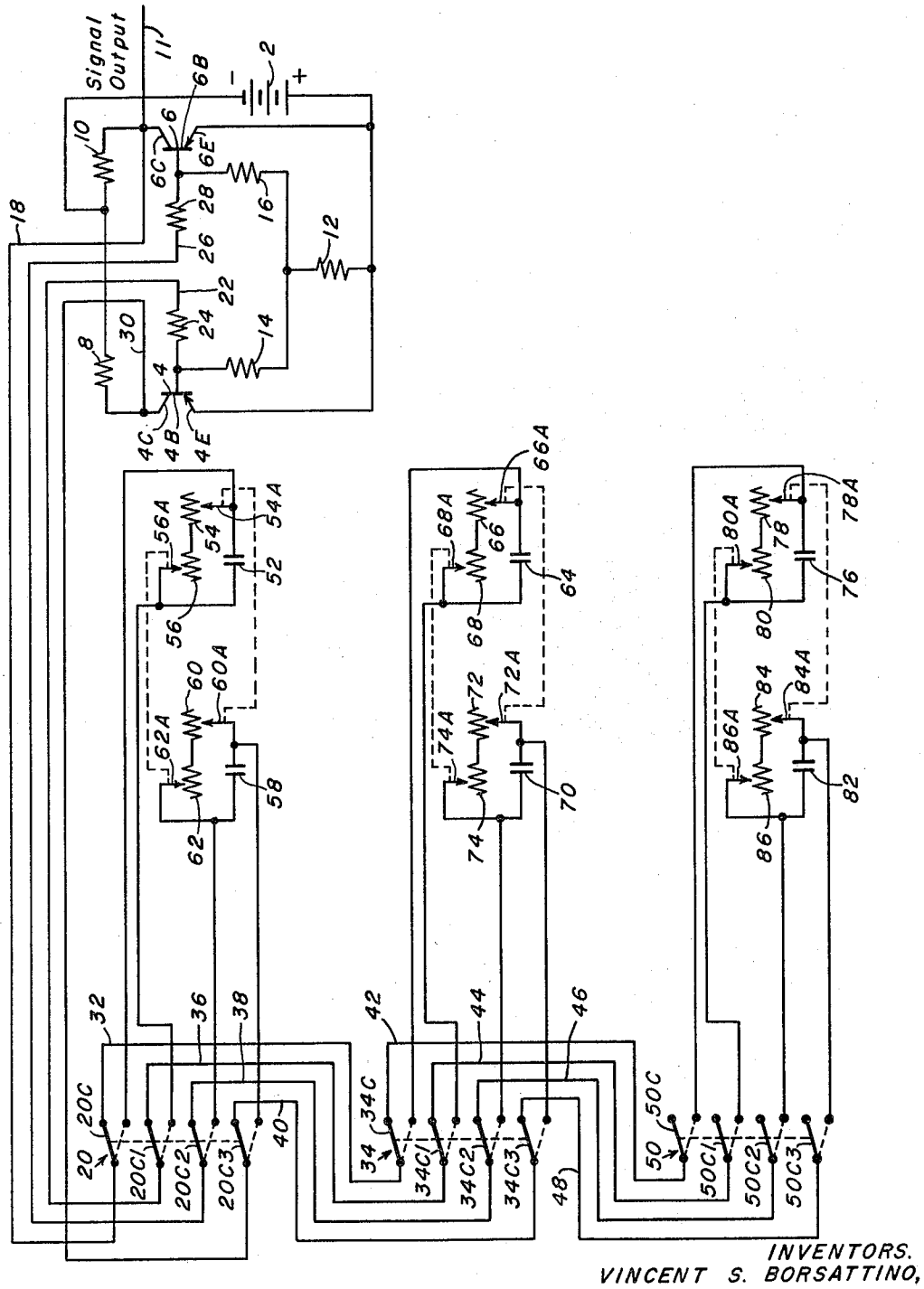
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MULTIPLE BAND VARIABLE MULTIVIBRATOR

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MULTIPLE BAND VARIABLE MULTIVIBRATOR

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This application which is a continuation-in-part of our co-pending application Serial No. 341,938, filed February 3, 1964, now abandoned, relates to a multiple band variable frequency oscillator of the resistor capacitor type and more particularly to such an oscillator which can be used with a carrier control system such as shown in our co-pending application Serial No. 337,037, filed January 10, 1964. As disclosed in our co-pending application we utilize a variable frequency multi-vibrator for each motor that is to be controlled. While this disclosed arrangement is satisfactory it is relatively expensive.

It is therefore an object of our invention to provide a multiple band variable frequency oscillator which can take the place of several variable frequency multi-vibrators at less cost.

Another object is to provide such an oscillator which will generate signals having several ranges of frequencies that differ greatly and which can vary the frequency of each signal within its relatively narrow range.

These and other objects will be more apparent after referring to the following specification and attached drawing, in which:

The single figure is a schematic view of the generator of our invention.

Referring more particularly to the drawing, reference numeral **2** indicates a battery or other low voltage power source. The positive terminal of the battery **2** is connected to emitters **4E** and **6E** of transistors **4** and **6** which are Type 2N1404 or equivalent. Collectors **4C** and **6C** are connected to the negative terminal of power source **2** through resistors **8** and **10**, respectively. The resistor **8** has a slightly lower value than resistor **10** because signal output connection **11** is taken off collector **6C**. Base **4B** is connected to the positive terminal of battery **2** through current limiting resistor **12** and biasing resistor **14**. Base **6B** is connected to the positive terminal of battery **2** through resistor **12** and biasing resistor **16**. A lead **18** connects the collector **6C** to contact **20C** of multiple contact switch **20**. A lead **22** connects base **4B** through biasing resistor **24** to contact **20C1** of switch **20**. A lead **26** connects base **6B** through biasing resistor **28** to contact **20C2** of switch **20**. A lead **30** connects collector **4C** to contact **20C3** of switch **20**.

The contacts **20C**, **20C1**, **20C2** and **20C3** are normally in the full line position shown, but may be moved to the broken line position. When in the full line position contact **20C** is connected by lead **32** to contact **34C** of multiple contact switch **34**. When in full line position contacts **20C1**, **20C2** and **20C3** are connected by means of leads **36**, **38** and **40**, respectively, to contacts **34C1**, **34C2** and **34C3** of switch **34**. Contacts **34C**, **34C1**, **34C2** and **34C3** are normally in the full line position shown but may be moved to their broken line position. When in full line position the contacts **34C**, **34C1**, **34C2** and **34C3** are connected by leads **42**, **44**, **46** and **48**, respectively, to contacts **50C**, **50C1**, **50C2** and **50C3** of multiple contact switch **50**. The contacts **50C**, **50C1**, **50C2** and **50C3** are normally open as shown in full lines but may be moved to the broken line position shown.

A capacitor **52** is connected in series with contacts **20C** and **20C1** when in the broken line position. Variable resistors **54** and **56** are connected in series with each other and in parallel with capacitor **52**. A capacitor **58** is connected in series with contacts **20C2** and **20C3** when these contacts are in their broken line position. Variable resistors **60** and **62** are connected in series with each other and in parallel with capacitor **58**. Arms **54A** and **60A** of resistors **54** and **60** are mechanically interconnected so that the effective value of resistor **54** will always be the same as that of resistor **60**. Arms **56A** and **62A** of resistors **56** and **62** are mechanically interconnected so that the effective value of resistor **56** will always be the same as that of resistor **62**. A capacitor **64** is connected in series with contacts **34C** and **34C1** when in the broken line position. Variable resistors **66** and **68** are connected in series with each other and in parallel with capacitor **64**. A capacitor **70** is connected in series with contacts **34C2** and **34C3** when these contacts are in their broken line position. Variable resistors **72** and **74** are connected in series with each other and in parallel with capacitor **70**. Arms **66A** and **72A** are mechanically inter-connected so that the effective value of resistor **66** will always be the same as that of resistor **72**. Arms **68A** and **74A** are mechanically inter-connected so that the effective value of resistor **68** will always be the same as that of resistor **74**. A capacitor **76** is connected in series with contacts **50C** and **50C1** when in the broken line position. Variable resistors **78** and **80** are connected in series with each other and in parallel with capacitor **76**. A capacitor **82** is connected in series with contacts **50C2** and **50C3** when these contacts are in their broken line position. Variable resistors **84** and **86** are connected in series with each other and in parallel with capacitor **82**. Arms **78A** and **84A** are mechanically inter-connected so that the effective value of resistor **78** will always be the same as that of resistor **84**. Arms **80A** and **86A** are mechanically inter-connected so that the effective value of resistor **80** will always be the same as that of resistor **86**.

The value of resistors **14** and **24** are the same as the values of resistors **16** and **28**, respectively. The values of elements **52**, **54** and **56** are the same as the values of elements **58**, **60** and **62**, respectively. The values of elements **64**, **66** and **68** are the same as the values of elements **70**, **72** and **74**, respectively. The values of elements **76**, **78** and **80** are the same as the values of elements **82**, **84** and **86**, respectively. However, the values of capacitors **52**, **64** and **76** preferably differ from one another and the values of the resistors connected in parallel with these capacitors also preferably differ from the values of the resistors connected in parallel with the other capacitors. In any event the values of the circuits including the capacitors and related resistors must differ one from another.

In operation, assuming that it is desired to obtain an output signal having a frequency within a range determined by the values of elements **52**, **54**, **56**, **58**, **60** and **62**, the contacts of switch **20** are moved to their broken line position. This frequency may be changed within the range by changing the position of arms **56A** and **62A** in the same manner as in our co-pending application. With the contacts of switch **20** in the broken line position, the collector **6C** is connected through line **18**, switch **20C**, capacitor **52** and resistors **54** and **56**, switch **20C1** and line **22** to base **4B**. Also collector **4C** is connected through line **30**, switch **20C3**, capacitor **58** and resistors **60** and **62**, switch **20C2** and line **26** to base **6B**. Thus the desired signal is obtained at output line **11** in a manner similar to other multivibrators. When it is desired to obtain an output signal having a frequency within a range determined by the values of elements **64**, **66**, **68**, **70**, **72** and **74**, switch **20** is actuated to move its contacts to the solid line position shown and switch **34** is actuated to move its contacts to the broken line posi-

tion shown. This frequency may also be varied within this range by moving the position of arms **68A** and **74A** in the same manner as in our co-pending application. When it is desired to obtain an output signal having a frequency having a range determined by the values of elements **76**, **78**, **80**, **82**, **84** and **86**, switches **20** and **34** are positioned with their contacts in the full line position shown and switch **50** is positioned with its contacts in the broken line position. This frequency may be varied by changing the position of arms **80A** and **86A**. The purpose of the resistors **54**, **60**, **66**, **72**, **78** and **84** is to enable compensation to be made for any shift in frequency due to aging of the parts. It will be understood that additional signals having still different frequencies may be obtained by the use of additional multiple contact switches and additional capacitors and variable resistors associated with the switch. The values of these additional capacitors and resistors would, of course, vary from the values of the capacitors and resistors of the other units. The selective connections between the transistors **4** and **6** to the capacitors and resistors of the various units will be apparent.

While one embodiment of our invention has been shown and described, it will be apparent that other adaptations and modifications may be made without departing from the scope of the following claims.

We claim:

1. A multiple band variable frequency oscillator comprising a first unit including a pair of like transistors each having a base, a collector and an emitter, a D.C. power source, means connecting one side of said power source to each of said emitters, a connection between the other side of said power source and one of said collectors, a resistor in said connection, a connection between the said other side of said power source and the other of said collectors, a resistor in said last named connection, a connection between the said one side of said power source and one of said bases, a resistor in said last named connection, a connectioin between the said one side of said power source and the other of said bases, and a resistor in said last named connection; a second unit; a third unit; each of said second and third units having a first capacitor connected in parallel with a first variable resistor, a second capacitor connected in parallel with a second variable resistor, the values of the first and second capacitors being equal to one another, and means for varying the effective value of the first and second variable resistors so that the effective value of the first variable resistor will be the same as the effective value of the second variable resistor, the values of the variable resistors and capacitors of the second unit differing substantially from the values of the variable resistors and capacitors of the third unit; and means for selectively connecting the collector of one of said transistors to the base of the other transistor through the first capacitor and first variable resistor of the second and third units and selectively connecting the base of said one transistor to the collector of the said other transistor through the second capacitor and second variable resistor of the second and third units; said last named means including a first switch having four contacts associated with said second unit, one side of two of said contacts being connected to the collector of one of said units and the base of the other of said transistors, one side of the other two of said contacts being connected to the collector of said other transistor and the base of the said other of said transistors, a second switch having four contacts associated with said third unit, the other side of the first said two of said contacts in the first position of said first switch being connected to one side of two of said contacts of said second switch and in their second position being connected to the first capacitor and first variable resistor of the second unit, the other side of the said other two contacts of said first switch in their first position being connected to one side of the other two contacts of said second switch and in their second position being connected to the second capacitor and second variable resistor of the second unit, the other side of the first said two of said contacts of the second switch in their first position being connected to the first capacitor and first variable resistor of the third unit, the other side of the said other two contacts of the second switch in their first position being connected to the second capacitor and second variable resistor of the third unit, an output signal being obtained from said first and second units when the contacts of said first switch are in their second position, and an output signal being obtained from said first and third units when the contacts of said first and second switches are in their first positions.

2. A variable frequency generator according to claim **1** including a variable resistor in series with each of said first and second variable resistors, and means for varying the effective values of the last named variable resistors in the second unit so that the effective values thereof are the same, and means for varying the effective values of the last named variable resistors in the third unit so that the effective values thereof are the same.

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J. KOMINSKI, *Assistant Examiner.*

UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,286,197 November 15, 1966

Vincent S. Borsattino et al.

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

In the heading to the printed specification, lines 3 to 5, for "Vincent S. Borsattino, 4627 Lincoln St.; Chursel E. Marker, 793 Indiana St.; Jesse W. Shalla, 2424 W. 57th Place, all of Gary, Ind." read -- Vincent S. Borsattino, Chursel E. Marker, and Jesse W. Shalla, all of Gary, Ind., assignors to United States Steel Corporation, a corporation of Delaware --.

Signed and sealed this 12th day of September 1967.

(SEAL)
Attest:

ERNEST W. SWIDER
Attesting Officer

EDWARD J. BRENNER
Commissioner of Patents