

Aug. 1, 1950

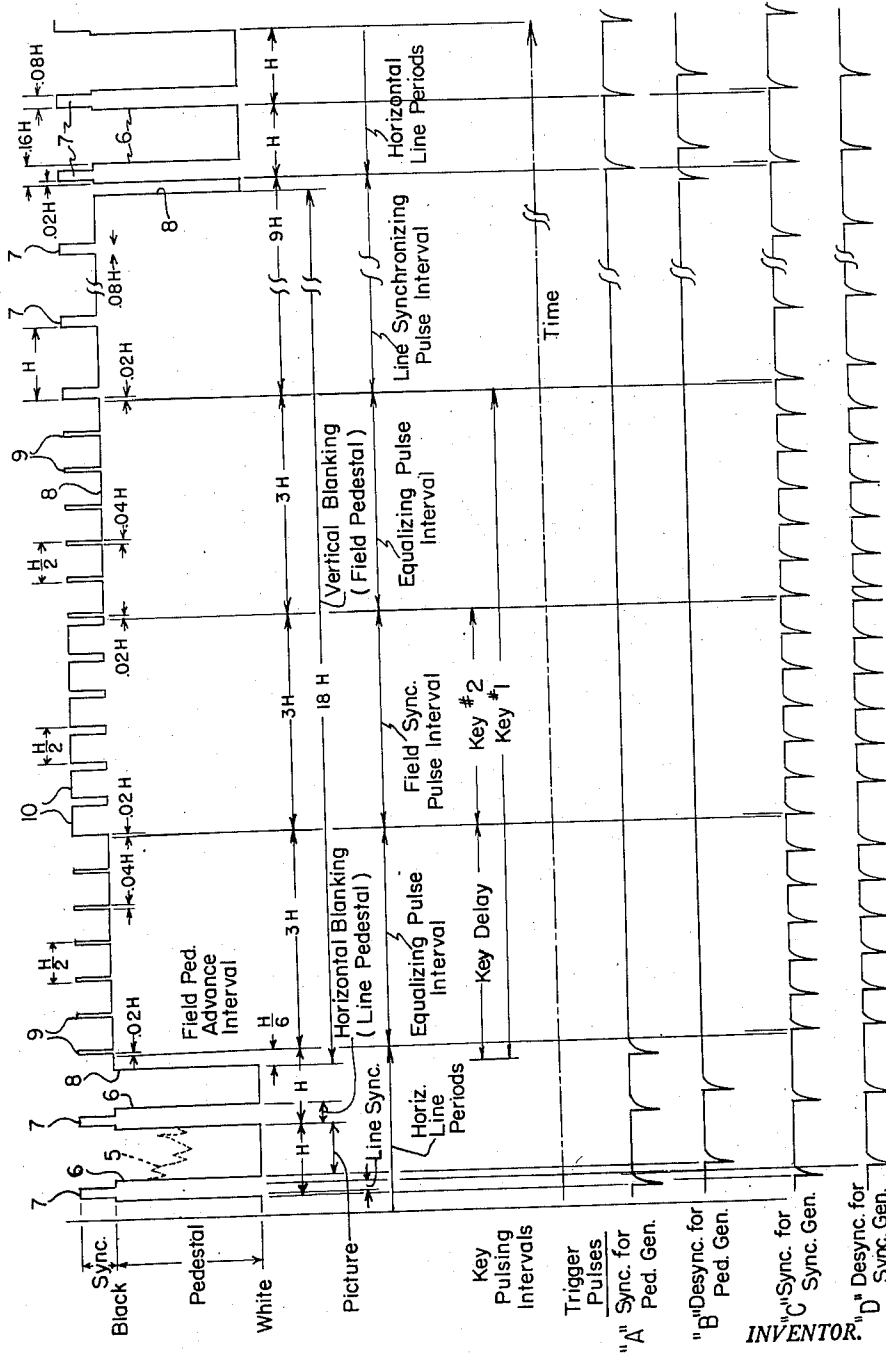
R. R. GANNAWAY  
VIDEO SIGNAL GENERATOR

2,516,972

Filed Nov. 12, 1947

5 Sheets-Sheet 1

FIG. 1



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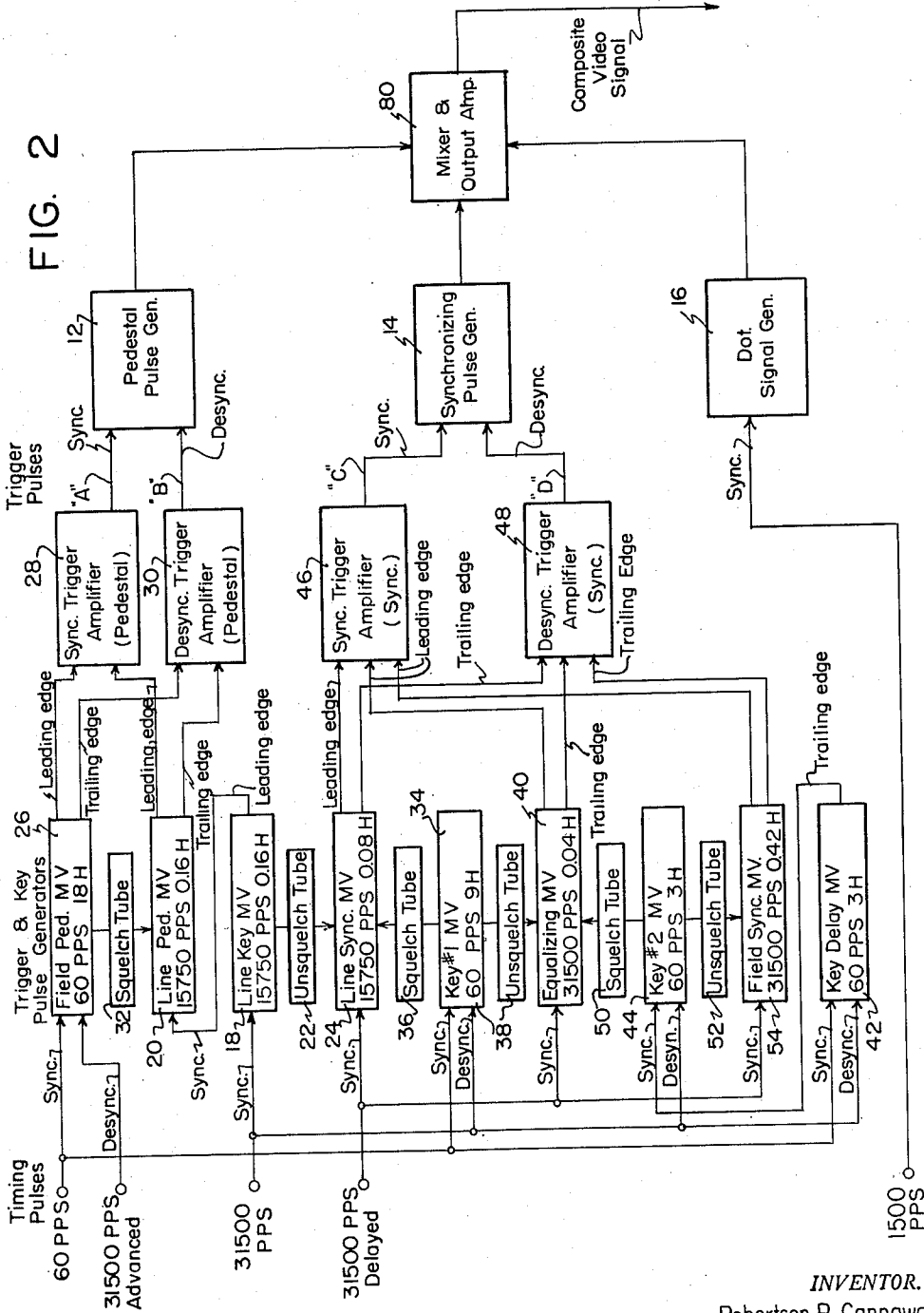
R. R. GANNAWAY  
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FIG. 2



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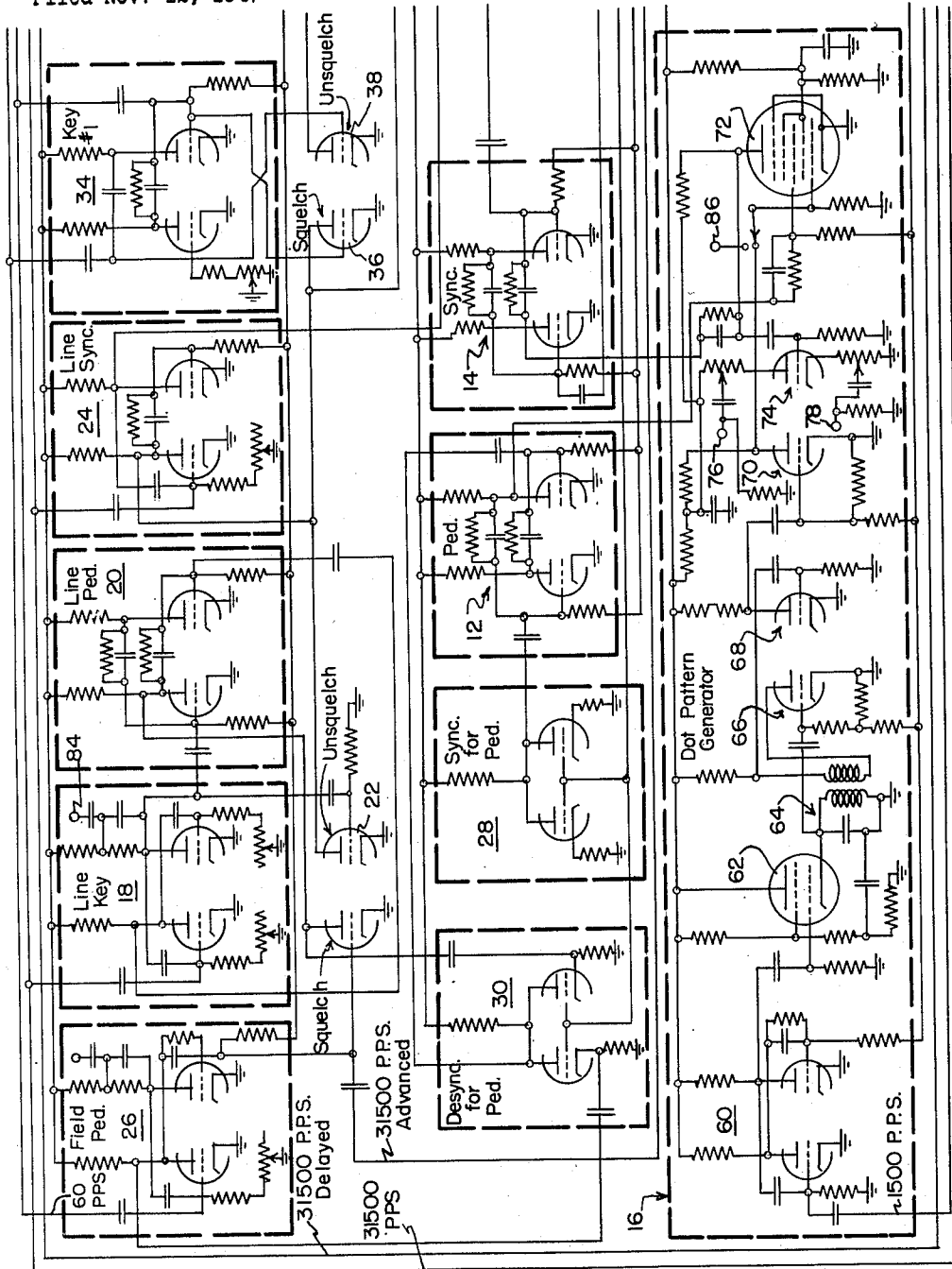


FIG. 3

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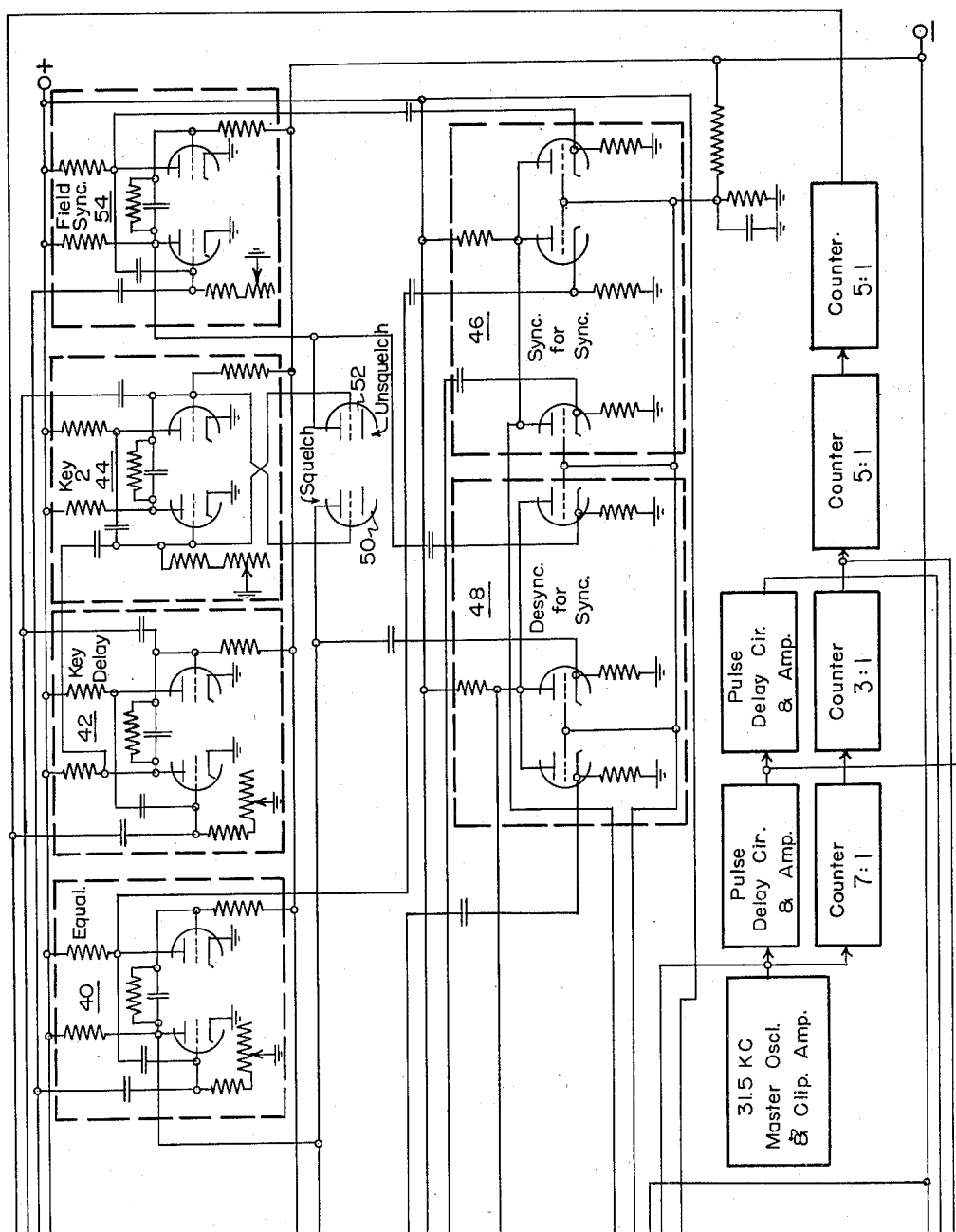
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R. R. GANNAWAY  
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**2,516,972**

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R. R. GANNAWAY  
VIDEO SIGNAL GENERATOR

2,516,972

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FIG. 5

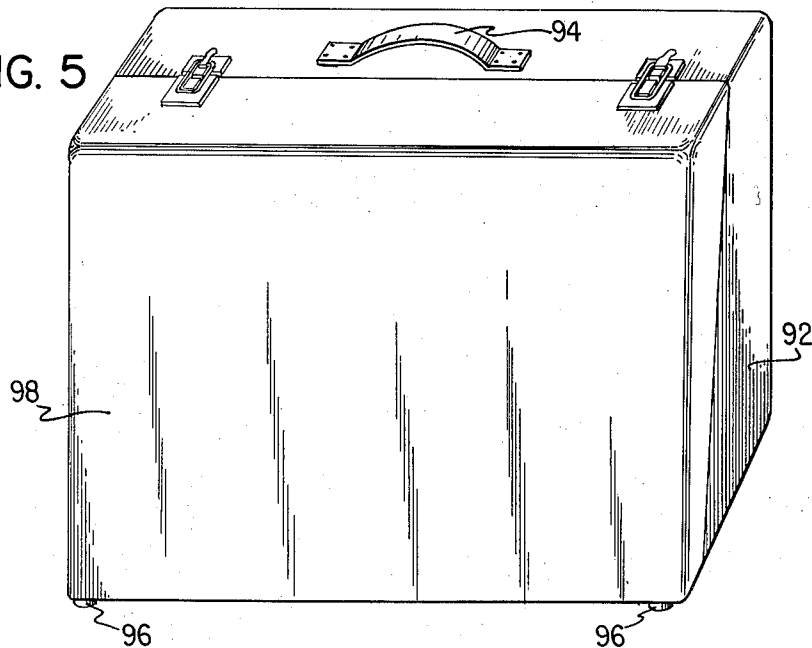
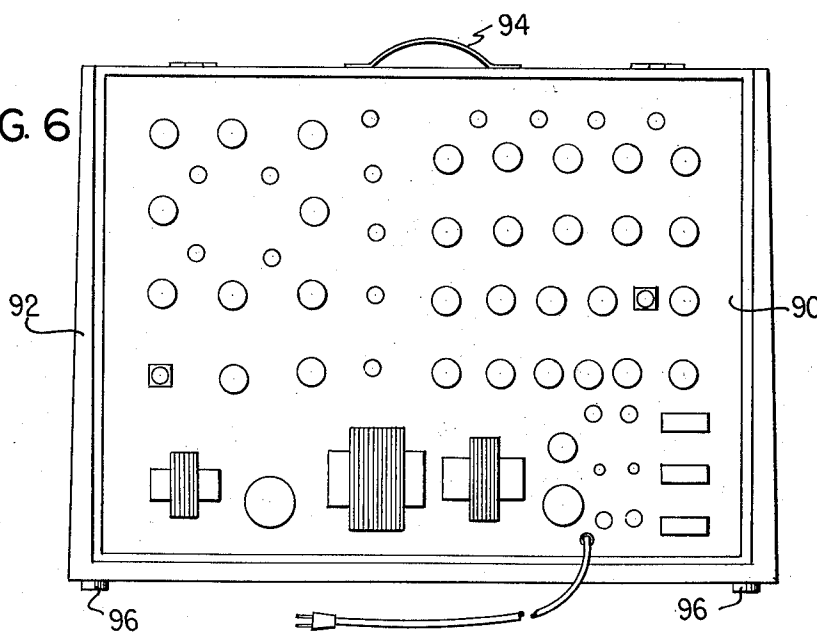


FIG. 6



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## UNITED STATES PATENT OFFICE

2,516,972

## VIDEO SIGNAL GENERATOR

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Application November 12, 1947, Serial No. 785,378

11 Claims. (Cl. 178—69.5)

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This invention relates to picture transmission systems, and particularly to video signal generators for use in these systems. It is especially adapted to be employed in test equipment for servicing television receivers, although not limited to such use.

Composite video signals, such as are used in commercial television systems, for instance, include various synchronizing pulses superimposed on pedestal pulses that occur at predetermined intervals in the signal. The pedestal pulses are of two kinds, consisting of line pedestals, which occur once for each line period to produce horizontal blanking during the retrace interval between lines, and field pedestals which produce vertical blanking during the retrace intervals between successive field scanning operations. The synchronizing signals are of several types—line synchronizing, equalizing, and field synchronizing. The line synchronizing pulses occur during the horizontal blanking intervals between lines and are superimposed on the line pedestal pulses. They also occur during the latter portion of the vertical blanking interval, being superimposed upon the field pedestal pulse in this instance. The equalizing pulses occur during an initial portion of the vertical blanking interval, and also during a second similar portion of the vertical blanking interval. The field synchronizing pulses occur during the interval between these two groups of equalizing pulses. The shapes, durations and timing of all these pulses have been standardized for commercial equipment. The television picture components are located intermediate the various pedestal (blanking) pulses in the composite signal.

In generating video signals it is customary to produce the various synchronizing pulses (line, field and equalizing) and the pedestal pulses (line and field) by wave-shaping methods in separate generating circuits, following which these pulses are brought together in the composite video signal. According to present practice these standard recurrent-pulse portions of the composite video signal are formed from elementary signals such as sine waves, and the timing and shaping of the pulses proceed concurrently. This method has necessitated a complex series of gating and clipping operations. At each step in the process, waveform distortions must be carefully avoided. For instance, coupling time constants must be adequate to prevent the introduction of extraneous slopes which might cause variation of clipping levels, and various other precautions must be observed as is

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well known in the art. Consequently, the apparatus utilized heretofore to generate video signals has been complicated, bulky and expensive, and in some instances it has been considered impractical, as for example, in service installations.

A general object of the present invention is to simplify and reduce the cost of the equipment needed to generate television video signals without impairing the accuracy of the signals produced thereby.

A specific object of the invention is to separate the functions of wave-shaping and of timing in constructing the pedestal and synchronizing signals.

Other objects are to eliminate many of the disadvantages of present-day video signal generators, and to provide an improved apparatus which facilitates the production of video signals.

The invention is characterized by several unique features, among which it may be noted that pip-like timing pulses derived from an elementary constant-frequency signal are converted respectively into pairs of trigger pulses (synchronizing and desynchronizing) which control the formation of the rectangular pulse components of a composite video signal. These rectangular pulses (commonly referred to as "square waves") are of variable width depending upon the spacing between the pulses in each corresponding pair of trigger pulses. The spacing between individual pulses in each pair is controlled by multivibrators or equivalent devices according to the particular width of the square (i. e., rectangular) wave whose formation they control, and the spacings between pairs of trigger pulses depend on the periods of the timing signals. Suitable square wave generators of the type adapted to be triggered on and triggered off are used, and I propose to allocate one such generator for the pedestal pulses and another for the synchronizing pulses in a composite video signal. Arrangements are made herein for automatically suppressing the trigger pulses in the various sets when they are not needed, so that a single generator can be used to produce pulses of different widths; that is to say, both field and line pedestal pulses originate in one generator, and the line synchronizing, equalizing and field synchronizing pulses originate in another generator.

For a better understanding of the invention, together with other objects, features and advantages thereof, reference is had to the follow-

ing description of the invention taken in connection with the accompanying drawings which illustrate a preferred embodiment.

In the drawings,

Fig. 1 is a timing diagram to show the relations of the various trigger pulses to the composite video signal in an apparatus constructed according to the principles of my invention;

Fig. 2 is a block diagram of the video signal generator, indicating its essential components;

Figs. 3 and 4 together constitute a schematic wiring diagram of the apparatus, with certain conventional portions thereof being shown in simple block form or omitted;

Fig. 5 is a perspective view of the signal generator mounted in a carrying case for portability; and

Fig. 6 is an elevational view of the chassis in the portable unit.

In pursuance of the above stated objects of my invention, I provide pedestal and synchronizing pulse generators of the type adapted for the production of accurately shaped pulses in response to timed trigger signals. The function of timing these pulses is performed by trigger pulse generators which are not required to produce accurately shaped pulses. I have found that the Eccles-Jordan trigger circuit is particularly well suited for the purpose of producing the pedestal and synchronizing pulses, and in accordance with the preferred embodiment of the invention disclosed herein, I provide one such circuit for generating the pedestal pulses and another for generating the synchronizing pulses. These pulse generators are accurately triggered on and off by multivibrators which are controlled by well known timing circuits, the positions and durations of the respective pulses being determined according to the functions which they will perform in the completed signal (that is, horizontal and vertical blanking, line and field synchronizing, and equalizing).

A typical composite television video signal (with the picture signal components omitted therefrom) is illustrated diagrammatically at the top of Fig. 1. The picture is transmitted and received during those portions of the horizontal line periods (designated H) intervening between the regularly spaced blanking intervals, which occur while the scanning and receiving electron beams are retracing. The picture signal amplitude will, of course, vary in accordance with the image that is being received. In the usual video signal the picture component for any particular horizontal line may have an irregular appearance as indicated by the broken line 5 in Fig. 1. If desired, an artificially produced picture signal, such as a series of dots, may be provided (as is the case in the illustrated embodiment of the invention), the representation of such a signal being omitted from Fig. 1.

The picture signal variation takes place between extreme amplitudes respectively designated "black" and "white" in Fig. 1. In standard negative picture modulation the minimum level is white and the maximum level of the picture signal is black, as is well known. The horizontal blanking is produced by line pedestal pulses 6 in the video signal, which have an amplitude equal to or greater than the black level of the signal. During the horizontal blanking intervals, additional pulses known as line synchronizing pulses 7 are transmitted, these pulses being superimposed on the line pedestal pulses 6 and extending into the blacker-than-black region of

the signal. The line synchronizing pulses 7, as may be observed in Fig. 1, are narrower than the line pedestal pulses 6.

After each field has been scanned, and prior to scanning of the succeeding field, there is a vertical blanking interval which is produced by a field pedestal pulse 8. These field pedestal pulses, like the line pedestal pulses 6, are at the black level of the signal. Superimposed on each field pedestal pulse, in the blacker-than-black region, are several series of pulses comprising the equalizing pulses 9, field synchronizing pulses 10, and line synchronizing pulses 7. The equalizing and field synchronizing pulses 9 and 10 occur at the rate of two per line period. The standard field pedestal pulse has a width which must be between 13H and 21H, a typical value being 18H, where H is a line period. In the first 3H there is transmitted a train of six equalizing pulses 9, followed in the next 3H by an equal number of field synchronizing pulses 10. These are succeeded by another series of six equalizing pulses 9 in the third 3H. The remainder of the vertical blanking interval is occupied by line synchronizing pulses 7 spaced apart by complete line periods. At the end of the vertical blanking interval the scanning beam is ready to commence viewing another field, and the picture signals, line pedestal pulses, and line synchronizing pulses again occur in the previously described order.

The time interval between the beginning of the field pedestal and the first equalizing pulse is not critical, as is well known. A proposed value is .02H with a negative tolerance of zero and a positive tolerance of H. In the present instance, a value of  $\frac{1}{6}H$  has been chosen in order clearly to differentiate the commencement of this pulse from the first equalizing pulse 9. This is done for convenience only, and the invention is not limited thereby.

In accordance with the present invention I propose to generate the pedestal pulses (both field and line) of a composite video signal in a square wave generator 12, Fig. 2, which may be of the Eccles-Jordan type. Likewise, all of the synchronizing pulses (by which term is meant the line synchronizing, field synchronizing, and equalizing pulses) are generated in another square wave generator 14 which may be of the Eccles-Jordan type. Details of these particular generators are shown in the schematic circuit diagrams, Figs. 3 and 4. Each of the generators 12 and 14 has two stable states, so that the various recurrent pulses in the composite video signal can be initiated and terminated at the appropriate times by applying to the generators 12 and 14 trigger pulses which are designated in Figs. 1 and 2 by the letters A, B, C and D. The trigger pulses A synchronize the pedestal pulse generator 12; the trigger pulses B desynchronize the pedestal pulse generator 12; trigger pulses C synchronize the synchronizing pulse generator 14, and the trigger pulses D desynchronize the synchronizing pulse generator 14. The time relations between the trigger pulses and the composite video signal are represented in Fig. 1.

The terms "synchronize" and "desynchronize" as used with reference to circuits controlled by the trigger pulses and other control pulses described hereinafter are, for all practical purposes, synonymous with "initiate operation of" and "terminate operation of," respectively, the first-mentioned nomenclature being extensively employed in the art because of the particular

manner in which multivibrators and trigger circuits controlled by these pulses function.

Referring now primarily to Fig. 2, which may be supplemented by reference to Figs. 1, 3 and 4 where necessary, the above-mentioned trigger pulses are obtained from various multivibrators as indicated. The multivibrators are timed in their operations through the medium of timing pulses which are derived from standard timing pulse generators that are familiar to those skilled in the art. These timing pulse generators are, in the present instance, required only to synchronize and desynchronize the various multivibrators and have no connection whatsoever with shaping the final output pulses produced by the pedestal and synchronizing pulse generators 12 and 14, the shaping function being performed entirely by the latter generators.

The timing pulses which control the multivibrators are of four kinds—31,500 pulses per second, 31,500 pulses per second advanced, 31,500 pulses per second delayed, and 60 pulses per second (the last-mentioned pulses coinciding with certain of the "advanced" pulses). In addition, a pulse signal of intermediate frequency, such as 1500 pulses per second, derived from the same timer chain is employed to synchronize the picture signal generator 16 which preferably is of the type that furnishes a dot pattern when the equipment is being used for test purposes.

A line key multivibrator 18 is synchronized by the 31,500 pulses per second timing signal and is adjusted to divide the pulse repetition frequency 2 to 1. This line key multivibrator synchronizes the line pedestal multivibrator 20 as indicated, the leading edge of the multivibrator output being utilized for this purpose. The terms "leading edge" and "trailing edge" denote which of the tubes in each multivibrator is effective in furnishing output. The line key multivibrator also operates an "unsquelch" tube 22 which permits the line synchronizing multivibrator 24 to operate on alternate synchronizing pulses from the 31,500 pulses per second delayed signal source. Thus, the multivibrators 20 and 24 normally function to supply those portions of the various trigger signals A, B, C and D that are instrumental in producing the line pedestal and line synchronizing pulses.

The terms "squelch" tube and "unsquelch" tube designate tubes which enable certain multivibrators to control the operation of certain other multivibrators. A squelch tube becomes conducting when its controlling multivibrator fires, and shunts the controlled multivibrator, preventing it from responding to synchronizing pulses. An unsquelch tube becomes non-conducting when its controlling multivibrator fires, thus permitting the controlled multivibrator to operate normally.

For producing the field pedestal pulses there is provided a multivibrator 26 that is synchronized by the 60 pulses per second signal and desynchronized by the 31,500 pulses per second advanced signal. While each multivibrator is to be adjusted to a certain period of operation as indicated in Fig. 2, the length of this period may be made to vary step-wise by applying a desynchronizing signal to such a multivibrator. The "trailing edge" of the multivibrator then occurs coincidentally with one of the desynchronizing pulses so that the period of the multivibrator operation will vary in steps rather than continuously as would otherwise occur. The "leading edge" pulses from the field pedestal and line pedestal multivibrators 26 and 20 are applied to an amplifier 28, having separate amplifying sections

for the two pulses, and a combined output circuit through which the trigger signal A is applied to the pedestal pulse generator 12 for synchronizing this generator. The "trailing edge" pulses from the multivibrators 26 and 20 are fed to an amplifier 30 which furnishes a combined desynchronizing trigger signal B to the pedestal generator 12. The field pedestal multivibrator 26 controls a squelch tube 32 for squelching the line pedestal multivibrator during the vertical blanking interval. Hence, line pedestal trigger pulses are not generated while field pedestal trigger pulses are being generated.

The pedestal pulse generator 12 has a first component, including the left-hand tube in the rectangle 12, Fig. 3, to which are applied the "sync" triggers A (Figs. 1 and 2) from the amplifier 28 for initiating the various pedestal pulses. Similarly, the generator 12 has a second component, including the right-hand tube in the rectangle 12, Fig. 3, to which are applied the "desync" triggers B (Figs. 1 and 2) for terminating the various pedestal pulses. These two tubes actually are enclosed by a single envelope in the construction as shown. Each tube has an abrupt action so as to impart steep leading and trailing edges to the generated pulses. The manner in which these tubes are coupled together for providing an Eccles-Jordan type of trigger circuit is clearly illustrated in Fig. 3 and is well understood by those skilled in the art.

During the first portion of the vertical blanking interval it is essential that the line synchronizing multivibrator 24 be prevented from functioning. This is accomplished by the key No. 1 multivibrator 34 which is synchronized by the 60 pulses per second timing signal and desynchronized by the 31,500 pulses per second timing signal. The multivibrator 34 has a period of operation equal to 9H during which time it operates the squelch tube 36 for suppressing the line synchronizing multivibrator 24, and the unsquelch tube 38 to condition the equalizing pulse multivibrator 40 for operation. The key delay multivibrator 42 synchronizes the key No. 2 multivibrator 44 which commences operation when the period of the key delay multivibrator ends. However, inasmuch as the key delay multivibrator operates for approximately the first 3H of the vertical blanking interval, the key No. 2 multivibrator 44 is inactive during that time. Therefore, the equalizing pulse multivibrator 40 is effective to feed synchronizing and desynchronizing trigger pulses respectively to the amplifiers 46 and 48, the outputs of which are applied to the synchronizing pulse generator 14.

The synchronizing pulse generator 14 shown in Fig. 3 has essentially the same construction as the pedestal pulse generator 12 previously described. "Sync" triggers C (Figs. 1 and 2) are applied by the amplifier 46 (Fig. 4) to the left-hand tube in the rectangle 14 for initiating the respective synchronizing pulses. "Desync" triggers D are applied by the amplifier 48 to the right-hand tube in the rectangle 14 for terminating the respective synchronizing pulses.

During the second 3H of the vertical blanking interval the key No. 2 multivibrator operates the squelch tube 50 for suppressing the equalizing pulse multivibrator 40 and it also operates the unsquelch tube 52 for exciting the field synchronizing multivibrator 54. The multivibrator 54 is effective to supply those trigger pulses in the signals C and D for producing the wide field synchronizing pulses 10 of Fig. 1. When the key No. 2 multivibrator 24 ceases operating, the un-

squelch tube 52 again suppresses the field synchronizing multivibrator 54, while the equalizing pulse multivibrator 49 is again unsquelched. This causes equalizing pulses 9 to be resumed throughout the third 3H of the vertical blanking interval, at the end of which time the key No. 1 multivibrator 34 ceases operating and the multivibrator 49 is squelched.

During the latter portion of the vertical blanking interval the line synchronizing multivibrator 24 is free to operate to produce the line synchronizing pulses 7 through the medium of the synchronizing pulse generator 14.

The picture signal generator 16 of Fig. 2 is illustrated schematically at the bottom of Fig. 3. The 1500 pulses per second timing signal is used to synchronize a multivibrator 60 whose width is adjusted to about 2H. The multivibrator 60 cuts off a normally conducting starting tube 62 thereby interrupting the flow of current in the coil of a tank circuit 64. When the tube 62 is cut off, a train of oscillations is set up in the tank circuit 64 at the resonant frequency of this circuit. A "keep-alive" oscillator 66 prevents the amplitude of the oscillations from decreasing until the starter tube 62 again becomes conducting as the multivibrator 60 returns to its normal state to terminate the oscillations. The frequency of the tank circuit 64 is adjusted to be an even multiple of the line frequency, e. g., the 40th multiple, or 630 kc. The result is a series of chains of sine waves of 630 kilocycles frequency, these chains occurring 1500 times per second, or 25 times per field, and lasting for about two horizontal lines of the scanning, depending upon the adjustment. These waves are passed through an amplifier 68 to a pulse shaping circuit 70 that forms the waves into pulses for use as a dot pattern in the video signal. These dot pattern pulses are combined with the pedestal pulses in the mixer 72, into whose plate circuit are also fed the synchronizing pulses, and the combined signal is fed to the output amplifier 74. The composite video signal then appears at the terminals 76 and 78 which are alternatively selectable depending upon whether a positive or negative composite signal is desired. In Fig. 2 the mixer 72 and output amplifier 74 are designated generally by the numeral 80. The picture signal appears on the viewing screen as 25 horizontal rows of dots with 40 dots in each row. Choice of a particular number of rows and dots per row is arbitrary, and the invention is not restricted thereby.

The television video signal generator disclosed herein is of considerably simpler construction than the prior types of apparatus for this purpose. It is ideally suited for use in test equipment to service television receivers. However, it may be employed in television transmitters as well. To this end there are provided terminals 82 and 84, Fig. 3, in the field pedestal and line key multivibrator circuits 26 and 18, respectively, whereby the operation of the illustrated pedestal and synchronizing pulse generating equipment may be correlated with that of a television camera or other picture signal source, and the grid of the mixer 72 to which the dot pattern signal normally is applied may be switched instead to a terminal 86 so that signals from the picture source will appear in the output of the mixer to replace the dot pattern.

The video signal generator herein disclosed is especially suited for portable use. In Figs. 5 and 6 there is illustrated a portable unit complete with power supply and all of the components il-

lustrated schematically in Figs. 3 and 4. The generator chassis 90 is mounted vertically in a carrying case 92 having a handle 94, feet 96 and a detachable cover or lid 98. In Fig. 6 the chassis is shown exposed to view after removal of the cover 98, the various tubes and other circuit elements being represented by circles and rectangles for simplicity. The entire unit measures approximately 24 inches by 16 inches by 7 inches.

Numerous advantages of the disclosed system will be apparent to those skilled in the art. Electrically, the apparatus is much simpler in design and easier to maintain than prior video signal generators. Almost all of the tubes may be of a uniform type, preferably double triodes. The apparatus also has improved mechanical features such as relatively small size and weight. The cost of the generator is sufficiently moderate so that it will be a profitable addition to servicemen's equipment. The circuit design is highly adaptable for locating trouble in television receivers. The various components of the test apparatus can be operated independently, if desired, so that only those components of the receiver which respond, for example, to the pedestal pulses or the synchronizing pulses are tested. A variety of other uses will readily suggest themselves.

While a preferred embodiment of the invention has been illustrated and described, it will be obvious that modifications and variations can be made therein without departing from the spirit of the invention as set forth in the appended claims.

I claim:

1. In an apparatus for generating a composite video signal including synchronizing pulses of various durations and pedestal pulses of various durations, all of said pulses occurring respectively at predetermined times in the video signal, the combination comprising a first trigger circuit adapted to be triggered back and forth between two stable states for respectively initiating and terminating each of the various synchronizing pulses occurring in the video signal, a second trigger circuit adapted to be triggered back and forth between two stable states for respectively initiating and terminating each of the various pedestal pulses occurring in the video signal, a plurality of multivibrators, one for each of the various kinds of synchronizing pulses and pedestal pulses included in the composite video signal, each of said multivibrators being effective intermittently to produce pairs of trigger pulses in which the pulses of each pair are separated by the time interval occupied by a pulse of a particular kind in the composite video signal, timing control means effective to space the successive operations of each multivibrator to coincide with the successive occurrences of a particular kind of pulse in the video signal, and a plurality of pulse-handling devices operatively interposed between said multivibrators and said trigger circuits whereby all of the trigger pulses corresponding to the various synchronizing pulses in the video signal are applied to said first trigger circuit, and all of the trigger pulses corresponding to the various pedestal pulses in the video signal are applied to said second trigger circuit.

2. In a video signal generator, a trigger circuit including a pair of electron tubes for generating pulses to be included in the video signal, the first of said tubes being effective when operated to initiate a pulse, and the second of said tubes being effective when operated to terminate the

pulse, said trigger circuit being so arranged that each tube is rendered operative in response to a momentary trigger pulse applied thereto, trigger pulse generators each being adapted intermittently to generate pairs of trigger pulses, wherein each pair consists of a leading pulse and a trailing pulse, a first pulse-handling device for applying all of the leading pulses from said trigger pulse generators to said first tube in said trigger circuit, a second pulse-handling device for applying all of the trailing pulses from said trigger pulse generators to said second electron tube of said trigger circuit, and timing control means for causing all of said leading and trailing trigger pulses to occur in a predetermined timed sequence, with a trigger pulse of each type being intermediate two trigger pulses of the other type.

3. In a video signal generator, pedestal pulse generating means comprising a trigger circuit having a first electron tube effective in response to a momentary synchronizing trigger pulse to initiate a pedestal pulse, and a second electron tube effective in response to a momentary desynchronizing trigger pulse to terminate the pedestal pulse initiated by said first electron tube, a first multivibrator adapted to furnish alternate synchronizing and desynchronizing trigger pulses, a second multivibrator adapted to furnish alternate synchronizing and desynchronizing trigger pulses, pulse-handling means for applying all of said synchronizing trigger pulses from both of said multivibrators to said first electron tube, other pulse-handling means for applying all of the desynchronizing trigger pulses from both of said multivibrators to said second electron tube, and timing means to effect operation of said multivibrators coincidentally with the respective occurrences of horizontal and vertical blanking intervals in the output video signal.

4. In combination with the pedestal pulse generating means set forth in the preceding claim 3, squelch means to prevent operation of one of said multivibrators when the other of said multivibrators is operating.

5. An apparatus for supplying the synchronizing pulses of a composite video signal, comprising a trigger circuit having a first electron tube component effective when operated to initiate a synchronizing pulse and a second electron tube component effective when operated to terminate the synchronizing pulse, a first multivibrator effective when operated to apply intermittent pairs of trigger pulses to said trigger circuit, a second multivibrator effective when operated to apply intermittent pairs of trigger pulses to said trigger circuit, control means including a third multivibrator for causing said first and second multivibrators to operate at different times, and pulse-handling devices operatively interposed between said trigger circuit and said multivibrators for feeding the first trigger pulse of each pair of pulses furnished by said first and second multivibrators to said first component and the second trigger pulse of each pair of pulses furnished by said first and second multivibrators to said second component.

6. An apparatus as set forth in the preceding claim 5, wherein said control means includes a squelch tube operatively interposed between said third and first multivibrators, and an unsquelch tube operatively interposed between said third and second multivibrators.

7. In a picture transmission system, a composite video signal generating means compris-

ing a pedestal pulse generator, a synchronizing pulse generator, each of said pulse generators being of the type that includes a first electron tube component effective when operated to initiate a rectangular pulse and a second electron tube component effective when operated to terminate the rectangular pulse, a picture signal generator, means for combining the respective outputs of all of the aforesaid generators to furnish the composite video signal, field pedestal and line pedestal multivibrators for triggering said pedestal pulse generator; line synchronizing, equalizing and field synchronizing multivibrators for triggering said synchronizing pulse generator; each of the aforesaid multivibrators being adapted when operated to furnish a pair of trigger pulses for exciting the respective one of said pulse generators, pulse-handling devices whereby the first trigger pulse in each pair is applied to the first component of the respective pulse generator and the second trigger pulse of each pair is applied to the second component thereof, timing control means for operating all of said multivibrators in a predetermined timed relation, including key multivibrators, squelch tubes, unsquelch tubes and a source of timing signals, all arranged to govern the sequence and manner in which the various trigger pulses are generated to correspond with the respective occurrences of the various pedestal and synchronizing pulses in the composite video signal.

8. An apparatus for generating a composite video signal including recurrent pulses of various types having different time durations, such apparatus comprising a plurality of trigger pulse generators each operative to furnish synchronizing and desynchronizing trigger pulses in alternate sequence coincidentally with the respective times at which the recurrent pulses of a particular type start and stop, pulse generating means including a first portion for initiating a pulse and a second portion for terminating such pulse, both of said portions being responsive to trigger pulses applied thereto, pulse handling means for applying to said first portion said synchronizing trigger pulses as the same are generated by said plurality of trigger pulse generators, other pulse handling means for applying to said second portion said desynchronizing trigger pulses as the same are generated by said plurality of trigger pulse generators, with said pulse generating means being operative to generate the recurrent pulses of the various types in response to said trigger pulses, and output means for incorporating the pulses generated by said pulse generating means in a video signal wave.

9. An apparatus for generating a composite video signal including rectangular pulses of various durations occurring at different times in the signal, such apparatus comprising a plurality of trigger pulse generators each operative to furnish synchronizing and desynchronizing trigger pulses in alternate sequence, control means timing the operation of said trigger pulse generators for causing the synchronizing and desynchronizing trigger pulses furnished by each of said trigger pulse generators to coincide with the respective times at which rectangular pulses of a given duration are initiated and terminated in the video signal, a rectangular pulse generator capable of being triggered back and forth between two stable states for respectively initiating and terminating a rectangular pulse, pulse handling means for applying all of the synchronizing trigger pulses from said trigger pulse gen-

erators to said rectangular pulse generator for initiating rectangular pulses therein, other pulse handling means for applying all of the desynchronizing trigger pulses from said trigger pulse generators to said rectangular pulse generator to terminate the rectangular pulses therein, with the duration of each rectangular pulse being determined by the time interval between a synchronizing trigger pulse and the succeeding desynchronizing trigger pulse, and output means for incorporating the generated rectangular pulses in a video signal wave.

10. An apparatus for supplying the various kinds of synchronizing pulses that occur in a composite video signal, such apparatus comprising a rectangular pulse generator having two input terminals and being capable of assuming alternate stable states in response to the application of trigger pulses to the respective input terminals, a line synchronizing multivibrator, an equalizing multivibrator, a field synchronizing multivibrator, each of said multivibrators being effective when operated to furnish synchronizing and desynchronizing trigger pulses at the respective times when the synchronizing pulses of a particular kind start and stop in the video signal, a pulse handling device for applying all of the synchronizing trigger pulses from said multivibrators to one of said input terminals, another pulse handling device for applying all of the desynchronizing trigger pulses from said multivibrators to the other of said input terminals, with the various pulses generated by said rectangular pulse generator having various time durations according to the time intervals between successive trigger pulses, a plurality of control multivibrators effective to limit the operation of each of said first-mentioned multivibrators to given time intervals, and timing means for periodically timing the operations of all of said multivibrators.

11. An apparatus for supplying the various kinds of synchronizing pulses that occur in a

composite video signal, such apparatus comprising a rectangular pulse generator having two input terminals and being capable of assuming alternate stable states in response to the application of trigger pulses to the respective input terminals, a plurality of multivibrators for triggering said rectangular pulse generators, each of said multivibrators being effective when operated to furnish alternate synchronizing and desynchronizing trigger pulses at the respective times when the synchronizing pulses of a particular kind start and stop in the video signal, pulse-handling devices for respectively applying the synchronizing trigger pulses from all of said multivibrators to one of said input terminals and for applying the desynchronizing pulses from all of said multivibrators to the other of said input terminals to initiate and terminate the respective rectangular pulses in said generator, with the various pulses generated by said rectangular pulse generator having various time durations according to the time intervals between successive trigger pulses, timing means for operating said multivibrators, and control means including other multivibrators and squelch circuits so related to the first-mentioned multivibrators as to condition them for operation in predetermined sequence according to the various types of synchronizing pulses that occur in a composite video signal.

ROBERTSON R. GANNAWAY.

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| 2,258,943 | Bedford     | Oct. 14, 1941 |
| 2,350,536 | Schlesinger | June 6, 1944  |
| 2,406,760 | Goldmark    | Sept. 3, 1946 |
| 2,465,371 | Grieg       | Mar. 29, 1949 |