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FRITZ SCHRÖTER, OF BERLIN, GERMANY, ASSIGNOR TO GESELLSCHAFT FÜR DRAHT-
LOSE TELEGRAPHIE M. B. H., BERLIN, GERMANY, A CORPORATION OF GERMANY

CONTINUOUS PICTURE TRANSMISSION

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The present invention relates to a method of and means for picture exploration and recording for telegraphic facsimile transmission by wire or by radio by the use of the photoelectric principle. For the same purpose it has been previously suggested to effect the analysis and reassembly of the picture in such a way that light spots or foci are moved transversely to the direction of a continuously travelling strip or tape shaped picture carrier supporting the specimen to be transmitted or receiving surface and across the latter, which has become known as cross-line exploration. All of the means heretofore suggested for this purpose involve arrangements in which the strip or tape shaped continuously travelling picture carrier is explored in a planar manner, that is to say, that it forms or presents a plane or level surface at the particular point where the luminous spot passes over it, the light spot describing over it a rectilinear or a circular path in the plane of the picture strip. Since in this latter case the density of the picture points near the margins of the picture strip is greater than in the central portions of the arc described over it so that, to partly obviate this inconvenience, it has been necessary to describe very shallow arcs, though this militates against, and results in complications as regards, continuity of exploration, i. e., utilization of time, necessity of duplicating, exploring and recording means alternating in operation; but transversal exploration by the light spot along a straight line involves the disadvantage that it has heretofore not been feasible in a perfect manner to insure equal sharpness of the luminous spot at all points along this path, and to maintain its speed at a constant rate along the path.

The present invention discloses ways and means adapted to obviate these inconveniences inherent in cross-line exploration, and the same chiefly consists in that the picture strip is curved transversely (at right angles) to its forward feed direction, and in that the curvature is adapted to the circular path of a luminous spot moved by revolvable optical means, so that everywhere the speed

of the same is constant and that perfect focal sharpness is insured.

For further details of the invention, reference is made in what follows to the accompanying drawings wherein Fig. 1 shows an embodiment of one form of the invention; Fig. 2 shows a cross-section of a modified form of the invention illustrated by Fig. 1; Fig. 3 illustrates a modified form of light control applicable to Figs. 1 and 2; and Fig. 4 illustrates a form of diaphragm.

On account of the fact that the picture strip is curved transversely to its feed direction and is so explored (or recorded), the present invention distinguishes itself fundamentally from arrangements in which the curvature lies in the longitudinal direction by that the picture strip intermittently in longitudinal sections together with interruptions in the transmission, is wound upon or along the inner face of a cylindrical drum, being thereupon explored by revolving optical means helically by lines in longitudinal direction. In this scheme, such portion of the strip as happens to occupy the inner face of the cylinder must be arrested with relation to the drum during transmission, being displaced incidentally only parallel to itself and the axis of rotation of the said optical means, in other words, transversely to its longitudinal sense. Hence, transmission and conveyance of the picture strip through the exploring zone of the apparatus alternate. The picture is conveyed through by jerks, or intermittently, so as to introduce a new longitudinal section into the exploring zone for the purpose of transmission. However, in the arrangement as here disclosed the connected picture strip travels continuously and not intermittently through the exploring zone so that the transmission need not to be interrupted at any time.

The simplest form of construction according to this invention consists in that the picture strip at right angles to its forward feed direction is curved to an extent so that it forms a nearly closed cylinder surface, the axis of the cylinder thus formed coinciding with the axis of revolvable mirror means. The light for the exploration and recording

of the picture is supplied in axial direction of the optical means, at an angle of inclination of 45 degrees with relation to said direction, to a deflecting mirror or deflecting prism, the light being thereby thrown in the radial direction in which concentration into a sharp focus is effected by lenses, the focus or luminous spot thus describing a circular path adapted to the picture strip curvature upon rotation of the shaft. The essential features of this arrangement can be clearly seen from Fig. 1 which at the same time shows a further improvement of the invention. It has been found that it is difficult to bend together into a nearly closed cylinder a film or paper strip with certain prescribed properties, and that it is also associated with difficulties to pass the same in such shape, in spite of friction and unfavorable position of the points of engagement for tension and thrust, at a constant rate of speed in proper manner through the exploring and the recording or reproducing apparatus. Especially in the use of celluloid films for photographic picture reception the stiffness of this material offers great trouble in the above respect. Since the film is usually paid out from a cylindrical storage roll, and since the stiff celluloid can be curved only in a gradual way, it will be seen that between the point where the picture strip leaves the roll and the place where it has its most nearly perfect curvature, a great distance would have to be provided, and this means a complication, in building the apparatus. It is substantially easier to carry the invention into effect in such a way that the picture strip (picture telegram carrier and receiving tape) is curved only semi-cylindrically. But in order to fully utilize the outfit it is possible and practical to pass another similarly bent or curved picture strip simultaneously through the apparatus. In this way two different pictures or documents can be transmitted simultaneously, or else the incoming picture may be recorded in duplicate at the receiving end.

Working in a way as before mentioned with a picture surface bent semi-cylindrically, it will be found convenient, even if but one picture is explored or recorded, in order to fully utilize the optical revolving means, to double the luminous spot or focus in such a way as shown in Fig. 1. In this figure, 1 denotes the revolving deflection mirror presenting an angle of inclination of 45 degrees with reference to the axis of rotation of the optical means. Since the mirror, when the picture strip is curved into a nearly closed cylinder, need to act only unilaterally since it is then possible to utilize the entire rotation of the shaft (in which case unilateral axial light supply, for instance, by light pencil 2 would suffice), when employing the semi-cylindrical film curving scheme, the deflecting mirror 1 is so arranged that it will deflect towards both sides. One good plan is to place two rectangular prisms whose hypotenuse faces are silver coated adjacent to each other in a way as illustrated. The parallel rays 2 arriving from the illumination device 4 which are indicated by a simple arrow, are then deflected in a way as shown to the objective 6, being condensed by the latter in the shape of a sharp focus upon the picture surface. But at the same time parallel rays 3 coming from the illuminating device 5 (which are marked by a double-headed arrow), are deflected in diametrically opposite direction and are condensed by the objective 7 so as to form a focus upon the picture surface being displaced with reference to the former focus by an angle of 180 degrees. The entire outfit is secured by a convenient support so as to insure a rigid connection with the shaft. The latter, at least at one end, should be hollow and be conveniently supported in order that the light may be supplied in axial direction. The objectives 6 and 7 should be suitably adjustable in order that sharp foci may be obtained. The cylindrical guide or conveyor surfaces between which the picture strip is passed, have a slit 8 upon the inner face in which the focus or the two foci travel for the purpose of exploration or photographic recording of the picture. In the case of photoelectric exploration (at the transmitter end), parts 12 and 13 denote photoelectric cells, say, annular selenium cells, or, better still, photoelectric cells of well known kind which allow the passage of the light coming from 1 through the inner space of the annulus, while upon the side turned towards the picture and being responsive to light action they will collect light reflected from its elements within a maximum solid angle. The exploration method itself may be regarded as well enough known. In the present case, the illuminating devices 4 and 5 consist of constantly burning light sources, say, glow-lamps. In the case of photographic recording of the incoming picture, however, 4 and 5 represent light valves or relays, which, controlled by the incoming currents, cause variation in brightness of the ray pencils 2 and 3. For instance, Kerr cells or glow-discharge tubes may preferably be used for this purpose. Of course, these light valves are stationary with relation to the rotation of the mirror 1. In the case in question, the parts 12 and 13 do not denote photoelectric exploring cells, but rather protective diaphragms revolving conjointly with the optical means and designed to preclude any stray light reflected from the impinged portions of the film from other parts of the film. The travel of the film strip 10 is in the direction of the arrow 9. In case another film strip is to be transmitted, the latter is indicated at 11.

As can be readily seen from Fig. 1, during the relatively slow travel of the picture strip 10 through the arrangement shown in the drawing, the illuminating devices 4 and 5 act alternately upon the picture surface so that, for instance, upon the picture surface 10 the first semi-circle is traced by one focus and the next half by the other focus, and these semi-circles appear as straight transverse lines once the picture strip has been straightened out again.

Fig. 2 illustrates the change over device for the exploration at the sending end by means of photoelectric cells. For the sake of simplicity, the latter are shown of the ordinary, not of annular, form. For the purpose of utilizing the entire rotation of the optical means, also in this case where only a single (semi-cylindrical and curved) picture strip is to be transmitted, two diametrically opposite cells 12, 13, are employed, the latter being changed over in convenient manner by a distributor partaking of the rotational movement and being connected with the rest of the equipment (amplifiers, transmitter apparatus). In Fig. 2, the photoelectric electrodes 14 and 15 are united with a joint collector ring whence the current is taken off by means of a contact 17. The positive suction electrodes of the photoelectric cells are associated with slip rings 18 and 19, respectively, each of which occupies a nearly complete semi-circle. The contacts 20, 21, insure proper change over. Regardless of whether only one semi-cylindrical curved picture surface is to be explored or whether two such surfaces are to be explored (10 and 11), the two photoelectric cells 12 and 13 are alternately connected with or changed over to the proper circuit. Thus, even in transmitting only one picture, the full rotation can be utilized. Of course, for the simultaneous transmission of two pictures, also two transmitters are required to which the two circuit paths connected with the contacts 20, 21 are brought by way of amplifiers, while the return to 17 is common to both.

Fig. 3 refers to the following cases: If simultaneously two picture strips are transmitted, then in the light of what precedes, and in analogy with the change over of the two diametrically opposite exploring photoelectric cells, it is necessary at the receiving end to effect a corresponding change over of the currents coming from the two receivers to the two light valves 4 and 5. However, even if only one picture is to be transmitted, it will, as can be inferred from the above description, be necessary to produce two foci displaced with relation to each other by an angle of 180 degrees so as to utilize the entire optical means. This is accomplished in a way as illustrated in Fig. 1. The luminous spot travelling over and scanning the picture strip originated then alternately from the

one and from the other light relay. In the case of such light valves as consume but low amounts of electrical energy, it is then advantageous to connect both in parallel electrical relationship. If this is inadmissible for reasons of energy requirements for the control, then the two light valves 4 and 5 must be connected alternately in such a way that, at any given instant, that relay is controlled by the incoming current whose focus happens to scan the picture surface. If the incoming picture is recorded in duplicate by using the upper and the lower semi-cylinder, electric change over of the two light valves by a revolving contact device may be dispensed with, and the two light relays may constantly work in parallel to each other. If only one document or the like is transmitted, also a single receiving light valve may be used as shown in Fig. 3 so as to insure savings in equipment and energy expenditure, and the light passed by the same (subject to intensity control) can be branched. Referring to Fig. 3, 22 denotes for instance, the upper electrode of a Kerr cell which is interposed between the Nicol prisms 23, 24, and which acts in well known manner. Diaphragm 25 makes it possible to filter out or separate a definite part of the passed ray pencil. An angular mirror 26 of any convenient kind will then serve to split the light into two halves in the two opposite directions being marked respectively by simple and double-header arrows. One half of the light impinges by way of mirrors 27, 28, and the other half by way of mirrors 29, 30, upon the revolving deflector mirror 1. The other parts bear the same reference numerals as in the preceding illustrations.

Fig. 4 shows a special form of construction of the protective diaphragm revolving in the receiving recorder apparatus, the purpose of which is to preclude and render inactive such stray light as has been reflected from the film surface. With this end in view, the said diaphragm should most conveniently be made hollow, as shown, in such a manner that a conical part is inserted into a cylinder 12, within which part the impinging ray describes a conical path. Such light as is reflected from the picture surface 10 will in the main be reflected into the angular space 31 where it is dissipated by simple or multiple reflection and incidental absorption in the conveniently blackened surface.

The invention has been illustrated in its broadest form and it is to be understood that I do not intend to limit myself to the specific form shown but that other modifications may be made such as fall clearly within the spirit and scope of the invention as defined by the following claims, wherein I claim:

1. In a facsimile system, in combination a cylindrical support member, a plurality of record strips carried by said support mem-

ber, means provided by said cylindrical support member for causing each of said record strips to conform to the periphery of said support member, a plurality of optical systems within said support member, said optical systems being arranged along the axis of said cylindrical support member, means for continuously advancing said record strips relative to said support member, means for rotating said optical systems within said support member at a constant rate of speed, a plurality of external light sources, means for directing the light issuing from said external light sources towards said optical systems carried within said support member, and means provided by said optical systems for alternately and successively projecting the light rays issuing from said external sources to trace light paths upon said record surfaces in a direction at right angles to the line of advance of said record strips and directing the light for tracing alternate paths on each of said record strips from one of said light sources and the interspersed adjacent paths from the other of said light sources.

2. In a picture transmission system, a message form for supporting a plurality of pictures to be transmitted at the same time, a stationary source of light located at either end of said message form, optical means for projecting the light from said sources to corresponding points on said supported pictures, said optical means alternately projecting light from said sources to said picture surfaces and causing the light from each of said sources to be alternately projected to each of said pictures, means for causing the light projected to each of said pictures to traverse each entire picture surface, a plurality of photo cells in the path of the reflected light from said pictures, whereby varying intensities of reflected light vary the currents flowing in said cells, and means for controlling a transmitter from said cells.

3. In a picture transmission apparatus, a support for carrying a plurality of messages to be transmitted, a stationary source of light at each end of said support, means for directing the light issuing from each of said light sources within said supports and longitudinally with respect thereto, means for diverting the said light issuing from either end of said support at an angle and projecting it upon the said messages mounted upon said support, said light diverting means being arranged to alternately project the light from said sources from one to the other of said messages to be transmitted, means for collecting the light reflected from said messages and electrical means controlled by said reflected light for varying the strength of an electric current in proportion to the intensity of light and shade of said message to be transmitted.

4. A picture transmission system including a plurality of stationary light sources, a message form for carrying a plurality of pictures to be transmitted, optical means for projecting the light from each of said sources to a point on each of said supported pictures, means for mounting said optical means within said message form, means for rotating said optical means and causing each of said light beams reaching said optical means to alternately and successively trace a path across each of said picture surfaces, and photoelectric means associated with each of said optical means for receiving the light reflected from said picture surface and varying the strength of an electric current in proportion to the intensity of light and shade upon each of said picture surfaces carried by said message form.

5. A facsimile transmitting system comprising a cylindrical support member, a plurality of messages each covering half of the surface of said cylindrical support member mounted on said support for transmission, means for causing each of said picture strips to conform to the shapes of a half of said cylindrical support member, a stationary source of light at each end of said cylindrical support surface, means for directing the light issuing from said sources within said cylindrical support member, a plurality of optical systems within said support member, each of said optical systems being located along the axis of said support member, means for continually advancing said picture surface at a predetermined rate with respect to said support member, means for redirecting the light reaching said optical systems so as to trace a focus path along said picture surfaces and alternately and successively subject each of said picture surfaces to both of said external light sources, light sensitive means associated with said optical systems for receiving light reflected from said picture surface, and electrical means associated with said light sensitive means for modulating a carrier frequency in accordance with variations in the intensity of light and shadow controlling said light sensitive means.

FRITZ SCHRÖTER.