May 10, 1927. 1,627,701

M. C. HALL

SYSTEM FOR TRANSMITTING AND REPRODUCING PICTURES

Filed Dec. 20, 1923 2 Sheets-Sheet 1

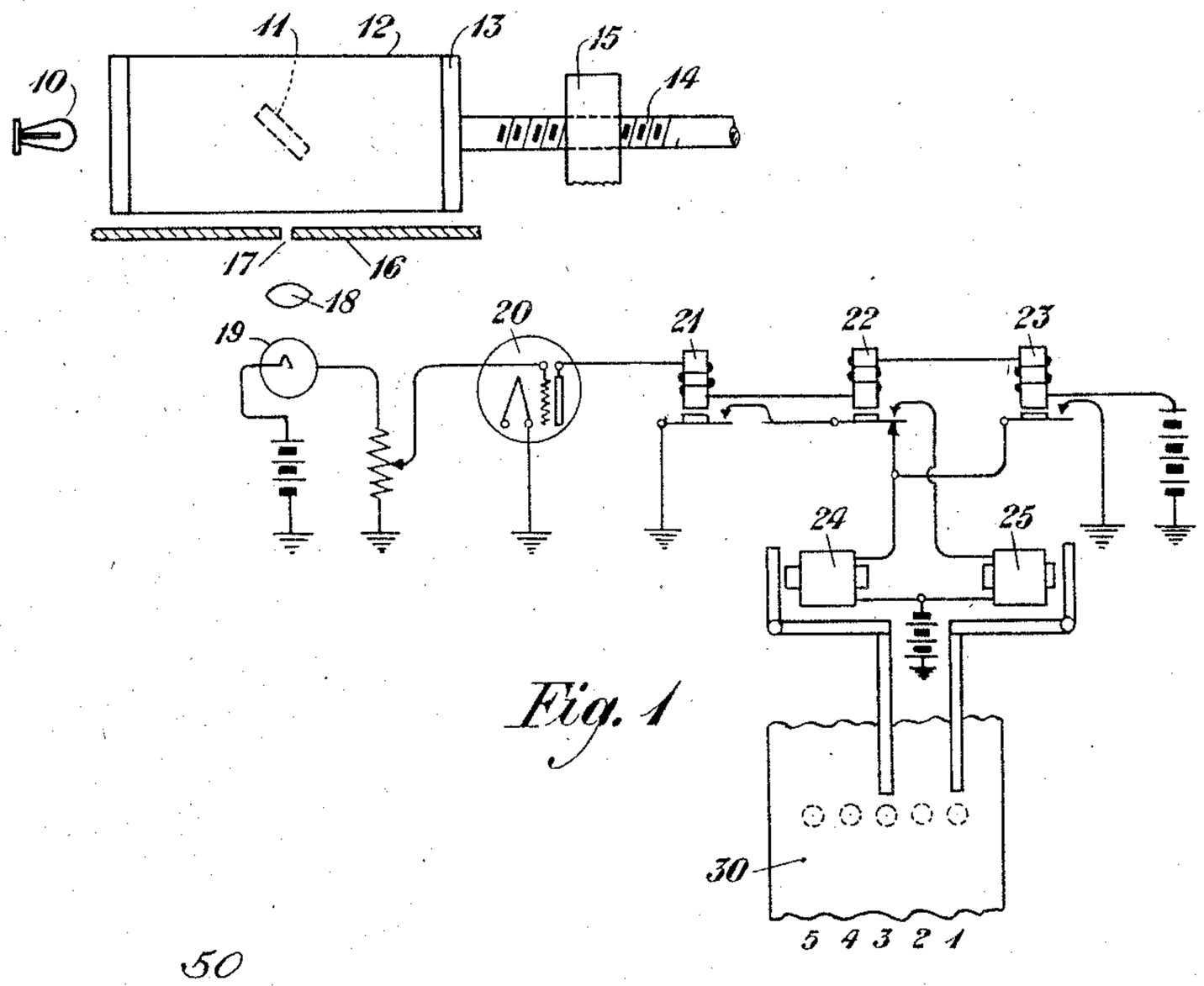

Fig. 1

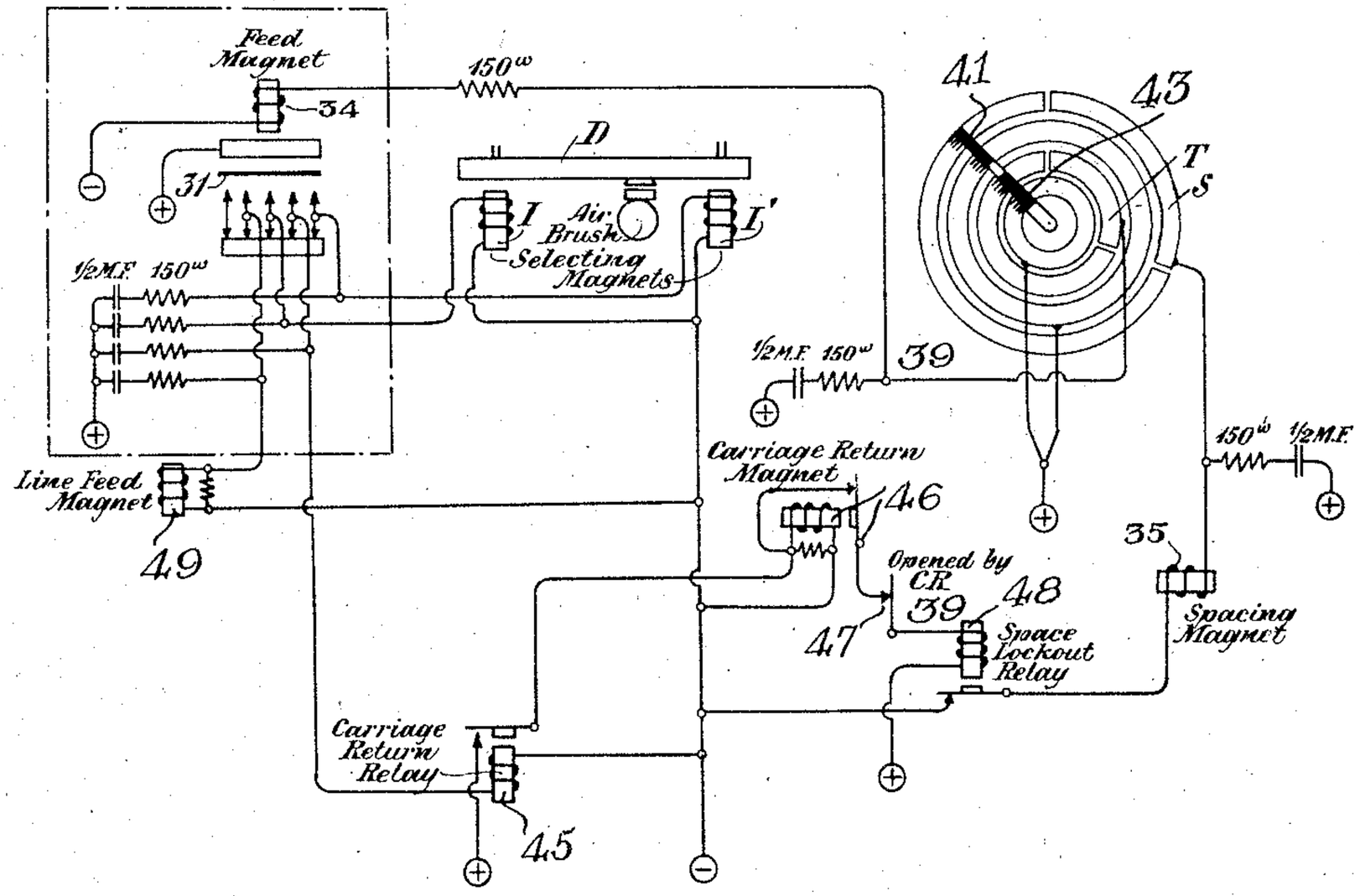

Fig. 5

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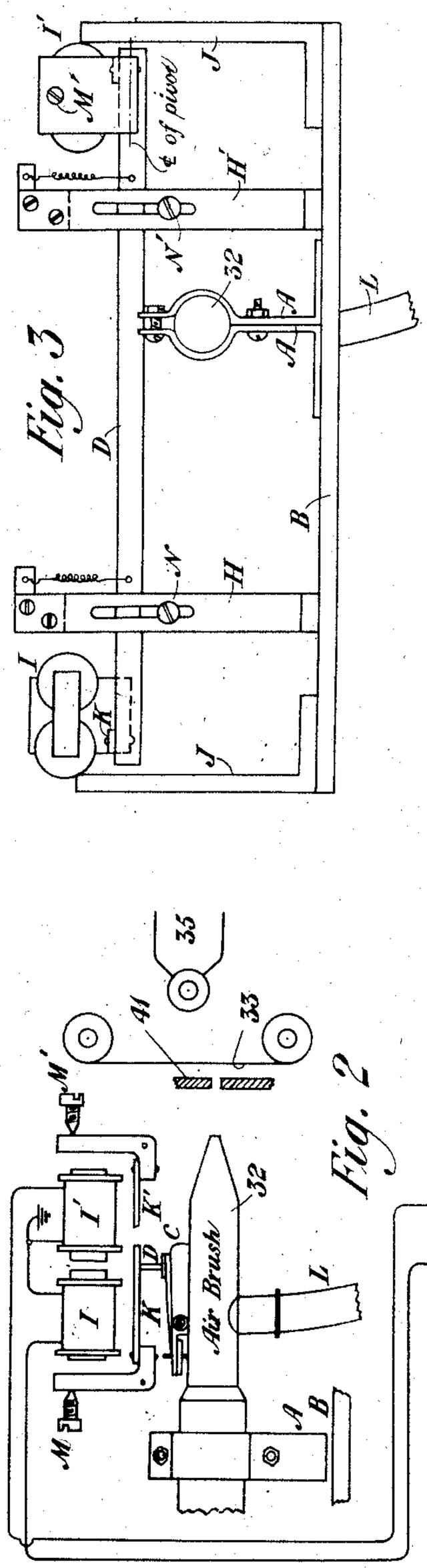

Fig. 3

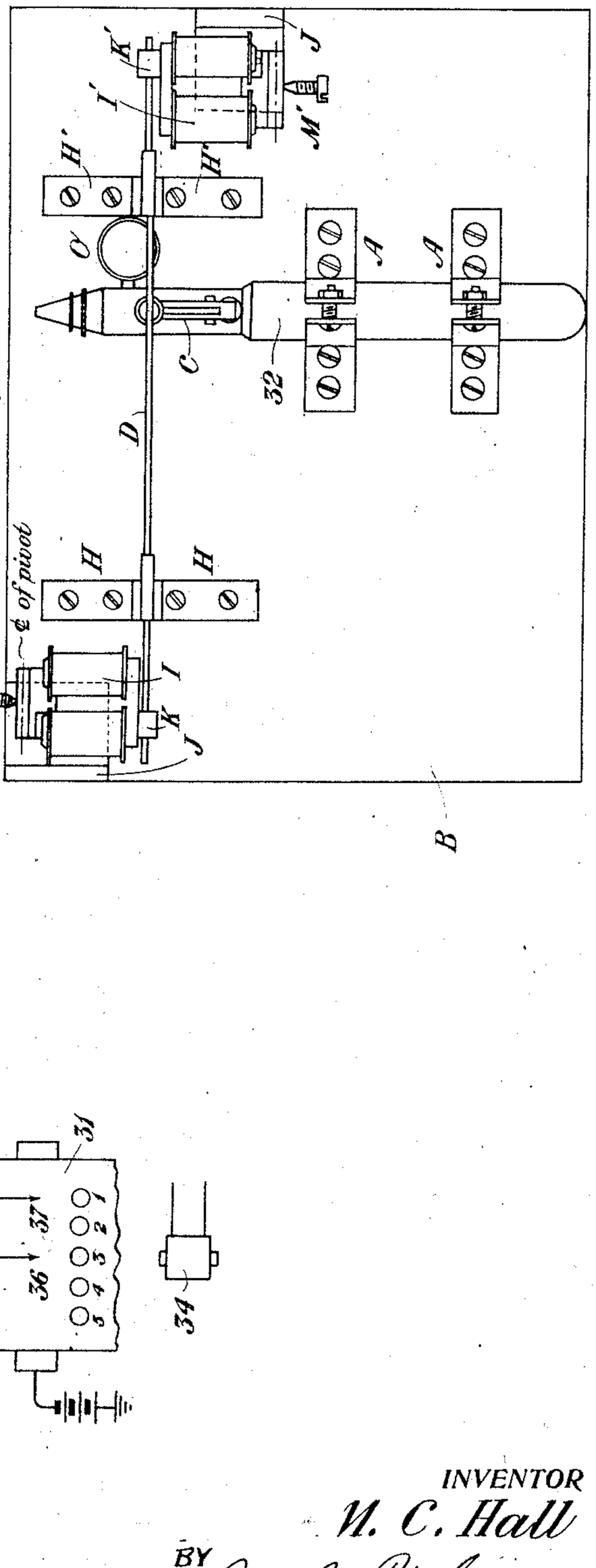

Fig. 4

Fig. 2

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UNITED STATES PATENT OFFICE.

MERTON C. HALL, OF NEW YORK, N. Y., ASSIGNOR TO AMERICAN TELEPHONE AND TELEGRAPH COMPANY, A CORPORATION OF NEW YORK.

SYSTEM FOR TRANSMITTING AND REPRODUCING PICTURES.

Application filed December 20, 1923. Serial No. 681,850.

The principal object of my invention is to provide a new and improved method and suitable apparatus for transmitting pictures to a distance and reproducing them at the receiving point. Another object of my invention is to provide for reproducing a transmitted picture by means of an air brush directed to successive elements of a picture receiving surface. Another object is to transmit code combinations corresponding to the degree of light or shade of the successive picture elements and to operate an air brush at the receiving end governed in accordance with these code combinations. These and various other objects of my invention will become apparent on consideration of a disclosure of one way in which my invention may be practiced. It will be understood that the following specification relates to this particular embodiment of the invention and that the invention is defined in the appended claims.

Referring to the drawings, Figure 1 is a diagram of apparatus at the transmitting end; Fig. 2 is a side elevation of the picture recording apparatus at the receiving end; Fig. 3 is a corresponding end elevation; Fig. 4 is a corresponding top plan view; and Fig. 5 is a diagram of the receiving apparatus.

At the transmitting end the picture in the form of a semi-transparent film 12 is wrapped on the glass drum 13 which is rotated step by step, and traversed relatively slowly in the direction of its axis by the engagement of the screw threads 14 with the rack 15. Light from the source 10 is reflected by the mirror 11 within the drum 13 through the film 12 and the hole 17 in the screen 16 and is focused by the lens 18 on the photoelectric cell 19.

The quantity of light falling on the photoelectric cell 19 governs the current in circuit therewith and therefore determines the voltage on the grid of the three-electrode vacuum tube amplifier 20. Thus it will be seen that the output current of the amplifier 20 will vary in accordance with the degree of shade in the film 12 at the part thereof in registry with the hole 17.

The output current from the amplifier 20 passes through three marginal relays in series, 21, 22 and 23. The adjustments are made so that for white in the picture none of these relays picks up; for light grey 21 only picks up; for dark grey 21 and 22, but not 23, pick up; and for black all three of them pick up.

It will readily be seen in Fig. 1 that the circuits are so arranged that the magnets 24 and 25 are energized according to the following table; magnet 24 or 25, when energized, determines that a hole shall be punched in the corresponding position on a tape 30, which is advanced step by step to correspond with the stepped rotation of the drum 13. One manner of controlling the tape punching and feeding operations is disclosed in the copending application, Serial No. 681,853, filed December 20, 1923. Said application also discloses means for automatically punching the carriage return and line feed codes in addition to the codes representing the picture shades.

Shade.	Marginal relays.	Relays 24 and 25.	Code.
White	None.	Neither.	– –
Light grey	21	24	0 –
Dark grey	21, 22	25	– 0
Black	All.	Both.	0 0*

The shades referred to in the first column of the foregoing table are the shades in the picture, which are not necessarily the same as in the film.

The tape prepared in this way is sent through a transmitter as for printing telegraphy, and at the receiving end the corresponding impulses operate a machine to punch out a similar tape. The received tape 31 in Fig. 2 determines the operation of an air brush, which will next be described, as shown in Figs. 2, 3 and 4. The air brush indicated generally by the numeral 32 receives compressed air through the conduit L and ink from the well O, and the quantity of ink delivered is determined by the extent to which the valve lever C is depressed. The air brush 32 is supported by the standard A on the base B which also carries the supports J for the two magnets I and I′. When energized, these magnets cause their respective armatures K and K′ to press down on the respective ends of the floating lever D which rests across the valve lever C. By means of the armature back stops M and M′ and the stops N and N′ in the guides H and H′, the range of travel of the ends of the lever D is determined. As shown in Figs. 3 and 4, a certain displacement of the arma-

ture of magnet I will depress the valve lever C only about half as much as the corresponding displacement of the armature of magnet I′. Accordingly when neither I nor I′ is energized, the valve is closed; when I alone is energized, the valve is opened to a degree that we may call one unit; when I′ is energized, the air brush valve is opened two units; and when both I and I′ are energized, the air brush valve is opened three units.

The magnets I and I′ are operated or non-operated according to whether or not a hole is punched at positions 3 and 1, respectively, on the tape 31. When a hole is punched at position 3, the brush 36 makes contact through it with the metal cylinder to which battery is connected. Current then flows through magnet I to operate it. Similarly, when a hole is punched at position 1, current flows through I′ to operate it.

The picture receiving sheet 33 is moved step by step before the air brush 32, and at each step it receives ink from the air brush 32 so that if the air brush valve is closed, the impressed shade is white; if open one unit, the impressed shade is light grey; if open two units, dark grey; and if open three units, black.

Between the picture receiving surface 33 and the nozzle of the air brush 32 is a screen 41 with a hole defining an element of the picture. The screen stops the sprayed ink except at the hole and limits and defines the element of the surface 33 to which the ink is applied.

Fig. 5 shows circuit arrangements suitable for controlling the various functions of the receiving device. The tape at the transmitting end as prepared in the manner hereinbefore described is employed to send code impulses over the line and by means of well known apparatus, a similar tape is produced at the receiving end. This tape 31 is passed through the tape transmitter 50 to control a page printer with which is associated the distributor 39. The brushes of distributor 39 make one revolution for each code combination in the tape 31. Just after the magnets I and I′ have been operated, brush 41 engages segment S, and operates magnet 35 which causes the paper 33 to be advanced across its length one step. At the same time, brush 43 engages segment T and operates the tape feed magnet 34, advancing the tape to the next position. When a carriage return combination occurs in the tape, relay 45 is operated and in turn operates the carriage return magnet 46 to restore the paper 33 to its initial position at the beginning of the line. When the carriage starts to return, the contacts 47 are mechanically closed, causing relay 48 to operate. The operation of relay 48 at this time prevents the letter spacing operation during the return of the paper carriage. When the carriage is completely returned, contacts 47 open to release relay 48 and to condition magnet 35 for subsequent operation. The occurrence of a line feed signal combination in tape 31 operates magnet 49 to advance the paper one step in the direction of its length. This process is repeated until each linear element of the picture 12 is tested and reproduced on the page printer.

I claim:

1. The method of transmitting a picture which consists in making a record in code form corresponding to the characteristics of the picture elements, transmitting current impulses to reproduce said record, applying coloring material to a surface at the receiving end, and electrically governing said application by the reproduced record.

2. The method of transmitting a picture which consists in making a mechanical record corresponding to the characteristics of successive picture elements, transmitting current impulses under control of said record to reproduce said record at the receiving end, applying coloring material to a surface at the receiving end, and electrically governing said application by the reproduced record.

3. In combination, an air brush, a valve controlling its operation, and two magnets connected to operate said valve additively, the effect of one magnet alone being double that of the other magnet alone.

4. Picture transmitting and reproducing means comprising means to punch a tape in accordance with the degree of light and shade of the successive elements of the picture to be transmitted, means to send current impulses to reproduce a similar tape at the receiving end, a picture receiving surface, an air brush, means to move said surface relatively to said air brush, and means to control the air brush by the tape produced at the receiving end.

5. The method of transmitting a picture which consists in making a record in code form corresponding to the characteristics of the picture elements, transmitting current impulses to reproduce said record, spraying coloring material on a surface at the receiving end, and governing said spraying by the reproduced record.

6. In combination, an air brush, a picture receiving surface before it, a screen with a hole between them defining a picture element, means to step the receiving surface along to present successive elements before the hole, and means to adjust the air brush to put the proper shades on the respective elements.

7. In combination, an air brush, a picture receiving surface before it, a screen with a hole between them defining a picture element, means to step the receiving surface along to present successive elements before

the hole, and means to adjust the air brush to put the proper shades on the respective elements in accordance with received code currents transmitting a picture.

8. Picture transmitting and reproducing mechanism comprising means for making a perforated record in accordance with the characteristics of successive elements of the picture to be transmitted, means under control of the perforated record for sending current impulses to reproduce a similar record, a receiving surface, a device for projecting coloring material to said surface, means to move said surface relatively to said device, and means to control said device by the reproduced record.

9. Picture transmitting and reproducing mechanism comprising means for making a perforated record in accordance with the characteristic shades of successive elements of the picture to be transmitted, means under control of the perforated record for sending current impulses to reproduce a similar record, a receiving surface, a device for projecting ink upon said surface, means for moving said surface relatively to said device, and means to control said device and the movement of said surface by the reproduced record.

10. Picture transmitting and reproducing mechanism comprising means for making a record in code combinations corresponding to the characteristics of successive elements of the picture to be transmitted, means under control of the record for sending current impulses to reproduce a similar record, a receiving surface, an air brush for projecting coloring material upon said surface, means for moving said surface relatively to said air brush, and means to control said air brush and the movement of said surface by the reproduced record.

In testimony whereof, I have signed my name to this specification this 19th day of December, 1923.

MERTON C. HALL.