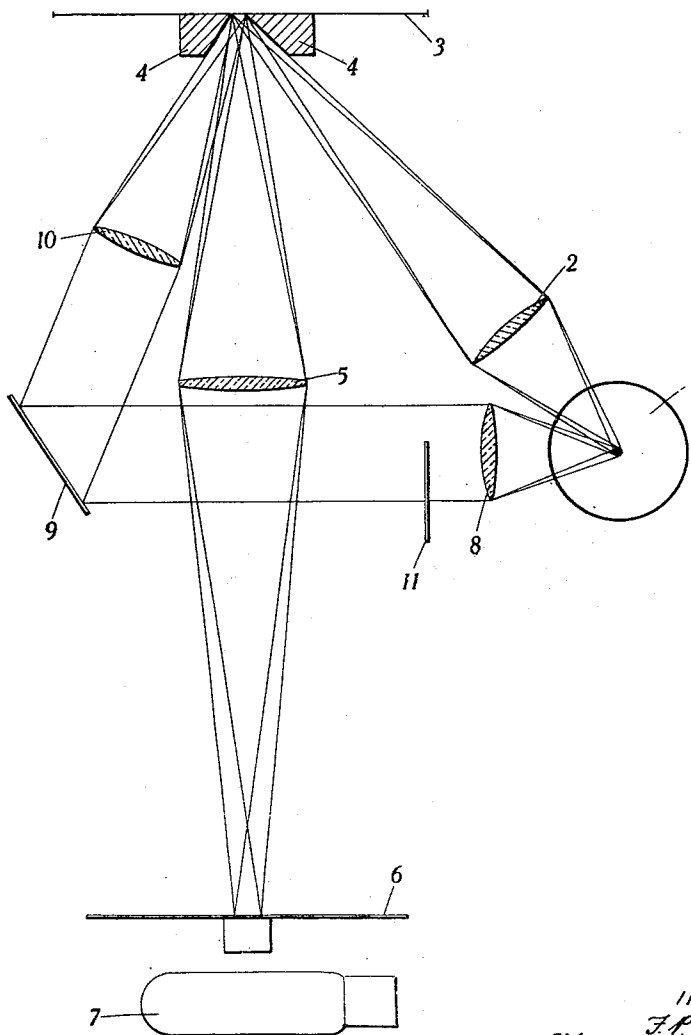


Fig. 8



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UNITED STATES PATENT OFFICE

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FACSIMILE SIGNALING SYSTEM

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Application January 6, 1942, Serial No. 425,714
In Great Britain January 24, 1941

7 Claims. (Cl. 178—6.6)

This invention relates to facsimile signaling systems, and more particularly to improved forms of facsimile scanning head which reduce the effect of variation in amplifier gain.

When subject matter comprising marks on a plain background is transmitted over a communication channel by means of a facsimile telegraph system, it is desirable to establish two opposite signaling conditions, one corresponding to the marks (hereinafter called "black") and the other to the background (called "white"), which conditions may be represented by the sending of "tone" and "no tone" respectively. Now, with normal messages, written in pencil or ink on white or light-coloured paper, it is found that when the pencil or ink is being scanned the amplitude of the tone is not reduced to zero, but to one-third, or perhaps two-thirds, of the amplitude corresponding to white. Consequently, a receiving instrument must be able to discriminate between the full amplitude of the tone corresponding to white and the lower value of the tone corresponding to black. The responding level of the receiver will thus be set at the mid point between these two levels, i. e., approximately 80-85% of the full amplitude. Under these conditions, it is obvious that should there occur an incidental increase of 15% in the gain of the system, the receiver will record nothing, whereas if the gain decreases by 15% the receiver will record all black. Such incidental variations in gain are to be expected, particularly in portable apparatus operating from batteries.

The present invention is concerned with the procedure, already known, of subtracting from the signals a constant signal substantially equal in amplitude to the "black" signal, so that practically no signal is sent during "black" periods, while during "white" periods the difference only between white and black is transmitted. Thus the transmitted signals consist of "tone" and "no tone," and much larger variations of gain can be tolerated.

In known methods of carrying this out serious disadvantages are apparent. Thus, in the method where the signals at some stage in the amplifier are mixed with a locally-generated tone, variations in this tone occur which affect the accuracy of the cancellation. It is also necessary to maintain accurately the correct frequency and phase of this tone, and the apparatus is thereby rendered complicated and difficult to adjust; also, much electrical power is dissipated in performing this function and this is a disadvantage in portable equipment.

In another known method applicable to "chopped" light systems, the cancellation is effected at the photo-electric cell stage of the amplifier by producing two out-of-phase light beams directed towards two separate photo-cells, the outputs of which are combined; only one beam is modulated by the signals and the difference between the two photo-cell outputs constitutes the transmitted signal. This method has the disadvantage that two photo-cells and their separate circuits are required instead of one, and variation in sensitivity of the cells will cause inaccurate cancellation.

An advantage of the present invention is that, in a "chopped" light system employing two beams of light from the same lamp, only one photo-cell is required. The additional beam of light is directed from the lamp to the chopper and scanning discs in such a way as to cause a secondary beam of light to enter the photo-cell, this beam and the main beam being interrupted out-of-phase with each other. The quantity of light in this secondary beam is the same as that in the principal beam when black is being scanned.

The effect of these two equal out-of-phase beams can be shown graphically to be the same as a steady beam of light entering the cell with a very small amount of ripple. Since the photo-cell is reactively coupled to the amplifier, the steady unidirectional potential set up is not communicated to the amplifier; thus, while black is being scanned, no signal is generated. When white is being scanned, the effect of the secondary beam is merely to reduce the signal amplitude. The ratio of black to white signal has thus been increased from $70/100$ to probably $5/100$.

It will be seen that, with this method, there is no possibility of variations of the amount of cancellation, since one lamp and one photo-electric cell only are used. A simple practical means of carrying the invention into practice is to use a tape masking device, which provides a light reflecting surface of the same width as the aperture itself and adjacent to it.

A description will now be given of the accompanying drawings. In these drawings, Figs. 1 to 4 show one embodiment of the invention, and Figs. 5 to 7, and Fig. 8 show alternative arrangements.

Figs. 1 to 4 show the invention as applied to the tape facsimile transmitting system described in the patent application Ser. No. 443,440 and comprises a modification of the mask 4 shown in the drawings accompanying that specification. The mask 4 is provided with portion 4a,

which is in the form of a thin, flat strip, of a width equal to the width of the slit itself, i. e., the width between the edge of the strip and the mask. The total mask aperture, i. e., surface 4a and the surface of the tape 3 exposed in the slit, is brightly illuminated by means of the lamp 1 and the lens 2. An image of these surfaces is produced on the disc 6 by means of the lens 5. The disc 6 is provided with holes arranged in spiral form, so that, as the disc rotates, successive holes pass across successive elemental portions of the image of the aperture. The size of the holes is arranged so as to be equal to the width of the image of the slit, and the radial distance between adjacent holes is equal to the diameter of the holes (see Fig. 4). Thus, if the disc is in such a position that the image of the slit falls exactly upon a hole, the image of the mask 4a will fall exactly upon the portion of the disc between adjacent holes. The surface of the mask 4a is treated so that it reflects light with an intensity equal to that reflected from the "black" portions of the characters marked on the tape. Consequently, if the slit discloses a "black" portion of a character, the light reflected from the slit and from the mask will be of equal intensity, and therefore, when a hole in the disc 6 passes successively across the areas corresponding to the slit and the surface, no variation of the light falling onto the photo-electric cell will occur. Since the "black" portion of the tape and the prepared surface reflect some light, a quantity of light enters the cell. The frame parts 4 of the mask are truly black and of dull surface so as to reflect a negligible amount of light. Therefore, when a hole in the disc passes from the frame part of the image to the dully illuminated region corresponding to the image of the prepared surface and "black" tape, the light passing to the cell through this hole suddenly increases from practically zero to a finite value. Since, however, the preceding hole is, at that moment, just leaving the dully illuminated area, the total quantity of light entering the photo-cell is the same at every instant. Since the photo-electric cell is reactively coupled with the amplifier, no signal will be generated. If, now, a portion of plain white tape is exposed in the slit, the intensity of the light reflected through the slit will be greater than the intensity of the light reflected from the treated mask surface, and consequently a pulsating beam of light will fall onto the photo-electric cell as the holes in the disc pass the image of the slit, and a signal will be generated in the amplifier.

In the arrangement shown in Figs. 5 to 7, the mask 4 is arranged to expose a plain portion of the tape below the portion on which the characters are written; a concentric row of holes is provided in disc 6 to scan this plain portion; and the lens 5 is arranged to produce an image of the slit on the surface of the disc 6, in such a position that the portion of the slit exposing the characters is scanned by the row of holes arranged in spiral form, and the portion of the slit exposing the tape below the characters is scanned by the concentric row of holes. Immediately in front of the disc 6, and in the path of the beam of light from the portion of tape below the characters, is arranged a filter 12, which may be in the form of an adjustable film of graduated density, so that the amount of light passing through the concentric row of holes may be varied. The concentric row of holes and the spiral row of holes are angularly spaced with re-

spect to one another so that a hole in the concentric row and a hole in the spiral row pass alternately across the image on the slit. The light passing through the disc is arranged to fall onto a photo-electric cell 7, as in Fig. 1. The graduated filter 12 is adjusted so that the amount of light passing through the concentric row of holes will be equal to the amount of light passing through the spiral row of holes when the slit exposes a "black" portion of the tape 3, in which case a constant amount of light will pass to the photo-electric cell. If, however, the slit exposes a plain portion of the tape, the amount of light passing through the spiral row of holes will be greater than the amount of light passing through the concentric row of holes; thus, a pulsating quantity of light will fall onto the photo-electric cell and a signal will be generated.

It is evident that any suitable means may be employed to control the intensity of the secondary beam in place of the graduated adjustable film 12; for instance, an aperture of adjustable size may be used, but care must be taken that the modulation of the light of the secondary beam is substantially sinusoidal. One method of carrying out this operation is to provide an opaque slide, with one edge at a small angle to its direction of motion, so arranged that, at one extreme limit of its motion, the edge obscures the concentric row of holes, while at the other extreme the holes are exposed. The holes thus travel along the controlling edge, and at mid-adjustment for example, one-half of the hole is always obscured but the modulation of the light beam remains sinusoidal.

Fig. 8 shows a modification of the arrangement in Figs. 5 to 7. Here the portion of the tape below the characters exposed in the slit is illuminated by a second beam of light, which is controllable in intensity. For this purpose, an image of the filament of the lamp 1 is projected by means of a second lens system, comprising the lens 8, the mirror 9 and the lens 10. A shutter 11 is provided in front of the lens 8 to control the amount of light falling on to the mirror 9. The disc 6 is provided with two rows of holes, as in the arrangement shown in Figs. 5 and 7. The operation of the device is the same as that of the arrangement shown in Fig. 5, except that the intensity of the beam of light passing through the concentric row of holes is regulated by means of the shutter 11 instead of by means of the graduated film 12.

What is claimed is:

1. A facsimile transmitter for transmitting telegraph messages from characters comprising dark area portions written on a running tape comprising a source of scanning light, a mask overlying said tape having a slot extending across said tape through which scanning light from said source may pass, a scanning disc provided with a plurality of spirally arranged openings, means to pick up light from said source reflected back from separate areas in at least two independent beams, one of said beams being reflected from the tape area reserved for said messages and another of said beams being reflected from an area of constant reflection characteristic and having a constant value corresponding to the dark area portions of the tape, and to project said beams so picked up onto one surface of said scanning disc, the openings in said scanning disc being disposed so that each opening scans the respective beams one after another, and a photo electric cell disposed on the other

side of said scanning disc in the path of rays of light from both of said beams, whereby when dark area portions of tape are being scanned the photo-electric cell receives impulses from both beams of approximately the same low light level.

2. A facsimile transmitter for transmitting telegraph messages from characters comprising dark area portions written on a running tape, comprising a source of scanning light, a mask overlying said tape having a slot extending across said tape through which scanning light from said source may pass, a scanning disc provided with a plurality of spirally arranged openings, means to pick up light from said source reflected back from separate area portions in at least two independent beams, one beam being reflected from an invariably dark area and having a constant value corresponding to the dark areas of the tape and the other beam being reflected from the writing area of the tape and having a value varying with the light reflected from the light and dark portions of said area and to project said beams onto one surface of said scanning disc in the path of said openings, said openings being disposed so that each scans the respective beams one after another, and a photo electric cell disposed on the other side of said scanning disc in the path of rays of light from both of said beams whereby when dark areas of the tape are being scanned the photo-electric cell receives impulses from both beams of approximately the same low light level and when light area portions of the tape are scanned, the cell receives alternately pulses of high light value and low light value.

3. A facsimile transmitter for transmitting telegraph messages from characters comprising dark area portions written on a running tape comprising a source of scanning light, a mask overlying said tape having a slot extending across said tape through which scanning light from said source may pass, a member of the same size as said slot having the same light reflecting qualities as the dark areas of the tape and disposed adjacent to said slot in the path of rays of light from said source, a scanning disc provided with a plurality of spirally arranged openings, means comprising optical systems to pick up light from said source reflected from said member and from said slot area, and to project said light onto the surface of said scanning disc in the path of said openings in the form of

two independent beams, a light responsive device disposed on the opposite side of said scanning disc, said openings being arranged so that each opening scans one beam after another whereby said light responsive device receives alternately a variable uniform light impulse from said member and a light impulse from said tape, the latter varying with the value of the light reflected from the elemental portions of the writing area of the tape.

4. A facsimile transmitter according to claim 3 in which the surface of said mask has less efficient light reflecting qualities than said member.

5. A facsimile transmitter according to claim 2 comprising means to pick up light from said light source reflected from a strip of the tape not reserved for writing and having an invariable reflection characteristic.

6. A facsimile transmitter according to claim 2 comprising means to pick up light from said light source reflected from a strip of the tape near the edge thereof, of invariable reflection characteristic reflected from an unmarked area of the tape near the edge thereof, and light filtering means disposed in the path of said light to reduce the intensity of said light to substantially that of the light reflected from the dark area portions of the writing.

7. A facsimile transmitter for transmitting telegraph messages from characters comprising dark area portions written on a running tape, comprising a source of light, means for projecting a scanning beam from said source towards said tape, means to pick up light from said source reflected from separate areas in at least two independent beams, one being reflected from an area of invariable reflection characteristic and having a constant value corresponding to the dark area portions of the tape, and the other being reflected from the writing area of the tape and having values varying with the light reflected from the light and dark portions of said area, means to project said beams onto a rotating scanning disc provided with a plurality of spirally arranged openings, said beams being placed in the path of said openings so that each opening scans said beams one after another, a photo-electric cell disposed on the other side of said scanning disc in the path of both of said beams, and amplifying means reactively coupled with said photo-electric cell.

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