

March 28, 1950

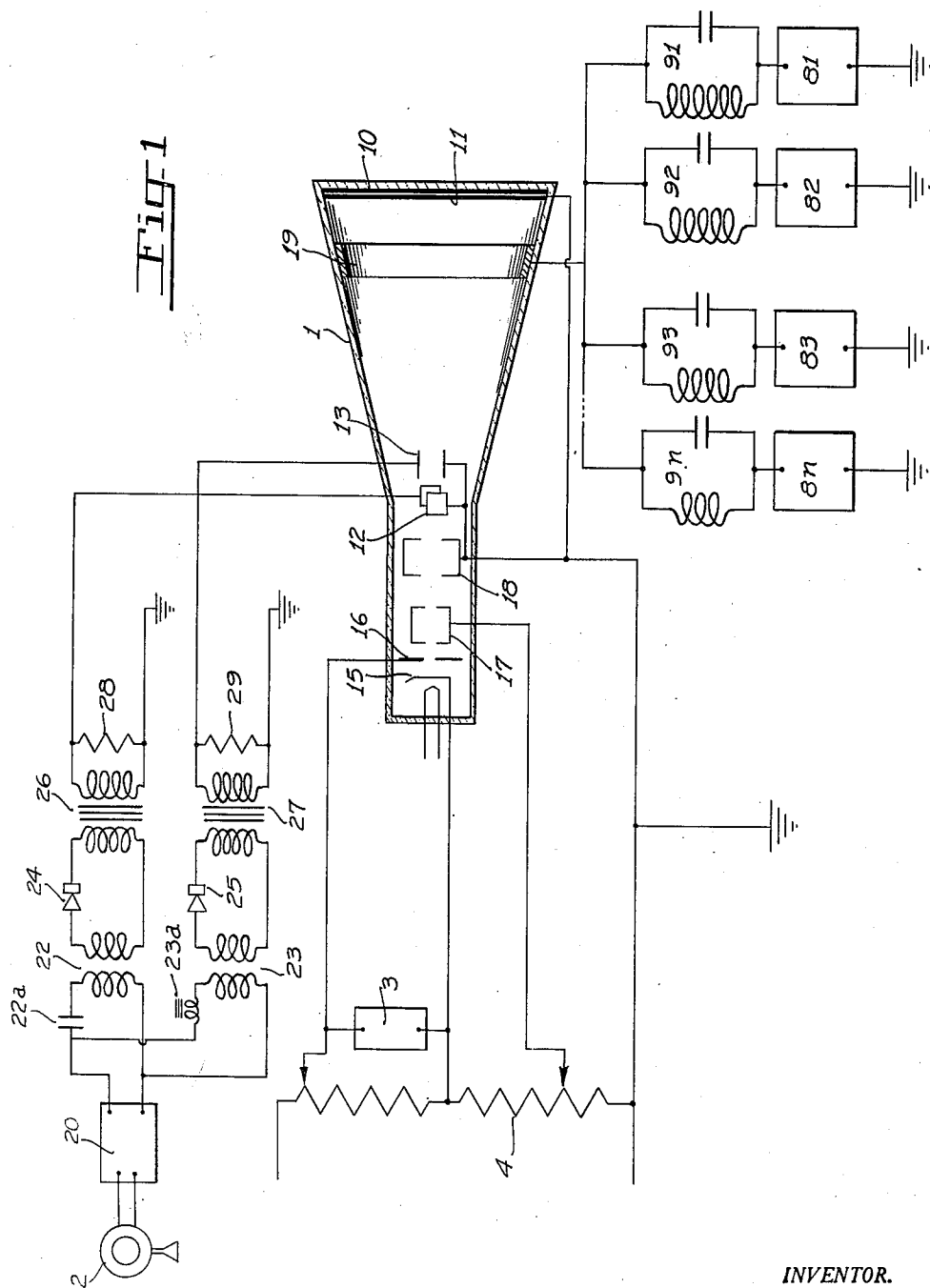
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2,501,788

TRANSLATING DEVICE AND METHOD

Filed Jan. 7, 1946

2 Sheets-Sheet 1



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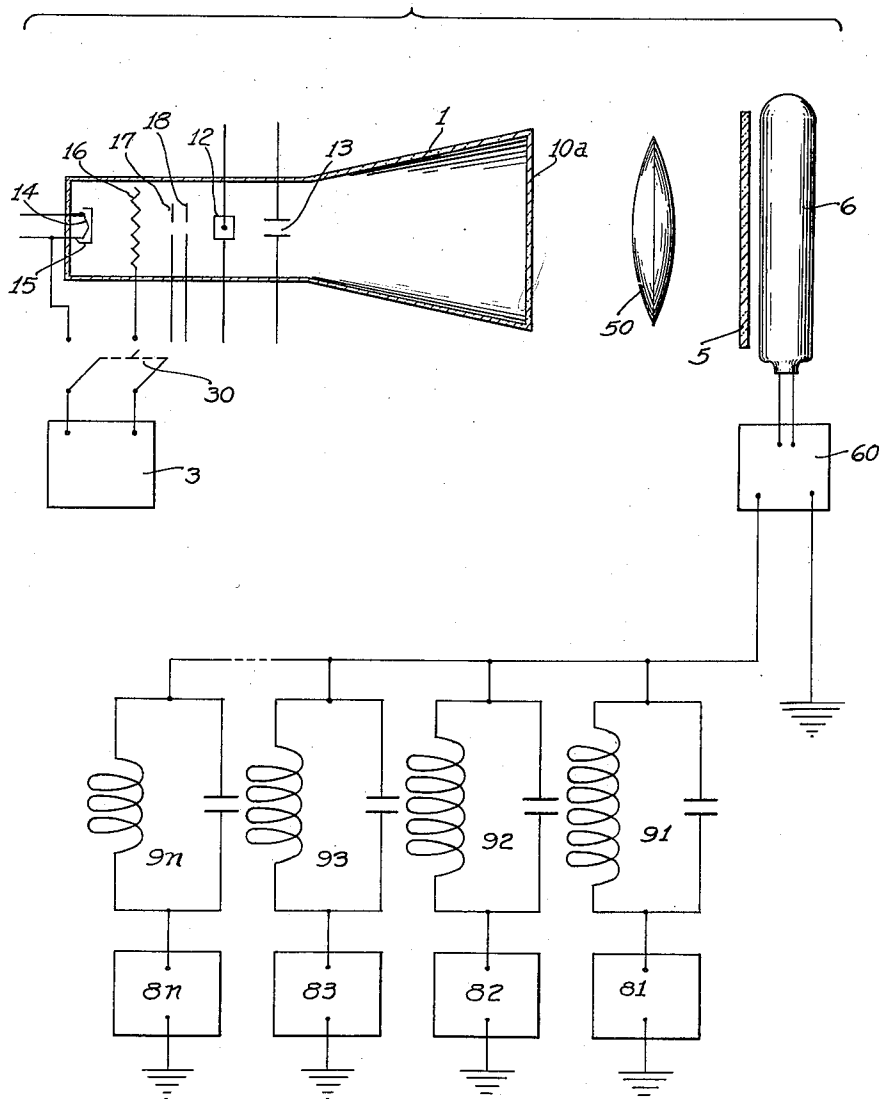
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2 Sheets-Sheet 2

Fig. 2



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TRANSLATING DEVICE AND METHOD

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13 Claims. (Cl. 250—27)

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In the following specification will be explained how, coincident with the production of and through the intermediary of a characteristic and permanently lasting initial impression upon an electronic "brain," there is initially produced a result which is related as effect to the initial signal as cause, in such manner that the electronic "brain" "remembers" and "associates" the cause and the effect (in other words, is conditioned), to the ultimate end that, upon repetition of the original signal, or cause, the conditioning or remembrance of the electronic "brain" will produce the same effect as before, selecting from multiple possible effects that particular effect which alone corresponds to the repeated cause or signal.

The present invention is to be distinguished from devices which are purely selectors, wherein because each circuit of several is connected or arranged in advance, by design, to receive and react to one signal or stimulus only, a different stimulus for each circuit, it will upon all occasions react to such stimulus, and to that stimulus only. Such an arrangement involves no conditioning or remembrance, merely pure design selection on the part of a reasoning operator of the correct signal to cause the desired effect.

The present invention is also to be distinguished from all prior devices of the type wherein, since the signal has certain distinctive characteristics, the final operating device is painstakingly adjusted until it responds to those characteristics. That is adjustment of the effect to the cause. The present invention differs therefrom in that the effect is made to become a natural and automatic consequence of the cause, and the cause produces not only such effect, but conditions a retentive element in such manner that, upon reproduction of the cause, the retentive element by association reproduces the corresponding effect.

There is produced, by such an arrangement, what may be likened to remembrance in the human brain, or to conditioned reflexes in animals of all kinds, yet produced by instrumentalities which are wholly inanimate, and which include as an essential element an electronic device of special construction or arrangement, in the nature of a special or specially arranged cathode ray tube.

To illustrate briefly the nature and capabilities of the present invention, if at a selected oscillator frequency there is produced initially an electrical resultant of directing into a microphone a selected sound made up of different frequencies, for example, and that resultant be impressed upon a

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suitable cathode ray tube, in such manner that a permanent trace is impressed upon the tube's screen, the tube in effect "remembers" the words, but "associates" them with the frequency. If an output circuit from the tube is made responsive to the selected frequency to produce a given result in response to signals at that frequency from the tube, thereafter, whenever that same sound is received by the microphone, the "remembrance" of the tube associates the words with the correct frequency, and by such "association" produces the desired result through the output circuit.

Moreover, the same electronic "brain" can receive and be conditioned with other or numerous, impressions, as a result of other signals, whether originating as sound or some other reproducible effect. Each resulting separate trace made permanently upon the cathode ray tube screen is given a different identifiable characteristic corresponding to a different oscillator frequency applied to the tube simultaneously with trace formation. Upon repetition of any one of such signals the "brain" will identify it and produce the response which alone corresponds to the repeated signal.

Since the number of impressions capable of retention by the electronic "brain" is theoretically infinite, the number of signals receivable by, and responses produced by, such an arrangement is limited only by practical consideration as to segregation of circuits each of which receives or responds to a single signal only.

From the above it can be seen that the broad purpose of this invention is to provide electronic means, such as a cathode ray tube, and circuit means of which such electronic means is a part, whereby the associative principle in learning, known as the principle of the conditioned reflex, may be employed for automatic control of mechanical or like functions, through the medium of a properly conditionable or preconditioned electronic device.

It is the general object of this invention to provide an electrical system, including an electronic device, upon which may be impressed any intelligence which can be translated into or expressed in the form of a characteristic electrical signal, and which at a later time will respond in a predetermined and characteristic manner whenever a like signal is again impressed into the system and upon the device.

It is a further object to provide such a system and electronic device which will be capable of receiving a large number of original signals, and to initially produce thereby results which are in-

dividually characteristic of a corresponding signal, and primarily only that signal, which system and electronic device, upon repetition of any one of those signals, will respond in the manner, and only in that particular manner, which is identical with the response initially produced by that signal.

As has already been stated, the invention contemplates the use of an electronic device such as a cathode ray tube, so arranged that it will, in effect, "remember" signals impressed upon it, which device is able to distinguish each signal, when again impressed, from any other signal, and which as a result of such "remembrance" will operate the desired instrumentality, or otherwise produce the intended and uniquely corresponding result. A single device can "remember" a large number of different signals, and can selectively operate a corresponding number of different instrumentalities. To this extent, then, its comparison to the human mind or brain, which recognizes, distinguishes, and acts upon intelligence previously acquired by or impressed upon it, is quite apt.

The scope of the present invention can best be ascertained by study of the present specification, including both the accompanying drawings and the appended claims. However, it should be borne in mind that the present invention is the first demonstration to any practical end of "remembrance" by inanimate means, as a result of an initial command or impression, to produce an intended result upon repetition of that command or impression. The particular form and arrangement chosen for purposes of explanation is by no means the only possible form, and hence the present specification, including the claims, is to be given the broadest interpretation consonant with the breadth of the invention as indicated above, and in the claims which follow.

Figure 1 is a diagrammatic showing of a complete circuit arrangement for the attainment of the end indicated above, wherein is included a cathode ray tube modified from present practice in order that it may be suited to such end.

Figure 2 is a similar showing, with parts of the circuits omitted, illustrating the use and arrangement of an unmodified cathode ray tube.

My invention includes, as the most practical means presently available, an electronic device such as a cathode ray tube, and builds upon the present-day state of such electronic art, which now affords varied means of producing, focusing, deflecting, and varying the intensity of a cathode ray in an evacuated "tube" or chamber. By the present invention there is introduced the principle of associating with such a tube a screen which is susceptible of permanent alteration by the cathode ray of high intensity, initially employed to produce simultaneously a desired and characteristic result, and of using this so-conditioned screen as a recording surface to mediate between mechanical or electrical actions or effects to be controlled and the corresponding individual signals upon their repetition and re-impression at lower intensity upon such screen. The screen may be one of special nature, within the tube, as is contemplated by the form of Figure 1. My United States Letters Patent No. 2,449,752, September 21, 1948, discloses a cathode ray tube of the type useful in this connection. Alternatively the screen may be a photographically sensitive screen which is placed in such position relative to a conventional cathode ray tube as to record an image of the trace upon the

screen, and which reacts through the medium of photo-sensitive means to produce the intended result, as is contemplated by the form of Figure 2.

The tube of Figure 1 includes a special metallic coating upon the interior of the glass envelope, together with a very thin layer of material, capable of permanent change under the influence of a beam of great intensity, overlying the metallic coating, and consonant with the latter. By way of example a satisfactory coating consists of a thin film or undercoating of metallic potassium 10 on the interior of the glass W, and overlying this metallic film a very thin layer or overcoating 11 of potassium hydroxide with adsorbed hydrogen, to comprise a sensitive coating 10. In Figure 1 the actual layers are greatly exaggerated as to thickness. The metallic potassium layer 10 need only be thick enough to offer a continuous surface, and a single molecular layer 11 of potassium hydroxide with adsorbed hydrogen is sufficient. As one of many alternative forms, a metallic sodium film at 10 is covered by a very thin film 11 (ideally approaching molecular thickness) of paraffine, volatilizable by the intensified cathode ray. In all forms, dependence is placed on the fact that when a cathode ray strikes a metallic surface, electrons are emitted therefrom. An unimpaired thin coating on such a metallic surface as 10 alters the freedom of electronic emissions, but the coating ceases to be unimpaired when broken by impact of an intensified cathode ray during the time a signal selected for future recognition is being impressed upon the screen. The overcoating 11 may be converted from potassium hydroxide to metallic potassium, in the first instance above, merging with the potassium of the undercoating 10; in the case of the paraffine overcoating, it may simply be volatilized by the beam to leave exposed the metallic sodium. In any case, the beam effects a permanent change in the nature of the composite screen coating, wherever the beam's trace bombards the screen at high intensity, and that permanent change alters the capability of emission of electrons from the changed portions of the screen, when subsequently bombarded, at lesser intensity.

Other metals may be used as the undercoating, such as other alkali metals, or caesium, or selenium. The overcoating 11 should be compatible with or consonant to the undercoating 10, in each case.

Where, in this specification, relative intensity of the electron beam is referred to, as "great" intensity or "lesser" intensity, it is scarcely possible to define these terms in absolute quantitative units, for the reason that these values will necessarily vary in accordance with the characteristics of the tube and the nature of the screen coating employed. In general, "great" intensity refers to an intensity such that, under the conditions present, the beam produces an irreversible chemical or micro-physical change in the screen, whereas a beam of "lesser" intensity is one which produces only a reversible or electronic reaction upon the screen, secondarily emitting such electrons as bombard the screen, without permanent change in the nature of the screen itself. If the screen is of metallic potassium coated with potassium hydroxide, the beam of great intensity produces a chemical change; if the screen is of a metal coated with paraffine, such a beam produces a micro-physical change. In either case, a beam of lesser intensity produces only an electronic effect, receiving and emitting electrons without

change in the chemical or physical properties of the screen itself.

As is well known, a cathode ray tube has horizontal deflector plates or coils 12, and vertical deflector plates or coils 13. In the most elementary form of my invention I impress upon these respective plates or coils (hereinafter called plates) any intelligence which is capable of being expressed as two components, in the form of electrical signals. One component is impressed upon the horizontal plates 12, while the other component is impressed upon the vertical plates 13. In a very simple case, for example, the horizontal deflection of the electron beam may be a function of time, while the vertical deflection may be proportional to the amperage in an electric circuit carrying a brief pulse of current (for example, in a spotwelding circuit). Obviously, any particular combination of current versus time will result in a definite and characteristic trace, different from all other combinations of those or any other factors. If that trace be permanently impressed upon the screen, it will be retraced when the generating conditions are repeated, will be recognized or remembered, in effect, and will reproduce the same results as were produced when it was generated.

In the form of my device which is shown in Figure 1 the screen of the cathode ray tube Y is of special composition, as has already been discussed, to the end that an electron beam of great intensity will permanently change the character of the screen, throughout the trace of such beam over the screen, so as to alter its capacity for secondary emission of electrons from the affected area, as compared with the remainder of the screen, when subsequently bombarded with an electron beam of lesser intensity.

To illustrate, the cathode ray tube 1 of Figure 1 has the conventional heater 14, cathode 15, grid 16, anodes 17 and 18, vertical deflecting plates 13, and horizontal deflecting plates 12. The large end of the tube, in the preferred form of Figure 1, departs from conventional practice in that it carries a special coating, of the nature previously discussed, capable of suffering permanent change under the influence of a powerful electron beam. Also provided is a collector ring 19 for the purpose of collecting electrons resulting from secondary emission from the screen coating 10, and of transmitting the same to output circuits. The cathode 15, grid 16, and anodes 17 and 18 are supplied with appropriate direct current voltages in any usual or known manner, as by tapping a resistance 4 which is placed across a suitable source of direct current.

Inserted between the grid and cathode leads is an oscillator 3, of conventional or suitable design. This oscillator should be provided, in any desired manner, with suitable adjustments to enable it to give an output of any selected one of a large number of frequencies. Such oscillators, having the capabilities indicated, are relatively common, and their design is a matter of common knowledge in the art, hence the present invention is not concerned with, nor to be limited by, the specific design of such an oscillator. By means of this oscillator 3 the electron beam may be modulated at selected frequencies, so that the beam will be a series of characteristically spaced, brief pulses.

The vertical and horizontal deflecting plates 13 and 12, respectively, as mentioned previously, may be supplied with signal impulses from any desired source. In Figure 1 a microphone 2 of

any suitable design is shown feeding a conventional amplifier 20, the output of which is fed into a dividing input circuit. Each division contains, for example, a characteristic inductive link 22 or 23, which feed the corresponding rectifiers 24 and 25. The rectified impulses are delivered to the deflection plates 12 and 13 through the transformers 26 and 27, which serve the multiple purposes of stepping up the deflection voltages to the desired level, smoothing the rectified impulses, and restoring two-directional characteristics of the deflection voltages so that the entire screen area may be traversed by a ray starting from a centralized rest position. The resistances 28 and 29 further serve to smooth out the curves of voltage applied to the deflection plates. All these modifications of the input energy are for the purpose of providing a reproducible pattern or trace of deflections derived from incoming signals—in the exemplified instance, sounds.

The dividing circuit may take various forms, depending upon the requirements of the particular case, so that in the broad sense no especial emphasis is placed upon the forms just described, nor upon any other specific form. The objective, in the form described, is to provide a circuit adapted to separate high and low frequencies and to represent their energy variations by relatively simple ray deflections within the tube. Indeed, a dividing circuit is not essential, but other circuits for impressing a trace pattern upon the screen are capable of being used.

Thus, the primary of inductive link 22 is in series with the condenser 22a, so it receives principally the higher frequencies, while the primary of link 23 is in series with inductance 23a, and so receives only the lower frequencies. The outputs of corresponding secondary coils of these linkages are rectified by rectifiers 24 and 25, and the resultant voltages after transformation by 26 and 27 are applied to the horizontal and vertical deflecting plates 12 and 13, respectively. The incoming signal has been segregated into two components, which are applied to the respective deflecting plates. Upon impressing the trace of the electron beam of great intensity upon a screen, of such nature as has already been described, the potassium hydroxide, paraffine or other over coating is destroyed and removed, or altered, leaving the metallic coating exposed and hence of altered characteristics, relative to the still-coated remainder of the screen, in its ability to emit secondary electrons when it is subsequently bombarded by the electrons of the cathode ray as this ray, at lesser intensity, retraces such a trace.

This cathode ray tube 1 is provided with suitable means for collecting the electrons from such secondary emission, to the end that they may be transmitted to output circuits for useful purposes. A collecting ring 19 serves as such means, and is connected to a group of resonant circuits 91, 92, 93 . . . 9n, each tuned to one of the frequencies of oscillator 3, and thence through individual devices to be operated, designated 81, 82, 83 . . . 8n to ground. These devices may be of considerable complexity, but their nature is unimportant to this invention so long as each is capable of being activated by an electrical impulse of the frequency delivered to it by its connected resonant circuit.

To set up the system for operation, it is first necessary to "teach" the system what is desired—to condition it—by suiting the action of

a device such as 81 to the input signal at 2, while simultaneously recording permanently upon the screen 10, 11 the resultant of that signal, for later "remembrance." To thus record a signal, the grid voltage is first adjusted to produce a very intense beam of electrons, and the oscillator 3 is adjusted to a selected frequency, one which corresponds to the frequency of one of the devices such as 81. The signal source—in the illustrated arrangement the microphone 2—is now excited by a selected signal, such as a selected reproducible sound. The resulting electrical impulse is amplified by amplifier 20, is broken down into horizontal and vertical components by the dividing circuit, and is transmitted to the plates 12 and 13 respectively. The horizontal deflection of the modulated electron beam will be proportional to the instantaneous intensity of the resultant of the higher frequencies, while the vertical deflection will be proportional to the intensity of the resultant of the lower frequencies.

The beam will thus trace an irregular but characteristic, definite, and reproducible path over the screen. Because of the high intensity of the generating or recording beam, and the nature of the screen layers, the beam will permanently alter the characteristics of the screen, as by removing the paraffine coating from the affected portions of the sodium layer. Since the beam is modulated by the oscillator 3, the trace left upon the screen will be a series of dashes rather than a continuous trace. Other signals may be similarly recorded usually (but not necessarily in every case) with a different modulation frequency, as determined by the oscillator 3.

As will by now be evident, if a similar signal (but accompanying a ray of lesser intensity) is again impressed upon the tube, with the modulator or oscillator 3 removed or deenergized, through a similar input circuit, the electron beam will again trace the same path as before, resulting in a certain characteristic secondary emission of electrons. If, however, a different signal is impressed upon the tube, the electron beam will trace a path over the unaffected areas of the screen, resulting in a different secondary emission. Thus, the output of the tube, representing the collected electrons resulting from secondary emission, will be of one value if the original signal is reimpressed, and of another value if some other signal is impressed. For example, if the originally and externally recorded sound is accurately reproduced and in the same way directed into the microphone, the unmodulated electron beam will retrace its original path. Even though the beam is now unmodulated, it will be apparent that the secondary emission of the screen will not be uniform throughout the trace of the unmodulated beam, but will vary as the beam travels now over the areas of the screen which were modified by the modulated recording trace—the dashes referred to above—and now over the intervening unmodified areas. This variation will be at the same frequency as was originally supplied by the oscillator during the recording of the trace.

The electrons resulting from this secondary emission are collected by the collector ring R, and delivered to that output circuit 91, 92, etc., which is resonant to the particular frequency represented by the variations in intensity along the trace upon the screen. Obviously, the current will pass selectively and automatically through whichever output circuit is tuned to the trace frequency, and only that device 81, 82, etc., will be

activated or energized which receives current through such resonant output circuit.

Any suitable signal, or combination of signals, which has been recorded, at a characteristic frequency, and then repeated, will activate the appropriate device. Such other signals may consist of words capable of identical reproduction, such as when first recorded on a magnetic tape, a film or disc, and, by playing them into the microphone, recorded as a trace on the cathode ray tube screen, each at a frequency corresponding to that for which a different output circuit 91, 92, etc., is tuned. Were human beings able to speak the same words repeatedly in identical manner then the apparatus could be made reliably responsive to directly spoken commands, as will be evident. Even in rudimentary form the apparatus might well be made responsive to directly spoken words, at least occasionally out of repeated tries, if the speaker cultivates ability to speak in the same manner into the microphone after recording as during recording on the cathode ray tube, especially if the cathode ray beam is not sharply focussed.

The system is thus capable of distinguishing and discriminating one signal from another, and of suiting the appropriate output action to the input signal. It is also capable of discriminating any of the recorded signals from any unrecorded signal, or vice versa. If a "strange" sound is directed into the microphone, the electron beam will not trace over any of the recorded paths, but will travel over some new and different path. The output of the tube, under such circumstances, will not be of any of the frequencies to which the output circuits 91, 92, etc., are tuned, and none of the devices 81, 82, etc., will be activated.

In describing the initial recording the output circuits were described as connected during the recording (as indeed they may be), in order to effect a close comparison between the conditioning of a child's or of a puppy's reflexes for example, by association of idea and corresponding action. However, the output circuits and devices are not necessarily connected at the time of recording, for it is only necessary that an adequate secondary electron emission, at proper frequency—one which corresponds to one output circuit—be collected and transmitted to the output circuit in order that the latter may be energized, and since the value and frequency, as determined by the trace, determine the energization of the output circuit, the latter need not be connected while the initial trace is being recorded. Being arranged to respond to an impulse of given value at a given frequency, it will respond thereto when, after initial recording, such an impulse is later transmitted to it.

It may be helpful further to illustrate the capabilities of the system by referring to the spot-welding example mentioned above. Herein, in the event the current-time relationship, which has produced the initial trace, is not reproduced exactly, and the subsequent beam therefore fails to follow the established and desired pattern, an alarm bell or light may be energized.

Heretofore it has been assumed that the device, as 81, and its energizing circuit, as 91, are directly responsive to the input signal through the interposition of the cathode ray tube. It may be found preferably to substitute, in the output circuit, a previously and somewhat differently condition cathode ray tube. Suppose there is directed into the microphone a given sound to condition the tube to excite output circuit 91. If in this cir-

cuit 91 (or in the output device 81) there is a second cathode ray tube which, when thus excited, has been "taught" to respond in an output speaker by producing a related but different sound, we have an indirect but nevertheless characteristic and related response.

So it can be seen that it is not outside the bounds of possibility, to "teach" such a tube and output circuit to function as a sound translating device, which might even apply as a translator between different languages if word reproduction can be "standardized," as by recording initially on a tape or disc, and playing back, as previously mentioned. The theoretical possibilities of the invention appear illimitable.

The form illustrated in Figure 2, from which is omitted the showing of an input circuit, employs a cathode ray tube 1 of known or conventional formation, instead of a specially arranged tube. It has a normal fluorescent screen 10a. The focusing and accelerating anodes are energized in the usual manner. The incoming signal is impressed upon the deflection plates 12 and 13, causing the electron beam to traverse a trace in the normal manner. Such trace, however, is imaged by a lens 50, and is recorded upon a photographic film or plate 5, so placed as to receive the trace's image.

After all desired traces (each at its characteristic frequency) have been thus photographically impressed upon the photosensitive surface 5, the latter is developed and fixed. If removed for this purpose, it should be replaced accurately. While it is not wholly necessary, it may also be reversed or printed, making the image of the trace transparent, or translucent as compared to the surrounding unmodified areas.

Now if the signal is reimpressed upon 12 and 13 with the oscillator 3 removed or inactive, as by opening switch 30 the beam will follow the same path, illuminating the screen 10a uninterruptedly. The optical image of the trace will fall upon successive clear line segments on the film 5, which, if the film be reversed, will represent previous points of peak ray-intensity. Passing through these clear portions of the photographic image, light from the image of the uninterrupted trace will strike a photoelectric cell 6, giving rise to electrical impulses of the same frequency as was originally produced by the oscillator for modulation of the generating ray. Such impulses may, of course, be suitably amplified at 60, as required to cause them to produce the desired result. Each impulse, being characteristically modulated in accordance with its photographically recorded trace, may be distinguished from all other impulses, and can be directed to useful ends through the proper one of the tuned circuits 91, 92, 93 . . . 9n, and thence to the proper operating device 81, 82, 83 . . . or 8n, just as in the case of the system previously described.

It has been assumed heretofore that the oscillator 3 will produce modulations at definite frequencies. This is not essential, for the oscillator 3 may be arranged to modulate variably, as by the variations of voice frequencies, impressed upon the input circuit through the medium of a suitably responsive device, and with suitably responsive output circuits.

I claim as my invention:

1. Translating apparatus adapted for reacting selectively to prerecorded stimuli repeated to the apparatus after recording, said apparatus comprising record producing and retracing means

having an impressionable medium and cooperating stimuli recording means operable electrically to create spatially interrelated recordings in said impressionable medium, which are of configurations characteristic of different stimuli impressed on said recording means, input means connected to said recording means for applying electrical stimuli thereto, adjustable modulating means connected to said recording means to apply thereto selected modulation stimuli simultaneously with the application thereto of selected stimuli from said input means, the resulting records in said impressionable medium thereby incorporating both said input stimuli and said modulation stimuli, said record producing and retracing means further having means cooperating with said impressionable medium and responsive to the repetition of an input stimulus, for retracing the record of such stimulus in said impressionable medium, and adapted to produce thereby a detectable electrical signal having the modulation characteristic of said stimulus, and discriminator means receptively connected to said responsive means to receive such signal, and comprising signal-modulation-sensitive means having sensitivity selective of individual modulations and adapted automatically to produce different translative results related as effect to such input stimuli as cause.

2. Electric translating apparatus comprising means for creating an electrically deflectable beam, impressionable means interposed in the path of said beam to be affected thereby to form a lasting beam trace impression with deflection of said beam, means coacting with said impressionable means to produce therefrom an electrical response when said beam is caused to scan along a trace impression, beam deflecting means adapted to deflect said beam to produce such trace impression and such scan in response to an electrical signal applied and reapplied, respectively, to said deflecting means, means for deriving electrical signals for application to said deflecting means, which signals represent characteristics of impressed stimuli, modulating means coacting with said deflecting means in producing different modulation effects on said beam when different stimuli are so impressed, the effects becoming incorporated compositely in said beam trace impressions, and detecting means selectively reactive to said electrical responses produced with the rescanning of beam trace impressions to produce related operative results responsively to the impression of different stimuli.

3. An electronic translating device adapted to respond selectively to messages recorded and then repeated to the apparatus, as said messages are repeated, said device comprising a cathode ray tube having an impressionable screen adapted to retain a lasting impression of a beam trace pattern, beam deflecting means for said cathode ray tube comprising separate deflecting members disposed at an angle to each other and operable to scan the beam over said screen along different paths in response to different deflecting voltages applied thereto, electrical response means associated with said screen and adapted to produce an output signal characterized by a beam trace pattern upon retracing said pattern which has been impressed on said screen, means for producing deflecting voltages for application to said deflecting members, which voltages are different components of a stimulus impressed on such means, to produce a beam trace pattern representative configurationally of said stimulus,

means for impressing a selectable modulation characteristic on said beam coincidentally with the impression of said stimulus, to impart an identifiable modulation effect on the resulting beam trace impression on said screen, different modulation effects being given to different stimulus patterns, and modulation detecting means associated with said electrical response means and adapted to react selectively to different output signals corresponding to different stimuli to produce different operative results.

4. Electrical translating apparatus adapted for reacting selectively to stimuli previously recorded in said apparatus, said apparatus comprising a cathode ray tube having an impressionable screen adapted to form lasting impressions of different beam trace patterns, beam deflecting means for said cathode ray tube and adapted to scan the beam thereof in two dimensions over said screen, an input device adapted to receive controlling stimuli and to convert such stimuli into beam deflecting voltage impulses for application respectively to said deflecting means, each stimulus being converted into at least two such impulses which represent different characteristics of such stimulus, means for modulating the intensity of the beam at a selectable frequency differently with different stimuli to impart different modulation characteristics to said impressions, detector means operable to produce modulation-bearing electrical impulses by the retracing of patterns on said screen, and discriminator means having separate elements adapted to react individually to different modulation frequencies to produce operative results related as effect to such stimuli as cause.

5. Apparatus as in claim 4, in which said input means comprises harmonic analyzer means adapted to separate an impressed stimulus into voltage harmonics in an upper and a lower range, for application to said deflecting means to produce a beam trace pattern characterized by such stimulus and differently for others.

6. In a robot device responsive to applied stimuli, an electronically responsive record medium of the secondary emission type carrying spatially interrelated trace impressions, the configurations of which are representative of different recorded stimuli and which bear individual identifying modulation patterns along said trace impressions, electrically detectable on scanning said impressions individually by the modulated secondary emissions therefrom.

7. In a robot device responsive to applied stimuli, a record medium carrying spatially interrelated separately identified stimuli impressions, the configurations of which are representative of different stimuli, signal output means operable by scanning said impressions selectively in response to the application said stimuli to produce an output signal characteristic of the identification of each impression so scanned, and discriminator means responsive selectively to the different output signals to produce different operative results thereby unique to each such stimulus.

8. The method of recording a group of stimuli in sequence for producing sequential responses selectively to repetition of said stimuli in a predetermined sequence, said method comprising the steps of forming a stimuli carrier medium coating with a record medium, applying stimuli sequentially to said carrier medium to scan said record medium, thereby to form lasting record impressions thereon representing said stimuli,

imparting different stimuli-identifying effects to said carrier medium as said stimuli impressions are formed, by intensity modulating said carrier medium at different frequencies corresponding to individual stimuli, reapplying said stimuli sequentially to said carrier medium without modulation thereof to scan said impressions, said record medium being adapted upon scanning individual record impressions thereon to form modulated electrical signals identifying different stimuli, and detecting said signals selectively to produce corresponding different operative results in the same sequence.

9. A robot device adapted to respond to sonant commands to produce predetermined effects related thereto, comprising a record medium bearing, each with different modulated recording characteristics, a vocabulary of different record patterns corresponding to selected sound stimuli, to condition the device for robot operations, contacting record scanning means responsive to such sounds and operable therefrom to scan selectively the record pattern of each such recorded stimulus on said medium, said medium being adapted responsively to such scanning to produce detectable modulated signals unique to individual stimuli, detecting means associated with said recording medium and operable by repetition of recorded sounds to convert said detectable modulated signals to electrical output signals corresponding to such sounds, and means responsive selectively to said output signals to produce distinctive operative results related individually to sounds repeated to the device.

10. In combination with a cathode ray tube, having an associated screen structure adapted to retain permanently thereon a plurality of characteristic initial traces produced by deflection of an intense beam in said tube, the traced screen areas having a different scanning response property than untraced areas, signal input circuit means operable initially to deflect a high intensity beam in said cathode ray tube to produce selected permanent characteristic traces on said screen structure corresponding to selected input signals, beam intensity modulating means operable during such initial beam deflection to impress in such traces identifying modulation characteristics unique to different input signals, means operable to effect scanning of said selected traces by the beam at low intensity by repetition of corresponding selected input signals, said screen structure thereby producing modulated scanning responses associated with the different traces, and coating output circuit means operable to separate such individual scanning responses to produce selected results therefrom.

11. The combination defined in claim 10 in which the modulation means comprises a variable frequency circuit and in which the output circuit comprises a frequency-discriminator circuit having selective branches tuned individually to the modulation frequencies of the individual traces.

12. A system for reacting to an impressed stimulus, upon its repetition, comprising a cathode ray tube, and including a screen structure associated therewith, said screen structure being characterized in the alterability of its scanning response properties along the trace of the electron beam by controlling intensity of such beam, input circuit means operable to control beam deflection of said cathode ray tube, and responsive to a selected signal to produce a corre-

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sponding beam-deflecting stimulus which effects upon said screen structure a permanent trace characteristically related in form to said signal, coating modulating means simultaneously operable to modulate the beam during such deflection to produce a characteristic scanning response modulation in said permanent trace, and output circuit means operably connected to said screen structure and responsive to scanning response impulses generated by retracing such trace to produce a circuit reaction characteristically related to such trace, and differently for the different traces characteristically modulated.

13. The system as defined in claim 12 in which the cathode ray tube includes individual beam deflecting means disposed operatively to produce beam deflection in different directions on the screen structure, and further in which the input circuit means include harmonic separating circuit branches connected individually to said sep-

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arate beam deflecting means, whereby to apply separate signal harmonic components to said individual deflecting means and produce beam trace patterns shaped in accordance with the different applied stimuli.

THOMAS N. ROSS.

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Certificate of Correction

March 28, 1950

Patent No. 2,501,788

THOMAS N. ROSS

It is hereby certified that errors appear in the printed specification of the above numbered patent requiring correction as follows:

Column 10, line 36, strike out the word "therefrom" and insert the same after "produce", line 27, same column;

and that the said Letters Patent should be read with these corrections therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 11th day of July, A. D. 1950.

[SEAL]

THOMAS F. MURPHY,
Assistant Commissioner of Patents.