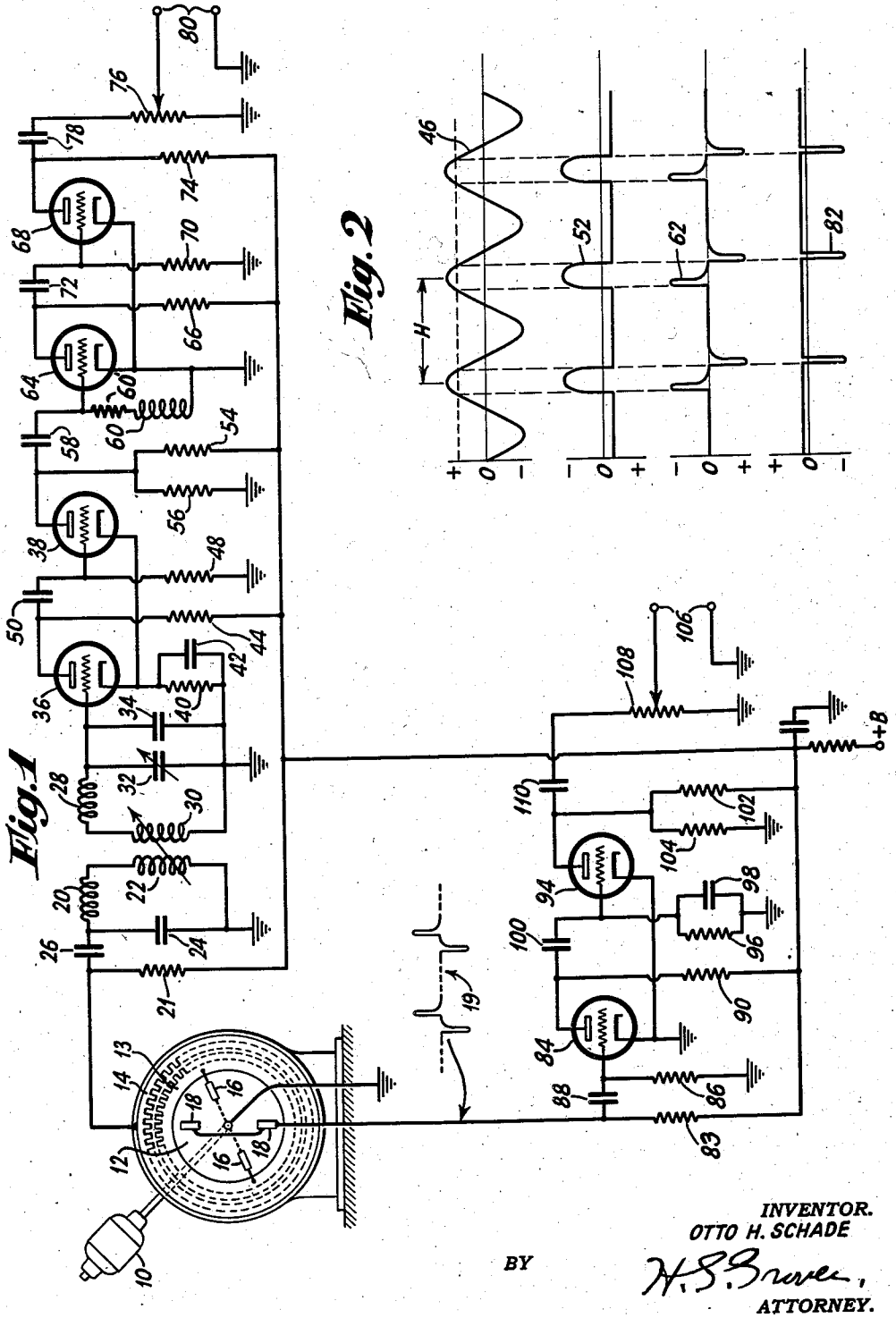
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TELEVISION SYNCHRONIZING SIGNAL IMPULSE GENERATOR

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TELEVISION SYNCHRONIZING SIGNAL IMPULSE GENERATOR

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This invention relates to a system for producing synchronizing signals such as are used to maintain television receiving sets in synchronous operation with the television transmitting system. Such synchronizing signals are also used to maintain various parts of a television transmitting system in synchronism. More specifically, the present invention relates to a simple and compact system whereby master synchronizing impulses may be produced for controlling a television system, the master synchronizing impulses being utilized for controlling the operation of cathode ray beam deflection generators and for controlling impulse generators such as a multivibrator or blocking os 'llator that may produce various wave forms such as those required by the R. M. A. television standards.

In previously used master synchronizing signal impulse generators, a considerable number of tubes have been employed and normally, such systems generally use a plurality of multivibrators, relaxation oscillators, counter circuits, or blocking oscillators in order that the various necessary frequencies may be produced and may bear the proper phase relationship with respect to each other. In such known systems, it is generally the practice to generate the line deflection frequency of 13,230 cycles per second directly by some type of an electronic oscillator and to use these oscillations for controlling various circuit means for frequency division whereby a frequency of 60 cycles per second may be produced which will bear a desired relationship to the originally produced 13,230 cycles per second. The 60 cycle voltage variations must have very rigid phase relationship with respect to power supply frequency and such relationship is difficult to maintain in electronic systems due to voltage surges in the power line. Such electronic systems, as stated above, require a great number of tubes and are somewhat critical in adjustment and operation. These systems are expensive to manufacture, and in view of the fact that so many types and so many frequency devices are necessary, a failure of one part of the apparatus is difficult to locate and in fact, it is not infrequent that the entire panel must be returned to the factory for proper and complete diagnosis. In the present invention, a relatively small number of tubes are used, and the system is very simple, so that the cost of producing the synchronizing impulse generator is very materially reduced, and furthermore, should any trouble arise, it is not difficult to diagnose the trouble and to make the necessary part replacement to place the system in operation again. Moreover, the characteristics of the tubes used may vary within fairly wide limits without affecting the phase rigidity or wave form of the impulses produced. With the present system, even in view of its simplicity, it is possible to produce the vertical and horizontal synchronizing impulses and to maintain any desired phase relationship between these impulses.

Accordingly, it is one purpose of the present invention to provide a master television synchronizing impulse generator which is simple in operation and which employs a minimum of parts and tube complements.

Still another purpose of the present invention resides in the provision of a master television synchronizing impulse generator which will produce both the vertical and the horizontal synchronizing impulses at double or single line frequency, the system being simple in arrangement and relatively easy to maintain in proper operating condition.

Other purposes and advantages of the present invention will become more apparent to those skilled in the art from a reading of the following specification and claims, particularly when considered with the drawing, wherein:

Figure 1 represents a preferred circuit arrangement of the present invention, and,

Figure 2 shows the wave forms occurring at various points in the circuit shown in Figure 1.

In the present invention, a voltage variation of sinusoidal wave form is generated, the frequency of the wave form being equivalent to the desired frequency for horizontal scanning. In present television systems this frequency is 13,230 cycles per second. A preferred manner of producing the 13,230 cycle sine wave voltage variation is by means of a synchronous motor 10 operated from a 60-cycle power line. If such a device is used, and if the motor has a rotation speed of 1800 R. P. M., then a disc 12 connected to the armature should have 441 teeth cut in the peripheral portion 13 thereof so that the desired frequency may be generated. Associated with the disc 12, which is attached to the armature of the motor 10, is a stationary member 14 in the form of an annulus, the inner surface of which is provided with 441 cooperating teeth, the shape of the teeth on both the periphery of the rotating member 12 and the stationary member 14 corresponding somewhat to the teeth used in ordinary spur gears. The external diameter of the rotating peripheral member 13 and the internal diameter of the stationary member 14 should be only slightly different in dimension so

that there is only a relatively small distance between the teeth of the rotating member and the cooperating teeth of the stationary member 14. When the rotating member is in such a position that the teeth of the two members 13 and 14 are opposite each other, then a maximum capacity relationship will exist between the two members. However, when the rotating member is moved sufficiently to place the teeth of the rotating member opposite the space between the teeth of the stationary member, then a minimum capacity relationship will exist. This capacity relationship is utilized to produce the voltage variation for controlling the first tube of the master synchronizing impulse generator. Furthermore, if the width of the top of the teeth and the space between the teeth are substantially equal, the voltage variation produced when the rotating member is revolved can be made to have substantially a sinusoidal wave form.

The rotating member 12 is preferably made of an insulating member such as "Bakelite," while the peripheral portion 13 carrying the teeth is made of brass or some similar easily milled nonmagnetic conducting material. The brass ring or peripheral member 13 may be attached to the insulating portion 12 by any desired known means.

For producing voltage variations of 60 cycles per second, diametrically opposed conducting inserts are placed along radial paths within the insulating portion of the rotating member 12, these inserts being connected electrically to the external conducting member 13 and to the shaft of the motor 10 which is in turn connected to ground. Cooperating with the side of the rotating member 12 are a pair of stationary conducting members 18 which are also diametrically opposed with respect to the axis of the rotating member and which cooperate with the inserts 16 in such a manner that, as the disc is rotated, a certain variable capacity relationship will exist between the rotating and stationary members 16 and 18 respectively. Accordingly, maximum capacity between these members will exist twice for each revolution of the disc, and this maximum capacity relationship will only exist for a predetermined relatively short space of time as determined by the arcuate width of the stationary and/or rotating members. Since the motor is operated from a 60-cycle power line and since the motor is synchronous in operation, the voltage variations which may be derived from the stationary members 18 will be at the rate of 60 cycles per second, but, what is more vital, and irrespective of any change in the 60-cycle power line so far as frequency is concerned, a ratio of 220½ to 1 will exist between the voltage variations produced at the stationary ring 14 as compared to the voltage variations which are derived from the stationary members 18. This relationship is very important and must be maintained if proper synchronous operation of a television system is to result. Although a voltage variation of substantially sinusoidal wave form may be derived from the stationary ring member 14, the voltage variation of 60 cycles which is derived from the stationary members 18 is not sinusoidal in shape in view of the relatively small width of the numbers 16 and 18 as compared to their distribution. A certain differentiating effect caused by the circuit is produced on the short generated impulse so that the impulses derived from the stationary members 18 are relatively short in duration and have a wave form similar to the shape of the curve 19 shown in Figure 1.

The circuit arrangement which is associated with the motor for producing the desired frequencies is also shown in Figure 1. In order that the voltage variations as derived from the stationary member 14 will be of a practical value in intensity, the stationary ring 14 is connected to a source of positive potential through a load resistance 21. Coupled to the ring 14 is a tuned circuit including inductances 20 and 22, and a condenser 24. The values of the inductances and the condenser are so chosen that the circuit resonates at substantially the produced frequency. The coupling between the resonant circuit and the stationary ring member 14 is by way of condenser 26.

Electromagnetically associated with the first resonant circuit is another resonant circuit which includes the inductances 28 and 30, as well as the condensers 32 and 34. This resonant circuit is also tuned to substantially the frequency produced at the stationary ring 14. The inductances 22 and 30 are relatively closely coupled, but for adjustment purposes the mutual coupling of these two inductances is preferably manually variable as indicated by the arrow drawn through the two inductances. Furthermore, the condenser 32 is preferably made adjustable in order that the resonance point of the second resonant circuit may be shifted for varying the phase relationship of the voltage appearing in the second resonant circuit with respect to the voltage appearing in the first resonant circuit. This shifting in phase is desirable for reasons which will be pointed out later.

An amplifier tube 36 is provided having a cathode, a control electrode and an anode. The cathode is connected to ground potential through a resistance 40 which is by-passed by condenser 42 in order that the desired potential relationship may be produced between the control electrode and the cathode. Furthermore, the anode of tube 36 is connected to the source of positive potential through the load resistance 44. The voltage variations which appear in the second tuned circuit including the inductances 28 and 30 and the capacitances 32 and 34 are applied to the control electrode of the amplifier tube 36 to alter the impedance of this tube. Accordingly, the current appearing in the load resistance 44 will be varied and the potential of the anode of tube 36 will fluctuate in accordance with the potential applied to the control electrode of the tube. The wave form which is applied to the control electrode of tube 36 is shown by way of example in the curve 46 in Figure 2. This voltage variation is substantially of sinusoidal wave form, as pointed out above.

The output from the amplifier tube 36, which is a 13,230 cycle voltage variation of substantially sinusoidal wave form as indicated at 46 in Figure 2, is applied to an electron tube 38. This tube also includes a cathode, a control electrode and an anode. The cathode of tube 38 is connected to the cathode of tube 36 while the control electrode is connected to ground by way of a relatively high resistance 48. The control electrode of tube 38 is also coupled to the anode of the amplifier tube 36 by way of condenser 50. The grid current rectification or diode action, together with the potential of the cathode of tube 38, permits this tube to act as a clipper, so that it responds to only a portion of the applied voltage so far as the wave form is concerned. Ac-

cordingly, with a predetermined design of the clipper tube 38, a wave form such as shown at 52 in Figure 2 is present at the anode of the tube 38, since tube 38 is made conductive only by the positive peaks of the applied wave form as shown in Figure 2. The anode of tube 38 is connected to a source of positive potential through a load resistance 54, and the anode of the clipper tube 38 is also connected to ground through resistance 56 in order that the potential applied to the anode of the tube may be reduced. Furthermore, the use of the resistance 56 assists in flattening the tops of the impulses of wave form 52. In view of the characteristics and the biasing of the clipper tube 38, a voltage variation having a wave form such as indicated at 52 in Figure 2 is present at the anode of this tube, the fundamental frequency of the voltage variations being 13,230 cycles per second.

The voltage variation which is present at the anode of the clipper tube 38 is impressed across a differentiating circuit including condenser 58 and inductance 60. The resistance 60' indicates the inherent resistance of the inductance 60, and in fact, the inductance 60 may be replaced by a resistance. These elements are chosen of such a value that the voltage variation which is present at the anode of the clipper tube 38 will be differentiated and accordingly, the initial portion of each impulse of the voltage variation at the clipper tube 38 will produce a short impulse in the voltage at the junction of the condenser 58 and the inductance 60, whereas the trailing portion or final portion of each impulse of the voltage variation at the anode of tube 38 will produce a short impulse of opposite polarity at the junction of the condenser 58 and the inductance 60. Accordingly, the wave form appearing at the junction of the condenser 58 and the inductance 60 will be similar to that shown at 62 in Figure 2. This voltage variation is applied to the control electrode of an amplifier tube 64 which tube includes a cathode, a control electrode and an anode. The cathode is connected to ground, whereas the anode is connected to the source of positive potential through a load resistance 66. Since the tube 64 operates as an amplifier tube, the wave form of the voltage variation which appears at the anode of this tube is substantially identical with the wave form which is impressed upon the control electrode of the tube, and accordingly resembles the curve shown at 62 in Figure 2. The value of the inductance 60 is adjusted or chosen to produce impulses of the desired width since changes in the value of the inductance alter the width of the positive and negative impulses produced by the differentiating effect described above.

Another clipper tube, 68, is also used which includes a cathode, a control electrode and an anode, the cathode of the clipper tube 68 being connected to ground and the control electrode being connected to ground by way of a high grid resistance 70. The control electrode of the clipper tube 68 is coupled to the anode of tube 64 by way of condenser 72. The grid current rectification or diode action causes tube 68 to operate as a clipper tube so that the tube is rendered conductive only during the positive peaks of the voltage variation applied thereto. Accordingly, the voltage which appears at the anode of the clipper tube 68 comprises a series of negative impulses of relatively short duration and of 13,230 cycles per second. The plate of the clipper tube 68 is connected to a source of positive potential through a load resistance 74, and the voltage variation is impressed across a potentiometer 76 by means of a condenser 78. The intensity of the voltage variations which are present at the output terminals 80 may therefore be controlled by an adjustment of the movable contact along the potentiometer 76. The wave form which may be derived from the terminals 80 is represented by the curve 82 of Figure 2.

From the above it may be seen that through the use of a relatively small number of tubes television line synchronizing impulses may be produced which are relatively short in duration and which occur at the desired line frequency. The impulses as derived from the output terminals 80 are of sufficient intensity to drive a power output tube such as a 6L6 or a 6V6. If reversal of phase is desired an additional stage of amplification may be interposed between the output terminals 80 and the power amplifier tube to which the signals are applied.

In view of the shape of the rotating inserts 16 and the stationary members 18, the voltage variation which is present at the terminals 18 is substantially as shown at 19 in Figure 1 and corresponds very closely to the wave form shown at 62 in Figure 2 for the reasons given above. In order to increase the intensity of these voltage variations the stationary members 18 are connected to a source of positive potential through a high resistance 83, and these voltage variations are impressed upon the control electrode of an amplifier tube 84. This tube includes a cathode, a control electrode and an anode, and the control electrode is connected to ground by way of resistance 86. The cathode of the tube may be connected directly to ground or may be connected thereto through a cathode resistance. The control electrode of the tube 84 is coupled to the stationary plates 18 by way of condenser 88 so that the voltage variations from the plates 18 may be impressed upon the control electrode of the tube 84. The anode of this tube is connected to a source of positive potential through a load resistance 90. Since the tube 84 is to function primarily as an amplifier tube, then the voltage variations which are present at the anode of this tube are substantially identical in wave form to the voltage variation impressed upon the control electrode of the tube.

The voltage variations which are present at the anode of tube 84 are impressed on the control electrode of a clipper tube 94, the cathode of which is connected to ground. The control electrode of the clipper tube is also connected to ground through a grid resistance 96, the resistance being shunted by condenser 98. Coupling between the anode of the tube 84 and the control electrode of the clipper tube is produced by the condenser 100. The anode of the clipper tube is supplied with positive potential through the load resistance 102, and the anode is also connected to ground by way of resistance 104 in order that the voltage as applied to the anode may be reduced in intensity and in order to produce more nearly rectangular wave form. Due to the biasing and the portion of the operating characteristics of the tube 94 which are used, the tube is rendered conductive only when the positive peak impulses are impressed upon the control electrode of the tube, and accordingly, a voltage variation of 60 impulses per second may be derived from the output terminals 106. This wave form is similar in shape to the wave form shown at 82 in Figure 2, and the synchronizing impulses are

relatively short as compared to the interval between the impulses. The intensity of the impulses may be controlled by the position of the adjustable contact along the potentiometer 108, which is coupled to the anode of the clipper tube through the condenser 110.

As stated above, in view of the fact that the voltage variations as derived from the stationary elements 18 and from the stationary ring 14, bear a fixed relationship to each other so far as frequency is concerned, an angular adjustment of the stationary members 18 may be made to control the phase relationship between the 60 impulse per second voltage variations and the 13,230 impulse per second voltage variations. Since it is realized that a very accurate and fine adjustment of the phase relationship between these voltage variations could not be adequately made through a manual rotary adjustment of the stationary contacts 18, the condenser 32 of the second resonant circuit referred to above is made adjustable so that the phase of the 13,230 impulse per second oscillation may be altered by very small amounts. Through an adjustment of this condenser the beginning or front of each 60-cycle impulse may be made to have the desired phase relationship with respect to the impulses of line frequency which are derived from the output terminals 80. The latitude of the condenser 32 is entirely sufficient to make phase adjustments between the line and frame synchronizing impulses within substantially one-half cycle of the line frequency. After the necessary adjustment is made, the circuit will continue to operate at that particular phase relationship and since the line and frame synchronizing impulses are initially derived from a common rotating member, a very rigid and definite frequency relationship between the two synchronizing signals is possible.

From the above, therefore, it may be seen that a very simple and compact system has been devised for producing master television synchronizing impulses which may be used in conjunction with any television system and is particularly useful in portable television equipment. Because of its size and light weight the device described is also extremely advantageous where television transmitting equipment is to be used in an airplane.

As a modification of the device, the rotating member or disc 12 may be caused to rotate at 3600 R. P. M. in which case double line frequency would be produced and would be available at the output terminals 80. Under these conditions, however, only one rotating insert 16 is used, and only one cooperating stationary member 18 is used, in order that 60 impulses per second will still be available at the output terminals 106. The operation of the device at 3600 R. P. M. is sometimes desirable, especially where double line frequency is necessary to produce the stabilizing impulses which are transmitted by a television transmitting station beginning immediately preceding a vertical synchronizing impulse and continuing for some few lines after the termination of the vertical synchronizing impulse.

Although the device as explained above shows separate amplifier and clipper tubes, it is possible, however, to combine these tubes into a single envelope so that tubes 36 and 38 are combined, 64 and 68 are combined, and 84 and 94 are combined. When this is done, tubes of the type 6SC7 or 6N7 may be used.

When the rotating member 12 is rotated at 3600 R. P. M. and double line frequency is produced, then single line frequency may be produced by using a multivibrator or frequency divider, which is triggered by alternate oscillations of the double line frequency. The output of the multivibrator will therefore be the proper line frequency, and this output may be supplied to the circuit shown in Figure 1.

Furthermore, double line frequency may be produced by using a phase inverter energized from the output of the amplifier 36 and feeding the output of the phase inverter through a clipper tube having its output in parallel with that of the clipper 38. If both line frequency and double line frequency are desired, a separate differentiating circuit including tubes such as tubes 64 and 68 may be used. Each differentiating circuit will supply single line impulses mutually displaced 180° and the sum of the two differentiating circuits will supply double line frequency.

Various other alterations and modifications may be made in the present invention without departing from the spirit and scope thereof, and it is desired that any and all such modifications be considered within the purview of the present invention except as limited by the hereinafter appended claims.

I claim:

1. A television synchronizing impulse generator comprising means for generating a voltage variation of substantially sinusoidal wave form, means responsive to the generated sinusoidal wave form for producing impulses of a predetermined frequency and of a short duration as compared to the time interval between impulses, a capacitance and an inductance connected in series, means for applying the produced impulses across said capacitance and inductance for differentiation thereby so that very short positive and negative voltage variations will be developed across said inductance corresponding to the beginning and end of each applied impulse, a discharge tube having a cathode, a control electrode and an anode, means for impressing the developed very short voltage variations between the control electrode and the cathode of said tube, and means whereby said tube is rendered conductive only when the voltage variations of positive polarity are impressed thereon so that very short impulses of the said predetermined frequency are present at the anode of said tube.

2. A television synchronizing impulse generator comprising means for generating a voltage variation of substantially sinusoidal wave form, means responsive to the generated sinusoidal wave form for producing regularly recurring impulses of a predetermined fixed frequency, said impulses having a relatively high rate of change at their beginning and end and said impulses being of short duration as compared to the time interval between impulses, a differentiating circuit comprising a capacitance and an inductance connected in series, means for impressing the produced impulses across said differentiating circuit to develop very short voltage variations of opposite polarity across said inductance corresponding to the beginning and end of each applied impulse, a discharge tube thaving a cathode, a control electrode and an anode, means for applying the very short voltage variations to the control electrode of said tube, and circuit means whereby said tube is rendered conductive only when voltage variations of a predetermined

polarity are impressed thereon so that very short impulses of the said predetermined fixed frequency are present at the anode of said tube.

3. A television synchronizing impulse generator comprising means for generating a voltage variation of substantially sinusoidal wave form, means responsive to the generated sinusoidal wave form for producing regularly occurring impulses of a predetermined constant frequency, said impulses being generally of rectangular wave form and being of short duration as compared to the time interval between successive impulses, a differentiating circuit comprising a capacitance and an inductance connected in series, means for applying the produced impulses to said differentiating circuit to develop very short voltage variations of negative and positive polarity across said inductance corresponding to the beginning and end of each applied impulse respectively, a discharge tube having a cathode, a control electrode and an output electrode, means for coupling the inductance to the control electrode of said tube, and circuit means whereby said tube is rendered conductive only when the very short voltage variations of positive polarity are impressed thereon so that very short impulses of the said predetermined constant frequuency are present at the output electrode of said tube.

4. A television synchronizing impulse generator comprising means for generating voltage variations of substantially sinusoidal wave form and of a predetermined fixed frequency, a first resonant circuit tuned substantially to the generated frequency, means for impressing the generated frequency on said resonant circuit, a second resonant circuit magnetically coupled to said first resonant circuit, means including a condenser for altering the tuning of said second resonant circuit to shift the phase relationship of voltage variations in the second resonant circuit as compared to the generated voltage variations, an electron tube having a cathode, a control electrode and an anode, means for coupling the control electrode of said tube to the second resonant circuit, means whereby the tube is rendered conductive only during a portion of each cycle of the generated frequency so that short impulses at the predetermined fixed frequency will be present at the anode of said tube, a circuit including a series capacitance and a reactance, means for impressing the impulses from the anode of said tube upon said series circuit to produce very short impulses of opposite polarity across said reactance for each impulse impressed on the series circuit, a second discharge tube, and means whereby said second discharge tube is rendered conductive only by the very short impulses of a predetermined polarity whereby the output of said second discharge tube will supply very short impulses at a predetermined fixed frequency.

5. A television synchronizing impulse generator comprising means for generating voltage variations of substantially sinusoidal wave form and of a predetermined frequency, a first resonant circuit tuned substantially to the generated frequency, means for coupling said resonant circuit to said generating means, a second resonant circuit coupled to said first resonant circuit, means for altering the tuning of said second resonant circuit to shift the phase relationship of the generated frequency, an electron tube having a cathode, a control electrode and an anode, means for coupling the control electrode of said tube to the second resonant circuit, means for maintaining a predetermined voltage relationship between the control electrode and the cathode so that the tube is rendered conductive only during a portion of each cycle of the generated frequency whereby short impulses of the predetermined frequency will be present at the anode of said tube, a differentiating circuit, means for impressing the impulses from the anode of said tube upon said differentiating circuit to produce very short impulses of opposite polarity for each impulse impressed thereon, a second discharge tube, and means whereby said second discharge tube is rendered conductive only by the very short impulses of one polarity whereby the output of said second discharge tube will supply very short impulses at the predetermined generated frequency.

6. A television synchronizing impulse generator comprising means for generating voltage variations of substantially sinusoidal wave form and of a predetermined constant frequency, a first resonant circuit tuned substantially to the generated frequency, means for coupling said resonant circuit to said generating means, a second resonant circuit coupled to said first resonant circuit, means for altering the tuning of said second resonant circuit to shift the phase relationship of the voltage variations appearing in said second resonant circuit, an electron tube having a cathode, a control electrode and an anode, means for coupling the control electrode of said tube to the second resonant circuit, means for maintaining the anode positive with respect to the cathode, means for maintaining a predetermined voltage relationship between the control electrode and the cathode whereby the tube will be rendered conductive only during a portion of each cycle of the generated frequency whereby short impulses of the predetermined constant frequency will be present in the anode circuit of said tube, a differentiating circuit including a capacitance and a reactance, means for impressing the impulses from the anode of said tube upon said differentiating circuit to produce very short positive and negative impulses for each impulse impressed thereon, a second discharge tube, and means whereby said second discharge tube is rendered conductive only by the very short positive impulses so that very short impulses of the generated constant frequency will be supplied by said second discharge tube.

7. A television synchronizing impulse generator comprising means for generating voltage variations of substantially sinusoidal wave form and of a predetermined relatively high frequency, means for simultaneously generating voltage variations of a relatively low frequency fixed with respect to the relatively high frequency, means for producing relatively short synchronizing impulses from the voltage variations of the relatively low frequency, a resonant circuit tuned to substantially the relatively high frequency, means for impressing the voltage variations of relatively high frequency upon said resonant circuit, means for altering the tuning of said resonant circuit whereby the phase relationship of the relatively high and the relatively low frequencies may be adjusted, and means coupled to said resonant circuit for producing very short synchronizing impulses at said relatively high frequency.

8. A television synchronizing impulse generator comprising common means for generating voltage variations of a predetermined relatively high frequency and for simultaneously generat-

ing voltage variations of a relatively low frequency, the two frequencies being relatively fixed with respect to each other, means for producing short synchronizing impulses from the voltage variations of relatively low frequency, means including a resonant circuit tuned to substantially the frequency of the voltage variations of relatively high frequency, means for impressing the voltage variations of relatively high frequency upon said resonant circuit, means including a condenser for altering the tuning of said resonant circuit to shift the phase relationship of the relatively high frequency voltage variations with respect to the relatively low frequency voltage variations, and electronic means coupled to said resonant circuit for producing very short synchronizing impulses at said relatively high frequency.

9. A television synchronizing impulse generator for producing line and frame synchronizing signals comprising means for generating voltage variations of substantially sinusoidal wave form and of line frequency, means including a portion of said first named means for simultaneously generating voltage variations of frame frequency definitely fixed with respect to the line frequency, means for producing short frame synchronizing signals from the voltage variations of frame frequency, means including a resonant circuit tuned to substantially the voltage variations of line frequency, means for impressing the voltage variations of line frequency upon said resonant circuit, means for altering the tuning of said resonant circuit to shift the phase relationship of the line and frame frequencies, and means coupled to said resonant circuit for producing very short line synchronizing signals fixed in frequency with respect to the frame synchronizing signals and of a predetermined phase relationship with respect thereto.

10. A television synchronizing impulse generator comprising a single means for producing voltage variations of a relatively high and of a relatively low frequency, the two frequencies being of fixed frequency relationship, means for producing short synchronizing impulses at the relatively low frequency from the voltage variations of relatively low frequency, a pair of coupled resonant circuits tuned to substantially the relatively high frequency, means for impressing the voltage variations of relatively high frequency upon one of the tuned circuits, means for altering the tuning of the other resonant circuit in order to vary the phase relationship of the two frequencies, means coupled to said other resonant circuit for producing impulses at the relatively high frequency from the voltage variations of relatively high frequency, a circuit comprising a series connected capacitance and inductance, means for applying the impulses at the relatively high frequency upon said series circuit whereby very short voltage variations of opposite polarity will be produced across said inductance for each applied impulse, and means responsive to the very short voltage variations of a predetermined polarity to produce very short synchronizing impulses of the relatively high frequency whereby two series of synchronizing impulses of the two frequencies are produced having a fixed frequency relationship and having an adjustable phase relationship.

11. A television synchronizing impulse generator comprising a single rotary means for producing voltage variations of substantially sinusoidal wave form of a relatively high and voltage variations of a relatively low frequency, the two frequencies having a fixed frequency relationship, means for producing short synchronizing impulses at the relatively low frequency from the voltage variations of the relatively low frequency, a pair of mutually coupled resonant circuits tuned to substantially the relatively high frequency, means for impressing the voltage variations of relatively high frequency upon one of the tuned circuits, means including a condenser for altering the tuning of the other resonant circuit in order to vary the phase relationship of the two frequencies, means coupled to said other resonant circuit for producing impulses at the relatively high frequency from the voltage variations of sinusoidal wave form of relatively high frequency, a differentiating circuit comprising a capacitance and an inductance, means for impressing the produced impulses upon said differentiating circuit whereby very short positive and negative voltage variations will be present across said inductance for each impressed impulse, means for adjusting the length of the very short impulses, and means responsive to the very short positive voltage variations to produce very short synchronizing impulses of the relatively high frequency whereby two series of synchronizing impulses of the two frequencies may be produced having a fixed frequency relationship and having an adjustable phase relationship.

12. A television synchronizing impulse generator for producing line and frame synchronizing signals comprising a single rotary means for producing voltage variations of line and of frame frequency, the two frequencies having a fixed frequency relationship, means for producing short frame synchronizing signals from the voltage variations of frame frequency, a pair of coupled resonant circuits tuned to substantially the line frequency, means for impressing the voltage variations of line frequency upon one of the tuned circuits, means for altering the tuning of the other resonant circuit in order to vary the phase relationship of the two frequencies, means coupled to said other resonant circuit for producing impulses of line frequency from the voltage variations of line frequency, a differentiating circuit, means for impressing the produced impulses upon said differentiating circuit whereby very short voltage variations of opposite polarity will be generated for each applied impulse, means for adjusting the length of the very short generated impulses, and means responsive to the very short voltage variations of a particular polarity to produce very short line synchronizing signals, whereby line and frame synchronizing signals are produced having a fixed frequency relationship and having an adjustable phase relationship.

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