

March 17, 1942.

F. J. BINGLEY

2,277,000

SYNCHRONIZING SYSTEM

Filed Sept. 17, 1940

3 Sheets-Sheet 1

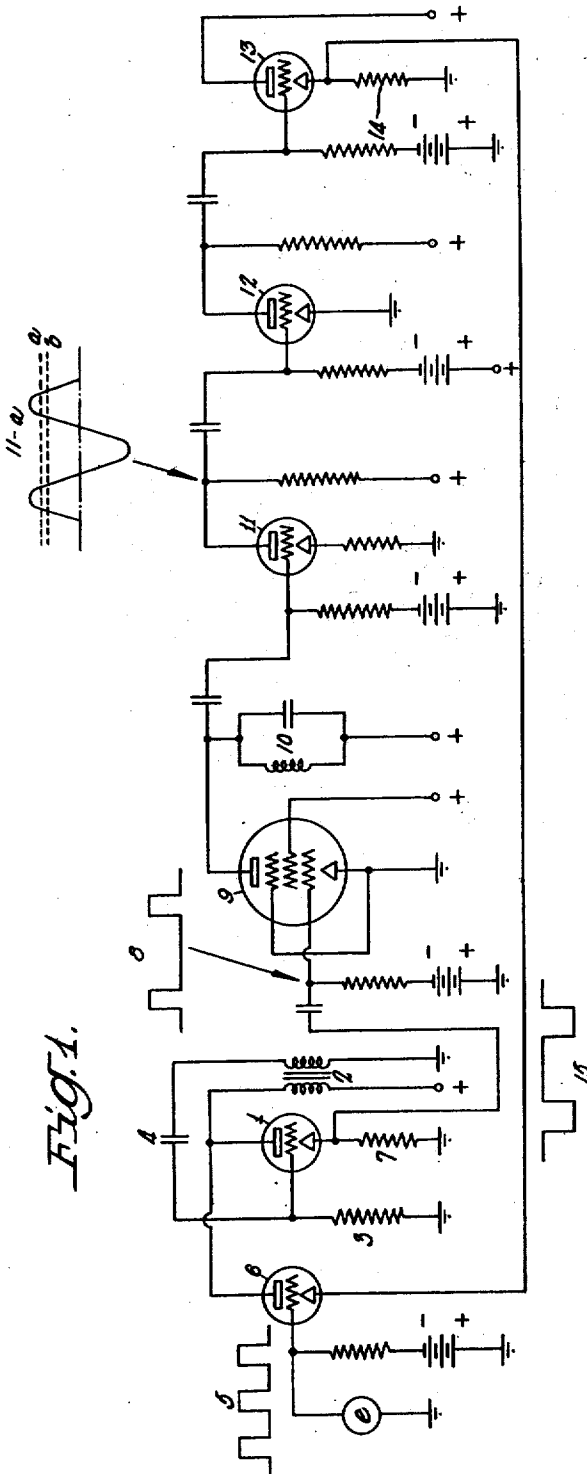


Fig. 3.

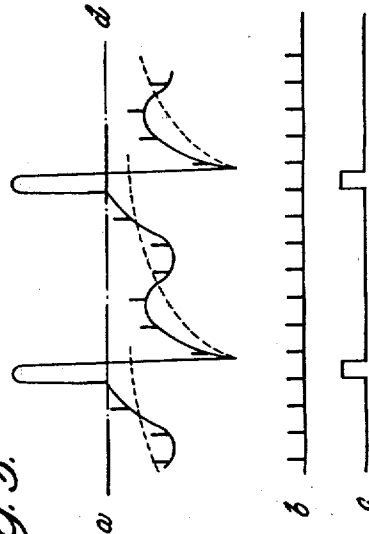
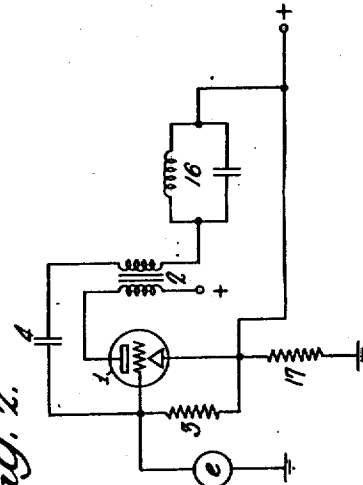


Fig. 2.



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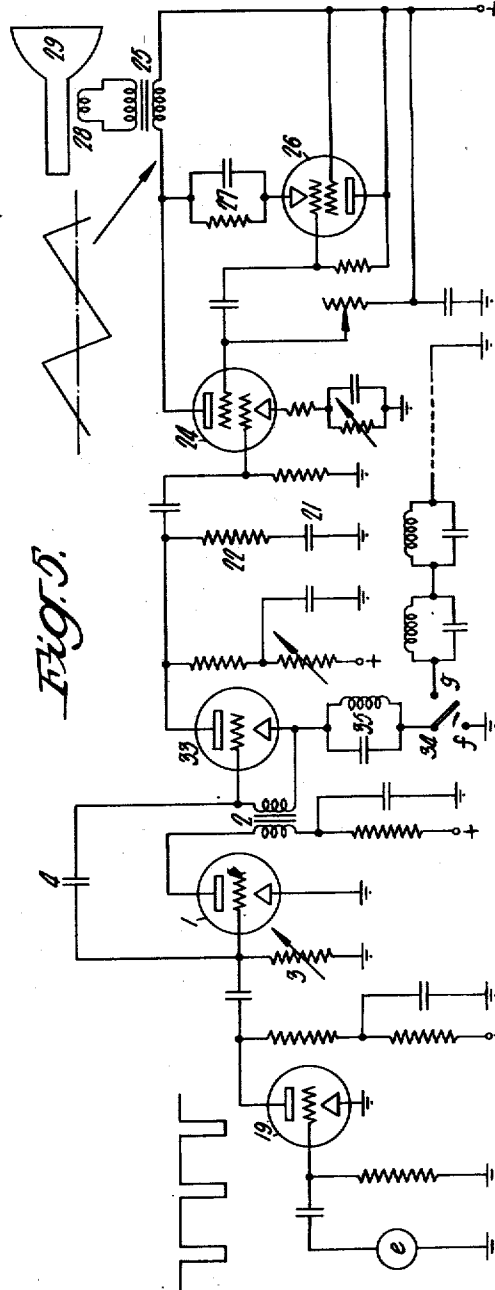
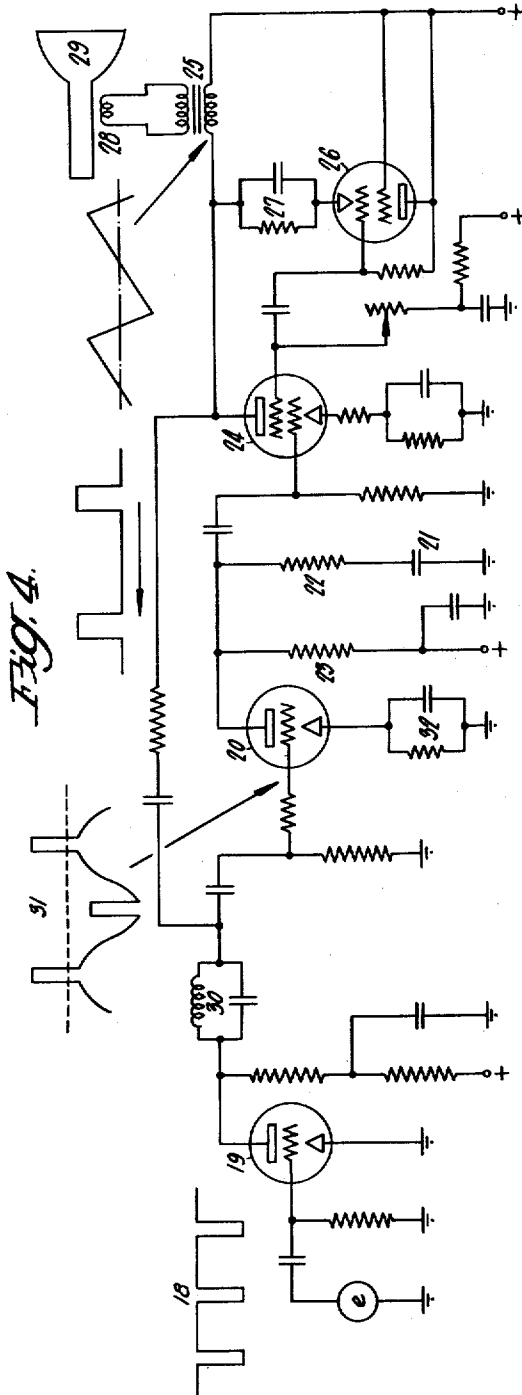
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3 Sheets-Sheet 2



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3 Sheets-Sheet 3

Fig. 6.

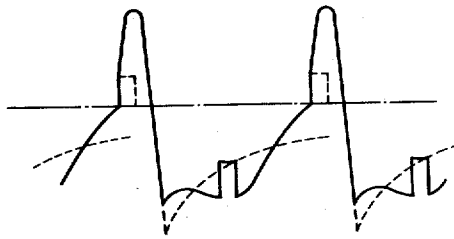
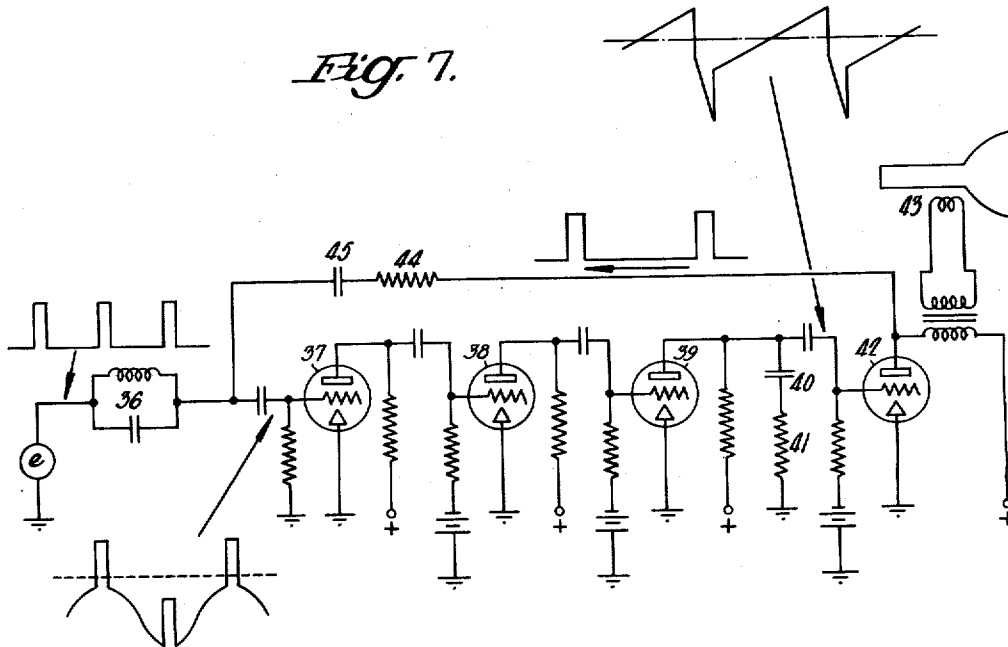


Fig. 7.



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UNITED STATES PATENT OFFICE

2,277,000

SYNCHRONIZING SYSTEM

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Application September 17, 1940, Serial No. 357,179

19 Claims. (Cl. 178—69.5)

This invention relates generally to electrical systems designed to be actuated or set in operation periodically by recurrent pulse signals supplied thereto. The invention relates to various improvements in such circuits, and more specifically to a method of and means for increasing the tendency of such a system to be actuated by desired pulse signals occurring with a given period, and for decreasing the tendency of the system to be actuated by undesired pulses and extraneous noise signals occurring in the intervals between said desired pulse signals. The invention is particularly adapted for use in a television system, for example in the deflecting circuits thereof, and in various types of frequency dividers synchronized by periodically recurrent pulse signals. However, it is to be understood that the invention is not restricted in its application to any particular system.

In the television art, it is often desirable to generate relatively large pulse signals timed by periodically recurrent, accurately spaced but relatively small pulses which are conveniently referred to as "synchronizing pulses." Various devices for this purpose are known, examples of which are the blocking tube oscillator, gas discharge tube oscillators, multivibrators, and the like. Such devices have the advantage that, in the absence of synchronizing pulses, they will continue to oscillate at a rate which is usually somewhat lower than that at which they oscillate when synchronized. A device of this type possesses the added desirable feature that it is more readily actuated by a pulse signal during certain parts of its cycle than during other parts thereof. This tends to insure the actuation of the device only by certain desired periodically recurrent pulses, and not by other pulses occurring periodically or at random or by noise pulses. However, it has been found that, although these devices are less susceptible to actuation during certain portions of their periods than during others, the difference in susceptibility to actuation in different parts of the cycle, and the rate of transition from low susceptibility to high susceptibility, are not sufficiently great to insure that the device will not be actuated by an undesired pulse or signal.

It is an object of the present invention to provide in such a device novel means for increasing the difference in susceptibility to actuation as between different parts of the cycle and for emphasizing the transition between low and high susceptibility. It should be here noted that the novel means provided by this invention is not

limited to oscillatory pulse generating devices, as above mentioned, but is applicable also to non-oscillatory systems for amplifying the relatively small synchronizing pulses. Thus, as will be shown later, the invention is applicable to a so-called direct driven deflecting system which employs a cascade of amplifiers to magnify the incoming synchronizing pulses and make them of suitable amplitude for operating a discharge circuit in a television deflecting system. Such an amplifier would be operated so as to be cut-off except upon the arrival of a synchronizing pulse. However, in normal operation of such a device, in order to obtain the greatest possible amplification of the synchronizing pulses, the tubes should be barely cut-off during the intervals between synchronizing pulses. This mode of operation unfortunately makes the system very susceptible to noise voltage, extraneous pulses and the like. By means of the present invention, it is possible to avoid this difficulty without impairing the amplification.

A further important particular application of the present invention is to an oscillatory frequency divider employing a blocking-oscillator or similar device. Such devices have long been used as frequency dividers but have proven unsatisfactory where a large division is sought, due to the tendency of the oscillator to respond to other than the desired subharmonic of the signal whose frequency is divided. By means of the present invention, it is possible greatly to reduce the tendency of the divider to synchronize on other than the desired subharmonic.

The invention may be clearly understood by reference to the drawings, in which:

Fig. 1 is a schematic diagram of a frequency divider of the blocking-oscillator type embodying the invention;

Fig. 2 is a schematic diagram of another embodiment of the invention in a frequency divider circuit;

Fig. 3 is an explanatory diagram which will facilitate an understanding of the device of Fig. 2;

Fig. 4 is a schematic diagram of a television cathode ray tube deflecting circuit embodying the invention;

Fig. 5 is a schematic diagram of another form of cathode ray tube deflecting circuit embodying the invention;

Fig. 6 is an explanatory diagram which will facilitate an understanding of the system of Fig. 5; and

Fig. 7 is a schematic diagram of a cathode ray

tube deflecting circuit of the direct driven type embodying the invention.

Referring first to Fig. 1, it is well understood by those skilled in the art that a blocking-oscillator comprises an extremely overcoupled regenerative vacuum tube oscillator in which feedback occurs through a transformer having its primary connected in the plate circuit and its secondary coupled to the grid. The grid circuit includes a time circuit which determine the free period of oscillation. Such an oscillator is that shown in Fig. 1 comprising the tube 1, the transformer 2, and the time circuit consisting of the resistor 3 and the condenser 4. In its quiescent condition, the grid of the tube 1 is biased beyond cut-off by a voltage in the time circuit which leaks off gradually until the grid voltage is such that the tube is no longer blocked, at which time the plate will start to draw current. The increase in the plate current will induce a voltage in the grid circuit by means of the transformer 2 which will cause the plate to draw more current. As a result, the plate current and grid voltage will increase rapidly until the grid draws current and charges the condenser 4. The voltage across the condenser will oppose that developed in the secondary of the transformer, with the result that grid voltage and plate current will finally decrease rapidly until the only voltage applied to the grid will be that due to the charge on the condenser. This voltage will be negative with respect to the cathode and of sufficient magnitude to bias the tube beyond cut-off. The tube is then inactive until this bias has been sufficiently reduced to permit the tube to conduct, which may obtain either by the discharge of the condenser through the resistor 3 or by the application of an opposing voltage from some external source.

With the device adjusted to oscillate freely with a period which may be greater by several times than the interval between pulses applied to synchronize it, it may be made to begin a new cycle in response to each of these timing pulses. However, if noise pulses or other extraneous signals be introduced in the intervals between the desired timing pulses, they may tend to actuate the device and thereby falsely synchronize it. This is particularly the case where the oscillator is used in the capacity of a frequency divider. For example, given a series of time-spaced pulse signals occurring at a predetermined frequency, it may be desirable to have the oscillator respond to only certain of these pulses occurring with a period equal to a multiple of the interval between successive pulses. By proper adjustment of the oscillator and with sufficient uniformity in the size and shape of the pulses, the device may be made to respond to every other pulse, to every third pulse, etc. But, as the number of pulses intervening between those which it is desired should fire the oscillator is increased, the operation of the oscillator becomes unstable due to its tendency to fire on other than the desired pulses. In order to avoid this, it has been found desirable to "quench" the oscillator during the interval between the occurrence of pulses which it is desired should actuate it. By quenching the oscillator is meant that, during the period of quenching, the oscillator is rendered less susceptible to actuation by pulse signals and the like than it would be ordinarily. Quenching may be effected, for example, by applying to the oscillator a voltage of polarity opposite to that which would tend to fire it.

The method of quenching in its broader aspects and in certain applications is disclosed and claimed in U. S. Patent No. 2,141,343 of R. L. Campbell and in my copending application Ser. No. 224,646, now Patent No. 2,231,792, issued February 11, 1941. However, the present application relates specifically to a particular type or mode of quenching which I have chosen to call "resonant quenching." In "resonant quenching" the quenching voltage is developed by applying the pulse signal generated by the oscillator to a circuit comprising one or more resonant circuits tuned to a frequency bearing a particular relation to the desired synchronized frequency of the oscillator. The voltage developed across the resonant circuit may be applied directly to the oscillator so as to effect quenching, or it may be first modified or shaped to give a desired quenching characteristic.

Returning now to the circuit of Fig. 1, suppose that a train of periodically recurrent pulse signals 5 be supplied from the source *e* to the grid of a thermionic amplifier 6, the plate of which may be directly coupled to the plate of the blocking tube 1 so as to supply to said plate pulses of the opposite polarity to those at 5. These pulses will be of such polarity that they will tend to actuate the oscillator or fire it. However the oscillator may be so adjusted as to fire at some subharmonic of the frequency of these pulses. For example, in the case illustrated, it may be adjusted to fire on alternate pulses only. This adjustment is dependent primarily upon the values of the resistor 3 and the condenser 4. This adjustment is well known and need not be discussed in great detail. It is not feasible to lay down any exact rule for the determination of these values in any specific case, since the values chosen will vary greatly with conditions and the mode of operation sought. Suffice it to say that the free period of the oscillator will, in general, be greater than the synchronized period and may even be several times as great, particularly when resonant quenching is to be used.

Across the resistor 3 will be developed pulse signals shown at 8 occurring at the desired subharmonic frequency. These may be applied to the grid of the pentode 9 whose plate circuit includes a resonant circuit 10 tuned approximately to the subharmonic frequency, and across which there is developed, in response to the pulses 8, a sine-wave of this frequency. The latter is amplified and its phase reversed in tube 11, appearing thereafter as shown at 11-a. To obtain the desired quenching voltage, it may be expedient to select only a portion of this sine-wave, for example that portion between the levels *a* and *b*. This is conveniently done by the "microtome" circuit comprising the tubes 12 and 13. These tubes should be properly biased to give across the cathode load resistor 14 a signal 15 comprising a series of negative pulses occurring at harmonic frequency and corresponding substantially in time to the undesired pulses in the signal from source *e*. The high potential end of this resistor may be connected to the cathode of the tube 6. It will then be seen that the cathode of tube 6 will be maintained at a more positive potential during the greater part of the oscillator cycle than during the time when the oscillator is to be fired. Preferably the cathode should be so positive that the tube is completely cut off and incapable of passing any pulse signal of ordinary amplitude which may occur during the interval between desired actuating pulses.

However, the negative excursions of the quenching signal 15 should be sufficient to render the tube 6 capable of passing the desired synchronizing pulses to the plate of the oscillator tube 1. Of course it will generally be preferable to have the negative excursions slightly longer in duration than the synchronizing pulses themselves in order to condition the tube 6 slightly beforehand, that there may be no danger of excluding a desired synchronizing pulse. It will be obvious that other methods of and means for utilizing the quenching voltage are possible but it is not deemed necessary to discuss them in detail as the various methods of applying quenching have been considered in detail in my above-mentioned Patent No. 2,231,792.

The effect of the resonant quenching of the blocking-oscillator in the manner just described will be greatly to increase its utility as a frequency divider by greatly reducing its susceptibility to firing except at the time of arrival of the desired timing pulse. The action of the system as a whole might be otherwise described by saying that just before the arrival of the desired timing pulse, the oscillator, which has hitherto been passive, is conditioned by being rendered capable of synchronization by a pulse signal supplied to it.

A simplified form of the quenched blocking-oscillator for use as a frequency divider is shown in Fig. 2 where like numbered parts correspond to those in the oscillator of Fig. 1. Here the resonant circuit 16 is included in the grid return circuit of the oscillator. For purposes of explanation, let it be assumed that it is desired to use the oscillator to obtain a frequency division by seven. In Fig. 3 at a the normal exponential decay of negative grid voltage which is typical of the operation of the usual form of blocking-oscillator is represented by broken lines. Since the susceptibility of the oscillator to firing is dependent upon grid voltage, it is apparent that as the grid voltage decays the curve becomes flatter and there is very little change in this susceptibility. The effect of including the resonant circuit in the grid return is to add to the grid voltage a sine-wave which may be subjected to more or less decay throughout the cycle. The resonant circuit is excited at the beginning of each cycle of oscillation by the grid of the tube drawing a pulse of current. When the grid current ceases the resonant circuit 16 oscillates freely and substantially independently of the rest of the circuit until it is again excited by the initiation of a new cycle. The period of the resonant circuit 16 is so chosen that a positive peak of oscillation corresponds substantially to the time of occurrence of the pulse which it is desired should fire the oscillator. The effect upon the grid voltage is clearly shown in Fig. 3 at a where the modified grid voltage curve is represented by the solid line. At b there is shown the series of time spaced pulse signals which are applied to the grid of the oscillator from the source e and which are to be subjected to frequency division, for example by seven. As shown in Fig. 3 at a these pulses will ride on the grid voltage wave and, when one rises above the level d the oscillator will fire. The effect of adding the sine-wave voltage is to increase the rate of change of grid voltage just before the arrival of the seventh pulse after the beginning of each oscillation. This increase in steepness of the grid voltage curve greatly increases the tendency of the oscillator to fire on the seventh pulse and

appreciably decreases the tendency to fire on the sixth and eighth pulses. In the resulting output signal derived, for convenience, across the load resistor 17 in the cathode of the tube, and shown in Fig. 3 at c there will be one pulse for every seventh pulse in the input signal.

The considerations involved in the choice of the resonant frequency of the circuit 16 will be apparent from the foregoing discussion. In the embodiment just described, the resonant frequency of this circuit was made approximately one and one-third times the frequency at which it was desired that the device should oscillate. However, it will be understood that, in all cases, there will be a number of frequencies to which this circuit might be tuned to give satisfactory results, so long as the ultimate effect is to cause the oscillator to synchronize on the desired subharmonic. It is also feasible, as will be explained presently in connection with another embodiment, to include a plurality of circuits resonant at different frequencies, the effect of which will be to increase to an even greater degree the tendency of the oscillator to synchronize on the desired subharmonic. It may also be observed that although it is generally desirable to use a resonant circuit having as high a value of Q as is conveniently possible, satisfactory results are obtained even with relatively low Q circuits inasmuch as the circuit, as in the above case, may be required to oscillate freely for only slightly more than one cycle. It will be apparent that the advantages of applying the invention to frequency dividers in general are independent of the degree of division although, of course, the greater the degree, the greater will be the need for its application.

Another important application of the invention is its use in connection with cathode ray tube beam deflecting circuits such, for example, as are used in television. Sometimes these circuits employ oscillators similar to those just described for the purpose of producing large pulse signals in response to the relatively small synchronizing pulses. The disturbance of the oscillator produced by extraneous pulse signals and noise voltages tends to disrupt the operation of the deflecting circuit and thereby impairs reception of the television signal. In particular, the standard television synchronizing signal now in use includes, in addition to the usual horizontal and vertical synchronizing pulses, a series of so-called double horizontal frequency pulses which are inserted before and after the vertical synchronizing pulses for the intended purpose of improving vertical synchronization and for maintaining horizontal synchronization during the vertical blanking period. Unfortunately, however, the alternate double frequency pulses, which occur between those which are intended to maintain horizontal synchronization, have a decided disturbing effect upon the horizontal deflecting system so that steps must be taken to exclude them. By applying the present invention to any of the usual forms of deflecting circuits it is possible to eliminate these undesired double frequency pulses as well as other extraneous pulses, so as effectively to prevent them from disturbing the operation of the deflecting system. It will, of course, be understood that the method may also be used in the vertical circuit to exclude horizontal synchronizing and noise pulses and it may be applied in much the same manner as shown in Fig. 15 of my aforementioned copending application to effect a separation between horizontal and verti-

cal synchronizing pulses. This application of the present invention will be apparent to those skilled in the art from the teachings of the present application and my aforementioned copending application. It is deemed unnecessary, therefore, to describe such a system in detail in the present application.

In Fig. 4 is shown a typical horizontal deflecting circuit for a television receiver employing a gas discharge tube oscillator and embodying my invention. In discussing this circuit it will be assumed that double horizontal frequency pulses are present though, as is well known, these are present only at certain times in the synchronizing signal. The operation of the system during the absence of these pulses will be essentially the same as regards the exclusion of the noise but there will be no double frequency pulses to be eliminated. Double horizontal frequency pulses of negative polarity, shown at 18, are supplied from a source *e* to the synchronizing signal amplifier 19 and thence, in reversed polarity, to the grid of a gas discharge tube 20. In the output circuit of the latter is provided a charging circuit comprising the condenser 21 and the resistors 22 and 23. The condenser 21 is charged through resistors 22 and 23 until the actuation of the tube 20 by a pulse signal applied to its grid, when the condenser discharges rapidly through resistor 22 and the impedance of the tube 20. The resistor 22 tends to protect the gas tube by limiting the current and also adds an impulse component to the voltage across 21 and 22, which is desirable for the purpose of cutting off the output tube 24 during the electron beam return time. The combined sawtooth and impulse voltage developed across the impedance comprising the condenser 21 and the resistor 22 is applied to the grid of the output tube 24 whose plate circuit includes the primary of the deflecting output transformer 25. The said primary winding is also included in the plate circuit of the wave-form control tube 26. This latter tube is suitably biased by means of the circuit 27 and is controlled by a signal applied to its grid from the screen circuit of the output tube 24 in accordance with the invention of Robert C. Moore described in application Serial No. 351,765, filed August 7, 1940. This tube cooperates with the output tube 24 to produce a sawtooth wave-form deflecting current in the primary winding of the transformer 25, which is reproduced in the deflecting coil 28 associated with the cathode ray tube 29 for the purpose of deflecting an electron beam in a manner familiar to those skilled in the art.

It will be apparent that, were the pulses 18 to be applied directly to the grid of the gas tube 20, there would be at least a tendency for the tube to be fired by each of the succeeding pulses. Actually the tube does so fire, under most circumstances, on each of the pulses with the result that the horizontal scanning is disrupted and the television image impaired. Hence, in accordance with the present invention, a resonant circuit 30 may be interposed between the amplifier 19 and the discharge tube 20. This circuit may be tuned to approximately the horizontal frequency and is preferably actuated by amplified pulse signals of horizontal frequency obtained from some part of the circuit subsequent to the discharge tube 20, for example, across the primary of the output transformer 25 where a large pulse is available. The horizontal frequency sine-wave developed across the resonant circuit 30 adds to the incoming pulse signals in the manner shown at 31 so

that the desired pulses are lifted up upon the positive peaks while the alternate and undesired pulses, as well as any undesired noise pulses and the like, are dropped down into the valleys between sine-wave peaks. The bias on the gas tube 20 may be so adjusted, for example, by means of the biasing circuit 32, to pass only the peaks of the desired pulses, for example, that portion of the signal 31 above the level designated by the broken line. It will, of course, be understood that the invention need not be applied to the circuit in the exact manner shown, since many variations are possible both with respect to the location of the resonant circuit and with respect to the manner of exciting the same.

In Fig. 5 is shown a novel method of applying resonant quenching to a deflecting circuit utilizing a blocking-oscillator. The circuit, with the exception of the substitution of a blocking-oscillator and a vacuum discharge tube for the gas discharge tube oscillator of Fig. 4, is substantially the same as that circuit and accordingly like parts are designated by the same reference numerals. The resonant circuit 30 is here omitted between the amplifier 19 and the oscillator. Positive polarity pulses are applied to the grid of a blocking-oscillator comprising the tube 1, the transformer 2, the resistor 3 and the condenser 4. It will be noted that the low potential side of the transformer secondary is not connected directly to ground as is usual, but rather the said secondary is connected between grid and cathode of the discharge tube 33 in whose output is connected the sawtooth-impulse impedance comprising the elements 21 and 22. One or more resonant circuits may then be connected between the cathode of the tube 33 and ground whereby quenching is effected. For example, with the switch 34 in the position *f*, the resonant circuit 35 is included in the cathode circuit of the tube 33. Each time the tube fires in response to a pulse from the oscillator, the resonant circuit will be excited by a pulse of current. The sine-wave voltage developed will add to the grid voltage of the tube 33 and will modify it as shown by the solid line in Fig. 6. As a result, the desired pulse will be raised up upon the crest of the positive peak of the sine-wave to fire the oscillator, while alternate double horizontal frequency pulses, as well as undesired noise pulses *a* and the like will fall into the valleys created by the sine-wave. In this case it is generally desirable to have the circuit 35 resonant at a frequency slightly higher than the synchronized frequency of the oscillator. The amount by which this frequency exceeds the synchronized frequency will depend largely upon the nature and duration of the pulses applied to oscillator to synchronize it. As has already been suggested, it may be desirable to augment the resonant quenching effect by the use of additional resonant circuits which are preferably tuned to multiples of the frequency to which the first circuit is tuned. Any desired number of resonant circuits may, of course, be used, the improvement in the operation being commensurate with the number employed. As shown in Fig. 5, additional resonant circuits are included when switch 34 is in the position *g*.

As pointed out heretofore, the invention is applicable also to non-oscillatory or so-called direct driven deflecting systems for television purposes and the like such, for example as that disclosed in Patent No. 2,141,343, issued December 27, 1938, to R. L. Campbell. Such an application of the present invention is shown in Fig. 7, where posi-

tive polarity synchronizing pulses from the source *e* are supplied through the resonant circuit 36 to the grid of amplifier tube 37. The output of this tube may be further amplified and its phase reversed in the tube 38, the output of which is supplied to the discharge tube 39 which controls the charging and discharging of the condenser 40. A combined sawtooth and impulse voltage is developed across the impedance comprising the condenser 40 and the resistor 41, which voltage is fed to the grid of the output tube 42 for producing the desired sawtooth current wave in the deflecting coil 43. The necessary impulse voltage to actuate the resonant circuit 36 is conveniently obtained by a connection through resistor 44 and condenser 45 from the plate of output tube 42 to one side of the resonant circuit 36, though it will be understood that this connection may be made in other ways. The operation of this circuit is substantially that described in connection with the previous circuit. In the present circuit, however, the incoming synchronizing pulses are simply amplified instead of being employed to synchronize a self-oscillatory device for generating relatively large pulses. The voltage developed across the resonant circuit in response to the pulses from the plate of tube 42 will be such as to bias the grid of amplifier tube 37 more negative during the intervals between desired pulses from source *e*.

Although the invention has been described with reference to certain specific embodiments it will of course be understood that the scope of invention is to be determined only by the appended claims.

I claim:

1. In a system for generating electrical pulse signals in response to periodically recurring timing pulse signals and in which the generation of a pulse signal is initiated by the triggering action of a timing pulse, a source of periodically recurring timing pulses coupled to said system, and means for effectively increasing the tendency of said system to respond to at least some of said timing signals and for effectively reducing the tendency of said system to respond to other timing signals which may be supplied by said source and to extraneous signals which may unavoidably be introduced into said system, said means comprising a resonant circuit coupled to a part of said system so as to have impressed thereon the pulse signals generated by said system, and a connection between said resonant circuit and another part of said system for applying the wave-form developed by said generated pulse signals to said system in a manner to control the responsiveness of the system.

2. In a system for generating electrical pulse signals in response to periodically recurring timing pulse signals and in which the generation of a pulse signal is initiated by the triggering action of a timing pulse, a source of periodically recurring timing pulses coupled to said system, and means for effectively increasing the tendency of said system to respond to at least some of said timing signals and for effectively reducing the tendency of said system to respond to other timing signals which may be supplied by said source and to extraneous signals which may unavoidably be introduced into said system, said means comprising a resonant circuit coupled to a part of said system so as to have impressed thereon the pulse signals generated by said system, and a connection between said resonant circuit and the coupling from said source to said system whereby

the wave-form developed by said resonant circuit in response to said generated pulse signals is superposed upon the signal supplied from said source to said system in a manner to modify the effect of the signals from said source upon said system.

3. In a system for generating electrical pulse signals in response to periodically recurring timing pulse signals and in which the generation of a pulse signal is initiated by the triggering action of a timing pulse, a source of periodically recurring timing pulses coupled to said system, an amplifier for the signals from said source, and means for effectively increasing the tendency of said system to respond to at least some of said timing signals and for effectively reducing the tendency of said system to respond to other timing signals which may be supplied by said source and to extraneous signals which may unavoidably be introduced into said system, said means comprising a resonant circuit coupled to a part of said system so as to have impressed thereon the pulse signals generated by said system, and a connection between said resonant circuit and said amplifier for applying the voltage developed by said resonant circuit to said amplifier in a manner to control the gain of said amplifier.

4. In a system for generating electrical pulse signals in response to periodically recurring timing pulse signals and in which the generation of a pulse signal is initiated by the triggering action of a timing pulse, a source of periodically recurring timing pulses coupled to said system, a vacuum tube amplifier for the signals from said source, said tubes being biased so as to permit them to amplify only those pulse signals from said source which exceed a particular amplitude level, and means for effectively increasing the tendency of said system to respond to at least some of said timing signals and for effectively reducing the tendency of said system to respond to other timing signals which may be supplied by said source and to extraneous signals which may unavoidably be introduced into said system, said means comprising a resonant circuit coupled to a part of said system so as to have impressed thereon the pulse signals generated by said system, and a connection between said resonant circuit and said amplifier for applying the voltage developed by said resonant circuit to said amplifier in a manner to modify the bias applied to said amplifier tubes.

5. In a system for generating electrical pulse signals in response to periodically recurring timing pulse signals and in which the generation of a pulse signal is initiated by the triggering action of a timing pulse, a source of periodically recurring timing pulses coupled to said system, and means for effectively increasing the tendency of said system to respond to at least some of said timing signals and for effectively reducing the tendency of said system to respond to other timing signals which may be supplied by said source and to extraneous signals which may unavoidably be introduced into said system, said means comprising a network consisting of a plurality of resonant circuits coupled to a part of said system so as to have impressed thereon the pulse signals generated by said system, said resonant circuits being tuned to frequencies which are multiples of a given frequency at least as great as the frequency of occurrence of said timing pulses, and a connection between said resonant circuit and another part of said system for applying the

wave-form developed by said resonant circuit in response to said generated pulse signals to said system in a manner to control the responsiveness of the system.

6. In a self oscillatory system for generating electrical pulse signals in response to the triggering action of periodically recurring timing pulses, said system being self oscillatory at a predetermined frequency, a source of timing pulse signals periodically recurrent at a frequency greater than the natural frequency of said system, and means for effectively increasing the tendency of said system to respond to at least some of said timing signals and for effectively reducing the tendency of said system to respond to other timing signals which may be supplied by said source and to extraneous signals which may unavoidably be introduced into said system, said means comprising a resonant circuit coupled to a part of said system so as to have impressed thereon the pulse signals generated by said system, and a connection between said resonant circuit and another part of said system for applying the wave-form developed by said resonant circuit in response to said generated pulse signals to said system in a manner to control the responsiveness of the system.

7. In a self oscillatory system for generating electrical pulse signals in response to the triggering action of periodically recurring timing pulses, said system being self oscillatory at a predetermined frequency, a source of timing pulse signals periodically recurrent at a frequency greater than the natural frequency of said system, and means for effectively increasing the tendency of said system to respond to at least some of said timing signals and for effectively reducing the tendency of said system to respond to other timing signals which may be supplied by said source and to extraneous signals which may unavoidably be introduced into said system, said means comprising a resonant circuit tuned to a frequency greater than the natural frequency of said system and coupled to a part of said system so as to have impressed thereon the pulse signals generated thereby, and a connection between said resonant circuit and another part of said system for applying the wave-form developed by said resonant circuit in response to said generated pulse signals to said system in a manner to control the responsiveness of the system.

8. In a system for generating electrical pulse signals in response to periodically recurring timing pulse signals and in which the generation of a pulse signal is initiated by the triggering action of a timing pulse, a source of periodically recurring timing pulses coupled to said system, and means for effectively increasing the tendency of said system to respond to at least some of said timing signals and for effectively reducing the tendency of said system to respond to other timing signals which may be supplied by said source and to extraneous signals which may unavoidably be introduced into said system, said means comprising a resonant circuit coupled to a part of said system so as to have impressed thereon the pulse signals generated by said system, means for limiting the amplitude of the wave-form developed by said resonant circuit, and a connection from said limiting means to another part of said system for applying the wave-form developed by said resonant circuit in response to said generated pulse signals to another part of said system in a manner to control the responsiveness of the system.

9. In a television deflecting system synchronizable in response to periodically recurring time-spaced timing pulse signals and including means for generating pulse signals of greater magnitude in response to the triggering action of said timing pulses, means for effectively increasing the tendency of said system to respond to at least some of said timing signals and for effectively reducing the tendency of said system to respond to other timing signals which may be supplied thereto and to extraneous signals which may be introduced therein, said means comprising a resonant circuit coupled to a part of said system so as to have impressed thereon the pulse signals generated by said system, and a connection between said resonant circuit and another part of said system for applying the wave-form developed by said resonant circuit in response to said generated pulse signals to said system in a manner to control the responsiveness of the system.

10. In a television deflecting system synchronizable in response to periodically recurring time-spaced timing pulse signals and including means for generating pulse signals of greater magnitude in response to the triggering action of said timing pulses and means actuated by said generated pulses for producing a periodically varying electromagnetic field for deflecting an electron beam, means for effectively increasing the tendency of said system to respond to at least some of said timing signals and for effectively reducing the tendency of said system to respond to other timing signals which may be supplied thereto and to extraneous signals which may be introduced therein, said means comprising a resonant circuit coupled to said magnetic field producing means and actuated therefrom, and a connection between said resonant circuit and another part of said system for applying the wave-form developed by said resonant circuit in response to said generated pulse signals to said system in a manner to control the responsiveness of the system.

11. In a television deflecting system synchronizable in response to periodically recurring time-spaced timing pulse signals and including an inductive output circuit and means coupled thereto and responsive to said timing pulses for producing therein a periodic current of substantially sawtooth waveform, means for effectively increasing the tendency of said system to respond to at least some of said timing signals and for effectively reducing the tendency of said system to respond to other timing signals which may be supplied thereto and to extraneous signals which may be introduced therein, said means comprising a resonant circuit coupled to said inductive output circuit and responsive to voltage pulses developed thereacross, and a connection between said resonant circuit and another part of said system for applying the wave-form developed by said resonant circuit in response to said voltage pulses to said system in a manner to control the responsiveness of the system.

12. In a television deflecting system synchronizable in response to periodically recurring time-spaced timing pulse signals and including an inductive output circuit and means coupled thereto and responsive to said timing pulses for producing therein a periodic current of substantially sawtooth waveform, said means comprising a condenser, means for charging said condenser and spaced discharge means responsive to said timing pulses and providing a path for periodically discharging said condenser, means for ef-

effectively increasing the tendency of said system to respond to at least some of said timing signals and for effectively reducing the tendency of said system to respond to other timing signals which may be supplied thereto and to extraneous signals which may be introduced thereinto, said means comprising a resonant circuit included in said discharge path and responsive to current pulses produced therein, and a connection between said resonant circuit and another part of said system for applying the wave-form developed by said resonant circuit in response to said current pulses to said system in a manner to control the responsiveness of the system.

13. In an electrical system employing time-spaced pulse signals and including means actuated by desired pulses but subject to actuation by undesired pulses, the method of lessening the possibility of response to said undesired pulses, which consists in producing a sinusoidal voltage wave having a predetermined frequency relation to the frequency of occurrence of said desired pulses, and utilizing said voltage wave in a manner to decrease the responsiveness of said means to the undesired pulses.

14. In an electrical system employing time-spaced pulse signals and including means responsive to pulses exceeding a predetermined amplitude level, the method of lessening the possibility of response to undesired pulses, which consists in producing a sinusoidal voltage wave at least some of whose peaks occur in substantial coincidence with the desired pulses, and combining said voltage wave with said pulse signals thereby to raise the desired pulses above said amplitude level and to lower the undesired pulses below said amplitude level.

15. In an electrical system employing time-spaced pulse signals, means actuated by desired pulses but subject to actuation by undesired pulses, means for producing a sinusoidal voltage wave having a predetermined frequency relation to the frequency of occurrence of said desired pulses, and means for utilizing said voltage wave to decrease the responsiveness of said first means to the undesired pulses.

16. In an electrical system employing time-spaced pulse signals, means actuated by desired pulses but subject to actuation by undesired pulses, a resonant circuit energized by pulse signal energy to produce a sinusoidal voltage wave having a predetermined frequency relation to the frequency of occurrence of said desired pulses, and means for utilizing said voltage wave

to decrease the responsiveness of said first means to the undesired pulses.

17. In an electrical system employing time-spaced pulse signals, means responsive to pulses exceeding a predetermined amplitude level, means for producing a sinusoidal voltage wave at least some of whose peaks occur in substantial coincidence with the desired pulses, and means for combining said voltage wave with said pulse signals thereby to raise the desired pulses above said amplitude level and to lower the undesired pulses below said amplitude level.

18. In an electrical system; a source of a signal comprising a series of time-spaced pulse signals occurring at a particular frequency and including other pulse signals occurring in the intervals between said first pulse signals; means having an input circuit and an output circuit, and having its input circuit coupled to said source, and responsive to pulse signals exceeding a certain amplitude level for producing larger pulse signals; a net work comprising at least one resonant circuit coupled to the output circuit of said pulse-producing means and responsive to said produced pulses for generating a voltage wave which, when combined with signals from said source, is adapted to raise said first pulses above said certain level and to permit substantially all of said other pulses to fall below said level, thereby to increase the tendency of said pulse-producing means to respond to said first pulse signals and to reduce its tendency to respond to said other pulse signals; and means for supplying said voltage wave to the input of said pulse-producing means and for combining it with the signals from said source.

19. In a system for generating electrical pulse signals in response to periodically recurring timing pulse signals, means adapted to be triggered by said timing signals for generating said first-mentioned pulse signals, a resonant circuit, means for supplying pulse signals from said generating means to said resonant circuit, thereby to produce an alternating voltage having a frequency dependent on the resonant frequency of said circuit, and means for utilizing said alternating voltage to control the response of said generating means to the signals received thereby, whereby said generating means is caused to respond to desired timing signals and is effectively prevented from responding to undesired signals.

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