May 24, 1966 C. R. WOLFANGER 3,253,078

CHORUS CONTROL FOR ELECTRIC ORGANS

Filed June 19, 1963 4 Sheets-Sheet 1

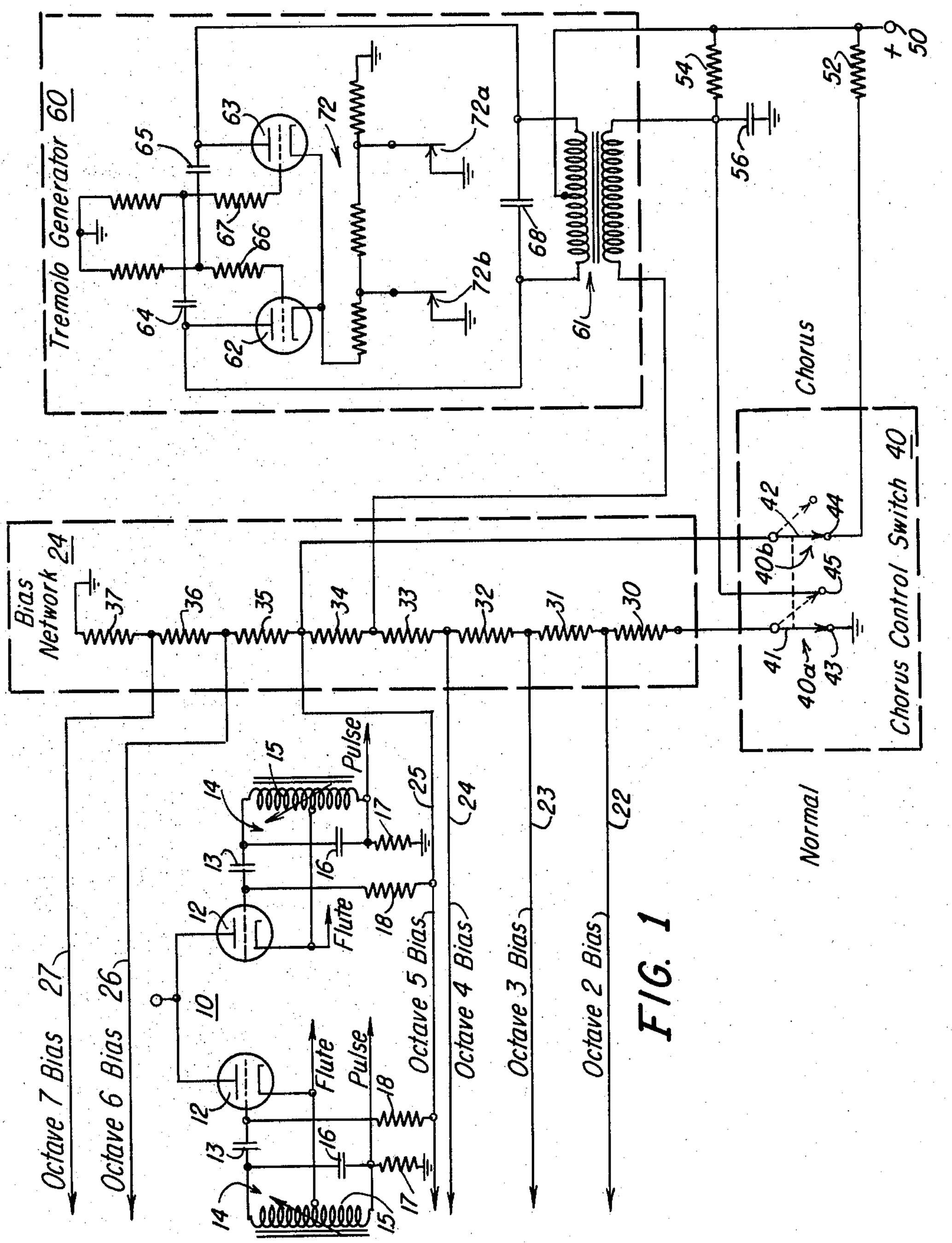

FIG. 1

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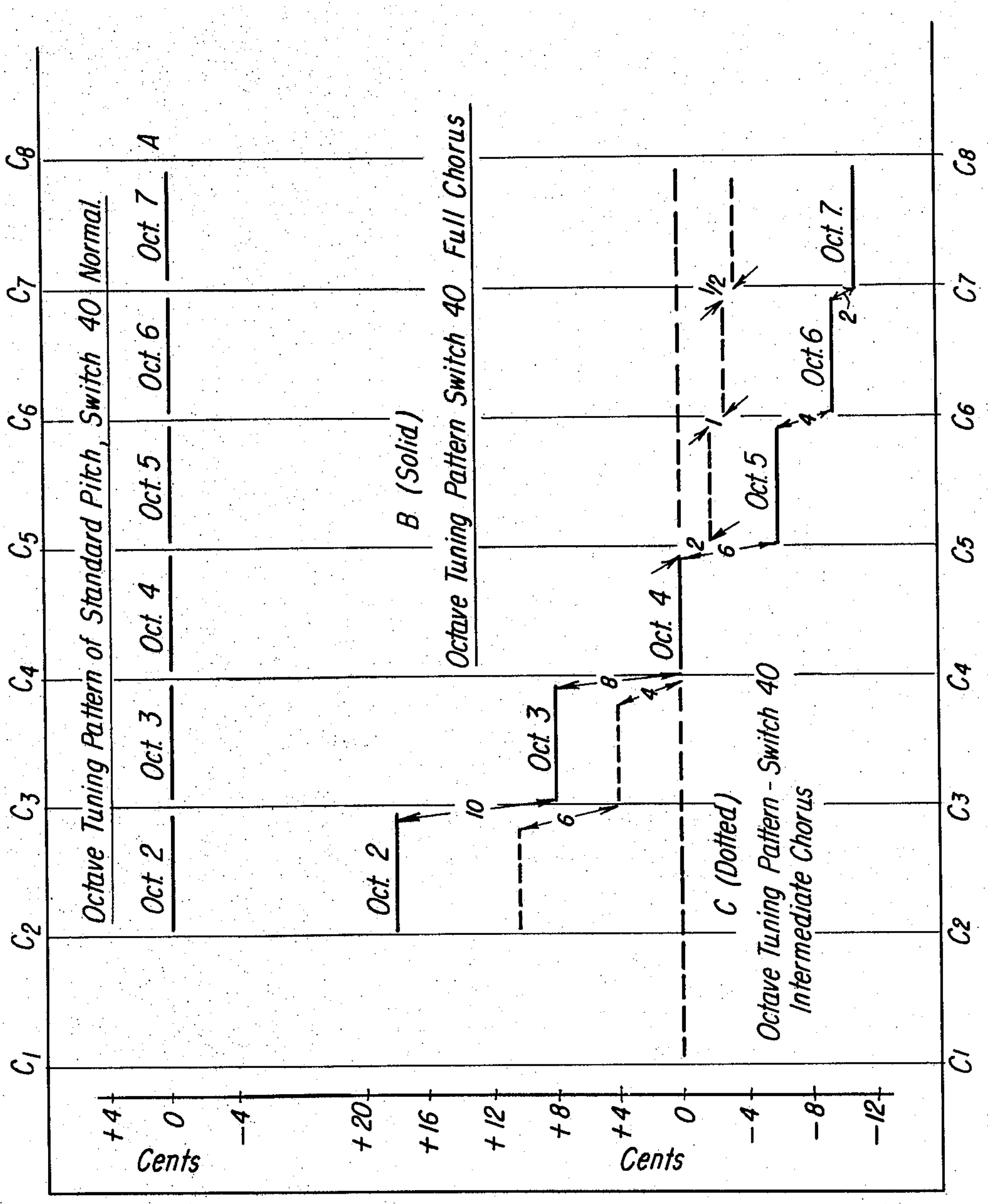

FIG. 2

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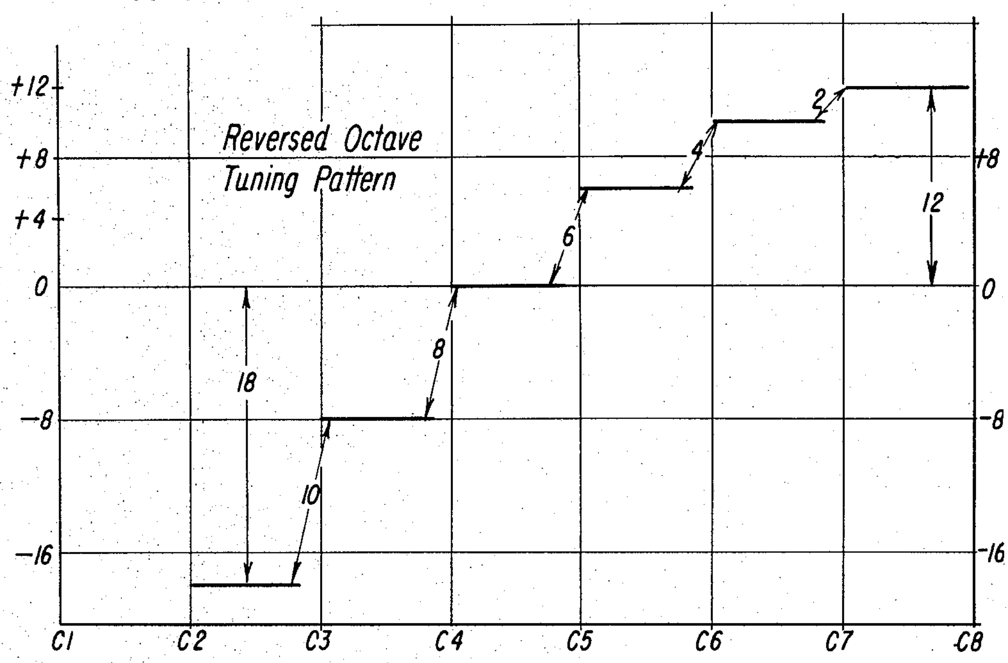
FIG. 3



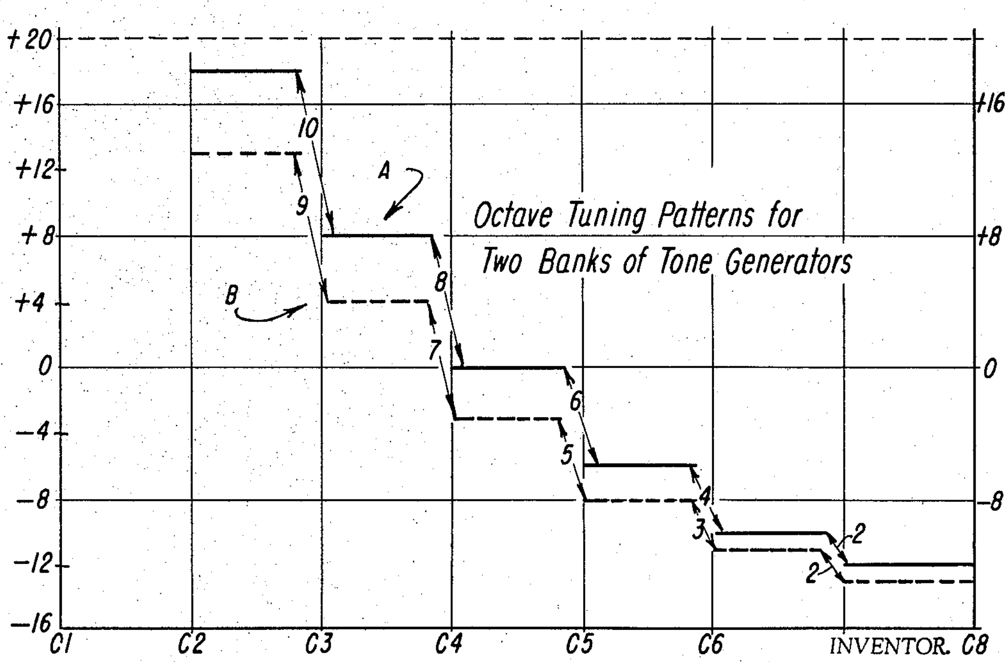


FIG. 7

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CHORUS CONTROL FOR ELECTRIC ORGANS

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FIG. 4

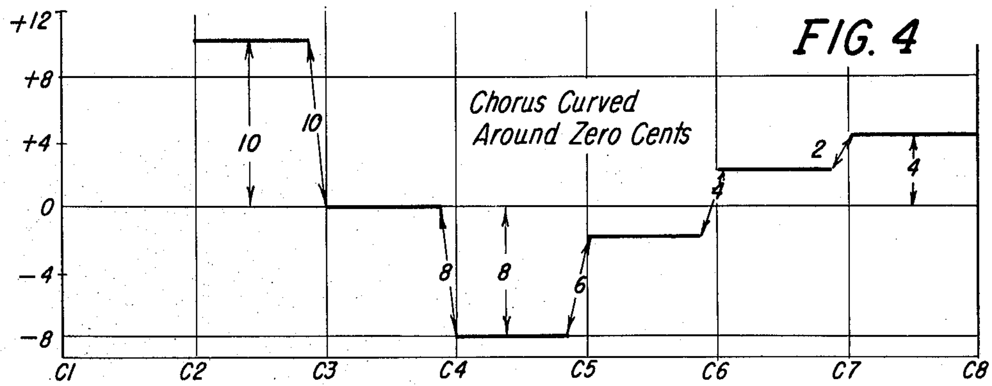


FIG. 5

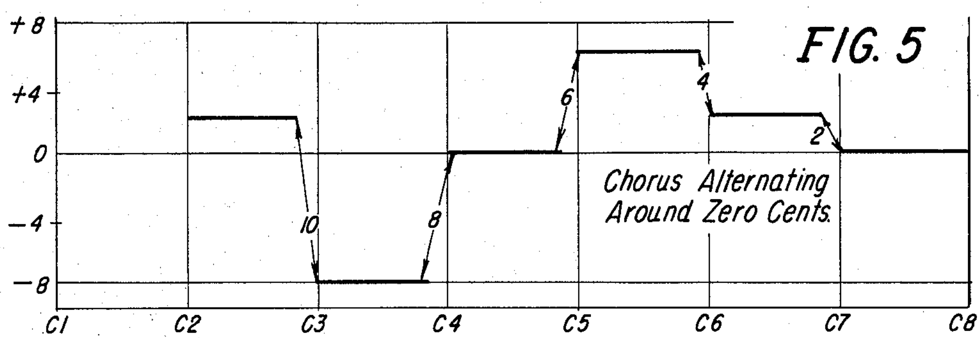
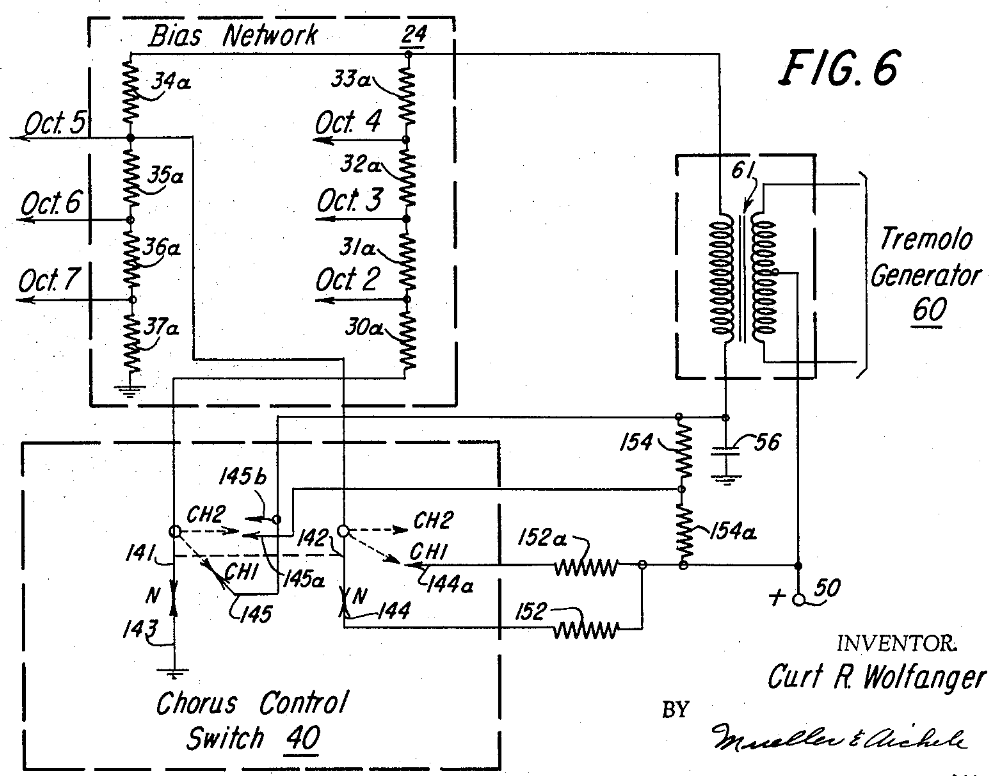


FIG. 6



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CHORUS CONTROL FOR ELECTRIC ORGANS

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14 Claims. (Cl. 84—1.24)

This invention relates generally to musical instruments and more particularly to methods and apparatus for creating a chorus effect in the tones generated by electronic, electric, and related types of organs having independent tone sources.

Many organs and similar musical instruments are provided with individual tone sources, such as tone generators or oscillators, which are selectively tuned to different frequencies corresponding to a series of musical notes over several octaves of a musical scale. Although each tone source may be precisely tuned to a selected frequency of the scale, this results in an overly pure, lifeless sound that is objectionable to many listeners. To add warmth, it is desirable to create a chorus effect by introducing mild beats when certain notes and chords are played at two or more pitches, as, for example, by detuning the tone generators so that some notes will be slightly sharp, others slightly flat, with still others remaining unchanged. Although this chorus effect can be created to a limited degree by reducing the stability of the tone sources and allowing the frequency to drift in a somewhat random manner, or by attempting to detune individual ones of the tone sources in a random fashion, the results are less than satisfactory. In the particular instance of organs utilizing electronic oscillators or generators as tone sources, considerations of circuit complexity, space and economics make it desirable to use a single or double bank of tone generators so that the notes for a number of stops are obtained from the same number of tone generators. Accordingly, there is a limited number of random beats which may occur, and without a large number of tone generators the randomly occurring beats produced by such techniques will not obtain full richness on certain notes and chords, may be missing on others, and even objectionable on still others.

It is therefore among the objects of the present invention to provide simple and economical means for creating a full chorus effect in organs and related musical instruments having a limited number of tone sources.

Another object is to provide a method of producing beats by octave detuning according to a predetermined schedule to create a desirable chorus effect in musical instruments such as organs and the like.

A further object is to provide, in an electronic organ utilizing a limited number of independent tone generators, simple and practical means for providing a full chorus effect.

Still another object is to provide, in an electronic organ having a limited number of independent tone generators, economical and conveniently operable circuit means to produce a full richness in tone when notes and chords are played at two or more pitches.

A feature of the present invention is the provision, in an electric organ utilizing a limited number of individual tone sources, of apparatus for shifting the frequency of the tone sources of each octave by a predetermined amount relative to a standard pitch to result in a desirable chorus effect.

Another feature is the provision of the method of creating a full chorus effect in an organ utilizing a limited number of independent tone sources by shifting the tuning of the tone sources of each octave a differing degree in in relation to the tuning of other octaves according to a predetermined tuning pattern.

A further feature is the provision of an electric organ

having individual electronic tone generators for each note of a musical scale, and of a switching arrangement for changing a circuit parameter determinative of the tuning of the tone generators in each octave in a prescribed manner, thereby producing octave detuning to create a full chorus effect.

Still another feature is the provision, in an electronic organ having a single bank of independent tone generators, of a simple and conveniently operable circuit including a switching arrangement which functions to change a biasing voltage supplied to individual tone generators so that selected octaves may be detuned either sharp or flat by a predetermined amount, which amount differs for each octave of the musical scale.

Further objects, features and attending advantages of the invention will become apparent from the following description when taken in conjunction with the accompanying drawings, in which:

FIG. 1 is a schematic diagram illustrating the manner in which the invention is incorporated in an electronic organ;

FIGS. 2–5 and 7 are representative octave detuning patterns useful in understanding the manner in which the invention creates a desirable full chorus effect; and

FIG. 6 is a schematic diagram illustrating an additional way in which the invention may be incorporated in an electronic organ.

In practicing the invention there is provided an organ having a plurality of individual tone sources to produce the notes of a musical scale. The number of tone sources is limited such that although the tones for a given stop on the organ are derived from separate sources, each stop derives tones from the same set of sources. Although the tone sources may include electrical, electronic, electromechanical and mechanical tone generators, in the preferred instance of electronic organs each tone generator includes an electronic oscillator having oscillation sustaining means such as a vacuum tube or transistor coupled with a frequency determining circuit such as a tuned parallel resonant circuit. The frequency of each tone generator is changeable within limits by varying an electrical parameter of the oscillator circuit, such as, for example, by changing a biasing voltage of the vacuum tube or transistor to result in a shift in impedance of the resonant circuit.

The tone generators are arranged so that selected groupings are provided with a common variable parameter for determining their frequency such that each grouping produces an octave of notes of the musical scale. In this manner, several groupings provide a range of octaves, with the tone generators of each octave evenly tuned to a standard pitch of the musical scale. To create a full chorus effect means are provided to change the electrical parameter provided for each octave of tone generators a selected amount, thereby detuning each octave relative to every other octave according to a predetermined schedule. Thus, some octaves are tuned sharp and others are tuned flat, each by differing amounts, with all notes of an octave either being detuned by the same amount or being detuned in fixed increments relative to a standard pitch.

In the accompanying drawings the invention is set forth with particularity for an electronic organ utilizing vacuum tube triode oscillators as tone generators, and with the tone generators of each octave receiving a biasing voltage from a voltage divider according to a predetermined arrangement. An example of one such organ is the model 630 produced by C. G. Conn, Ltd., Elkhart, Indiana, and in circuit detail forms no part of the invention. It is to be understood that other types of tone generators may be used, such as those employing transistors, and that other electrical parameters may be varied to provide the octave detuning which creates the full chorus effect, such as providing voltage or current sensitive impedance elements in the tuned circuit of the oscillator circuit of the tone generators, by varying the core of a tuning inductor or by adding and removing circuit components to the oscillator tuned circuit by a switching arrangement. And although set forth in terms of detuning entire octaves, each octave may be broken down into smaller increments as, for example, providing one-half octave detuning.

The system shown schematically in FIG. 1 illustrates circuit means for supplying bias voltage to several octaves of tone generators of an electric organ. Vacuum tube oscillator circuits **10** represent two of several tone generators which may be included in an octave, each of which are of identical circuit configuration. Triode **12** has its grid electrode coupled through capacitor **13** to tuned parallel resonant circuit **14**. Tuned circuit **14** includes tuning inductor **15** connected in parallel with capacitor **16**. Tuning inductor **15** of the resonant circuit is center tapped and the tap point is connected to the cathode of triode **12** to thereby provide a Hartly oscillator circuit. Inductor **15** is tunable so that the tone generator may be tuned to a predetermined frequency for a given D.C. bias on the grid electrode of triode **12**. The grid electrode of triode **12** is further connected by resistor **18** to octave bias bus **25**. Resistor **18** is high valued to provide circuit isolation and the voltage thereby supplied to the grid of triode **12**, in conjunction with the setting of coil **15**, establishes the frequency at which the tone generator oscillates. To detune the tone generator sharp or flat from a given pitch a change in bias voltage supplied to the grid electrode of triode **12** produces a phase shift in the signal coupled to tuned circuit **14** by capacitor **13**.

A sine wave, or flute tone, is derived from the cathode of triode **12**. A pulse tone is developed across resistor **17**, connected between one side of tuned circuit **14** and ground reference potential. The pulse tone is high in harmonic content to produce string-like sounds. Both the flute and pulse outputs of the tone generator are coupled by key switches for processing in the organ in a known manner. In a practical construction, two triodes may be enclosed in a single vacuum envelope to provide two oscillators, as shown. It is to be understood that a number of additional oscillators may be provided for coupling to octave bias bus **25** by an isolating resistor **18** to provide tone generators for the notes C5–B5, making up octave **5** of the organ. In a similar manner, further groups of oscillators may be provided with the grid electrode of the triode **12** connected by resistor **18** to bias busses **22** to **27** to provide octaves **2–7** in a completed organ.

Bias voltage for each octave bias bus is obtained from bias network **24**. This network includes a voltage dividing network comprised of resistors **30** through **37**, connected in a series string. Octave bias busses **22–27** are connected to the junction points of selective ones of resistors **30–37** to thereby distribute the desired bias voltage to the tone generators of each octave. One end of resistor **30**, which constitutes one end of the series voltage dividing string, is connected to the movable contact **41** of pole **40*a*** of double pole, double throw bias control switch **40**. Fixed contact **43** of switch pole **40*a*** is connected to ground reference potential. One end of resistor **37**, which constitutes the other end of the series string of voltage dividing resistors, is connected to ground reference potential. The movable contact **42** of pole **40*b*** of chorus control switch **40** is connected to the junction point between resistors **34** and **35** of the voltage dividing string. This is also the point to which octave bias bus **25** is connected to provide bias for the tone generators of octave **5**.

Direct current potential for the bias network **24** is supplied at terminal **50**. This terminal is also connected by resistor **52** to the fixed contact **44** of pole **40*b*** of chorus control switch **40**. A second fixed contact **45** of pole **40*a*** of chorus control switch **40** is connected by resistor **54** to terminal **50**. The common point between resistor **54** and fixed terminal **45** of chorus control switch **40** is connected through the secondary winding of transformer **61** of tremolo generator **60** to the junction point between resistors **33** and **34** of bias network **24**. Terminal **45** is further bypassed to ground reference potential by capacitor **56**.

Tremolo generator **60** includes triodes **62** and **63** cross coupled by capacitors **64** and **65** and resistors **66** and **67** to provide a push-pull oscillator circuit. The primary winding of transformer **61** is connected between the anode electrodes of triodes **62** and **63**, and shunted by capacitor **68** to provide a tuned circuit that develops an oscillating signal in the frequency range from approximately 5.7 to 7.2 cycles per second. This signal, when coupled to the secondary winding of transformer **61**, provides an A.C. modulation superimposed upon the octave bias voltages developed by bias network **24**. When supplied to the grid electrodes of individual tone generators, this A.C. modulation causes their frequency to vary around an established center value to produce a tremolo effect. The magnitude of this tremolo voltage may be controlled by switches **70*a*–70*b*** which are operable to shunt portions of cathode resistor **72** for triodes **62** and **63** to ground reference potential. When both are closed, as shown, oscillations cease, while successively opening switches **70*a*–70*b*** provides a higher valued cathode resistance that results in an increased amplitude of tremolo oscillations.

Chorus control switch **40** is shown in its NORMAL position, that is, in a position in which the chorus effect is not created in the organ. In this position a D.C. voltage path is supplied through resistor **52** and pole **40*b*** of switch **40** to the junction point between resistors **34** and **35**, and hence through resistors **35**, **36** and **37** to ground reference potential. A second D.C. voltage path is supplied through resistor **54** and the secondary winding of transformer **61** to the junction point between resistors **33** and **34**, and hence through resistors **33**, **32**, **31**, **30** and a pole **40*a*** of switch **40** to ground reference potential. The voltages developed across the voltage dividing resistors **30–37** in bias network **24**, when supplied with a D.C. potential in this manner, provides a bias voltage on each of octave bias busses **20–25** which tunes the tone generators for each octave of the organ on pitch. It is to be noted that with switch **40** in its NORMAL position the organ may be tuned by standard techniques. Chorus control switch **40** may be conveniently located on a stop tablet of the organ to allow the organist to use the chorus effect at his option or to play the organ as tuned in the standard manner.

When chorus control switch **40** is moved to its CHORUS position, pole **40*b*** is opened and voltage is removed from the junction point between resistors **34** and **35**. Concurrently pole **40*a*** is opened so that resistor **30** is disconnected from ground reference potential and connected instead to fixed contact **45**. The D.C. potential at terminal **50** is supplied through resistor **54** and hence through the series string of resistors **30–37** to ground reference potential. The connection through secondary winding **61** to the junction point between resistors **33** and **34** remains unchanged. Thus, with switches **40** in CHORUS position the voltages on octave bias busses **22–24** increase, tuning octaves **2** and **3** sharp, while the voltage on octave bias busses **26** and **27** decreases, tuning octaves **5–7** flat. Octave **4** remains substantially unchanged. In addition, the higher octaves are tuned flat and progressively smaller increments while the lower octaves are turned sharp and progressively large increments.

In a practically constructed circuit patterned after the system of FIG. 1, the following component values were utilized:

Resistors 30, 31, 33, 37	ohms	2700
Resistors 32, 34	do	3300
Resistors 35, 36	do	2200
Resistor 52	do	39,000
Resistor 54	do	22,000
Capacitor 56	microfarads	50

When used in conjunction with 12AU7 dual triodes connected as tone generators in the manner shown in FIG. 1, and with a 75 v. D.C. potential supplied to terminal **50**, the following changes in biasing voltages appearing on octave bias busses **22–27** were obtained:

Octave	Sw. 40 NORMAL (v. D.C.)	Sw. 40 CHORUS (v. D.C.)
2	2.5	12.2
3	5.8	11.2
4	10.3	11.3
5	12.2	7.0
6	7.9	4.5
7	4.4	2.3

It can be readily seen that the bias voltage for octave **4** increases only a slight amount, and there is no appreciable detuning of that octave. On the other hand, the bias voltage for octaves **2** and **3** increases in longer increments so that those octaves are detuned progressively sharp, while the bias voltage for octaves **5**, **6** and **7** decreases in smaller increments so that those octaves are detuned progressively flat.

FIG. 2 is a graph showing relative octave tuning patterns which may be obtained with a chorus control system of the above described type. The horizontal axis of the curves A and B is divided into octaves **2–7** such that octave **2** includes the tone generators for notes C2–B2, octave **3** for notes C3–B3, octave **4** notes C4–B4, octave **5** notes C5–B5, octave **6** notes C6–B6 and octave **7** notes C7–B7. The vertical axis represents deviation from standard tuning in cents. Standard tuning octave **4** contains A–440 c.p.s. at standard pitch. Curve A represents the tuning pattern with chorus control switch **40** in NORMAL position, and curve B represents the increments of detuning achieved when chorus control switch **40** is in CHORUS position.

The detuning of each octave in curve B is shown to be horizontal to represent average detuning for each octave for the purposes of illustration. However, since in a practical application the tone generators within an octave are operating at a different frequency while a fixed bias change is applied thereto. Thus, actual detuning curves will be somewhat slanted such that the lower notes in an octave are more sharp and the higher notes in an octave are more flat than the average shown. This tapering effect further prevents abrupt changes when moving from one octave to the next for a more natural effect. It is to be noted that octave **4** will remain substantially on pitch while lower octaves **2** and **3** are tuned sharp in progressively larger increments. Higher octaves **5**, **6** and **7**, on the other hand, are tuned flat from one another in progressively smaller increments. Each note in an octave is detuned almost an equal amount relative to other notes in the same octave, but a different amount relative to the notes of an adjacent octave. Thus, an approximately equally tempered scale is maintained while the chorus effect is being created.

Although the illustrated tuning pattern is one which produces particularly pleasant effects, other patterns may be obtained by adjusting the values for the resistors in bias network **24** and hence the change in bias voltage appearing on octave bias busses **22–27**. For example, emphasis of certain portions of the scale may be obtained by alternately detuning various octaves sharp or flat with respect to a selected octave that is tuned to standard pitch, or a sharper sound may be produced by reversal of the pattern shown in FIG. 2, such that higher octaves are tuned progressively more sharp and lower octaves are tuned progressively more flat. Reversal of tuning pattern such as that of FIG. 2 may be achieved by tuning the organ to pitch with switch **40** in CHORUS position, with the reverse tuning pattern being produced when switch **40** is returned to the heretobefore NORMAL position. An example of a reverse pattern is shown in FIG. 3, which is an exact reversal of the pattern of FIG. 2, while patterns illustrating alternating detuning are shown in FIGS. 4 and 5.

In addition, two positions of chorus control may be provided for a single bank of tone generators, as, for example, a first pattern similar to that of FIG. 2 but with a lesser degree of detuning between adjacent octaves and a second similar pattern providing the same degree of detuning as shown in FIG. 2. A switching arrangement by which two position chorus control may be carried out in an organ utilizing tone generators of the type illustrated in FIG. 1 is shown in FIG. 6. Bias network **24** is in circuit in the same manner as in FIG. 1 to supply a bias voltage to the bias busses of each octave as discussed. Chorus control switch **40** provided with additional fixed contacts for a second chorus position, is shown in its normal position such that movable ontacts **141** and **142** of each pole are connected to fixed contacts **143** and **144** respectively. In this position contact **143** is connected to ground and contact **144** is connected to terminal **50** through resistor **152** to establish the normal tuning bias for tone generators.

When switched to first chorus position (CH1) movable contact **141** is removed from ground and engages fixed contact **145** to receive a D.C. potential through from terminal **50** through resistors **154** and **154*a*** in series. Movable contact **142** is removed from fixed contact **144** and engages fixed contact **144*a*** to receive a D.C. potential from terminal **50** through resistor **152*a***, which potential is different from that provided when in its normal position. This causes a change in the bias voltages supplied to the tone generators in the manner discussed in conjunction with FIG. 1, but to a lesser degree. When switched to the second chorus position (CH2), movable contact **142** is opened while movable contact **141** is connected to fixed contacts **145*a*** and **145*b*** to receive D.C. potential derived from the junction between resistors **154** and **154*a***. Fixed contacts **145*a*** and **145*b*** are arranged on the switch to be simultaneously connected to movable contact **141**. This causes the bias voltages supplied to the tone generators to be changed in the same manner as before. The resulting detuning patterns are best illustrated in FIG. 2, where the octave detuning provided with switch **40** in CH2 position provides the pattern of curve B as previously discussed. With switch **40** in the intermediate position (CH) a subdued detuning pattern shown by curve C (dotted) is provided. It can be seen from FIG. 2 that the organist has the option of selecting a pattern which will give either an accented or a subdued chorus effect.

A more versatile utilization of the foregoing chorus effect in organs having more than one bank of tone generators is achieved by detuning each bank of tone generators independently of the others to the same general pattern, but with each bank detuned to a different degree. In such an instance each bank of tone generators is provided with a biasing and switching arrangement as shown in FIG. 1. This enables the chorus effect to be produced between two or more pitches as described, and further when the same octaves are combined by playing the same manual a celeste effect is produced. This is best illustrated with reference to FIG. 7, wherein the pattern A shown in solid lines represents one bank of tone generators and the pattern B shown in dotted lines represents a second bank of tone generators. Each pattern is similar to that of FIG. 2, but with a different degree of detuning between adjacent octaves for each bank of generators.

It can be seen that when played independently each bank of generators will produce the chorus effect as discussed, while the relative detuning between the same octaves of each bank can be combined to produce a one pitch celeste effect.

The foregoing method of producing a full chorus effect in an organ having a limited number of independent tone sources may also be accomplished by producing fixed detuning of adjacent octaves according to a selected predetermined pattern. This is particularly advantageous in organs having tone sources where a tuning shift is inconvenient or impractical, such as those utilizing extremely stable oscillators as tone sources or those utilizing so-called wheel generators as tone sources. Stable oscillators may, for example, be detuned a predetermined amount with respect to standard pitch by adjusting the core of the tuned circuit inductor to develop selected pattern.

Standard wheel generator systems may be modified to provide octave detuning by increasing or decreasing the whole frequencies imposed on the tone wheels that have the notes of respective octaves thereon. An independent wheel is provided for each octave of the scale and rotated at a different speed. This will result in each octave being detuned according to a predetermined pattern with respect to an adjacent octave. For example, the A tone wheel (rotated at 60 c.p.s.) may be modified to provide **A2** at 111 c.p.s. (16 cents sharp with respect to the standard 110 c.p.s.), **A3** at 221 c.p.s. (8 cents sharp), **A4** at 440 c.p.s. (in tune), **A5** at 878 c.p.s. (4 cents flat), **A6** at 1,754 c.p.s. (6 cents flat) and **A7** at 3,506 c.p.s. (7 cents flat). When the tone wheels are rotated at different speeds (for example 35.67540 for C, 44.94900 for E, 67.34400 for B, etc.), there is produced similar detuning for each octave, with a resulting desired tuning pattern wherein the higher octaves are detuned progressively sharp and the low octaves progressively flat.

The invention provides, therefore, an effective method and relatively simple apparatus for creating a full chorus effect for an electric organ having a limited number of tone sources. With a single bank of tone sources selected octaves or selected increments thereof are detuned a fixed predetermined amount relative to adjacent octaves to provide mild beats between octaves when notes or chords are played at two or more pitches. When used with organs having more than one bank of tone sources, it is further possible to provide a one-pitch celeste effect. Two or more tuning patterns may be provided to enable the organist to utilize the chorus effect to greater or lesser degrees. It is possible to detune progressively higher octaves sharp a decreasing amount and to detune progressively lower octaves flat an increasing amount for fullness of the musical effect. Other tuning patterns are also possible to produce octave detuning which will emphasize different portions of the musical scale. When embodied in electronic organs a simple switch for producing the effect may be conveniently supplied with a stop tablet of the organ so that it can be used at the option of the organist.

What is claimed is:

1. An electrical musical instrument including in combination, a plurality of tone generators for providing electrical tone signals representing the notes of a musical scale, each said tone generator including circuit means having an electrical parameter responsive to applied electrical signals for establishing the frequency of said tone signals, means for applying an electrical signal to selected groups of said tone generators, each said group of tone generators providing an octave of tones for the musical scale, and circuit means for changing the electrical signal applied to the tone generators of each octave by a predetermined amount, with the change in said electrical signal being different for each octave relative to other octaves, whereby the tuning of each octave is shifted in relation to every other octave to provide beats which create a chorus effect

2. An electrical musical instrument including in combination, a plurality of tone generators for providing electrical tone signals representing the notes of a musical scale, each said tone generator including circuit means having an electrical parameter responsive to applied electrical signals for establishing the frequency of said tone signals, means for applying an electrical signal to selected groups of said tone generators, each said group of tone generators providing an octave of tones for the musical scale, and circuit means for changing the electrical signal applied to the tone generators of each octave of the musical scale a predetermined amount, which predetermined amount differs from the change in the electrical signal applied to tone generators of other octaves in the musical scale by differing increments, with the higher octaves of said musical scale being tuned flat in progressively smaller increments and the lower octaves being tuned sharp by progressively larger increments, thereby providing beats between the tones of each octave to create a chorus effect.

3. An electrical musical instrument including in combination, a plurality of tone generators for providing electrical signals representing the notes of a musical scale, each said tone generator including oscillator means having a resonant circuit for establishing the frequency of oscillations and means for sustaining oscillations in said resonant circuit, each said oscillator means having a terminal adapted to receive a biasing potential to control the frequency of oscillations established by said resonant circuit, circuit means for applying a biasing potential to said terminals for selected groups of tone generators, with each said group of tone generators providing an octave of tones for the musical scale, and circuit means for changing the biasing potential applied to each said group of tone generators a predetermined amount, which predetermined amount differs from the change of biasing potential applied to other groups of tone generators, whereby the notes of each octave of the musical scale are detuned relative to other octaves an amount corresponding to the change in biasing potential applied to the tone generators therefor, thereby causing beats which create a chorus effect.

4. An electrical musical instrument including in combination, a plurality of tone generators for providing electrical tone signals representing the notes of a musical scale, each said tone generator including oscillator means having a resonant circuit for establishing the frequency of oscillations and means for sustaining oscillations in said resonant circuit, each said oscillator means having a terminal adapted to receive a biasing potential to control the frequency of oscillations established by said resonant circuit, circuit means for applying a biasing potential to said terminals for selected groups of tone generators, with each said group of tone generators providing an octave of tones for the musical scale, and circuit means for changing the biasing potential applied to each said group of tone generators a predetermined amount, which predetermined amount differs from the change in biasing potential applied to the tone generators of other octaves of the musical scale in differing increments, with said biasing potential decreasing in smaller increments for higher octaves and increasing in larger increments for lower octaves of the musical scale, thereby producing beats between the octaves to create a chorus effect.

5. In an electric organ, the combination including a plurality of individual tone generators, each said tone generator providing a tone of a frequency representing a note in a musical scale, terminal means on each said tone generator adapted to receive a biasing potential for controlling the frequency of oscillations thereof, means providing a plurality of biasing potentials of different magnitudes, circuit means for distributing each said biasing potential to the terminal means of selected groupings of said tone generators, with each said grouping providing tone signals for an octave of the musical scale, and circuit means for changing each said biasing potential a different predetermined amount relative to the change of other biasing potentials, thereby detuning each said octave a fixed amount slightly different from the detuning of every other octave, whereby beats are produced between octaves to create a chorus effect.

6. In an electric organ, the combination including a plurality of individual tone generators, each said tone generator providing a tone of a frequency representing a note in a musical scale, terminal means on each said tone generator adapted to receive a biasing potential to control the frequency of oscillations thereof, means for providing a plurality of biasing potentials each of different magnitude, circuit means for distributing each said biasing potential to the terminal means of selected groupings of said tone generators, with each said grouping providing tone signals for an octave of the musical scale, and means for changing each said biasing potential a predetermined amount different relative to the change of other biasing potentials, thereby detuning each said octave such that some octaves are tuned sharp by differing amounts and other octaves are tuned flat by differing amounts, whereby beats are produced between octaves to create a chorus effect.

7. In an electric organ, the combination including a plurality of individual tone generators, each said tone generator providing a tone of a frequency representing a note in a musical scale, terminal means on each said tone generator adapted to receive a biasing potential for controlling the frequency of oscillations thereof, biasing network means for providing a plurality of biasing potentials each of a different magnitude, circuit means for distributing each said biasing potential to the terminal means of selected groupings of said tone generators, with each said grouping providing tone signals for an octave of the musical scale, and means connected to said biasing network means to cause the biasing potentials of the tone generators of selected higher octaves to be decreased by progressively decreasing increments and to cause the biasing potential for the tone generators of selective lower octaves to be increased by progressively increasing increments, with the tone generators of each octave being uniformly detuned an amount differing from the uniform detuning of the tone generators of every other octave, thereby providing beats between the notes of each octave to create a chorus effect.

8. In an electric organ, the combination including a plurality of individual tone generators, each said tone generator including an oscillator circuit to provide a tone of a frequency representing a note in a musical scale, terminal means connected with each said oscillator to receive a biasing voltage for control of the frequency of oscillations thereof, a voltage dividing network including a plurality of series connected resistors, switch means operable between first and second positions, with said first position applying a direct current potential to selected points of said voltage dividing network to thereby provide biasing voltages at the junction points between successive ones of said series connected resistors, circuit means connected between individual ones of said junction points and the biasing terminals of selected groupings of said oscillators, with each said grouping biased to provide tone signals for an octave of the musical scale at a predetermined pitch, with a second position of said switch means applying said direct current potential to different selected points of said voltage dividing network to thereby change the biasing voltages provided at said junction point, and with said biasing voltage change providing uniform detuning of each octave of tone generators by different amounts relative to the detuning of the tone generators of other octaves, whereby beats are produced between the notes of each octave to create a chorus effect.

9. In an electric organ, the combination including a plurality of individual tone generators, each said tone generator including an oscillator circuit to provide a tone of a frequency representing a note in a musical scale, terminal means connected with each oscillator to receive a biasing voltage for control of the frequency of oscillations thereof, a voltage dividing network including a plurality of series connected resistors, switch means operable between first, second, and third positions, with said first position applying a direct current potential to selected points of said voltage dividing network to thereby provide biasing voltages at the junction points between successive ones of said series connected resistors, circuit means connected between individual ones of said junction points and the biasing terminals of selected groupings of said oscillators, with each said grouping biased to provide tone signals for an octave of the musical scale at a predetermined pitch, with said second switch position changing said biasing voltages a first predetermined amount and said third switch position changing said biasing voltages a second predetermined amount, with said changes of said biasing voltages providing octave detuning of said tone generators, whereby beats are produced between notes of each octave to create a chorus effect.

10. In an electric organ, the combination including a plurality of independent tone generators, each said tone generator including an oscillator circuit to provide a tone of a frequency representing a note in a musical scale, terminal means connected to each said oscillator to receive a biasing voltage for control of the frequency of oscillations thereof, a voltage dividing network including first and second parallel paths, each path comprising a plurality of series connected resistors, circuit means including a first resistor for connecting one end of each parallel path to a direct current potential supply, a plurality of biasing busses connecting the junction points of successive ones of said series connected resistors in each parallel path to the biasing terminals of selected groupings of said oscillator circuits, with the oscillator circuits of each said grouping providing tone signals for an octave of the musical scale, a switch having first and second sections and operable between first and second positions, with said first switch section having first and second terminals and said second switch section having first, second and third terminals, means connecting the first terminal of said first switch section to a junction between selected series resistors of said first parallel path, means including a second resistor connecting the second terminal of said first switch section to said direct current potential supply, means connecting the other end of said first parallel path to ground reference potential, means connecting the other end of said second parallel path to the first terminal of said second switch section, means connecting the second terminal of said second switch section to ground reference potential, and means connecting the third terminal of said second switch section to said direct current potential supply through said first resistor, so that said switch when in a first position causes biasing voltages to be distributed to the tone generators of each octave to thereby tune each note to a predetermined pitch, and when in a second position changes said biasing voltages for each octave of tone generators by differing amounts, thereby detuning each octave from said predetermined pitch a different amount relative to every other octave.

11. A musical instrument including in combination, a plurality of tone generators for providing tone signals representing the notes of a musical scale, each of said tone generators including first means for independently establishing the frequency of said tone signals so that said tone generators produce notes of the musical scale extending over several octaves, means for simultaneously operating generators for a plurality of octaves to produce a combination of tones, each of said generators including second means for changing the tuning thereof, and control means including a separate portion associated with said generators of each octave, said control means being operative to change the tuning of all of said tone generators for at least one of said octaves by a predetermined fixed amount, so that the tones produced by the generators for said one octave are detuned with respect to the tones produced by the generators of another octave to produce beats between octaves which create a chorus effect.

12. In an electrical musical instrument, the combination including a plurality of tone generators for providing tone signals representing the notes of a musical scale which extend over a plurality of octaves, each of said tone generators having means to establish the frequency thereof including first and second portions, said first portion being manually adjustable to establish the frequency of each tone generator independently of the frequency of the other generators, and control means coupled to said second portion of each tone generator for simultaneously detuning said tone generators of certain octaves by a predetermined amount with respect to a standard pitch, which predetermined amount is substantially the same for the tone generators of each octave and differs for the tone generators of adjacent octaves according to a predetermined pattern, whereby beats are produced between the notes and chords of adjacent octaves to thereby create a chorus effect.

13. In an organ having a keyboard, the combination including a plurality of tone sources for providing tone signals representing the notes of a musical scale which extend over a range of octaves, means actuated by the keyboard for operating said tone sources to simultaneously produce tone signals in different octaves, each of said tone sources having frequency determining means with first and second portions, said first portion of each frequency determining means being adjustable to establish the frequency of each tone source independently of the frequency of other tone sources, and control means connected to said second portion of said frequency determining means of each of said tone sources to control the frequency of said tone sources, said control means including means to detune said tone sources of certain octaves, with the detuning being the same for all said tone sources of any one octave, and being related to the detuning of said tone sources of adjacent octaves according to a predetermined pattern, whereby beats are produced between the notes of different octaves to create a chorus effect.

14. In an organ having a keyboard, the combination including a plurality of tone sources for providing tone signals representing the notes of a musical scale which extend over a range of octaves, means actuated by the keyboard for operating said tone sources to simultaneously produce tone signals in different octaves, each of said tone sources having frequency determining means with first and second portions, said first portion of each frequency determining means being adjustable to establish the frequency of each tone source independently of the frequency of other tone sources, and control means connected to said second portion of said frequency determining means of each of said tone sources to control the frequency of said tone sources, said control means including means to detune said tone sources of certain octaves, with the detuning being the same for all said tone sources of any one octave, and being such that higher octaves are detuned sharp and lower octaves are detuned flat, whereby beats are produced between the notes of different octaves to create a chorus effect.

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