

Sept. 24, 1946.

A. M. CARMEL
TELEVISION SYSTEM

2,408,293

Filed Oct. 14, 1944

3 Sheets-Sheet 1

Fig. 2

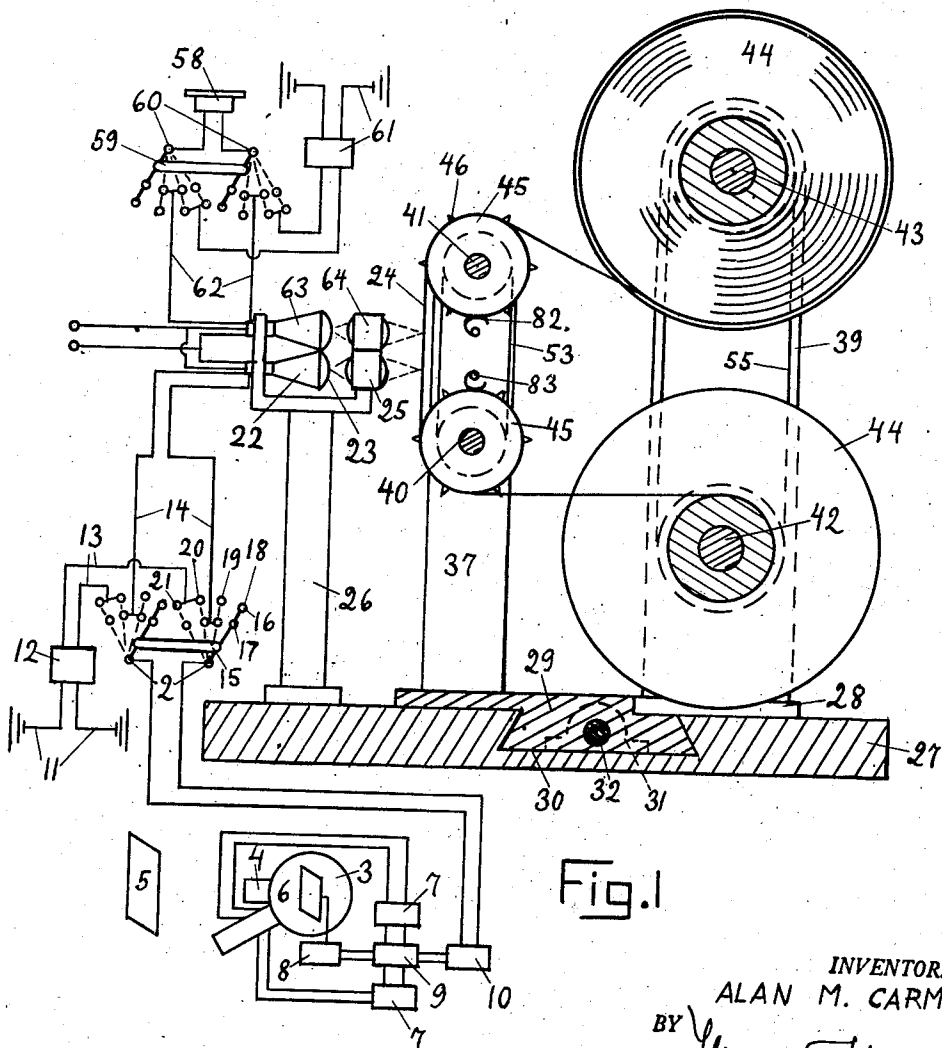
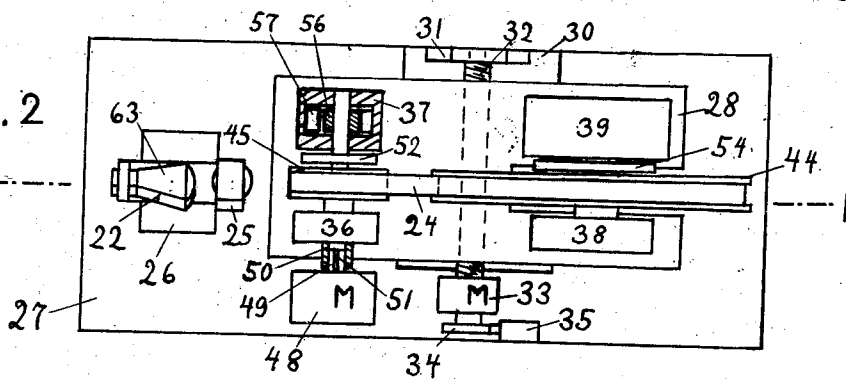


Fig. 1

INVENTOR.
ALAN M. CARMEL
BY *Maury H. Block*
ATTORNEY

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3 Sheets-Sheet 2

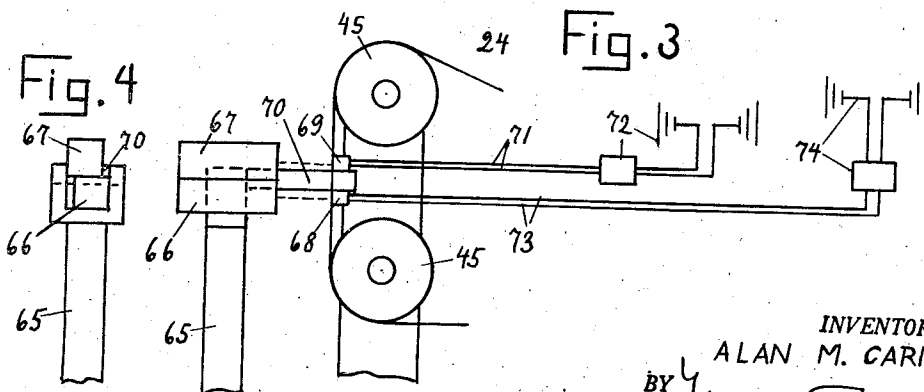
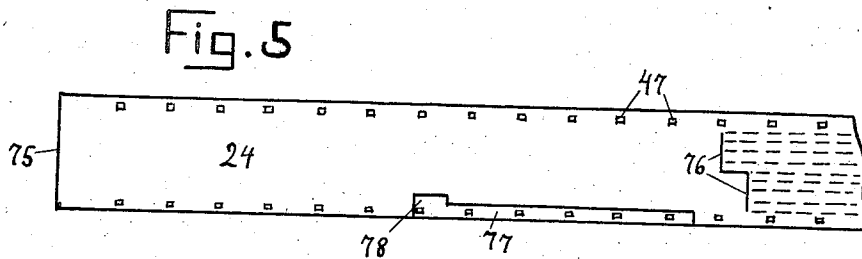
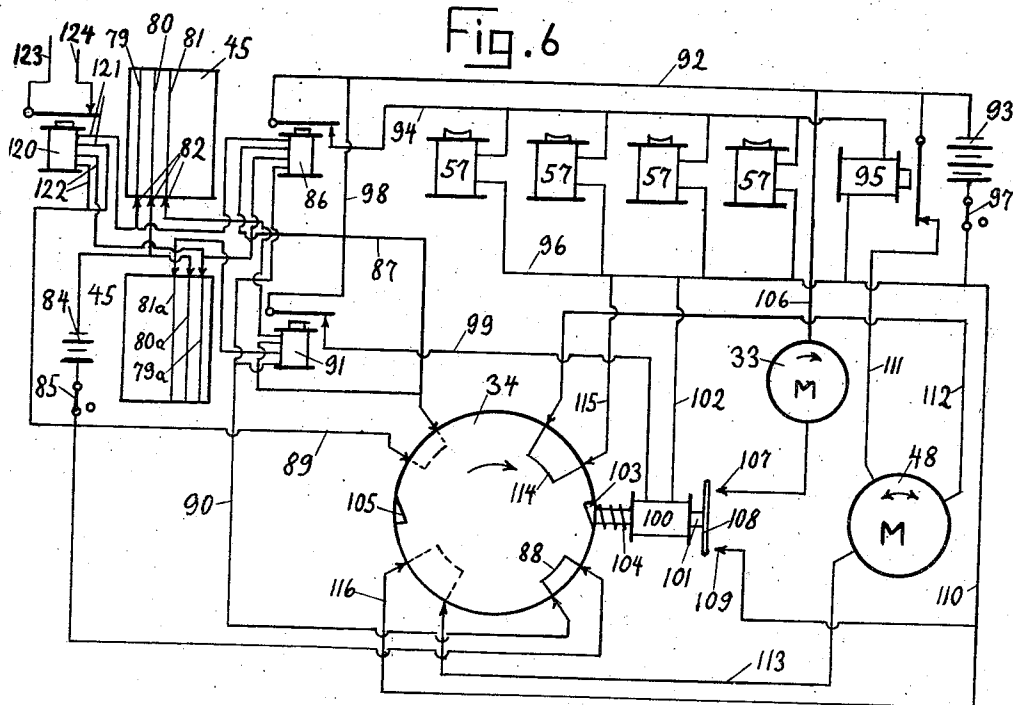
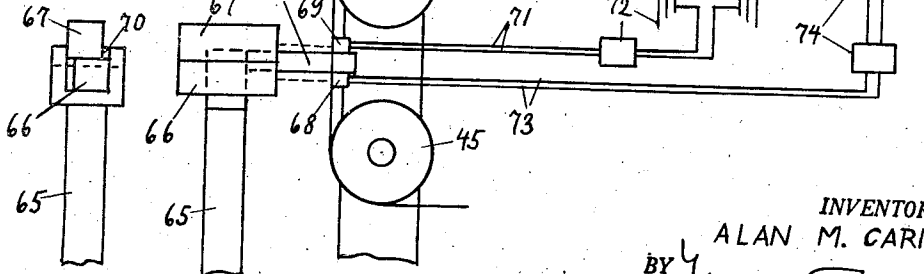


Fig. 4



INVENTOR.
ALAN M. CARMEL
BY *Wm. H. Wood*
ATTORNEY

UNITED STATES PATENT OFFICE

2,408,293

TELEVISION SYSTEM

Alan M. Carmel, Forest Hills, N. Y.

Application October 14, 1944, Serial No. 558,630

2 Claims. (Cl. 242-55)

1

My invention relates to television and its main objects are to make permanent records of television signals and to reproduce electric television signals from such records.

Other objects are to produce records of television signals which can be stored, which can be used at any future time for reproduction, which constitute documentary proof, for example, for legal or historic purposes, which can be shipped, which can be used for reproduction or broadcasting at places distant from the place of recording, which can be used several times, to make possible the distribution of television programs over unlimited distances, to make such a distribution independent from cable networks or relay stations, and to avoid distortions, expenses and other drawbacks resulting from networks or relays.

Further objects are to make records of this kind which can be multiplied inexpensively and which can be copied by photographic processes.

Still other objects are to facilitate the production of television programs, to facilitate this production in studios far from or not connected with broadcasting stations, to make possible this production in separate parts which can be reproduced coherently, to make possible the test of this production or of its parts before public reproduction, and to make possible the elimination or insertion of parts of this production.

Still further objects are to produce records of television action without motion picture equipment, to make possible the broadcasting of television action by stations which have no iconoscope or other scanning equipment, and to serve several broadcasting stations by one scanning device.

Still other objects are to make records of this kind from signals produced by conventional scanning devices, to derive the records from scanning devices operating without inertia or mechanically moving parts, except for parts for moving the record carrier, and to reproduce the recorded signals by means similarly free of inertia and in a manner adapted for broadcasting with conventional equipment and for reception with conventional receivers.

Still further objects are to record sound signals on the same carrier as the television or video signals, and to record and to reproduce sound and television signals simultaneously and synchronously. Usually television signals comprise synchronization and deflection signals in addition to signals picturing points of the scanned object, and I include the recording and reproduction of all these signals in my objects.

2

It is known that many more television signals than sound signals are required per unit of time. While sound signals have been satisfactorily recorded on motion picture films, the high frequency of television signals has been hitherto regarded as prohibiting proper recording on films. I have overcome this prejudice and have found that much more television signals than sound signals can be recorded per length unit of film due to the fact that, while sound signals must have distinguishably varying intervals, video signals may be recorded at uniform intervals requiring only the minimum length permitted by microscopic and photographic methods. Therefore, further objects are to move the record carrier with a speed just sufficient for such minimum intervals, to condense the television signals to such intervals, to make the record on a film of reasonable length and moving at reasonable speed, to make the records sufficiently small for the accommodation of several rows of signals on one film, and to record or reproduce one row after the other.

Still further objects are to use a film which is sufficiently broad to withstand the stress of its movement, to use moving means which do not cause sudden jerks or excessive stress, to provide means to gradually increase and retard the speed of the record carrier, and to provide means for reversing the moving direction and for shifting the film laterally relative to the recording or reproducing devices.

Still other objects are to use a plurality of record carriers or films, to use these carriers alternately for continuous recording or reproducing, and to utilize the time when one carrier is not used for recording or reproducing for reducing, reversing and accelerating the speed of this carrier.

Still further objects are to control the speed of the carriers and the switching from one carrier to another by markers carried by the record carriers.

Still other objects are to achieve all these results with relatively simple, inexpensive, effective and reliable means.

Still further objects and advantages will appear from the following description of an exemplifying embodiment of my invention, from the appended claims and from the accompanying drawings in which:

Fig. 1 shows a recording device according to my invention, some parts being shown diagrammatically, other parts in a vertical side elevation, some

3
of the latter parts being shown cut along the line 1-1 in Fig. 2.

Fig. 2 shows parts shown in Fig. 1, seen from the upper side in Fig. 1.

Fig. 3 shows a reproducing device according to my invention, some parts being shown diagrammatically, other parts in a side elevation corresponding to Fig. 1, some parts which are identical with the recording device shown in Fig. 1 being omitted.

Fig. 4 shows some parts shown in Fig. 3, seen from the left side in Fig. 3.

Fig. 5 shows a partial view of a film used for my invention, seen from the right side in Figs. 1 and 3.

Fig. 6 shows a schematical diagram of the means controlling the movement of the film.

Fig. 7 shows a partial view of a film used in a modification of the invention.

Fig. 8 shows a schematical diagram of control means used additionally in this modification.

Referring to Fig. 1, numeral 2 indicates the terminals of a television signals producing device which may have any known and suitable structure and, for example, may comprise a cathode ray oscillograph or iconoscope 3 with a camera 4 projecting a picture of an object 5 on a screen. This device may be further equipped in known manner with two deflection oscillators 7 and amplifiers 8, 9 and 10. According to the usual method, the produced television signals are conducted to a sender or transmitter, for example, by wires 13. This sender may comprise an ultra-short wave generator 12 and an open aerial-earth circuit 11 adapted to broadcast waves carrying the television signals.

The same signals are according to my invention conducted to a recording device, for example by wires 14, instead to the sender or in addition thereto. The transmission of the television signals to the wires 14 may be effected in any suitable manner, for example by conductive connection with the terminals 2. In the shown embodiment, the terminals 2 are connected to the turning points of a double arm switch 15, each arm of which carries two contacts 16 and 17. The switch 15 can be set in any of four positions 18, 19, 20 or 21. In the position 18 indicated by a full line for each arm, the terminals are disconnected. In the position 19, the terminals are connected through the contacts 17 to wires 14. In the position 20, the terminals are connected in the same way and also through the contacts 16 to the wires 13. In the position 21, the terminals are connected to the wires 13 alone.

The television signals supplied by wires 14 are transformed into light signals preferably by a device free of inertia, for example, by a cathode ray tube 22 of which the raying intensity or brightness of the light spot is modulated or controlled by the electric signals in known manner. The light rays originating from the screen 23 of the tube 22 and indicated in Fig. 1 by dotted lines are projected on a photographic film 24 preferably by a camera or lens system 25 of known and suitable structure.

The tube 22 and the camera 25 may be mounted on a common bracket 26 (Figs. 1 and 2) affixed to a base plate 27. During the recording operation, the film 24 moves in its longitudinal direction across the light beam projected by the camera 25 and with a speed sufficiently high to record the signals in a row, one after the other,

for example, with a speed not less than 10 yards per second. Preferably several rows of signals are recorded on the same film. Each subsequent row may be recorded after the moving direction of the film has been reversed, and the position of the film relative to the camera has been shifted across the film. All these movements may be effected by any suitable means, for example by the device described in the following.

A plate 28 is supported on an even surface of the base plate 27 and has a lower extension 29 fitting a groove or recess 30 of 27 slidably in direction perpendicular to the moving direction of the film 24. At one end of the groove 30, a bearing 31 is affixed to the base plate and rotatably supports the end pin of a shaft 32 passing through a threaded bore of the plate 28 or its extension 29 and having an outer screw thread engaging the thread of this bore. The other end of the shaft 32 is coupled with the shaft of a motor 33 affixed to the base plate 27 whereby rotation of this motor moves the plate 28 in the direction of the shaft 32. A disk 34 is co-axially affixed to an extension of the shaft of the motor 33 and can be engaged by a stopping device 35. The parts 34 and 35 and their functions will be described more fully later with reference to Fig. 6.

Four brackets 36, 37, 38 and 39 are mounted on the plate 28. Two parallel shafts 40 and 41 are rotatably supported in bores or bearings of the brackets 36 and 37. Similarly, two parallel shafts 42 and 43 are supported by the brackets 38 and 39. Each of the shafts 42 and 43 carries a reel 44 adapted to receive the film 24. Each of the shafts 40 and 41 carries a drum or wheel 45 coupled with the carrying shaft. The film runs from one reel 44, for example from the upper one, over one drum 45, passes before the camera 25 and runs then over the other drum to the other reel. The drums 45 may be provided with teeth 46 engaging small slots or perforations 47 (Fig. 5) provided in the film.

A motor 48 has a shaft 49 co-axially coupled with the shaft of one of the drums 45, for example with the shaft 40. The motor 48 may be mounted on the base plate 27, and its shaft 49 may have an end projecting into a tube-shaped extension 50 of the co-axial drum shaft and slidable in this extension in axial direction. In the rotating direction, the parts 49 and 50 may be coupled in any suitable manner, for example by a flat key 51.

Brakes are provided for one drum or preferably for all drums and reels. These brakes may be arranged, for example, in spaces located in the brackets 37 and 39 and may be constituted by iron cores 56 affixed to the braked shaft and surrounded by stationary brake magnets 57. The operation of these magnets will be described later with reference to Fig. 6.

The driving force of the motor 48 and the inert and braking forces acting on the shafts 40, 41, 42 and 43 are mutually transmitted. At least the transmission from one drum to the other does not rely on the film 24, but on a separate transmission which may comprise two wheels 52 affixed respectively to the shafts 40 and 41 and connected by a chain or belt 53. An exactly equalized rotation of the reels 44 may be secured by wheels 54 affixed respectively to the shafts 42 and 43 and connected by a chain or belt 55 whereby the length of the film portion between the two reels remains constant under all cir-

cumstances, and the film moves with a minimum of stress.

Preferably, sound signals are recorded simultaneously on the same film whereby television and sound signals are automatically synchronized. Electric sound signals may be produced in known manner, for example, by a device comprising a microphone 58. A double arm switch 59 constructed in a manner corresponding to the switch 15 may be connected to the terminals 60 of the microphone circuit. This switch 59 permits the sound signals to be conducted either to a sender 61 constructed similarly as the sender 11, 12, but operating with another wave length, or instead or in addition thereto, to wires 62 connected to the recording device.

These wires conduct the sound signals to a cathode ray tube 63 where they are transformed into light signals which are projected by a camera 64 on the film 24, the function and arrangement of the parts 63 and 64 corresponding to those of the parts 22 and 25. The tubes 22 and 63 as well as the cameras 25 and 64 are preferably so positioned that the two foci or recording spots on the film have a distance in the direction of the film movement whereby a favorable parallel and equidistant position of these tubes and cameras is made possible. In addition, the two foci have a distance in the crossing direction whereby the records will appear on the film in different rows as will be described later with reference to Fig. 5.

After the photographic film 24 has been exposed to the light signals and, eventually, has been developed and fixed in known manner, the film shows rows of a transparency varied or modulated according to the intensity of the signals. This film may be stored, shipped and used for reproduction of the electric signals at any place and time. During the reproducing operation, the film is moved in substantially the same manner as during the recording, and the same moving device comprising motors 33 and 48, reels 44, drums 45 and so on, or an identical device may be used for the reproduction. In so far as this moving device is concerned, Fig. 1 may be regarded as an illustration also of the reproducing device. The equipment particular to the reproduction is illustrated in Figs. 3 and 4.

In these figures, 65 indicates a bracket mounted in a manner similar to the bracket 25 and supporting a light source or projector 66, or, if sound signals are reproduced together with television signals, also a second light projector 67. These projectors may have any known structure adapted to direct strong, thin light beams or rays (indicated by dotted lines) on the film 24. The position of the projectors 66 and 67 corresponds to the position of the cameras 25 and 64 in Fig. 1 so that these rays hit the film at spots where corresponding signals are recorded. The rays pass more or less completely through the film and enter photo-electric cells 68 and 69 respectively which are positioned immediately at the other side of the film and generate electric signals of an intensity varying according to the transparency of the film whereby these signals correspond to the original electric signals recorded on the film. The cells 68 and 69 may have any known and suitable structure and may be supported in a fixed position relative to the light sources by an U-shaped arm 70 affixed to the bracket 65.

The electric signals reproduced by these cells may be used for sending or broadcasting in the

same manner as original signals. For example, they may be conducted by wires 71 to a sender 72 or by wires 73 to a sender 74 respectively which senders may be similarly constructed as the sender 11, 12.

Referring to Fig. 5, 75 indicates one end of the film 24 which is affixed to one reel 44, the other end being affixed to the other reel. The area used for the record begins at some distance from the end 75, for example, at the broken line 76. Preferably the film is made sufficiently broad to withstand considerable stress, for example, 35 millimeters wide. This width and the small height of the microscopic signals recorded makes it possible to divide the recording area into margins for the perforations 47 and into a large number, for example twenty, of signal rows of which only a few are indicated by dotted lines. Half of these rows may be used for television and the other half for sound signals. Preferably, the sound signal rows are positioned at one side, for example at the lower side in Fig. 5, and the television signals are positioned at the other side, each two co-operating television and sound signal rows having always the same distance.

Means to control the movement of the film are provided as will be described later with reference to Fig. 6. These means are preferably switched by the film which, for this purpose, may carry a marker, for example a very thin metallic layer 77 extending near the end 75 preferably along a margin of the film. The portion of this layer which is nearest to the end 75 is broadened by an extension 78. The other end of the film carries a corresponding layer and extension, preferably at the opposite margin. The measures and the positions of 77 and 78 are determined according to their relationship to other parts of the device which relationship will be described in the following. The length of the layer 77 is shown relatively reduced for the sake of better representation, and also the other measures of Fig. 5 have been adapted to this purpose.

Fig. 6 shows the drums 45 schematically. One drum carries three circular conductors flushing with the cylindrical surface of the drum. These conductors may be formed by wires 79, 80 and 81 positioned in grooves of a cylindrical drum body of insulating material. These wires are preferably positioned near one edge of the drum and parallel to this edge and have small distances which are shown exaggerated for the sake of clearer representation. When the marker or layer 77 runs over the drum, this layer conductively connects the conductors 79 and 80 and, at the time when the extension 78 runs over the drum, also the conductors 80 and 81. The other drum carries similar conductors 79a, 80a and 81a similarly positioned near the opposite edge of this latter drum and similarly connected when the layer of the other film end runs over the latter drum.

Each of these circular conductors is in permanent sliding contact with one of six resilient contacts 82 (Fig. 1) stationarily supported in any suitable manner, for example by insulating bolts 83 affixed to the bracket 36, and indicated by arrows in Fig. 6. Over such contacts, the conductors 80 and 80a are connected to one pole of a current source 84, the conductor 79 is connected over the exciting circuit of a relay 85 to a wire 87 terminating in a contact sliding on the disk 34. This disk carries a conductor 88 which, only in that position of the disk which is a half turn remote from the shown position, con-

nects the wire 87 to a wire 89 as indicated by a dotted line. The wire 89 is connected over a master switch 85 to the other pole of the current source 84. The relay 86 can be operated by a second exciting circuit having one pole connected to the conductor 79a and the other pole connected to a wire 90 which, in the shown position of the disk 34, is connected by the conductor 88 to the wire 89.

Another relay 91 can be also operated by two separate circuits which are supplied with current in the same manner as the described circuits operating the relay 86, except that, with respect to relay 91, conductor 81 takes the place which conductor 79 has with respect to relay 86, and correspondingly, conductor 81a takes the place of conductor 79a.

The switch operated by relay 86 has one pole connected over wire 92 to one pole of a current source 93 which may, for example, be constituted by the poles of an electric power network. The other pole of this switch is connected over wire 94 to several parallel branch wires in which the exciting circuits of the brake magnets 57 and of the interrupter relay 95 are inserted. One brake magnet is shown in each of four branch wires, but any desired number of such magnets arranged parallel or in series may be used. Beyond the parts 57 and 95 the branch wires are connected over wire 96 and a master switch 97 to the other pole of the current source 93.

The switch operated by the relay 91 has one pole connected by wire 98 to wire 92 and one pole of the current source 93. The other pole of this switch is connected by wire 99 to the exciting circuit of a solenoid 100 having an axially movable core 101 and being the essential part of the stopping device 35. Beyond the solenoid 100, this circuit is connected by wire 102 to wire 96, switch 97 and current source 93.

One end of the core 101 carries a head 103 affixed to the core and pressed against the disk 34 by a spring 104. The disk has two diametrically opposite recesses 105 fitting the head 103. In the shown arrangement, the disk can move in clockwise direction until the head 103 engages one of the recesses 105. Preferably, the leading wall of each recess 105 is obliquely, and the lagging wall is perpendicularly positioned with respect to the periphery of the disk, and the head 103 is correspondingly shaped whereby the disengagement occurs substantially instantaneously and the engagement somewhat slower.

The electromotor 33 coupled co-axially with the disk 34 is symbolically represented at another place in Fig. 6 for the sake of clearer representation. One pole of this motor is connected over wire 106 to wire 92 and the current source 93. The other pole is connected to a contact 107. The right end of the core 101 carries a contact arm 108 which is insulated from the core and connects the contact 107 with a contact 109 when the core is in a position disengaged from the disk 34. The contact 109 is connected by wire 110 to the switch 97 and the other pole of the current source 93.

The reversible electromotor 48 may run in either of the two rotating directions depending in known manner on which of its two circuits is supplied with current. These two circuits may have a common pole connected by wire 111 to one pole of the switch of the relay 95. The other pole of this switch is connected to one pole of the current source 93. The alternately used two other poles of the motor 48 are connected by

wire 112 or 113 respectively to contacts contacting the disk 34 at diametrically opposite points. The disk 34 carries a conductor 114 which, in the shown position of the disk, connects the wire 112 to a wire 115 and thereby to wire 96 and the other pole of the current source 93. In the opposite position of the disk, the conductor 114 connects wire 113 to a wire 116 (as indicated by dotted lines) and thereby to the latter pole of the current source.

The operations described in the following are identical for both the recording and the reproduction of the signals.

At the beginning, the substantial part of the film is wound around one of the reels 44, for example, the upper reel in Fig. 1. The other reel is empty except for the affixed end 75 (Fig. 5). All parts are in the positions shown in the figures. The relays 86, 91 and 95 do not operate whereby, according to their structure, the switches of the relays 86 and 91 are open, and the switch of the relay 95 is closed. The film is in a position where the metallic layer 77 and its extension 78 positioned near the leading end of the film contact the conductors 79, 89 and 81. This does, however, not excite the relays 86 and 91 because the wires 87 and 89 are disconnected. The master switches 85 and 97 are closed and remain closed throughout the operation.

As soon as the master switch 97 closes, the motor 48 starts in that direction which corresponds to the circuit comprising the wires 112 and 115 and which rotates the drums in anticlockwise direction (Figs. 1 and 3) winding the film from one reel to the other. After a very short time, the motor 48 reaches its full speed and the recording or reproducing operation described before begins, the film having just reached that position where the line 76 is in the proper position before the cameras 25 and 64 or the light projectors 66 and 67.

The motor 48 keeps running with uniform speed until the layer 77 near the lagging end of the film connects the conductors 79a and 89a. This closes one of the circuits operating the relay 86. Consequently, the switch of this relay closes the circuits operating the brake magnets 57 and the interrupter relay 95. The latter relay interrupts the circuit operating the motor 48. Due to the action of the brake magnets, the speed of the drums, of the film and of the motor 48 is quickly reduced. During this braking period, the film moves a little farther, and the extension 78 contacts the conductors 80a and 81a at that time when the motor comes to a standstill.

At this moment, the connection of the conductors 80a and 81a closes one of the circuits operating the relay 91. Consequently, this relay closes the circuit operating the solenoid 100. The solenoid pulls the core 101 to the right side, thereby disengaging the head 103 from the disk 34 and pressing the contact arm 108 against the contacts 107 and 109. This closes the circuit operating the motor 33. This motor starts and turns the disk 34 in clockwise direction whereby the conductors 88 and 114 are disconnected from the respective co-operating contacts. This interruption stops the operation of the relays 86 and 91, the relay 86 consequently interrupting the circuit operating the brakes and the relay 95, and the relay 91 consequently interrupting the circuit operating the solenoid 100. The relay 95 releases its switch into the closing position, but the motor 48 remains without current because

the conductor 114 does not close either of the two motor circuits.

The motor 33 turns the disk 34 until, after a half turn, the spring 104 presses the head 103 into the next recess 105 whereby the core 101 moves to the left side and causes the arm 108 to disconnect the contacts 107 and 109. The head 103 now stops further rotation of the disk which might result from inertia.

During the rotation of the disk 34, also the threaded shaft 32 (Fig. 2) has made a half turn and has shifted the plate 28 together with the drums and the film into a position proper for the next rows of signals (television and sound).

After the disk has made this half turn, the conductors 88 and 114 connect respective contacts positioned diametrically opposite to the contacts originally connected by these conductors. The circuit operating the motor 48 in opposite direction is hereby closed, and the entire process described is repeated with the film running in opposite direction. At the end of this second run, the movement is again braked, the film is shifted to the next rows, and the motor 48 is eventually started in again reversed direction in the manner described before. This is repeated until all rows of signals have been used.

The power of the motor and of the brakes is preferably so measured that each period from the beginning of the braking to the full speed in reversed direction takes only a small fraction of the time required for the entire run of the film. If it should be desired to interrupt the scanning, the recording, the light projecting or any other described operation during this reversing period, one or more additional relays 120 may be provided. Each relay 120 may be excited by circuits 121 or 122 which are supplied by the current source 84, comprise either the conductors 79 and 80 or the conductors 79a and 80a, and are closed by the layers 77. The switch of a relay 120 may be used to interrupt the connection between two wires 123 and 124 which may be parts of a circuit used in any of the devices shown in Figs. 1 and 3, for example parts of the circuit 14, of the circuit 62, of the circuit 71 or of the circuit 73, whereby the transmission of signals is interrupted whenever the film does not move at full speed.

According to a modification of my invention, ample time is provided for reducing, reversing and accelerating the speed of the film and for shifting from one row to another, and an uninterrupted recording or reproduction is obtained by using a plurality of signal carriers or films alternately and by switching from one carrier to another at the end of a row of signals. Each of these films may be operated by a separate device substantially identical to that described before, except for certain modifications of the control system which will be described in the following:

For example, two recording or reproducing devices are used, each of which includes a film comprising several rows in a manner similar to the film 24. Preferably, the recording or reproducing operation of the two devices alternate so that, after the first row of the first film has been used, the first row of the other film is used, thereafter the second row of the first film, the second row of the other film and so on until all rows of both films have been used.

In the following description of this modification, those parts of the first device which are identical with parts described before with refer-

ence to Figs. 1 to 6 are indicated by the same numerals as before, and some parts of the second device are indicated by numbers computed by adding 100 to the numbers indicating the identical parts of the first device.

Referring to Fig. 7, the film 125 of the first device differs from the film 24 (Fig. 5) merely in that the positions and measures of the markers 77 and 78 are so modified as required by the modified position of the conductors 79, 80, 81, 79a, 80a and 81a (which will be described later) and by longer braking time, and in that the film 125 carries additional markers controlling the switching from one device to the other. These additional markers may consist of two conductive layers 126, one near the inner end of each layer 77, and of two layers 127 positioned farther in the moving direction to the median part of the film at a suitable distance. All layers near the leading end of the film are positioned at one margin of the film, and all layers near the lagging end are positioned at the opposite margin. The film 225 of the second device carries corresponding markers 226 and 227.

Referring to Fig. 8, the drums 45 are provided with circular conductors 79, 80 and 81 or 79a, 80a and 81a respectively which are identical to the conductors indicated with the same numerals in Fig. 6, the conductors 80 and 80a being connected to one pole of the current source 84, and the conductors 79, 79a, 81 and 81a being connected to the other pole of this source in the manner and over the wires and devices shown in Fig. 6. All these circuits are controlled by the markers 77 and 78 of the film 125 in the manner described before with reference to Fig. 6.

In the modified system, the conductors 79 and 81 or 79a and 81a respectively are positioned at one side of the conductor 80 or 80a respectively. On the other side, an additional, similar conductor 128 or 128a respectively is arranged which conductor can be connected to the conductor 80 or 80a respectively by the layers 126 and 127, those of these layers which are positioned near one end of the film 125 co-operating with the conductors 80 and 128, and those of these layers which are positioned near the other end of the film co-operating with the conductors 80a and 128a. The second device comprises two drums 145 with conductors 179, 180, 181, 228, 179a, 180a, 181a and 228a.

The control systems of both devices may be supplied with current from two common sources 84 and 93. Each of the two systems comprises a control system identical to that described before with reference to Fig. 6, except for the modifications described in the following with reference to Fig. 8. Fig. 6 is to be regarded as a twice used supplement to Fig. 8, only those parts of Fig. 6 being shown again in Fig. 8 which are necessary to show the co-operation with the additional control means of the modified invention, other parts which operate in exactly the same manner as described before being omitted in Fig. 8 for the sake of clearer representation.

The additional control system comprises a motor 129, and two disks 130 and 131 driven by the motor 129. Preferably, the parts 129, 130 and 131 are coupled co-axially, and the two disks may be combined in one disk, these parts being shown separately merely for the sake of clearer representation.

A relay 132 can be operated by either of two exciting circuits. One of these circuits is connected on one side over sliding contacts similar

to 82 to the conductors 128 and 228 and on the other side to a contact 133 sliding on the disk 130. The contact 133 can be connected to another sliding contact 134 by either of four conductors 135 carried by the disk 130. The contact 134 is connected over wire 137 to the other pole of the current source 84. The other exciting circuit of the relay 132 is similarly connected on one side to the conductors 128a and 228a, on the other side to a sliding contact 138 which can be connected by either of the conductors 135 to a sliding contact 139 which is connected to wire 137.

The switch arm of the relay 132 is connected on one side over wire 140 to one pole of the current source 93, and on the other side, when in a closed position, over the exciting circuit of a solenoid 141 to the other pole of 93. The solenoid 141 has an axially movable core 142 carrying a head 143 fitting each of eight recesses 144 which are equidistantly distributed over the periphery of the disk 130. When the solenoid is excited, the head 143 is withdrawn from the engagement with the respective recess 144 against the pressure of a spring 146.

The other end of the core 142 carries a contact arm 147 which is insulated from the core and, in the withdrawn position of the head 143, forms a conductive bridge between two contacts 149 and 150 whereby a circuit 140, 152, 153 operating the motor 129 is closed.

The disk 131 carries circular conductors 154, 155, 156, 157, 158 and 159 which may be positioned on the cylindrical periphery of the disk, but are shown on a broad side of the disk for the sake of clearer representation. The conductors 155, 157 and 159 form full circles. The conductor 154 has two arc-shaped gaps, each smaller than 90 degrees and filled out with insulating material indicated by dotted lines. The conductors 156 and 158 have similar gaps of about 90 degrees. Both arc-shaped parts of the conductor 154 are permanently connected to the conductor 155 by conductors 160 carried by the disk 131, and the arcs of the conductors 156 and 158 are similarly permanently connected to the conductor 157 or 159 respectively.

The wire 111 leading to the common pole of the reversible motor 48 is connected to a stationary contact slidably contacting the conductor 154, except when this contact contacts the insulating material of one of the gaps of 154. The conductors 154, 160 and 155 connect the wire 111 to another sliding contact which is connected by wire 161 to one pole of the current source 93. This connection replaces the connection shown in Fig. 6 between wire 111 and this pole of the current source. The interrupter relay 95 may be omitted in the modified system. The two other poles of the motor 48 are connected by wires 112 or 113 to the other pole of 93 in the manner shown in Fig. 6.

The corresponding motor 148 of the second device is similarly connected, a wire 211 leading to a sliding contact positioned on the conductor 154 at an angle of 90 degrees relative to the sliding contact of the wire 111.

Means are provided in the modified recording system to control the cathode ray tube 22 of the first device and that of the second device alternately by the television signals generated by the scanning device, and the same means may be used in the corresponding reproducing device for connecting the cell 68 of the first device and that of the second device alternately to the sender 74. For example, the wires 14 carrying the tele-

vision signals in the recording device, are not immediately connected to the tubes 22, but one of these wires is connected over a wire 164 to a contact slidably contacting the conductor 157 on disk 131. As said before, conductor 157 is permanently connected to conductor 156. A wire 165 is connected to a contact slidably contacting the conductor 156, except when contacting the insulating material of one of the gaps of 156, and a wire 166 is connected to a sliding contact positioned on the conductor 156 at an angle of 90 degrees relative to the sliding contact of wire 165. The other wire 14 is connected to two branch wires 162 and 163. The other ends of the wires 162 and 165 are connected to the tube 22 of the first device, and the other ends of the wires 163 and 166 are connected to the tube 22 of the second device in the manner described before with reference to Fig. 1.

In the corresponding reproducing system, one of the wires 73 which are connected to the sender 74 has its other end connected to the wire 164, and the other wire 73 has its corresponding end connected to the branch wires 162 and 163. The wires 162 and 165 are connected, instead to a tube 22, to the cell 68 of the first device, and the wires 163 and 166 are correspondingly connected to the cell 68 of the second device.

Similar control means may be provided for the sound signals. For example, wires 167, 168, 169, 170 and 171 and the conductors 158 and 159 may co-operate with the wires 62 and the tubes 63 in the recording system or with the wires 71 and the cells 69 in the reproducing system in the same manner as the wires 162, 163, 164, 165 and 166 and the conductors 156 and 157 co-operate with the wires 14 and the tubes 22 in the recording system or with the wires 73 and the cells 68 in the reproducing system.

In the modified form, the invention operates as follows:

At the start, the disks 130 and 131 are in the positions shown in Fig. 8. The relay 132 is not excited and the circuits operating the solenoid 141 and the motor 129 are disconnected. The circuit operating the motor 48 is closed over the conductors 154 and 155. The circuit operating the motor 148 is disconnected at a gap of the conductor 154. Wire 164 is connected to wire 165 over the conductors 157 and 156, and wire 169 is connected to wire 170 over the conductors 159 and 158 whereby the system is set for operation of the first device.

The operation of the first device starts in the manner described before. When the markers 126 and 127 positioned near the leading end of the film 125 contact the conductors 80 and 128, this does not close the corresponding exciting circuit of the relay 132 because this circuit is interrupted between the contacts 133 and 134.

When the marker 127 positioned near the lagging end of the film 125 contacts the conductors 80a and 128a, the other exciting circuit of the relay 132 is closed, and consequently the relay closes the circuit exciting the solenoid 141. The core 142 moves to the right side, disengaging the head 143 from the recess 144 of the disk 130 and closing the circuit operating the motor 129 by means of the contact arm 147. The motor 129 turns together with the disks 130 and 131 until, after an eighth of a turn in clockwise direction, the spring 146 moves the head 143 into the next recess 144, stopping the disks and interrupting the contacts 149 and 150. During this turning movement, the conductor 154 reaches

13

a position where this conductor closes the circuit operating the motor 148. This latter motor starts and is gradually accelerated while the motor 48 continues running at full speed and the first device continues the recording or reproducing operation.

At the time when the motor 148 has reached its full speed or shortly thereafter, the marker 126 positioned near the lagging end of the film 125 contacts the conductors 80a and 128a, turning the disks 130 and 131 a second step of an eighth of a turn in the manner described before. During this turning movement, the conductor 154 reaches a position where the circuit operating the motor 48 is interrupted by a gap in this conductor. At the same time or shortly thereafter, the marker 77 positioned near the lagging end of the film 125 causes gradual reduction of motor 48's speed and then, the extension 78 of this marker causes the film 125 to shift to the next row and switches the motor 48 from one moving direction to the reverse direction in the manner described before with reference to Fig. 6. The motor 48 does, however, not start its reverse movement before the disk 131 has made another (third) step.

Also during the second step of the disks 130 and 131, the conductor 156 loses contact with the wire 165 and, at the same moment, comes in contact with the wire 166, and the conductor 158 loses contact with the wire 170 and comes in contact with the wire 171 whereby the system is set for operation of the second device which, at this time, is running with full speed.

During the run of the second device, the system operates in the same manner as during the described run of the first device, except that the two devices have exchanged their roles. A third turning step of the disks 130 and 131 is caused by the lagging marker 227 whereby the motor 48, the moving direction of which has been reversed before, is started. A fourth step is caused by the lagging marker 226 whereby the recording or reproducing operation is switched from the second device to the first device now running in opposite direction with the second signal row in operative position.

At the beginning of each of the four first steps, one of the four conductors 135 connects the contacts 138 and 139 while the contacts 133 and 134 are disconnected. After the fourth step, the contacts 138 and 139 are disconnected, and at the beginning of each of the following four steps, the contacts 133 and 134 are connected by one of the conductors 135 whereby these latter four steps are caused by those markers 127, 126, 227 and 226 which are positioned near the other ends of the films 125 and 225. These other ends, at these

14

times, being the lagging ends due to the reversal of the movement. With the moving direction reversed and with the second rows of the films in operative position, the operation continues in the manner described before.

After the eighth turning step of the disks 130 and 131, the control system is again in its original position and the third rows of the films are in operative position. Then, the operation continues until all rows have been used.

I desire it understood that my invention is not confined to the operations and devices described and shown, the same being merely illustrative, and that my invention may be carried out in other ways without departing from the spirit of my invention as it is obvious that the operations and devices described and shown are only a few of the many that may be employed to attain the objects of my invention.

Having described the nature of my invention and how it operates, what I claim and desire to secure by Letters Patent is:

1. A device for use in a television method comprising the recording of television signals, said device comprising a film sufficiently broad for several rows of signals, a drum having a cylindrical surface contacted by one side of said film, a plurality of conductors carried by said drum on said contacted surface, a conductive layer carried by said film on said contacting surface and extending over a portion of the length of said film, means to rotate said drum and to move said film in contact with said drum, and electric circuits controlling said moving means, said circuits comprising said conductors whereby said layer acts as a temporary connection for said conductors.

2. A device for use in a television method comprising the recording of television signals, said device comprising a film sufficiently broad for several rows of signals, a drum having a cylindrical surface contacted by one side of said film, a plurality of conductors carried by said drum on said contacted surface, a conductive layer carried by said film on said contacting side and extending over a portion of the length of said film, said layer having two different parts connecting temporarily some of said conductors, one of said parts connecting conductors which are not connected by the other part, means to rotate said drum and to move said film in contact with said drum, means to brake said movement, means to shift said film across the moving direction, means to reverse said moving direction, electrical circuits controlling said braking means and comprising some of said conductors, and electric circuits controlling said shifting and reversing and comprising others of said conductors.

ALAN M. CARMEL.