

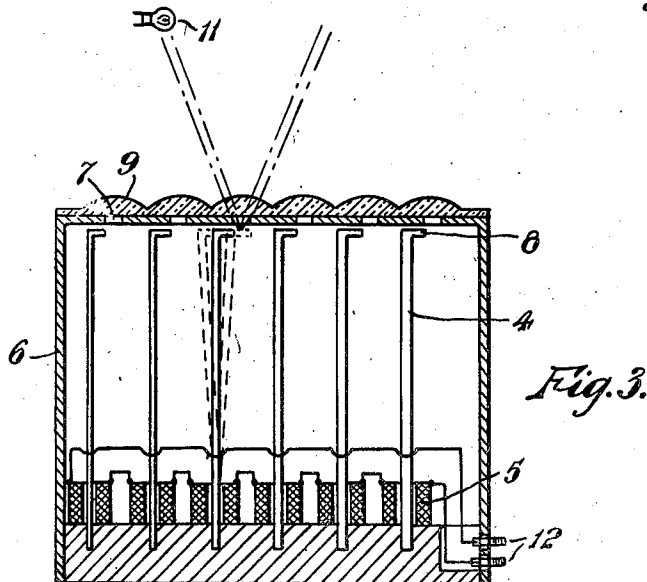
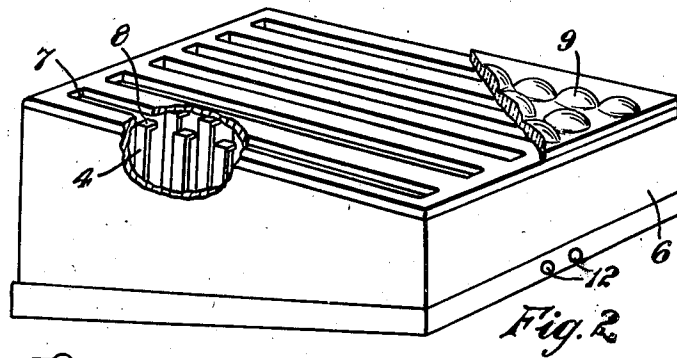
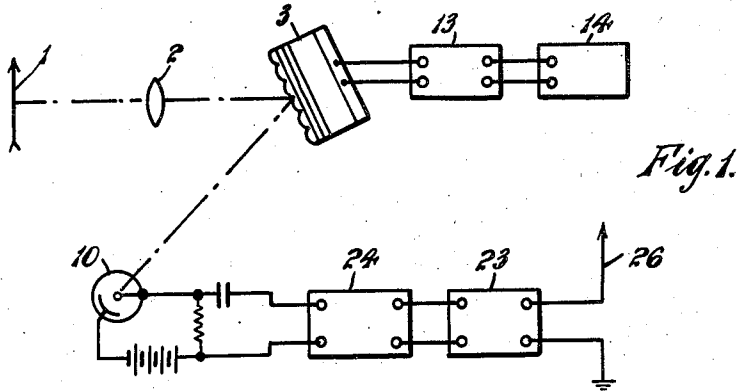
May 28, 1940.

F. VON OKOLICSANYI
TELEVISION AND LIKE SYSTEM

2,202,541

Filed Dec. 8, 1936

4 Sheets-Sheet 1



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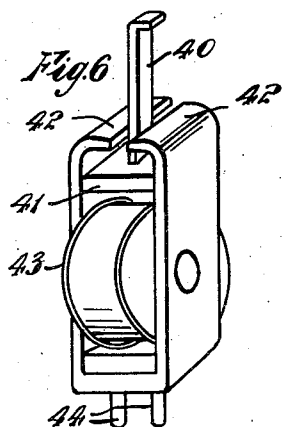
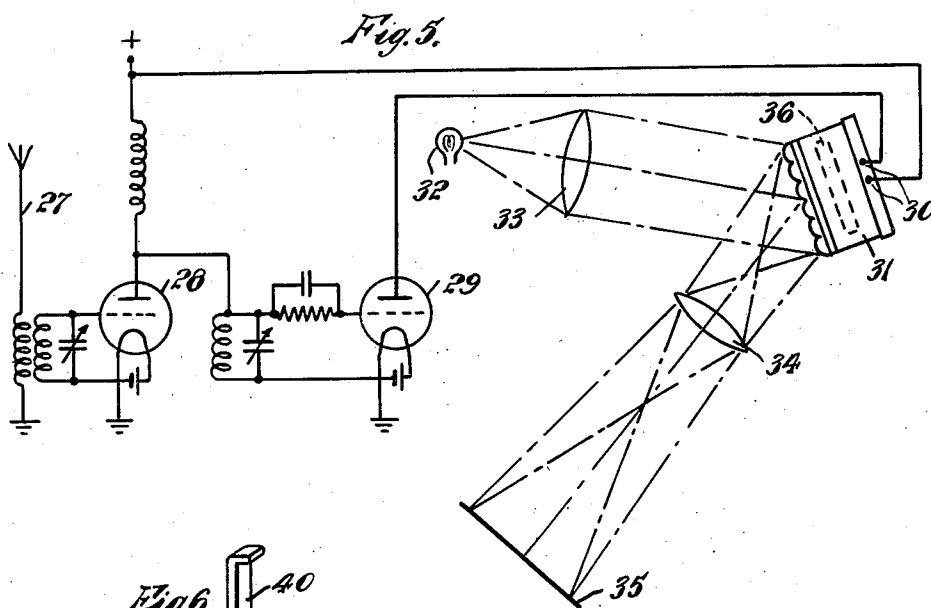
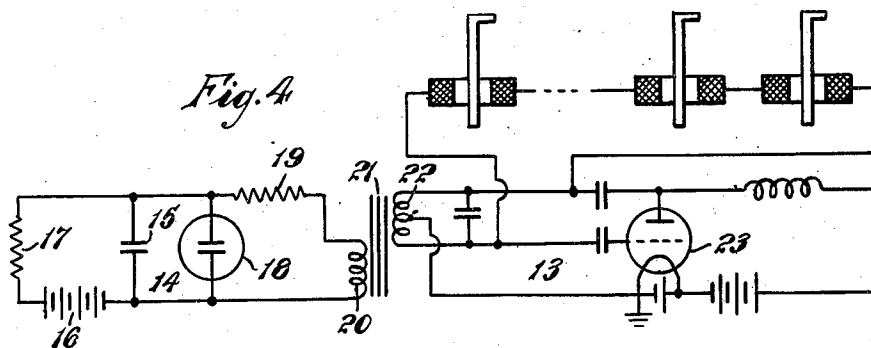
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4 Sheets-Sheet 2



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Fig. 7.

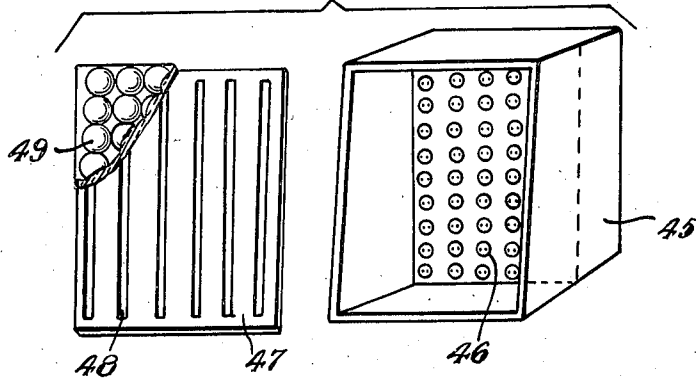


Fig. 8.

1	7	45	21	2	20	54	24	14	41
31	51	8	30	13	27	25	40	42	29
59	46	22	18	3	55	23	11	60	15
50	12	49	48	9	28	36	4	37	58
32	47	5	34	35	26	10	43	16	38
19	52	33	53	17	56	6	44	57	39

Fig. 9.

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	37	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60

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4 Sheets-Sheet 4

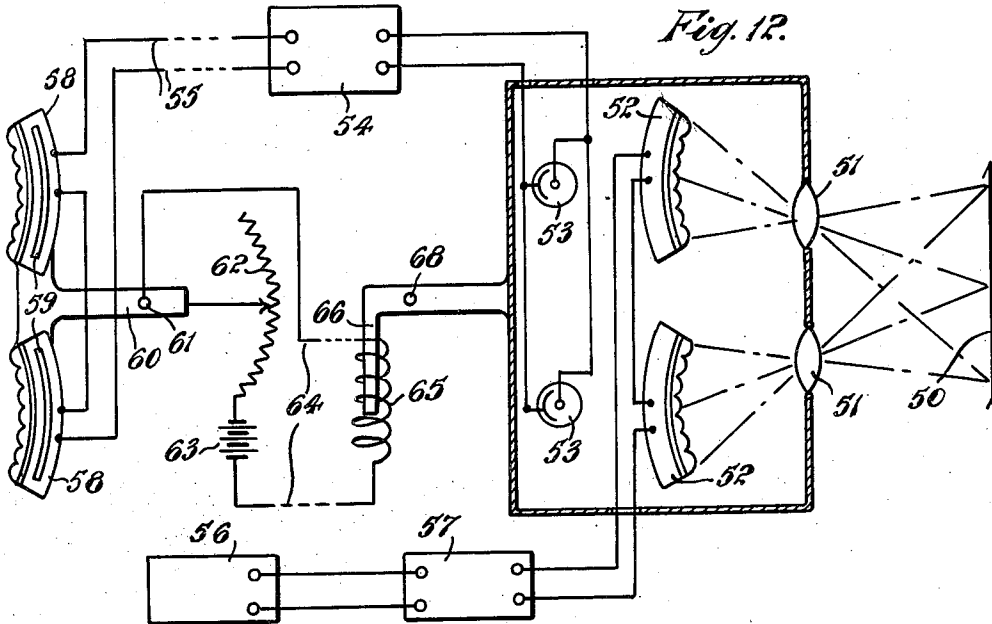
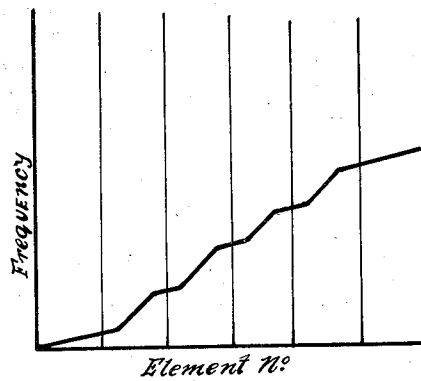


Fig. 10

100	102		104	106
108	110	114	118	140
	126	130	134	138
142	146	150	154	176
	162	166	170	174
178	180	182	184	

Fig. 11.



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UNITED STATES PATENT OFFICE

2,202,541

TELEVISION AND LIKE SYSTEM

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Application December 8, 1936, Serial No. 114,729
In Germany December 12, 1935

11 Claims. (Cl. 178--6)

The present invention relates to television and like systems.

For some purposes, for example, for military purposes and for television-telephone from one house to another, present-day television methods are unnecessarily costly, complicated and somewhat unreliable, and also require to be carefully operated on account of the synchronisation. It has always been an ideal to transmit the whole picture at once, instead of employing scanning methods, since the brightness of the picture is increased and the operation of the apparatus is simplified. From an economic point of view, a separate transmission channel and a separate amplifier for each single picture element is not feasible, and to overcome this difficulty it has already been proposed to allot to each picture point its own carrier frequency and to transmit this frequency complex over one channel. However, no suggestion has been made for practical apparatus embodying this proposal which avoids both at the transmitter and the receiver the use of rotating or moving parts which must rotate or move at constant or synchronous speeds. The accuracy of such speeds is of the highest importance since it determines the correct location of the picture elements on the receiving screen, and any slight variation of the speed will thus produce a serious distortion of the received picture. The ideal system for small portable transmitters and receivers and for television-telephone purposes is one in which all the picture elements are transmitted simultaneously and in which an inaccurate working of the transmitter cannot affect the location of received picture elements.

One object of the invention is to provide small portable transmitting and receiving systems operating on the principle of the simultaneous transmission of all picture elements, and avoiding the use of any constant speed rotating parts and any synchronizing means.

Another object of the invention is to provide a small portable television system for the transmission of simple messages which can be easily adapted to transmit such messages in code.

A further object of the invention is to provide a simple television system for producing stereoscopic images.

A still further object of the invention is to provide a television-telephone system in which the receiver operates with very low voltages and without rotating parts so that it can be worn with safety on the head of a subscriber.

Yet another object of the invention is to provide a television-telephone system in which the

receiver of one subscriber can be moved to produce a corresponding movement of the transmitter of another subscriber.

In general, these and other objects are achieved by a method which comprises forming an image of an object, generating a single oscillatory current, continually changing the frequency of said current between two limits, utilizing said current to maintain in constant vibration the individual members of a first set of resonant bodies, the number of said bodies being equal to the number of elemental areas of said image, and each body having a different natural frequency, utilizing the vibration of each of said bodies to interrupt the light from an elemental area of said image, translating the resulting light variations into electric currents and transmitting said currents over a single channel to a receiver, utilizing the received currents to vibrate the individual members of a second set of resonant bodies, each current vibrating that body which has a natural frequency equal to the frequency of the current, and utilizing the vibration of the bodies to control light to reconstitute the image.

The invention will now be described by way of example with reference to the accompanying drawings in which

Fig. 1 shows schematically transmitting apparatus embodying the invention;

Figs. 2 and 3 illustrate in detail the system of vibrating reeds;

Fig. 4 shows schematically the electrical circuit employed to excite the reed system;

Fig. 5 shows schematically receiving apparatus embodying the invention;

Figs. 6 and 7 show an alternative form of construction for the vibrating reed system;

Figs. 8 and 9 are explanatory diagrams illustrating the action of a television system embodying the vibrating reed system shown in Figs. 6 and 7;

Figs. 10 and 11 are explanatory diagrams illustrating an alternative form of the invention; and

Fig. 12 shows schematically a stereoscopic television-telephone system.

Referring to Fig. 1, an image of an object 1 is projected by means of a lens 2 on the surface of apparatus 3, which apparatus is shown in detail in Figs. 2 and 3. The apparatus consists of a plurality of reeds 4 each of which forms an armature of an electro magnet system, and are similar to the reeds of the well known frequency meters. The windings of the electromagnet system are shown at 5. This system of reeds is enclosed in a casing 6 in the upper surface of

which are provided slots 7, the arrangement being such that when a reed is deflected, its end surface 8 covers a slot, but when it is undeflected, it uncovers the slot. Each reed is tuned in such a manner that the natural frequencies of the reeds differ from one another. This is achieved in the arrangement of Figs. 2 and 3 by constructing all the reeds in one row so that they have the same thickness but decreasing lengths, and consequently increasing frequencies, whilst the reeds in the next row also have the same thickness and decreasing lengths, but their thickness is greater than that of the reeds of the first row, and so on. On the upper surface of the casing 6 is placed a series of spherical lenses 9, the number of these lenses being equal to the number of the reeds. These lenses may conveniently be formed from one piece of transparent material such as glass. The focal point of each lens is at the surface 8 of its corresponding reed. The surface 8 of each reed is polished so that if all the reeds were deflected so as to cover their respective slot 7, the light from the object 1 would be completely reflected upon the photo cell 10. The effect of each lens 9 is such that the light from one picture element 11 is concentrated by the lens upon the surface 8 of a reed when the latter is in its deflected position, and is reflected again through the lens 9 to the photo cell 10. Thus although the reflecting surfaces of the reeds do not themselves form a continuous surface, the action of the lenses 9 in concentrating the pencil of light from each picture element on to a reed and in diffusing it again to its original size after reflection by the reed, produces the same effect as if the reeds formed a continuous surface.

The windings of the electromagnetic system of the reeds are connected through the terminals 12 to an oscillator 13 which is controlled by a time base circuit 14. The action of these circuits is illustrated in more detail in Fig. 4. In this figure a condenser 15 is charged by a battery 16 through a resistance 17, until its voltage is equal to the breakdown voltage of the glow discharge tube 18. At this point a discharge takes place and a current flows through the resistance 19, the duration of the discharge being determined by the value of this resistance. The charging period then recommences and consequently currents having a saw-toothed wave form flow through the winding 20 of the coil 21. This coil has a dust-iron core and consequently the inductance of the winding 22 will vary in accordance with the value of the current flowing through the winding 20; that is to say its curve of variation will have a saw-toothed form. The coil 22 forms part of the oscillatory circuit of the valve oscillator 23, the output of which is connected to the windings 5. Consequently these windings will be traversed by an oscillating current the frequency of which varies continually in accordance with a changing inductance of the coil 22. The range of variation of this frequency is so chosen that it corresponds to the range of frequencies covered by the natural frequencies of the reeds 4. Hence all the reeds will be set into vibration and their damping is so chosen that they oscillate continuously with constant amplitude, each at its own frequency, in spite of the fact that they are only excited intermittently. In order to prevent the period of the time base currents themselves from affecting directly any reed this period must be so chosen that it is less than the lowest of the natural frequencies

of the reeds and greater than the highest frequency difference between two consecutive reed frequencies.

Hence the light reflected on the photo cell 10 is interrupted or "chopped" in such a way that the light from each picture element is "chopped" at a different frequency. There will thus be produced in the output circuit of the photo cell 10 a number of sub-carrier frequencies each representative of the one picture element and each modulated in intensity in accordance with the variation in brightness of the element. These currents are amplified in the amplifier 24 and are employed to modulate a carrier frequency in the modulator and transmitter 25 and are transmitted from the aerial 26.

It will be appreciated from the above that the end surfaces of the reeds may reflect or deflect or interrupt the light incident upon them so that it falls upon a light responsive device only in a selected position of the reeds, particularly in their extreme or resting position. The end surfaces of the reeds may also permit the light to pass unobstructed to a light sensitive device in one position of the reeds, while these end surfaces obstruct the light in another position of the reeds. Thus the end surfaces of the reeds serve to control the light's falling upon the light sensitive device.

If I refer, therefore, in the appended claims to a controlling action of the reeds and their end surfaces with respect to light falling upon a light sensitive device, I wish it understood that the above functions of the reeds and particularly their end surfaces are meant by it.

A receiver for use with the above described transmitter is illustrated in Fig. 5. The transmitted signals are received by the aerial 27, are amplified by the high frequency amplifier 28 and are detected by the detector valve 29. The output of this valve will thus consist of all the original modulated sub-carrier frequencies, and these frequencies are fed through the terminals 30 to the electromagnet windings of apparatus 31, which is similar in every respect to the apparatus illustrated in Figs. 2 and 3. Each sub-carrier frequency will thus set into oscillation a reed having the same natural frequency, the amplitude of the oscillation depending upon the amplitude of the sub-carrier frequency. Light from the source 32 is projected by a lens 33 on to the surface of the reeds and is reflected therefrom through the lens 34 on to the viewing screen 35. Since the amount of light reflected from each reed will depend only upon the amplitude of its vibration there will be reconstituted on the screen 35 an image of the object 1.

If desired, the lens 34 and screen 35 can be dispensed with and the surface of 31 viewed directly. Furthermore, instead of the light source 32, light from any source such as daylight can be admitted into the interior of the apparatus through a slot 36 in the casing of the apparatus, this light being transmitted past the reeds to the eye. In this case the slots 7 are so arranged that they are covered by the end surfaces of the reeds when the latter are in their stationary or normal position.

The number of picture elements in the received picture is obviously equal to the number of reeds, and this number is determined by the purpose for which the apparatus is employed. Thus, when the apparatus is used for military purposes the number of picture elements and hence the number of reeds employed can be relatively

small. For example, for the purpose of transmitting letters or simple messages, 100 picture elements would be sufficient, and in this case the total width of the frequency band employed is extremely small, and is of the order of the frequency band used in telegraphy. Thus the amplifier and other circuits used can be of very simple design. In Figs. 6 and 7 is illustrated a modification of the apparatus whereby such messages can be transmitted in code. In this case each reed and its associated electromagnetic system is formed as a single unit, as shown in Fig. 6. The reed 40 is secured to the bar 41 and vibrates between the pole pieces 42 of an electromagnet, the energising coil of which is indicated at 43. The ends of the coil windings are connected to the plugs 44 so that the whole system may be conveniently detached from the remainder of the apparatus, which is illustrated in Fig. 7. In this figure the casing 45 is provided with a number of sockets 46 into which can be plugged the reed systems. When all the reed systems are inserted the cover 47 which contains the slots 48 and the superimposed lens plate 49 is secured to the casing 45. For normal working the reed systems are inserted in their respective sockets in such order that the frequencies of the reeds increase progressively from one reed to the next as in the arrangement of Figs. 2 and 3. For code work, however, the reed systems are plugged into the sockets in a different order, which would depend upon the particular code being used, so that the frequency distribution is quite irregular. At the receiver the reed systems must be arranged in a manner exactly corresponding to those at the transmitter in order that an intelligible message could be received. This can be understood more readily by reference to Figs. 8 and 9 in which the small numbered squares represent the areas covered by each picture element, whilst the numbers represent order of the frequencies of the corresponding reeds. Thus the reed of the square numbered 1 will have the lowest natural frequency, the reed of the square numbered 2 will have the next highest frequency, and so on. Fig. 8 represents the arrangement at the transmitter in which the distribution of the reeds with respect to frequency is seen to be quite irregular. Fig. 9 represents an arrangement at the receiver in which the distribution of the reeds with respect to frequency is the normal one. The shaded squares represent the letter H which is being transmitted, and the quite irregular pattern which would be received by a receiver set up in this normal manner. It is clear that without a knowledge of the code it will be impossible to set up the receiver in a manner which corresponds to the set-up of the transmitter, since with 60 picture elements, for example, the probability of accidentally arriving at the correct combination is of the order of $1:10^{60}$. Also since the disturbance of the transmitted image is not produced by any periodical or regular change in the transmission, as is known secret transmission systems, it is impossible to detect the law governing this disturbance.

For the purpose of television-telephone, it is necessary to have a somewhat finer degree of definition as in the example previously described. This can be overcome, however, by making the definition in the centre of the picture finer than at the outside edges and by making the frequency difference between adjacent elements greater in the centre of the picture than at the edges. This is illustrated diagrammatically in Fig. 10, in which the numbered squares represent the pic-

ture elements, and in which it is seen that the size of the elements at the centre is much smaller than at the edge, the natural frequency allotted to each element being indicated by the number of the square. In Fig. 11 is shown a curve in which the frequency of the element is plotted vertically and the number of the element is plotted horizontally. It is seen that the frequency does not increase uniformly from element to element but increases in a discontinuous manner. For the purpose of clarity the definition in these figures is shown much coarser than would be employed in practice.

The television portion of a complete television-telephone system is shown schematically in Fig. 12. An image of the object 50 is projected by lenses 51 on to a pair of reed systems 52 which are similar to that illustrated in Figs. 2 and 3 but which are curved in one plane as shown. The frequency band covered by the natural frequencies of the reeds of one of the systems is different from and immediately adjacent to that of the other, so that any one reed of both systems has its own individual frequency which is not duplicated in either of the systems. Light is reflected from these systems by means (not shown) on to the photo electric cells 53 and the output of these cells is amplified at 54 and transmitted over the telephone line 55 to the receiver. 56 and 57 represent the time base circuit and oscillator for maintaining the reeds of the transmitter in continuous vibration and the frequency of the generated oscillation will change continuously over a range which covers the total frequency band of the two reed systems. The received currents are fed to the windings of the electro-magnets of two corresponding systems of reeds 58 and the television subscriber directly observes these two systems, one with each eye, so that stereoscopic vision is provided. Light is admitted through the slots 59 and is modulated by transmission past the vibrating reeds as described in connection with Fig. 5. The systems 58 are worn on the head of the subscriber and a link 60 which pivots about the point 61 is provided so that as he turns his head the value of the resistance 62 is altered. The changing currents from the battery 63 thus produced are transmitted over the line 64 to the transmitting station where they flow through the coil 65 and thus attract the armature 66 to a more or less degree. This produces a corresponding movement of the transmitter through the link 67 which pivots about the point 68. Thus as the subscriber at the receiver moves his head from side to side corresponding movements will be produced at the transmitter and he will thus see a different field of view reproduced in his receiver. Other methods of producing this movement are obviously possible. Thus, for example, an image of the eye of the subscriber may be formed on a system of photocells, so that as he moves his head changing currents are produced which can be utilized to control the movement of the transmitter or parts thereof.

I claim:

1. In a television and the like transmission system, a light sensitive cell, a transmitting circuit connected to said cell, a system of reeds capable of free vibration for a considerable period of time in their resonant frequency after the cessation of an exciting impulse and placed in the path of light emerging from an elemental area of an object to be transmitted towards said cell so that each reed controls said light's falling

upon said cell, each of said reeds being tuned to a different frequency, and means for generating vibration exciting impulses of a sequence shorter than said period of free vibration of said reeds and thereby sufficient for maintaining said reeds in continuous oscillation, whereby each element of an object is transmitted as a modulation of a distinct carrier wave.

2. In a television and the like system, an object to be transmitted, a light sensitive cell, a transmitting circuit connected to said cell, a system of reeds capable of free vibration for a considerable period of time in their resonant frequency after the cessation of an exciting impulse and placed so that each reed interrupts the light emerging from an elemental area of said object before falling on the cell, each of said reeds being tuned to a different frequency, a circuit adapted to produce currents having a saw-toothed wave form, a first coil traversed by said currents, a second coil forming part of the oscillatory circuit of a thermionic valve oscillator, both of said coils having a common dust-iron core, and means for feeding the output of said oscillator to said electromagnetic system to excite and maintain all of said reeds in continuous oscillation, whereby each element of the object is transmitted as a modulation of a distinct carrier wave.

3. A television and like transmitting system comprising a plurality of rows of reeds, each reed forming the armature of an electromagnet system and being tuned to vibrate at a frequency different from the vibration frequency of the remaining reeds, a reflecting end surface for each reed, a screen placed over said end surfaces, a number of slots in each screen equal to the number of said rows, the position of each slot coinciding with one extreme position adopted during vibration by said end surfaces of the reeds of the corresponding row, a plurality of lenses covering said slots and equal in number to the number of reeds, the focal point of each lens being situated in the area occupied by said end surface of the corresponding reed in said extreme position, means for forming an image of an object on the surface of said lenses, electrical means for producing an exciting current of changing frequency which periodically covers the frequency of free oscillation of said reeds, means for feeding said exciting current to said electromagnetic system and thereby maintaining said reeds in continuous oscillation, means for translating the light periodically reflected by said end surfaces through said slots and lenses into corresponding electrical variations, and means for transmitting said electrical variations over a common channel to a receiver.

4. A television and like transmitting system according to claim 4 wherein each reed is provided with its own electromagnet, the reed and electromagnet constituting a detachable unit.

5. A television and like transmitting system according to claim 4 wherein said electrical means comprise a thermionic valve oscillator having a tuned circuit which includes an inductance coil, means for producing an electric current of periodically changing amplitude, and means for utilizing said current to produce corresponding changes in the effective inductance of said inductance coil.

6. A receiving system for television and like signals which comprise a plurality of sub-carrier waves each fully representative of one element of an object, said system comprising a plurality of rows of reeds, each reed capable of vibrating

freely after a vibration exciting impulse ceased and forming the armature of an electromagnet system and being tuned to vibrate at a frequency different from the vibration frequency of the remaining reeds, reflecting end surface for each reed, a screen placed over said end surfaces a number of slots in said screen equal to the number of said rows, the position of each slot coinciding with a selected position of said end surfaces of the reeds of the corresponding row to be vibrated, a plurality of lenses covering said slots and equal in number to the number of reeds, the focal point of each lens being situated in the area occupied by said end surface of the corresponding reed in said selected position, means for applying said received sub-carrier waves to said electromagnet system to excite vibration of corresponding reeds, and means for illuminating such of said end surfaces that are vibrating to reconstitute the image so that the fraction of light reflected from each element and passing the fixed slot is determined by the angular position of the corresponding end surface.

7. A receiving system according to claim 6 wherein each reed is provided with its own electromagnet, the reed and electromagnet constituting a detachable unit.

8. A receiving system for television and like signals which comprise a plurality of sub-carrier waves each fully representative of one element of an object, said system comprising a plurality of rows of reeds, each reed capable of vibrating freely after a vibration exciting impulse ceased and forming the armature of an electromagnet system and being tuned to vibrate at a frequency different from the vibration frequency of the remaining reeds, an end surface for each reed, a screen placed over said end surfaces, a number of slots in said screen equal to the number of said rows, the position of said slots coinciding with a selected position of the end surfaces of the reeds of the corresponding row to be vibrated, a plurality of lenses covering said slots and equal in number to the number of reeds, each lens being focussed on the end surface of the corresponding reed, means for applying said received sub-carrier waves to said electromagnet system to excite vibrations of corresponding reeds, and means for transmitting light past such end surfaces that are vibrating through said slots and lenses to reconstitute the image.

9. A television system comprising a transmitter for producing a plurality of sub-carrier waves each fully representative of one element of an object, a receiver comprising a plurality of reeds each of which is capable of vibrating freely after a vibration exciting impulse ceased and forms the armature of an electromagnet system and each of which is tuned to a frequency different from the remaining reeds and means for applying said sub-carrier waves to said electromagnet system to excite vibration of corresponding reeds which control light to reproduce an image of said object, means for varying the strength of an electric current in accordance with movement of said receiver, a transmission channel for said electric current, and means at the transmitter for utilizing the variations in the strength of said current to produce corresponding movement of the transmitter.

10. In a television and the like system, in combination, a light responsive device, a transmitting circuit connected to said device adapted to produce a carrier wave and to modulate it depending on the intensity of light falling upon said device,

5 a plurality of detachable reeds capable of free
vibration for a considerable period of time in
their resonant frequencies after the cessation of
an exciting impulse, said resonant frequencies
10 being different inter se, said reeds each provided
with a controlling surface to be arranged in the
path of light to said device from an elemental
area of an object to be transmitted so that each
of said reeds when vibrating controls said lights
15 falling upon said device, electrical means for
producing vibration exciting impulses of changing
frequency which periodically cover said resonant
frequencies in a sequence shorter than said
period of time, an electromagnet system comprising
20 coil elements and cooperating armature elements,
one type of said elements being stationary and the
other type of said elements being associated individually
with one of said detachable reeds each, and means for
feeding said impulses to said coil elements and thereby
maintaining said reeds in continuous vibration.

11. In a television and the like system a light
responsive device, a circuit connected with said
device capable of producing a carrier wave and
25 modulating it depending on the intensity of light
falling upon said device, a plurality of reeds capa-

ble of free vibration for a considerable period
of time in their resonant frequencies after the
cessation of an exciting impulse, said resonant
frequencies being different inter se, said reeds
each provided with a reflecting surface to be
7 arranged in the path of light to said device from
an elemental area of an object to be transmitted
so that each of said reeds when vibrating interrupts
and reflects said light upon said device, an electrical
circuit adapted to produce currents 10 having a saw-toothed wave form covering the resonant
frequencies of all said reeds and of a period shorter
than said period of free vibration of said reeds, and
a first coil arranged to be traversed by said currents,
15 a second coil forming part of an oscillatory circuit of
a thermionic valve oscillator, said coils arranged on a
common dust-iron core, an electro-magnetic system
comprising coil elements and cooperating armature
elements, one type of said elements being stationary
20 and the other type of said elements associated individually
with one of said reeds each, and means for feeding the
output of said oscillatory circuit to said coil elements
so that vibration of all said reeds is excited and maintained. 25

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