July 25, 1967 J. B. BROMBAUGH 3,333,042

ELECTRONIC ORGAN WITH CHIFF

Filed Oct. 2, 1963 4 Sheets-Sheet 1

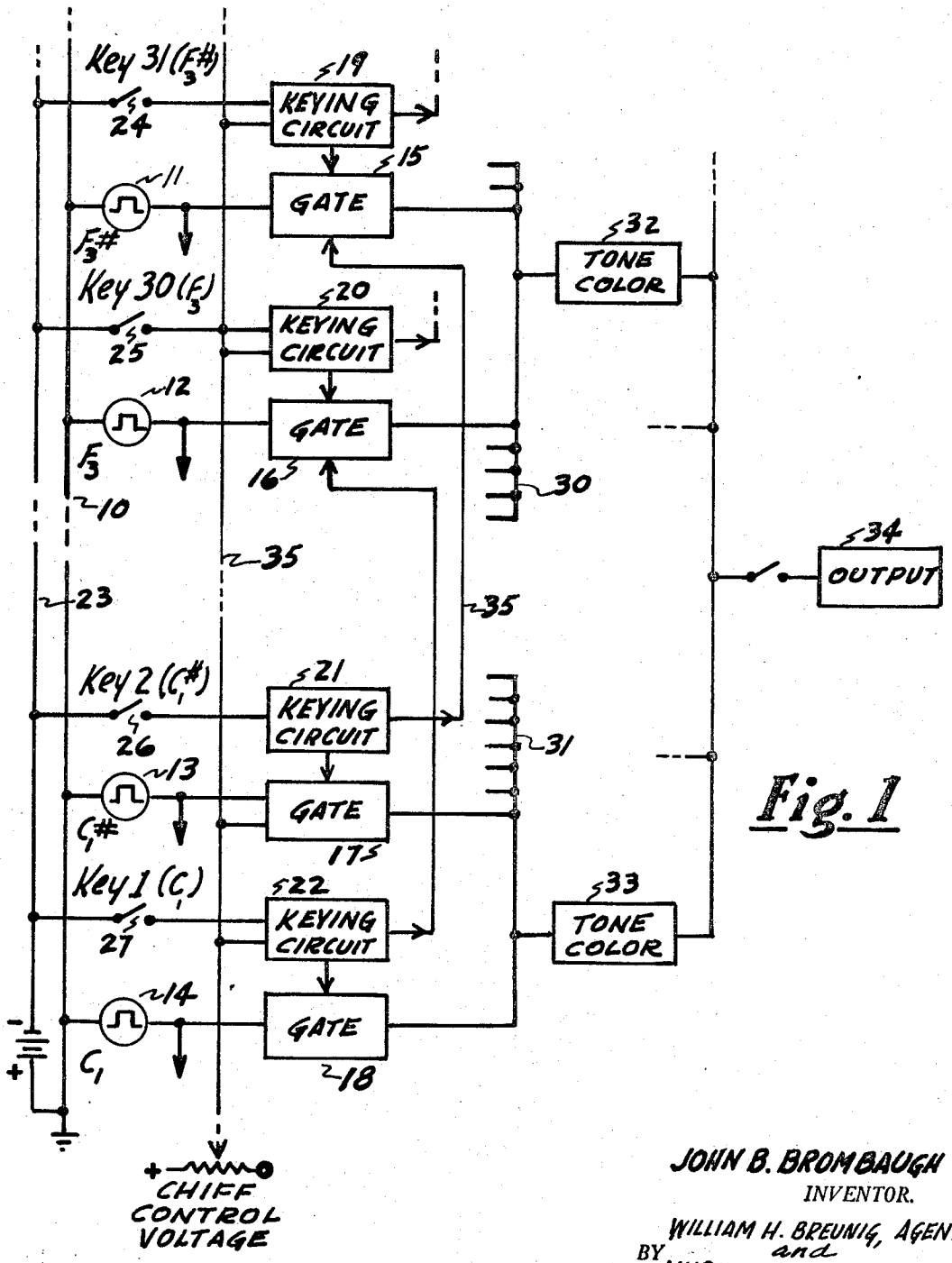


Fig. 1

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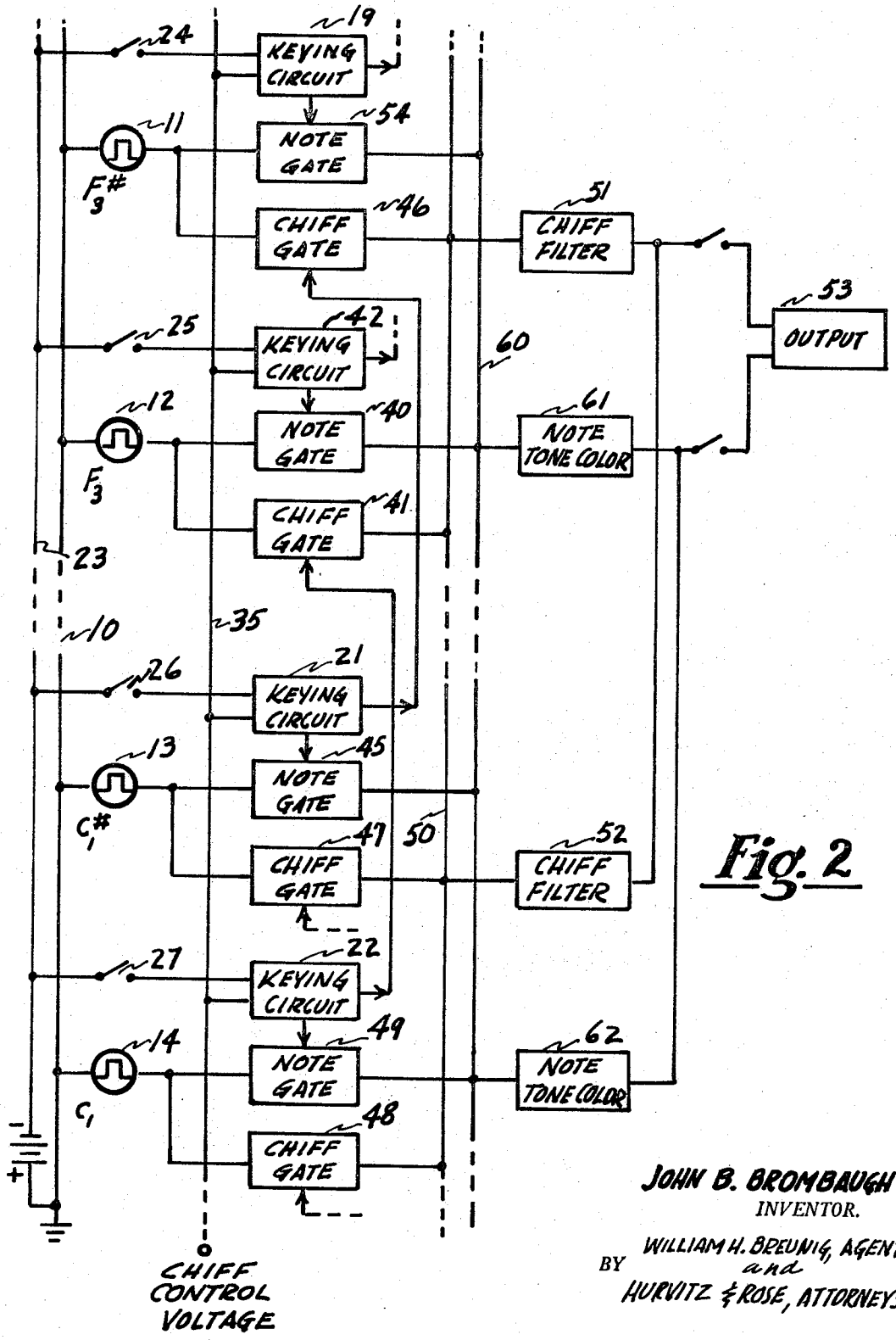


Fig. 2

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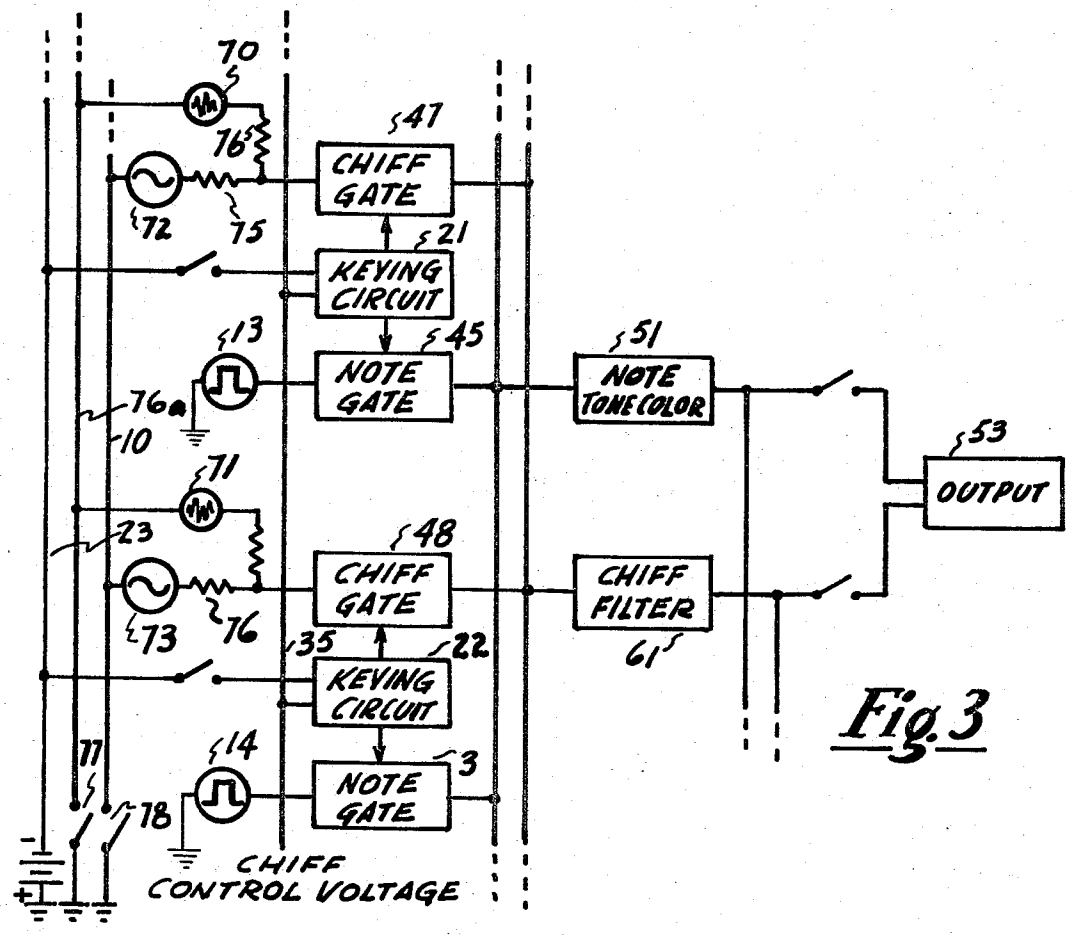


Fig. 3

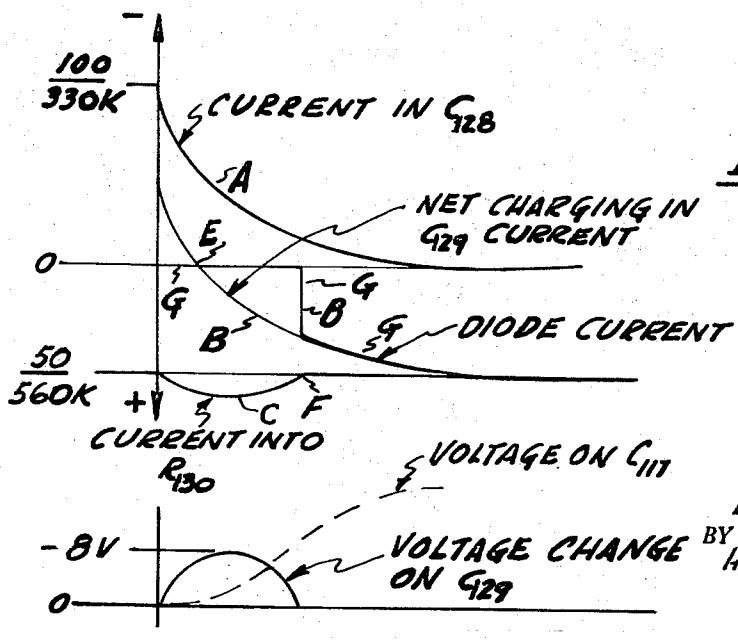


Fig. 5

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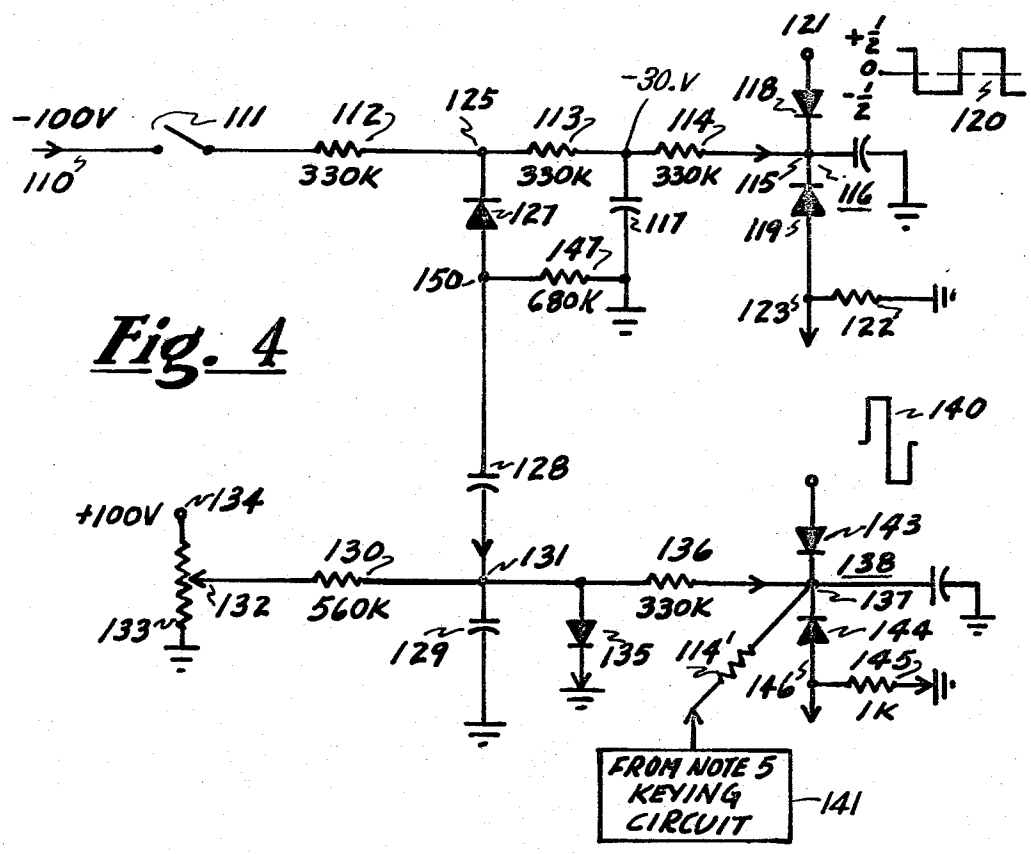


Fig. 4

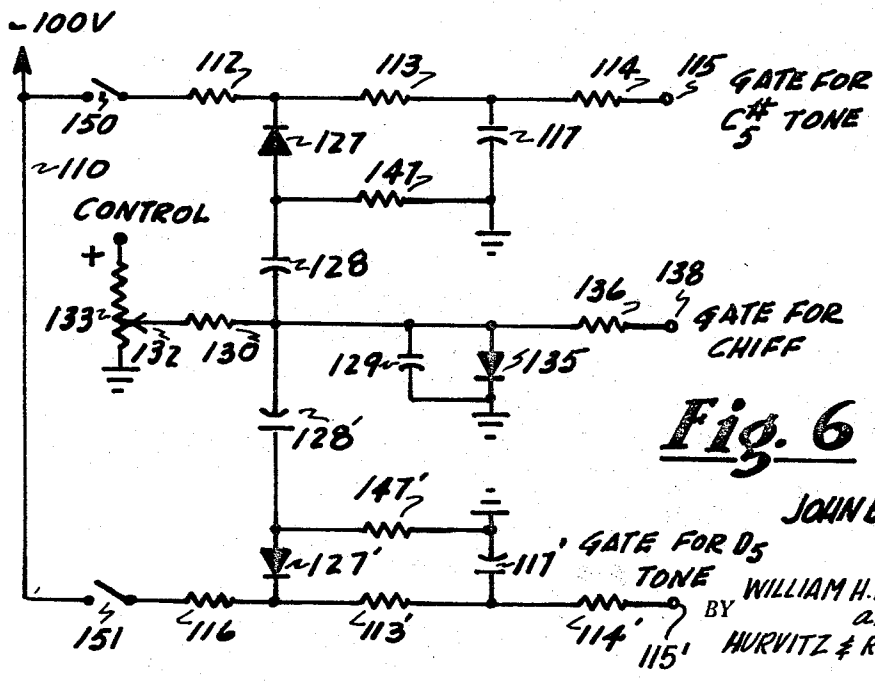


Fig. 6

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3,333,042

ELECTRONIC ORGAN WITH CHIFF

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Filed Oct. 2, 1963, Ser. No. 313,205
25 Claims. (Cl. 84—1.13)

The present invention relates generally to electronic organs and more particularly to organ systems having provision for addition of chiff components to certain of the notes of the organ. Perfection in electronic organs subsists in the minds of some musicians in duplication of total characteristics of pipe organs. Pipe organs inherently generate certain transient sound effects, especially at the initiation of each tone. These effects involve (1) a build up and decay of a spectrum of harmonics, constituting a tone, (2) an audible tonal content occurring only at initiation of a note, and which may be harmonically or inharmonically related to the steady state spectral components, but which does not derive from the tonal build up, having its own frequencies and its own envelope shape. The latter effect is called chiff. Since chiff generation involves production of tonal components inharmonically related to the accompanied tone, as well as a different wave envelope, the problem of incorporating chiff into electronic organs on an economic basis involves utilizing to the maximum extent organ components which are present in any case for tone production, so that the addition of chiff does not add unduly to the cost of the organ. It is entirely possible, for example, to provide chiff circuits which are separate and apart from the organ tone circuits and to key these by means of separate keys and key switches. In view of the large number of tones in an electronic organ of sufficient sophistication to justify the inclusion of chiff at all, such an expedient is not economically practical.

It is an object and feature of the present invention to provide an organ which includes chiff and in which the already existing components of the organ are largely made available as chiff generators.

Briefly describing a preferred embodiment of the invention, the tone generators of the organ are in the form of square wave oscillators. The square waves provide an array of harmonic frequencies associated with each tone, suitable for filtering to form the various tone colors of an organ. Should the array of harmonics prove insufficient because of the symmetrical wave shape of the generator outputs, the square waves may be added in appropriate frequency and amplitude relations to form triangular waves, and these can be used as basic tone materials. It is further conventional, especially in sophisticated organs, to transfer the basic wave shapes provided by the oscillators to headers through gating circuits, keyed on and off by means of key switches. In accordance with the present invention keying circuits are incorporated, in electronic organs, each of which is provided not only with a tone signal but also with a chiff signal deriving from a separate tone oscillator. The separate oscillator may be one of the oscillators already present in the organ. Since the organ uses continuously running oscillators which are gated through to the header, and continuously running chiff circuits which are also gated through the same or a different header, each key switch may, by means of a single pair of contacts, control both the tone gate and the chiff gate. By means of this device not only is the cost of switching maintained at a minimum but no possibility exists of mistiming the chiff with respect to the main tone. In order to simulate chiff successfully the chiff must be heard before the main tone is heard and there must be time overlap of the chiff with the main tone, during the rise time of the main tone. The key initiates both tones i.e. note and chiff, simultaneously, but the keying circuits are so arranged

that the chiff is passed through the gates in considerable amplitude during the rise time of the main tone, so that the chiff is clearly audible initially, and while the chiff still subsists, the main tone gradually is brought into peak amplitude and the chiff tone itself decays to zero. Accordingly, a delicate timing relationship exists which would be difficult to solve if the chiff gate and the main tone gate are controlled by separate contacts of key switches.

It is, accordingly, a broad object of the invention to provide a gating circuit for gating the main tones and chiff tones to a header wherein essentially separate gates are employed for the chiff and the main tone, both gates being differently keyed, however, by gate wave generator circuitry responsive to closure of a single switch, i.e. to application of a single keying voltage.

It is a further object of the invention to provide a novel organ having provision for deriving chiff from tone sources of the organ which are in any event available to produce organ tones and wherein the tone sources are constituted of continuously running oscillators.

A further object of the invention resides in the provision of a novel gating circuit capable of gating through an A.C. signal in accordance with two diverse wave shapes, one of which starts at zero and builds up to a maximum and decreases to zero in a relatively short time, while the remaining wave is building up from zero to a steady state value.

The above and still further features and objects of the invention will become clear upon consideration of the following detailed description of various embodiments of the invention, especially when taken in conjunction with the accompanying drawings wherein:

FIGURE 1 is a block diagram of an organ system, according to the invention.

FIGURE 2 is a block diagram of a modification of the system of FIGURE 1, employing separate chiff gates and note gates, whereas the system in FIGURE 1 employs a single gating circuit, including gates for both chiff and notes.

FIGURE 3 is a further modification of the system of FIGURE 2, wherein provision is included for incorporating noise into the chiff sounds.

FIGURE 4 is a schematic circuit diagram of a gating circuit employable in the systems of FIGURES 1 to 3.

FIGURE 5 is a wave form diagram showing certain charging currents and certain voltages, occurring in the gating circuit of FIGURE 4, and

FIGURE 6 is a schematic circuit diagram of a further gating circuit employable in the systems of FIGURES 1–3.

Referring now more particularly to the accompanying drawings, in the system of FIGURE 1, the lead **10** denotes a common ground lead for a series of continuously running tone oscillators **11, 12, 13, 14.** In the usual organ a very large number of oscillators are present, but to simplify the presentation only four oscillators have been shown, which are those generating the tone $F_3\sharp$, F_3, $C_1\sharp$, C_1, respectively. The tone oscillators **11–14,** inclusive, are connected in cascade with gates **15, 16, 17** and **18,** respectively. The gates may be normally closed and are placed in open condition in response to keying signal. Keying circuits for the gates **15–18,** inclusive, are **19, 20, 21** and **22,** respectively. A lead **23** provides a fixed D.C. voltage and key switches **24, 25, 26** and **27** proceed from the lead **23** to the keying circuits **19–22,** respectively, so that closure of any one of the keys results in application of D.C. voltage from the lead **23** to that key, causing the keying circuit to turn on the associated gates. The keying circuits incorporate wave shaping devices, so that in response to the steady D.C. voltage on the lead **23,** each keying circuit provides to its associated gates a pair of wave shapes, one appropriate for gating chiff and the other appropriate for gating the tone itself.

The tone generator **14** generates the tone C_1 continuously, the associated key **27** being key number 1 of an organ keyboard. The keying circuit, when supplied with D.C. voltage, generates note gating wave which is applied to the gate **18** and also a chiff gating wave which is applied to the gate **16**, which is associated with the oscillator **12** generating the tone F_3. The tone F_3 is 29 semitones above the tone C_1 and is thus at a frequency appropriate for the generation of chiff. The gates **15–18** are connected to appropriate headers, generally indicated as **30** and **31**, which lead to appropriate arrays of tone color filters **32**, **33** and the latter leads to an output circuit, **34**, normally constituted of amplifiers and loud speakers.

The gate **17** passes the tone signal $C_1\sharp$ from the oscillator **13** in response to closure of key **26** and consequent generation of the tone keying wave by keying circuit **21**. The latter also provides chiff keying signal to gate **15**. Accordingly, the note $C_1\sharp$ is acompanied by transient tone deriving from the generator **11** of the oscillator **11**, which generates tone $F_3\sharp$. Thus the same keying circuit **21** which gates open the gate **17** also supplies a gating voltage to the gate **15** which is of appropriate wave shape to sound like chiff. It will be noted that any one of the gates, as **16**, for example, may be required to pass chiff (in association with tone C_1), also may be keyed on by the key **25** and accordingly may be required to pass tone signal F_3. This implies that, if the notes C_1 and F_3 were played simultaneously, the one gate **16** would be subject to the gating wave of the keying circuit **22** and also the keying wave of the circuit **20**, of form, i.e. simultaneously to the chiff wave form and the main note wave form. It is found that the two tones do pass through the organ although in this circumstance the chiff tone may be masked. Since, however, the normal playing of music involves complicated fingering, and the playing of plural notes simultaneously at most times, at least most of the tones will always be provided with chiff, and if an occasional tone has its chiff masked, this will not detract from the quality of the music, even for the skilled musician. The chiff control line **35** applies variable control voltage to the keying circuits to control the duration and amplitude of the chiff gating waves and is to turn them off, as will appear hereafter.

Referring now to FIGURE 2 of the drawings provision is made for separate note gates and chiff gates. The oscillator **12**, for example, includes the note gate **40** and the chiff gate **41** both connected in parallel to the oscillator **12**. The note gate **40** is controlled by a keying circuit **42** while the chiff gate **41** is independently controlled in response to a keying circuit **22** of the key switch **27**. Thereby the closure of the key switch **26** is accompanied by playing of the note $C_1\sharp$ through the note gate **45** as well as by playing of a chiff note at frequency $F_3\sharp$ through chiff gate **46**. Playing of the note C_1 is accompanied by playing of the note F_3 with a chiff wave form through the chiff gate **41**. Each note of the musical scale then includes a key switch in the keying circuit, and generates a key wave for a note gate associated with the keyed oscillator in the chiff gate associated with an oscillator 29 semi-tones above the main tone pitch.

The chiff gates, identified as **46**, **41**, **47** and **48** all lead to a common chiff header **50**. The chiff header proceeds to chiff filters **51** and **52** each of which may consist of one or more filters as required to shape the square wave output of the tone generators to have a sound appropriate for chiff. The chiff filters are connected in parallel to an output circuit appropriate for an organ and including, usually, amplifiers and one or more loud speakers. The note gates which are identified as **40**, **54**, **45** and **49** are connected to a further tone bus **60**, which in turn proceeds to tone color filters **61**, **62**, appropriate to the organ in question, the tone color filters **61**, **62** being connected in parallel to the output source **53**.

The system of FIGURE 3 generally duplicates the

system of FIGURE 2 except in that the system of FIGURE 3 includes noise sources **70**, **71** and chiff oscillators in addition to note oscillators. **70** and **71** represent noise sources and **72**, **73** represent chiff tone sources, and **13**, **14** note tone sources. Sources **72**, **73** in the system of FIGURE 3 are not note tone oscillators, but are auxiliary to the note oscillators. Resistors **75**, **76** serve to combine the outputs of the signal sources as **70**, **72** into gate **47**. The inclusion of separate chiff oscillators **72**, **73** renders possible the improvement of chiff effects by specifically designing the oscillators **72**, **73** for their intended purpose in terms of tonal components and basic frequency. It may occur, in the case of an organ of the type illustrated in FIGURE 2, that no available tone generator can provide a chiff frequency. Such a difficulty cannot occur in the system of FIGURE 3.

It occurs, in systems such as those in FIGURES 1 and 2, that for the higher tones of the organ, no still higher tones are available from which chiff can be derived. This problem may be solved in a practical organ as a compromise measure, by utilizing relatively low chiff frequencies, i.e. instead of using tones 29 semi-tones above the main tone as a chiff source, lower frequency oscillators are employed for the purpose or chiff is omitted for high notes for which appropriate generator frequencies are not available. Moreover, two tone oscillators may be associated with the chiff signal oscillator, so that the chiff frequencies for two adjacent notes are the same. Of course, in such a system additional chiff oscillators may be provided as tone oscillators become unavailable for the high frequency notes, but as a practical matter, at the high frequency end of the scale frequency pitch discrimination becomes poor and the fact that the chiff is not approximately 5½ times the frequency of the main tone, as it should be, or is omitted entirely, becomes of no great importance. The noise generators **70**, **71** are supplied with power from the line **76***a* which may be provided with a switch **77** in order to disable the noise sources at will, so that the chiff generated by the system of FIGURE 3 includes or excludes noise, at will. By the same token, if switch **78** is opened the chiff will consist of noise alone, without chiff tone.

In the gating circuit of FIGURE 4, a source of negative D.C. voltage **110** (−100 v.) is connected in series with a switch **111**, three resistances **112**, **113**, **114** (330K each), and the control point **115** of a diode gate **116**. The junction of resistances **113**, **114** is connected to ground through a capacitor **117**. The diode gate **116** utilizes two diodes, **118** and **119**, having their cathodes connected to control point **115**. Square wave tone signals **120** (±½ v.) are applied to the terminal **121**, connected to the anode of diode **118**. A small output resistance **122** is connected between the anode of diode **119** and ground. **123** is an output lead for deriving voltage existing across output resistance **122**.

On closure of switch **111**, negative voltage builds up approximately exponentially (assuming only the portion of the circuitry of FIGURE 4 hereinabove specifically described) across capacitor **117** That voltage appears at control point **115**, minus any drop occurring in resistance **114**, and gradually biases gate **116** on, so that a replica of signal **120**, of gradually increasing amplitude, flows through output resistance **122**, and becomes available on output lead **123**.

Connected between ground and the junction **125** of resistances **112** and **113** seriatim are a diode **127**, a capacitor **128** and a capacitor **129**, the cathode of diode **127** being connected directly to point **125**. On closure of switch **111** the capacitors **128**, **129** charge exponentially through diode **127** and resistance **112**. The new voltage applied to the circuit of capacitor **117** is thus more complex than was above indicated for the simple case, in that the voltage as seen by capacitor **117** is exponential, on closure of switch **111** applied. The rise of voltage at control point **115** is thus only approximately exponential.

Nevertheless this voltage increases from zero to some negative value, which, for the circuit value recited is near —30 v.

The signal wave **120**, having excursions from +½ v. to —½ v. renders the diodes **118**, **119** alternately conductive to the voltage at control point **115**, so that A.C. output current flows in small output resistance **122**, which is a replica in respect to waveform of the signal **120**, but the amplitude of which derives from the varying control voltage at control point **115** and hence proceeds as a function of time from 0 v. to some maximum value perhaps .05 volt.

A relatively high resistance, **130**, is connected at one terminal to the junction **131** of capacitors **128**, **129**, and at its other terminal to the slider **132** of a potentiometer resistance **133**, connected between a positive voltage terminal **134** (+100 v.) and ground. Connected between junction point **131** and ground is a diode **135**, conductive to positive voltage. From junction point **131**, a resistance **136** (330K) extends to control point **137** of diode gate **138**, which duplicates the gate **116**. The diode **135** clamps point **131** to ground potential, in response to application of positive potential, but permits point **131** to go negative.

As long as switch **111** is open, then, control point **137** is at ground potential and any input signal **140**, or **141** (which are applied selectively), cannot control current flow through the gate **138**. The signal **140** may be assumed to be a replica, except for frequency, of signal **120**, i.e. to be a square wave of ±½ v. amplitude. The diodes of gate **138** are denominated **143**, **144**, its output resistance **145**, and its output lead **146**.

When switch **111** is closed, an exponentially decreasing current flows from ground, through capacitors **129**, **128**, diode **127**, resistance **112**, and switch **111** to terminal **110**. Because this current is initially greater than the current from slider **132** into resistor **130**, the diode **135** ceases conduction, since its anode goes negative, and capacitor **129** charges, with the voltage at point **131** proceeding in a negative sense. As the current through the branch containing capacitor **128** decreases, the charge rate on capacitor **129** also decreases until the time when the two opposing currents are equal. At this time, the charging of capacitor **129** stops and the maximum negative voltage appears across capacitor **129**. After this time, the current flowing into capacitor **129** from resistor **130** is greater than the current flowing out of capacitor **129** into capacitor **128**, hence capacitor **129** begins to lose its previously acquired negative charge and the voltage at point **131** proceeds back toward zero. When the voltage at point **131** reaches zero and tends to go positive, diode **135** conducts, which reduces the current to capacitor **129** to zero and the voltage at **131** remains clamped at zero.

The peak value and time duration of the voltage pulse occurring at point **131** depends on the current flowing through resistor **130** and may be varied by changing the voltage at slider **132**. Because the voltage at point **131** controls the level of signal passed by gate **138**, variation in the voltage at slider **132** may be used to affect the amplitude and duration of the signal passed by gate **138**. Typically 100 volts at slider **132** is capable of rendering gate **138** inoperative when key **111** is closed, thus giving no chiff effect. Reduction of the voltage at slider **132** to 50 volts provides a gating wave suitable for producing chiff effects in musical passages where the chiff producing register is used alone, i.e. without other tone colors. By further reducing the voltage at slider **132** to 25 volts, chiff of greater amplitude and longer duration is produced which is audible when other registers of the electronic organ are used together with the chiff producing register.

The charging currents which generate the chiff gating wave, are illustrated in FIGURE 5, wherein curve A shows the negative charging current into capacitor **128**, due to the voltage at terminal **110**. On closure of switch **111**, to a first approximation, only resistance **112** limits charging current. Hence the initial value of current is 100/330K; and the current decays exponentially to zero. The charging current for capacitor **129** is shown at B. When switch **111** is closed, negative current to capacitor **129** immediately assumes a value less than that into capacitor **128**, partly because of resistive paths around the capacitor, i.e., **130**, **133**, but primarily because capacitor **129** is subjected to positive current flow through resistance **130** (see curve C). In due time, i.e. at point E, these two current flows, one negative and the other positive, are equal, and net flow is zero.

Voltage at this time, at point **131**, is negative. Current into capacitor **129** then flows in an opposite sense at an increasing rate until point **131** attains zero potential. At the point F, zero potential at point **131** has been reached at which time the diode **135** clamps to ground, reducing not only the current into capacitor **129** to zero, but also the voltage across it.

Current in diode **135**, indicated at G, equals zero so long as point **131** is at negative potential, but increases rapidly when point **131** clamps, to pass the current then proceeding to capacitor **129**. The diode thus presents an alternate or shunt path for charging current. Diode current then continues to increase so long as charging current into capacitor **128** continues, which is for a considerable time. This occurs because capacitor **128** robs diode **135** of current through resistor **130**. When the circuit becomes completely quiescent, current through diode **135** equals the voltage at point **132** divided by 560K.

The diode **127** is required in order to isolate the capacitor **128** from the capacitor **117**. The latter is at —30 v. in a typical circuit while the capacitor **128**, at point **150**, is at about —60 v. Diode **127** blocks a discharge path from capacitor **128** into capacitor **117**, when key **111** is released, and requires capacitor **128** to discharge via resistance **147**. The capacitor **117** is required to discharge through resistance **114**. The diode **127** presents no path for current from capacitor **117**, because its anode is biased by the —60 v. at point **150**. Each of capacitors **128**, **117** thus discharges through a path of minimum resistance, i.e. 680K for capacitor **128** and 330K for capacitor **117**. Economies are effected in the system of FIGURE 1, by utilizing each gate for both tone and chiff frequency, where these are the same, by applying to the gate simultaneously both a chiff keying signal and a note keying signal. This can be simply accomplished by connecting to the point **137** of the chiff gate **138** the resistance **114'**, from a note keying circuit, where resistance **114'** corresponds with resistance **114** in FIGURE 4, but derives from another keying wave generator. This expedient permits reduction in number of gates and in number of connections from oscillators to gate.

The pitch interval between a note and its chiff is preferably twenty-nine semi-tones. Thus in an organ of 61 keys, taken for example, the lowest twenty-nine gates, pertaining to notes 1–29, where note 1 is the note of lowest pitch in the organ, will have only one input since they do not provide chiff for other notes. The next thirty-two gates will each receive two inputs, in the system of FIGURE 1, one pertaining to note and one to chiff. This may be accomplished as illustrated in FIGURE 4, where resistances **136** and **114'** carry the keying waves required to gate **138**.

To complete the system, gates **138** and sources **140** for the highest 29 keys remain to be provided. In a practical organ the sources **140** may be taken from the generators used for the higher pitched tone colors. This will provide 24 of the required sources **140** if the organ possesses a 2 foot stop, assuming the basic register having the chiff effect is an 8 foot stop. The remaining five sources must be added or else the chiff effect may be eliminated from the five highest keys. An alternate solution to this problem is to double up on the frequencies used for the chiff effect at these high frequencies, since the ear cannot read-

ily discriminate at this pitch. This may conveniently be done by providing 24 gates, the lower nineteen of which operate in the circuit already shown. Each of the remaining five gates are used in a circuit controlled by two note keys, i.e. two keys control a single chiff gate, the gates being modified for the purpose as in FIGURE 6. So the keys for notes #60 and #61 may control a chiff gating circuit for oscillator #85, etc. The circuitry is explained in conjunction with FIGURE 6.

In the system of FIGURE 6 three gates, as in FIGURE 4, are controlled by two switches **150**, **151**, connected to a single negative lead **110**. The relation of the keying circuits of FIGURE 6 is made clear by utilizing identical reference numbers for identical parts in the system of FIGURES 4 and 6, and priming the components added by FIGURE 6. The system of FIGURE 6 accordingly provides keying signal at terminals **115**, **138** if switch **150** is closed, at terminals **115'**, **138**, if switch **151** is closed, and at all three terminals **115**, **138**, **115'** if both switches **150** and **151** are closed simultaneously.

Modifications may be made in the invention without departing from the spirit of it. The invention having been described in certain exemplary embodiments, what is claimed as new and desired to be secured by Letters Patent is:

1. In an electronic organ, a gamut of tone sources, said tone sources constituting continuously running oscillators, an output device, gates associated with each of said sources for gating said tones from said sources to said output device, a keying circuit connected to each of said gates, a key switch associated with each of said keying circuits, each of said keying circuits generating paired gating waves on closure of the associated key switch, one of said gating waves having a shape appropriate to gradual build up of an organ tone, the other of said gating waves having a wave shape appropriate to a chiff component of a tone and means for applying the one of said gating waves to a gate associated with a tone oscillator having a predetermined pitch and the other of said gating waves simultaneousy to a gate associated with a tone oscillator of pitch suitable for providing chiff component for said predetermined pitch.

2. In an electronic organ, a gamut of continuously running oscillators arranged in frequency according to a musical scale, a chiff gate in cascade with each of a plurality of said oscillators, a note gate in cascade with each oscillator, an array of key switches, a keying circuit for each key switch and responsive to closure of the key switch for generating both a chiff gating wave and a note gating wave, and means applying the note gating waves to the note gates, respectively, and the chiff gating waves to preselected one of said chiff gates selected always to provide chiff from one of said oscillators and tone from a different oscillator paired with said one of said oscillators and selected to provide a suitable chiff component for said one of said oscillators.

3. The combination according to claim **2** and wherein said chiff oscillator for each note is approximately twenty-nine semi-tones in frequency above the note oscillator.

4. In an electronic organ, a first continuously running note oscillator of first pitch, a second continuously running note oscillator of different pitch, a D.C. voltage source, a key switch, a keying circuit, means responsive to closure of said key switch for connecting said D.C. voltage source to said keying circuit, said keying circuit including means for generating a first wave form appropriate to organ note envelopes and a second wave form appropriate to chiff wave envelopes in response to application thereto of said D.C. voltage, a first gate in cascade with said first note oscillator, a second gate in cascade with said second note oscillator, and means simultaneously applying said first wave form in keying relation to said first gate and said second wave form in keying relation to said second gate.

5. The combination according to claim **4** wherein is provided a third gate in cascade with said second note oscillator, a further key switch, a further keying circuit, means responsive to closure of said further key switch for applying said D.C. voltage to said further keying circuit, said further keying circuit including means for generating a further wave form appropriate to organ note envelopes in response to application thereto of said D.C. voltage, and means applying said further wave form to said third gate.

6. An electronic organ having a gamut of continuously running note oscillators arranged in respect to pitch according to a musical scale, a single key switching having only two contacts, means responsive to closure of said key switch for deriving from one of said oscillators a signal representing a musical note having no chiff and from another of said oscillators a chiff component of said musical note, and means combining said signal and said chiff component to form a musical note having a chiff component.

7. A keying circuit, including a gate having a control point, a source of negative D.C. voltage, a switch, and series resistances, all connected in series to the control point of said gate, a capacitor connected between a first point junction of said resistances and ground, a diode having its cathode connected to another junction point of said resistances, additional capacitors connected in series between the anode of said diode and ground, a relatively high resistance connecting said anode to ground, a source of positive D.C. voltage, a resistance connecting said source of positive D.C. voltage to a junction of said additional capacitors, a further diode for clamping said junction of said additional capacitors to ground, said further diode having its cathode directly connected to ground, a further gate, and a resistance connecting the anode of said further diode to a control point of said further gate.

8. In combination, a capacitor having one terminal connected to a reference point, a source of positive current, a resistance in series between said source and the other terminal of said capacitor, a source of negative current connected to the other terminal of said capacitor, said source of negative current having a value decreasing as a function of time to an absolute value lower than the absolute value of said positive current from an absolute value higher than the absolute value of said positive current, and a diode clamp shunted across said capacitor, said diode clamp having its cathode connected directly to said reference point.

9. The combination according to claim **8** wherein is further provided a further capacitor and a diode connected in series between said other terminal of said capacitor and said source of negative current, said diode being conductive in a forward direction to said source of negative current.

10. The unit according to claim **9** wherein is provided another capacitor having one terminal connected to said point of reference potential and its other terminal connected to said source of negative current, and additional resistances connecting said terminals of said another capacitor to the anode and cathode of said diode, respectively.

11. In an electronic organ, a gamut of tone sources, said tone sources constituting continuously running oscillators, an output device, gates associated with each of said sources for gating said tones from said sources to said output device, a keying circuit connected to each of said gates, a key switch associated with each of said keying circuits, each of said keying circuits generating paired gating waves on closure of the associated key switch, one of said gating waves having a shape appropriate to gradual buildup of an organ tone, the other of said gating waves having a wave shape appropriate to a chiff component of a tone and means for applying the one of said gating waves to a gate associated with a tone oscillator having a predetermined pitch and the other of said gating waves

simultaneously to a gate associated with a tone oscillator of pitch suitable for providing chiff component for said predetermined pitch, wherein said gating wave having a wave shape appropriate to a chiff component of a tone build up more rapidly than build up of said gating wave having a shape appropriate to gradual build up of an organ tone, said last mentioned wave shapes having overlapping regions.

12. The combination according to claim 11 wherein is provided two separate buses, and means coupling chiff components only to one of said buses and tone components only to the other of said buses.

13. An electronic organ, having a gamut of continuously running square wave tone oscillators tuned according to the musical scale for providing tone components,
a gamut of continuously running chiff oscillators, each at a frequency appropriate to provision of a chiff component for one of said tone components and having a wave shape appropriate to chiff sounds,
a plurality of noise sources,
separate voltage supply buses for said chiff and tone oscillators and for said noise sources,
means disabling either of said supply buses at will,
an array of chiff gates and noise gates,
an array of tone gates,
an array of key switches, and
means responsive to each of said key switches for concurrently rendering conductive one of said tone gates and the appropriate one of said chiff and noise gates.

14. The combination according to claim 13 wherein is provided a tone header and a chiff and noise header,
means connecting all said tone gates to said tone header,
means connecting all said chiff and noise gates to said chiff and noise header.

15. An electronic organ having,
a gamut of continuously running tone oscillators tuned according to the musical scale to provide tone components,
a gamut of continuously running chiff oscillators arranged each to provide a chiff component for one of said tone components,
a chiff gate connected in cascade with each of said chiff oscillators,
a tone gate in cascade with each of said tone oscillators,
a source of keying voltage,
key operated means for applying said keying voltage concurrently to render conductive at will one of said tone gates and that one of said chiff gates selected to provide a chiff component for the tone component passed by said one of said tone gates.

16. The combination according to claim 15 wherein is provided a tone bus connected to only to all said tone gates and a chiff bus connected only to all said chiff gates.

17. The combination according to claim 15 wherein is provided a noise source associated with each of said chiff oscillators,
means connecting each of said chiff gates in cascade with one of said noise sources.

18. The combination according to claim 17 wherein is provided means for at will disabling all said noise sources without disabling said tone and chiff oscillators.

19. The combination according to claim 17 wherein is provided means for at will disabling all said chiff oscillators without disabling said noise sources.

20. An electronic organ having
a gamut of continuously running note oscillators arranged in pitch according to a musical scale,
a source of keying voltage,
a plurality of chiff oscillators,
a separate chiff gate connected in cascade with each of said chiff oscillators,
a separate note gate connected in cascade with each of said note oscillators,
said note gates each including means for developing a note signal of relatively slow rise and relatively slow decay in response immediately to application and removal of a keying voltage, respectively,
said chiff gates each including means responsive immediately to application of said keying voltage for developing a chiff signal of relatively rapid rise to a peak value followed by immediate fall to a zero value.

21. The combination according to claim 20 wherein said note gates each includes
a solid state normally non-conductive diode gating circuit connected in series between one of said note oscillators and a load,
wherein said chiff gates each includes a solid state diode normally non-conductive gating circuit in series between one of said chiff oscillators and a load.

22. The combination according to claim 21, wherein said chiff gating circuits each further includes,
a capacitor having one terminal connected to a reference point,
a first source of current of one polarity,
a resistance in series between said source and the other terminal of said capacitor,
a second source of current of polarity opposite to said one polarity connected to the other terminal of said capacitor,
said second source of current having a value decreasing as a function of time to an absolute value lower than the absolute value of said current of one polarity from an absolute value higher than the absolute value of said current of one polarity, and
a diode clamp shunted across said capacitor,
said diode having an electrode connected directly to said reference point.

23. The combination according to claim 1 wherein the said gates have each a control point,
a source of negative D.C. voltage,
a plurality of resistors,
a circuit including one of said key switches and said plurality of resistors all connected in series between said source of negative D.C. voltage and said control point,
a capacitor connected between a first junction point of said resistors and ground,
a diode having its cathode connected to another junction point of said resistors,
additional capacitors,
said additional capacitors being connected in series between the anode of said diode and ground,
an additional resistor whose resistance is high as compared with any of said plurality of resistors,
said additional resistor connecting said anode to ground,
a source of positive D.C. voltage,
a further resistor connecting said source of positive D.C. voltage to a junction of said additional capacitors,
a further diode for clamping said junction of said additional capacitors to ground and having its cathode connected to ground,
a circuit including another further resistor connecting said junction of said additional capacitors to a control point of the second mentioned of said gates.

24. The combination according to claim 2, wherein the keying circuit for each key switch includes a first circuit which actuates the control point of the associated one of said note gates,
a second circuit which is controlled by the energization of said first circuit and actuates the control point of the associated one of said chiff gates, and
wherein said first circuit comprises a plurality of resistors, a source of negative D.C. voltage and said key switch all connected in series to said control point of said note gate,
a capacitor,
said capacitor being connected between a junction point of said resistors and ground,

a diode,

the cathode of said diode being connected to another junction point of said resistors,

an additional resistor whose resistance is high compared to any of said plurality of resistors,

the anode of said diode being connected to ground through said additional resistor.

25. The combination according to claim **24** wherein said second circuit comprises a second plurality of resistors,

a source of positive D.C. voltage,

said second plurality of resistors being connected in series between the control point of said chiff gate and said positive D.C. source,

a second capacitor connected between a junction of said second plurality of resistors and said anode of said diode,

a third capacitor connected between said junction of said second plurality of resistors and ground and a second diode,

said second diode clamping said junction of said second plurality of resistors to ground and having its cathode connected to ground.

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