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A. McL. NICOLSON

2,042,859

ELASTIC WAVE TELEVISION SYSTEM

Original Filed July 1, 1932

FIG. 1

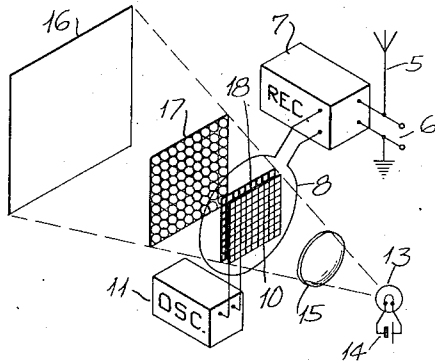


FIG. 7

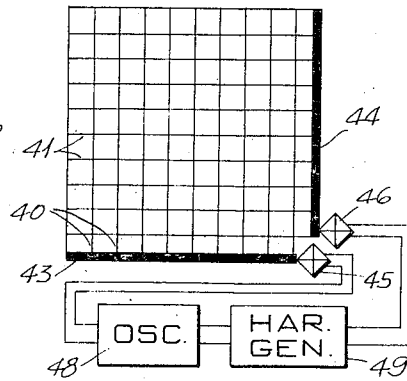


FIG. 2

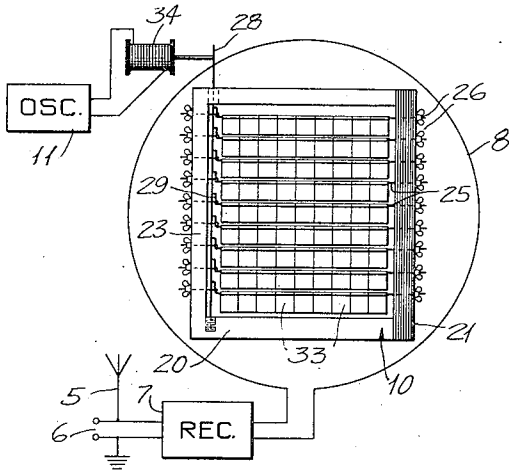


FIG. 9

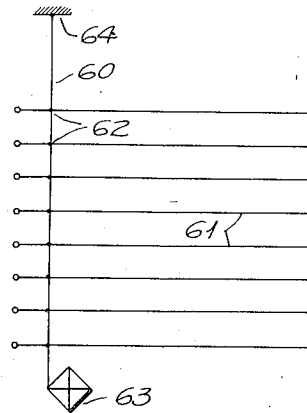


FIG. 3

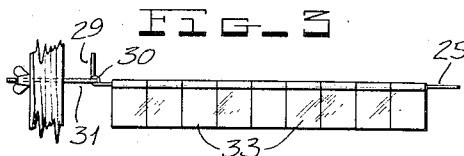


FIG. 10

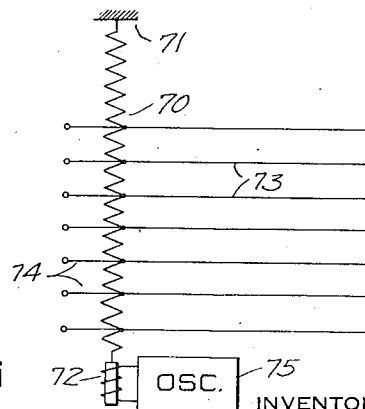


FIG. 4

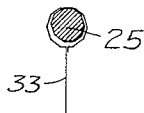


FIG. 5

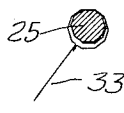


FIG. 8

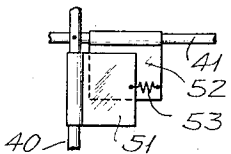
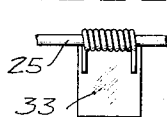


FIG. 6



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ELASTIC WAVE TELEVISION SYSTEM

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Original application July 1, 1932, Serial No.
 620,380. Patent No. 1,972,492, dated September
 4, 1934. Divided and this application Sep-
 tember 2, 1933, Serial No. 637,950

11 Claims. (Cl. 178—6)

This invention relates to electrical transmission systems, and particularly to such systems adaptable for the initiation and reception of electrical impulses characterized by the light and shade densities of objects or images thereof.

The present application is a division of co-pending application Serial No. 620,380, filed July 1, 1932 now Patent No. 1,972,492, granted Sept. 4, 1934.

An object of the invention is to initiate electrical impulses characterized by the light and shade densities of objects and transform such impulses into varying light intensities proportional thereto.

Another object of the invention is to obtain greater efficiency of reproduction of light images and to retain any desired image indefinitely.

A further object of the invention is to produce, with a given amount of light, images having a brilliancy many times greater than that obtainable at present.

A still further object of the invention is to produce a commutating effect without the use of any mechanical moving parts except that of wave motion within a metallic medium.

The present type of television transmission and reproduction of images has been based on the principle of scanning or exploring. This principle in brief, is the obtaining of electrical currents proportional to the light and shade densities of unit areas of objects in a serial order each unit area of the object or image providing a certain current amplitude or frequency which represents the light intensity value upon that unit area. It is necessary with such a system to produce all the unit areas within a time interval which permits the eye to retain the first light impulse during the entire period of scanning. Furthermore, to obtain the illusion of motion of objects, it is necessary to present each full image at the rate of at least ten images per second.

Basing further conclusions on the present standard speed of transmission which is sixty lines at twenty repetitions per second, each unit area is, therefore, presented to the eye during $1/72,000$ of a second. With sixty lines there exists approximately 3600 unit areas each of which is scanned and presented to the eye at this rate. It is obvious, therefore, that an intense light must be employed to obtain sufficient illumination for a practical sized image. If it is possible, however, to maintain the illumination of a unit area for a period of a twentieth of a second or longer, instead of the present $1/72,000$ of a second it is quite obvious that the intensity of the image will

be multiplied many fold without increasing the intensity of the light source itself.

The above feature is presented in the following disclosure together with a commutator operating without mechanical moving parts except the movement of certain mediums caused by the transmission of waves therethrough. It is well known mechanically that the speed of transverse waves along elastic mediums such as a wire is determinable by the tension in the wire and the nature of the material making up the wire. These waves may be propagated at a rate exceeding 2000 feet per second. In the same type of medium a longitudinal wave may be propagated at even greater speeds. In the present disclosure one or both modes of vibration are utilized, some modifications employing the heterodyne principle well known in the electrical art in which two elastic frequencies produce a beat note to which a mechanical element is resonant.

To obtain the persistency effect, that is, the retention of the light on a unit area for a period of approximately $1/20$ th of a second, a plurality of shutters or gates representing each unit area is adjusted by the incoming current impulses to pass a quantity of light proportional to the strength of the incoming impulse. This gate or shutter adjustment is maintained during the time period required to adjust the other shutters and continues in its original adjustment until such instant as the light intensity changes for that unit area. A system is thus disclosed in which only the shutters representing unit areas varying in intensity are operated thereby providing, in effect, a constant image. An oscillator of the periodic type provides the timing impulses for the shutters which when disconnected permits the maintaining of any image present at the instant of disconnection.

The invention may be more fully understood by reference to the following detailed description read in conjunction with the accompanying drawing in which:

Fig. 1 is a diagrammatic view of a receiver.

Fig. 2 is an elevational view of the persistent screen employed in the system.

Figs. 3, 4, 5 and 6 are detailed views of the shutter employed in the screen of Fig. 2.

Figs. 7 and 8 are view of a heterodyne type of shutter screen; and,

Figs. 9 and 10 are modifications of elastic wave transmitters for operating the screen of Fig. 2.

Referring specifically to Fig. 1 which is illustrating a receiving system, an antenna 5 or wire terminal 6 may impress on a receiver 7 incoming

currents characterized by the light and shade densities of unit areas scanned at a distant point. The image may be scanned in any well known manner such as by the spiral aperture disk method, cathode ray or arc scanner, the latter being shown in my U. S. Patent No. 1,863,278 of June 14, 1932.

The output of the receiver 7 is impressed upon a solenoidal type of field represented by a single turn 8, this solenoid surrounding a gate or shutter type screen 10. The screen is actuated by an oscillator 11. A source 13 energized from a supply 14 provides constant intensity light which is projected upon the screen 10 through a lens 15 and so focused by the aid of multiple lens 17 as to be properly projected upon a screen 16 to any desired size, the lens 17 eliminating the shadow of the shutter supports. A lattice frame 18 covers the spaces between shutters.

Referring now to Fig. 2 in which the screen 10 is shown in more detail, a frame is composed of two massive sections 20 and 21 with smaller sections 22 and 23. There is strung between the sections 23 and 21 a plurality of wires 25 of a gauge in accordance with the size of the screen used. These wires are adjustably attached to the sections 23 and pass through section 21 to tightening nuts 26. The section 21 is of a composite type in that it is composed of layers of wave absorbing material, that is, the first layer may be of cork, the second of fibre, and the third of harder substance, such as rubber or bakelite and so on to the back section which may be of steel to obtain the necessary support for tensioning the wires.

Perpendicular to, and adjacent wires 25, and several gauges larger, is a drive wire 28 which is connected to the wires 25 through vertical projections 29. The wire 28 may be attached to an absorbing section similar to section 21. The projections 29 are a part of the wires 25, that is, the wires 25 may be looped at points 30 and connected to the frame section 23 by shorter sections 31, while the upper points of the projection are attached to the wire 28. It is obvious from this construction that a transverse wave in the wire 28 in the plane of the screen will produce a similar wave in the wires 25 in the plane of the screen but with its direction of motion shifted 90°. Mounted upon the wires 25 are a plurality of metallic gate or shutter sections 33 of magnetic material which will be described and shown in more detail later. The wire 28 is activated by means of a relay 34 supplied from the oscillator 11 of a type which preferably produces a peaked wave form of only a half cycle at definite intervals. The field winding 8 is shown in the form of a single coil and completely surrounds the screen 10 to produce therein a uniform magnetic field. The receiver 7, antenna 5, and wire terminal 6 are shown as in Fig. 1.

In Fig. 3 one of the wires 25 has shown mounted thereon a row of shutters 33 which are strung adjacent one another so that their edges just clear one another as closely as possible. The lattice screen 18 of Fig. 1 is so placed behind the shutters as to obscure light which would ordinarily be admitted between the joints. Wire 25 is shown looping at the point 30 where it is joined to the short section 31 for tensioning to the support 23, while the vertical section of the wire 29 is connected to the wire 28 which in turn is connected to the armature of the relay 34.

Cross-sectional views of the wire 25 and the shutters 33 are shown in Figs. 4 and 5. In these

views it is evident that the wires 25 do not have a circular cross section but are polygonal and surrounded by slightly larger polygonal sleeve sections to which the gates 33 are attached. This construction is especially advantageous inasmuch as it allows the shutters 33 to remain in a fixed position when once adjusted until it is again adjusted either to its neutral position or a new position. In Fig. 6 another construction of shutter 33 is shown mounted upon the wire 25 in which the polygonal sleeve is replaced by a wire coiled about the wire 25 to form a support for the gate 33. This wire may be held in its adjusted position by friction.

Before continuing the description of the other modifications of this system, the operation of the above described embodiment will be given. The oscillator 11 produces, as stated above, an output wave which is peaked and intermittent to the extent that it produces in the wire 28 a transverse wave with a definite loop which will travel along the wire 28 at a definite speed, the proper speed being that of the speed in the transverse wires 25 divided by the number of wires. In other words, the wave in wire 28 will travel the distance between wires 25 in the same length of time that it takes a transverse wave initiated in wires 25 to travel the length of one of these wires. The waves in the wires 25 will be initiated in chronological order with the result that each gate will be released from the wire 25 in a serial order as the wave passes therealong, each shutter floating for an instant. As described above, the plane of the waves along the wires 25 is in the plane of the paper so that the progress of the wave raises the shutters 33 and in actual tests it was found that these shutters actually loosened themselves from the wire at different frequencies, although no tests were made to find a particular frequency more suitable than others. The oscillator 11 is so coordinated with the incoming signals that the proper shutter is loosened at the time the desired impulse is impressed on the field so that the shutter will be magnetically moved either forward or backward to admit light from the source 13.

For instance, where a certain unit area of a picture is represented by the maximum light intensity, a strong impulse will strengthen the field to adjust the shutter to its maximum opening when loosened by the transverse wave from the oscillator 11. This impulse will increase the field at the proper time, which is the time the particular shutter is loosened upon its wire. When the transverse wave has passed the shutter will settle in the position to which it was adjusted by the field and remain there until the wire is activated by another transverse wave in the wire, thus permitting the eye to see light in that particular unit area during the time the other shutters are being adjusted. If on the second activation this particular unit area has changed in light intensity to zero at the transmitter then the shutter will return to its normal position by the action of gravity. It is to be understood that a constant field supplementing the action of gravity may be employed. However, should the unit area have a lesser degree of intensity than the prior adjustment, then a new adjustment will be made by the lesser field strength. As a wave passes down the vertical wire 28 each wire will be activated in turn and commutation is obtained without the use of rotating or oscillating mediums of large proportions. The waves when

they reach the section 21 will be absorbed, eliminating standing waves in the wire.

It is to be noted that the field strength is so proportioned that the shutters cannot be moved thereby except when they have been loosened by the elastic waves in the supporting wires. The strength of an auxiliary field, when used to aid gravity, is also insufficient to move the shutters when at rest. This is especially desirable inasmuch as it permits the retention of any particular scene being transmitted by simply disconnecting the oscillator 11 from the screen. The last image will remain on the screen indefinitely since each shutter remains in its last adjustment. The scene can be reproduced at any later time by the projection of a light through the screen 10.

Referring now to the modifications in Figs. 7 and 8, a cross wire arrangement having vertical wires 40 and horizontal wires 41 which may be mounted similar to those in Fig. 2 is shown attached to driving mediums 43 and 44 respectively. These sets of wires lie in two planes adjacent one another but not contacting. Abutting the driving wire 43 is a motor crystal element 45, while transversely placed with respect to driving wire 44, is a motor crystal 46. The crystal 45 is connected to an oscillator 48 which also supplies an harmonic generator 49 the output of the latter being impressed upon the crystal 46. By this arrangement, no waves introduced in one set of wires are transmitted to the other directly through the wires. The oscillator 48 furnishes to the crystal 45 an electrical wave of super-audible frequency while the harmonic generator 49 supplies the generator 46 with a higher frequency. The wave produced in the driving wire 44 is transverse while that in the driving wire 43 is longitudinal but these waves beat together to produce the necessary beat frequency desired, which may be within the audible range.

Referring now to Fig. 8 a wire 40 and a wire 41 of Fig. 7 is shown having mounted thereon shutters 51 and 52 respectively, the shutters being interconnected by means of a coil spring 53. This is a unit area section and is mounted at each intersection of the wires 40 and 41. The spring 53 and the gates 51 and 52 provide a connection between the frequencies in the wires and is so constructed that the assembly is resonant to the beat frequency. When the two high frequencies arrive at the hinges of shutters simultaneously the beat frequency vibrates the assembly and loosens the shutters in the manner of that in Fig. 2. There is produced, therefore, by this construction a commutating arrangement on the heterodyne principle in which a longitudinal wave is sent along a driving wave initiating either longitudinal or transverse waves in the wires in one plane, while another frequency is sent along the wires in the other plane, neither frequency of which has any effect upon loosening the shutters except when both frequencies are present simultaneously to form the beat vibration. A model of this type of shutter provided an opening that increased along two sides in a perfect square. It is to be understood that the gates or some parts thereof are of magnetic material so as to be affected by the field as in Fig. 2. It is also to be understood that a single gate structure may be operated on the heterodyne principle by the use of parallel wires cooperating with wires 25 in Fig. 2 or cross wires as in Fig. 7 with interconnecting links.

Referring now to Figs. 9 and 10 two means of obtaining travelling waves without employing absorbing means is illustrated. In Fig. 9 a vertical driving wire 60 is connected to horizontal screen wires 61 at points 62. The wire 60 is driven from a crystal 63 to initiate therein a transverse wave, this wave passing the last wire and continuing on to a fixed support 64 from which it is reflected. However, the length of the section of wire 60 beyond its utility point, and the frequency of the periodic impulses placed thereon, are so proportioned that immediately beyond the utility point, the reflected wave and the succeeding wave meet and neutralize each other.

Similarly in Fig. 10 a coil spring 70 is fixedly mounted at point 71 and attached to an electromagnetic driving element 72. Attached to the spring 70 at uniform distances are horizontal wires 73 for mounting shutters, and tensioning wires 74. Upon activation of the relay 72 from an oscillator 75 a longitudinal wave of condensations and rarefactions is produced in the coil 70 which is projected therealong to the point 71 producing, as it goes along, a transverse wave in the wires 73. However, the section of the spring 70 beyond its utility point and the frequency of the impulses impressed thereon are so proportioned that the reflected wave is neutralized by the wave immediately following. These two figures disclose, therefore, a construction for eliminating transverse and longitudinal reflections without the use of an absorbing medium. It is to be understood, of course, that the wires 25 and 28 of Fig. 2 and the wires 40 and 41 of Fig. 7 may be equipped with an extension for neutralizing the reflected waves or may have the absorbing support such as section 21 in Fig. 2.

In the above description of the invention, advantage has been taken of the speed of propagation of elastic waves in highly elastic mediums such as steel and that this speed is controllable by tensioning and by the nature of the material. Furthermore, it will now be obvious that light intensification has been obtained by the use of shutters in the above manner while a commutating system has been evolved without the use of rotating or heavy movable parts.

Although it is realized that many modifications of the apparatus will occur to those skilled in the art based on the principles disclosed above, these equivalent systems are intended to be within the scope of the appended claims.

What is claimed is:

1. An elastic wave commutator system comprising a frame, a plurality of wires positioned at intervals across two opposing members of said frame, an elastic medium positioned at right angles to said wires and connected thereto adjacent the terminals thereof, said elastic medium having less tension and a larger cross section than said wires, and means for initiating a vibration at one terminal of said elastic medium, said vibration traversing the distance between said wires in approximately the time period required for said vibration to traverse the length of one of said wires.

2. In an elastic wave commutating device, a plurality of uniformly spaced wires in one plane, a second plurality of equally spaced wires in a second plane parallel with said first plane, means for initiating in said first plurality of wires an elastic vibration of a definite frequency, means for initiating in said second plurality of waves a second vibration of a different frequency, and means interconnecting said wires at regular in-

tervals, said means being resonant to the beat frequency between said frequencies initiated in said wires.

3. In an electromagnetic shutter screen for controlling unit areas of projected light in accordance with incoming television signals, a quadrilateral frame, a plurality of parallel wires connected between two opposite portions of said frame, a coil spring attached to said wires and mounted perpendicular thereof, means for initiating a longitudinal wave in said spring said wave creating in said wires transverse vibrations in a chronological order, a plurality of shutter elements mounted upon said wires, and a field winding upon which said signals are impressed for adjusting said shutters at the instant that said shutters are loosened by said transverse waves.

4. In a multiplex light shutter, a plurality of horizontal wires having a polygonal cross section and a plurality of sleeves having extensions therefrom mounted upon said wires, the interior of said sleeves having a cross section slightly larger than said wires and conforming to the configuration thereof, to maintain said extensions in various positions.

5. In an elastic wave commutator system a quadrilateral frame, a plurality of wires uniformly spaced across two members of said frame, one of said members having a plurality of sections of different densities for absorbing vibrations set up in said wires, an elastic medium positioned normal to and at one set of terminals of said wires, said electric medium terminating in a vibration absorbing medium, and means for initiating impulses at the opposite terminal of said elastic medium.

6. In an elastic wave commutating system, a plurality of wires uniformly spaced in a definite plane, a second plurality of wires perpendicular to said first plurality in a second plane adjacent said first plane, said planes being parallel, means for initiating in said wires in chronological order mechanical vibrations of different frequencies, an oscillator, an harmonic generator fed from said oscillator, driving units for each of said last mentioned means, and means for connecting said oscillator and said harmonic generator to said driving means.

7. In an elastic wave commutating system, a frame work, a plurality of wires spaced between opposite sections of said frame work, an elastic wave medium positioned at right angles to said plurality of wires and attached thereto, and means for initiating elastic waves in said last mentioned medium, said medium being proportioned with respect to the frequency of the waves initiated therein so that said waves are neutralized outside the connections to said plurality of wires.

8. In an elastic wave commutating system, a frame, a plurality of wires uniformly spaced between sections of said frame, an elastic medium at right angles to said plurality of wires and connected thereto, and means for initiating elastic waves in said elastic medium, said last mentioned elastic medium being so proportioned that the reflecting wave from one terminal thereof will meet the succeeding initiated wave beyond the connection of the last mentioned medium to said plurality of wires.

9. In an elastic wave television system, a source of light, a magnetic field, an incoming receiver connected to said field, a light gate positioned within said field comprising a frame, a plurality of elastic mediums between opposite sections of said frame, a plurality of shutters positioned on said elastic mediums to prevent light passing through said frame in a normal position, and means for producing elastic waves in said elastic mediums of said screen for loosening said shutters from said elastic medium in a serial order.

10. A television system in accordance with claim 9 in which said shutters are of magnetic material influenced by the incoming signals impressed upon said field.

11. A light gate for a television system comprising a frame, a plurality of elastic mediums positioned between opposite sections of said frame, a plurality of movable shutters arranged on said mediums, means for physically interconnecting certain of said shutters, and means for initiating high frequency waves in said mediums of different values, the combination of said waves providing a wave for activating said shutters.

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