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FREQUENCY SETTING METHOD FOR RADIO TRANSMISSION APPARATUS

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(56) Prior Art Documents
US 4849714
US 4745371
GB 2015277

(57) Claim

1. A frequency setting method for a radio transmission apparatus which transmits a burst signal by changing transmission frequency burst by burst, comprising the steps of:

(a) generating a frequency division data signal representative of a frequency division number and a strobe signal representative of frequency setting;

(b) feeding a single strobe immediately after beginning of a non-transmission interval after a burst immediately preceding a burst whose frequency should be set by a single strobe; and

(c) feeding said single frequency division signal immediately after a strobe signal has been fed immediately after beginning of a non-transmission interval which occurred after a burst two burst ahead of said burst whose frequency should be set by a single frequency division signal had ended.

3. An apparatus comprising:

transmitter means for successively transmitting bursts as predetermined intervals and changing the frequencies of said bursts in response to local frequencies;

frequency synthesizer means for generating said local frequencies in response to control data;

.../2

means for applying a first control datum of said control data to said frequency synthesizer means immediately after beginning of a non-transmission interval after a first one of said bursts had ended, said first control datum being used for setting the frequency of a second one of said bursts which follows said first bursts.

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COMPLETE SPECIFICATION

(ORIGINAL)

FOR OFFICE USE:

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Complete Specification Lodged:
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Name and Address of Applicant: NEC Corporation
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Complete Specification for the invention entitled:

Frequency Setting Method for Radio Transmission Apparatus

The following statement is a full description of this invention, including the best method of performing it known to me/us

ABSTRACT OF THE DISCLOSURE

A frequency setting system for a radio transmission apparatus of the type transmitting a signal in the form of bursts and changing transmission frequency burst by burst. A frequency division data signal representative of a frequency division number and a strobe signal representative of frequency setting are fed to a frequency synthesizer. The timings for generating the frequency division data signal and strobe signal are determined with no regard to the locking time of the frequency synthesizer which is dependent on the kind of the synthesizer, frequency, etc.

FREQUENCY SETTING METHOD FOR RADIO TRANSMISSION APPARATUS

BACKGROUND OF THE INVENTION

The present invention relates to a frequency setting method for a radio transmission apparatus of the type transmitting a signal in bursts and changing the transmission frequency burst by burst.

Radio transmission apparatuses of the type described include one which determines a transmission frequency in response to an output of a frequency synthesizer which is implemented with a PLL (Phase Locked Loop) system. Specifically, the frequency synthesizer changes the frequency of its output by changing the frequency division number. The frequency division number is given as a frequency division data signal which is applied to the frequency synthesizer. A strobe signal is also applied to the frequency synthesizer for determining the frequency division number setting timing.

The problem with the prior art frequency setting method described above is that the locking time necessary for the frequency synthesizer to lock the phase varies with the kind of the synthesizer, the width of change in frequency between successive bursts, and so forth. It follows that the timings for

feeding the frequency division data signal and subsequent strobe signal to the frequency synthesizer have to be controlled in matching relation to a particular configuration of the apparatus.

SUMMARY OF THE INVENTION

It is therefore an object of the present invention to provide a frequency setting method for a radio transmission apparatus which simplifies the control associated with frequency setting.

It is another object of the present invention to provide a generally improved frequency setting method for a radio transmission apparatus.

According to one aspect of the present invention there is disclosed a frequency setting method for a radio transmission apparatus which transmits a burst signal by changing transmission frequency burst by burst, comprising the steps of:

(a) generating a frequency division data signal representative of a frequency division number and a strobe signal representative of frequency setting;

(b) feeding a single strobe immediately after beginning of a non-transmission interval after a burst immediately preceding a burst whose frequency should be set by a single strobe; and

(c) feeding said single frequency division signal immediately after a strobe signal has been fed immediately after beginning of a non-transmission interval which occurred after a burst two burst ahead of said burst whose frequency should be set by a single frequency division signal had ended.

According to another aspect of the present invention there is disclosed a frequency setting method for a radio transmission apparatus which transmits a burst signal by changing transmission frequency burst by burst, comprising the steps of:

(a) generating a frequency division data signal representative of a frequency division number and a strobe signal representative of frequency setting;

(b) beginning to feed said frequency division data signal immediately after beginning of a non-transmission interval after a burst immediately preceding a burst whose frequency should be set by a frequency division data signal has begun;

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(c) feeding a strobe signal for said burst whose frequency should be set immediately after beginning of a non-transmission interval which occurred after said burst immediately preceding said burst whose frequency should be set by said frequency division data.

According to a further aspect of the present invention there is disclosed an apparatus comprising:

transmitter means for successively transmitting bursts as predetermined intervals and changing the frequencies of said bursts in response to local frequencies;

frequency synthesizer means for generating said local frequencies in response to control data;

means for applying a first control datum of said control data to said frequency synthesizer means immediately after beginning of a non-transmission interval after a first one of said bursts had ended, said first control datum being used for setting the frequency of a second one of said bursts which follows said first bursts.

BRIEF DESCRIPTION OF THE DRAWINGS

The above and other objects, features and advantages of the present invention will become more apparent from the following detailed description taken with the accompanying drawings in which:

Fig. 1 is a timing chart representative of a prior art frequency setting method for a radio transmission apparatus;

Fig. 2 is a block diagram schematically showing a radio transmission apparatus for practicing preferred embodiments of the present invention;

Fig. 3 is a block diagram schematically showing a frequency synthesizer included in the apparatus of Fig. 2;

Fig. 4 is a block diagram schematically showing a variable

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frequency divider included in the frequency synthesizer of Fig. 3;

Fig. 5 is a timing chart representative of a preferred embodiment of the present invention; and

Fig. 6 is a timing chart representative of an alternative embodiment of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

To better understand the present invention, a brief reference will be made to a prior art frequency setting method, shown in Fig. 1. Specifically, Fig. 1 shows a burst signal transmitted from a radio transmission apparatus, and a frequency division data signal and a strobe signal which are applied to the a frequency synthesizer. The burst signal is shown as having three bursts 101 to 103 to which are assigned three different frequencies f_1, f_2 and f_3, respectively. Since the frequency differs from one burst to another as mentioned, it is set burst by burst. For the burst 103, for example, the frequency f_3 is set by feeding frequency division data 103A included in the frequency division data signal and then a strobe 103B included in the strobe signal. Generally, PLL type frequency synthesizer needs a certain locking time t for locking the phase. Hence, an arrangement is made such that the delivery of frequency division data and strobe to the synthesizer is completed a period of time t before the time when the associated burst begins.

However, the locking time t of the frequency synthesizer

depends on the kind of the synthesizer, the width of change in frequency between successive bursts, and so forth, as discussed earlier. This results in the complicated control over the timings of the frequency division data and strobes.

Referring to Fig. 2, there is shown a radio transmission apparatus to which preferred embodiments of the present invention are applied and which assigns a different frequency to each burst. As shown, the radio transmission apparatus, generally 1, has a transmitter 10 for generating a radio signal, and a PLL type frequency synthesizer 20 for setting a transmission frequency of the transmitter 10. A frequency division data generator 30 feeds to the frequency synthesizer 20 a frequency division data signal and a strobe signal which provides the synthesizer 20 with a frequency division setting timing. A switch 40 switches on and off the output of the transmitter 10 to generate bursts while delivering them to an antenna 50. A controller 60 controls the operation timings of the frequency division data generator 30 and switch 40.

As shown in Fig. 3, the frequency synthesizer 20 has a variable frequency divider 21, a phase comparator 22, a reference signal oscillator 23, a low pass filter 24, and a VCO (Voltage Controlled Oscillator) 25. The VCO 25 delivers a signal whose frequency is variable to the transmitter 10 via a terminal 26. The variable frequency divider 21 receives the frequency division data from the frequency division data generator 30 via a

terminal 27 and the strobe signal via a terminal 28.

Fig. 4 shows a specific construction of the variable frequency divider 21. As shown, the variable frequency divider 21 has a programmable counter 210, a latch 211, and a shift register 212. 17-bit frequency data, for example, which is representative of a frequency division number is serially fed to the shift register or 17-bit shift register 212, via the terminal 27. After all 17-bit frequency data has been fed to the shift register 212, a strobe signal is applied to the latch 211 via the terminal 28. The frequency data lodged in the shift register 212 is applied to the programmable counter 210 to have its frequency changed thereby, so that the output frequency of the frequency synthesizer 20 itself is changed. A clock is fed to the shift register 212. In Fig. 3, the clock is not shown because the clock and the frequency division data are usually fed in a pair.

The frequency synthesizer 20 may be implemented by LSI "μPD2833C" available from NEC Corporation, Japan.

A preferred embodiment of the present invention practicable with the above construction will be described. Fig. 5 shows timings at which the illustrative embodiment generates a burst signal, a frequency division data signal, and a strobe signal. Let the following description concentrate on a burst 203 included in the burst signal by way of example. The burst 203 has a frequency f_3 which is set by a strobe 203B which is included in the strobe signal. As Fig. 5 indicates, the strobe 203B is fed to

the frequency synthesizer 20 at a time t_2 when the burst 202 immediately preceding the burst 203 has ended, i. e., immediately after the beginning of a non-transmission interval. Further, frequency division data 203A included in the frequency division data signal for setting the frequency of the burst 203 of interest begins to be fed at a time when a burst 201 two bursts ahead of the burst 203 has ended, i. e., immediately after a strobe 202B has been delivered at a time t_1 which is just after the beginning of a non-transmission interval. The controller 60, therefore, causes the strobe signal and subsequent frequency division data signal to be fed in synchronism with the timings at which the switch 40 is in an OFF state. In this configuration, while the output of the transmitter 10 is switched on and off by the switch switch 40, the frequency is set such that the different frequencies f_1 to f_3 are assigned to the bursts 201 to 203, respectively.

As stated above, the illustrative embodiment determines the operation timings with no regard to the locking tim t which is dependent on the kind of a frequency synthesizer, frequency, and so forth, whereby the control is simplified. Moreover, the frequency synthesizer does not need a high-speed clock because the entire non-transmission interval is usable as the locking time t, so that the design is easy and the carrier-to-noise (C/N) ratio is easy to improve.

Further, the interval between successive strobes is fully

available for the delivery of the frequency division data, meaning that the signal speed of the frequency data can be lowered. This is successful in reducing the interference between data signals which is apt to occur in the event of interchange of high-speed data, thereby eliminating the need for expensive cables such as shield cables for signal lines. Hence, the apparatus is inexpensive and simple in construction.

Referring to Fig. 6, an alternative embodiment of the present invention will be described. The operation timings shown in Fig. 3 are provided by the controller 60, as follows. Assume a burst 302, for example, which is included in a burst signal and has a frequency f_2. In this particular embodiment, frequency data 302A included in a frequency division data signal for setting the frequency f_2 begins to be fed at a time t_3 when a burst 301 immediately preceding the burst 302 has begun. A strobe 302B for setting the frequency f_2 is fed at a time when the burst 301 has ended, i.e., at a time t_4 which is just after the beginning of the non-transmission interval. The controller 60, therefore, causes the frequency division data signal and strobe signal to be delivered in synchronism with the operation timings of the switch 40. Specifically, while the output of the transmitter 10 is switched on and off by the switch 40, the different frequencies f_1 to f_3 are assigned to the bursts 301 to 303, respectively.

The advantages attainable with the alternative embodiment

shown and described are comparable with those which have been stated in relation to the previous embodiment.

In summary, it will be seen that the present invention provides a frequency setting method which allows the operation timings of a radio transmission apparatus to be determined with no regard to the locking time of a frequency synthesizer which is dependent on the kind of the synthesizer, frequency, etc. The method, therefore, promotes simple control over a radio transmission apparatus.

Various modifications will become possible for those skilled in the art after receiving the teachings of the present disclosure without departing from the scope thereof.

The claims defining the invention are as follows:

1. A frequency setting method for a radio transmission apparatus which transmits a burst signal by changing transmission frequency burst by burst, comprising the steps of:

(a) generating a frequency division data signal representative of a frequency division number and a strobe signal representative of frequency setting;

(b) feeding a single strobe immediately after beginning of a non-transmission interval after a burst immediately preceding a burst whose frequency should be set by a single strobe; and

(c) feeding said single frequency division signal immediately after a strobe signal has been fed immediately after beginning of a non-transmission interval which occurred after a burst two burst ahead of said burst whose frequency should be set by a single frequency division signal had ended.

2. A frequency setting method for a radio transmission apparatus which transmits a burst signal by changing transmission frequency burst by burst, comprising the steps of:

(a) generating a frequency division data signal representative of a frequency division number and a strobe signal representative of frequency setting;

(b) beginning to feed said frequency division data signal immediately after beginning of a non-transmission interval after a burst immediately preceding a burst whose frequency should be set by a frequency division data signal has begun;

(c) feeding a strobe signal for said burst whose frequency should be set immediately after beginning of a non-transmission interval which occurred after said burst immediately preceding said burst whose frequency should be set by said frequency division data.

3. An apparatus comprising:

transmitter means for successively transmitting bursts as predetermined intervals and changing the frequencies of said bursts in response to local frequencies;

frequency synthesizer means for generating said local frequencies in response to control data;

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means for applying a first control datum of said control data to said frequency synthesizer means immediately after beginning of a non-transmission interval after a first one of said bursts had ended, said first control datum being used for setting the frequency of a second one of said bursts which follows said first bursts.

4. A frequency setting method for a radio transmission apparatus which transmits a burst signal by changing transmission frequency burst by burst, said method being substantially as described with reference to Figs. 2-5 or Fig. 6 of the accompanying drawings.

5. An apparatus substantially as described with reference to Figs. 2-5 or Fig. 6 of the accompanying drawings.

DATED this SECOND day of JUNE 1992

NEC Corporation

Patent Attorneys for the Applicant

SPRUSON & FERGUSON

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Fig. 1

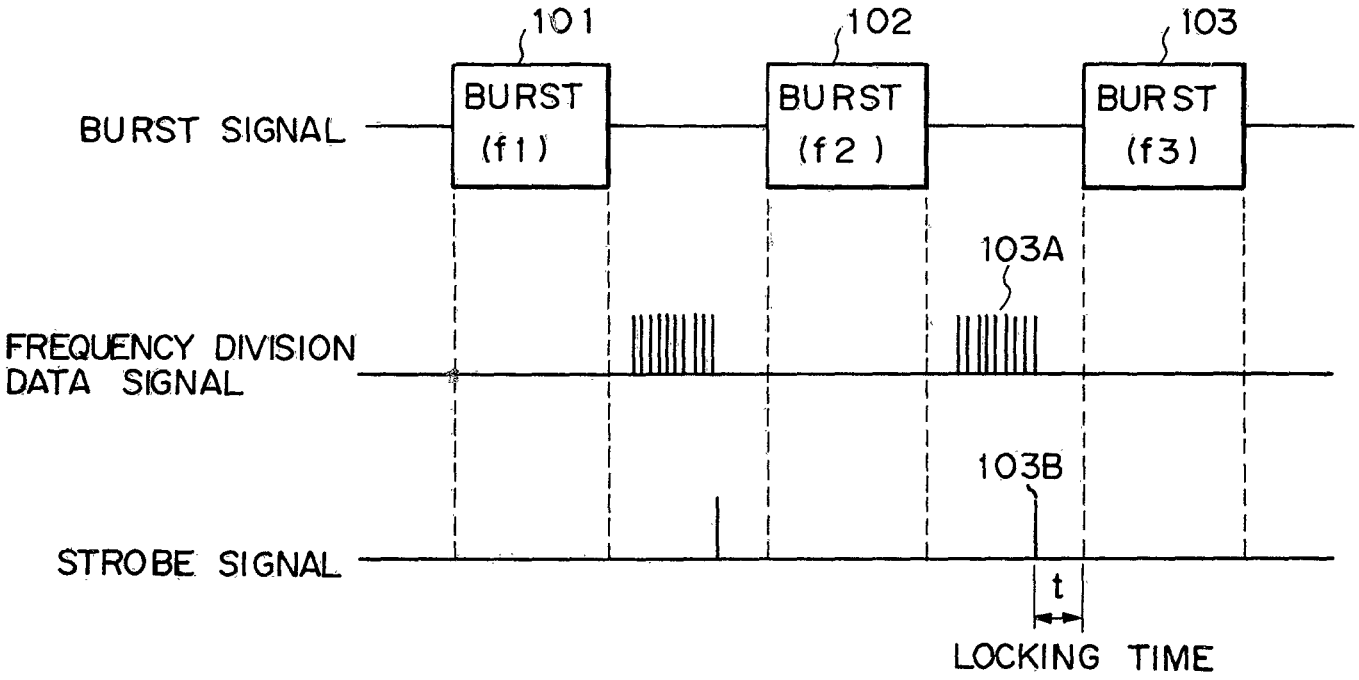

101
102
103
BURST SIGNAL
BURST (f1)
BURST (f2)
BURST (f3)
103A
FREQUENCY DIVISION DATA SIGNAL
103B
STROBE SIGNAL
t
LOCKING TIME

Fig. 2

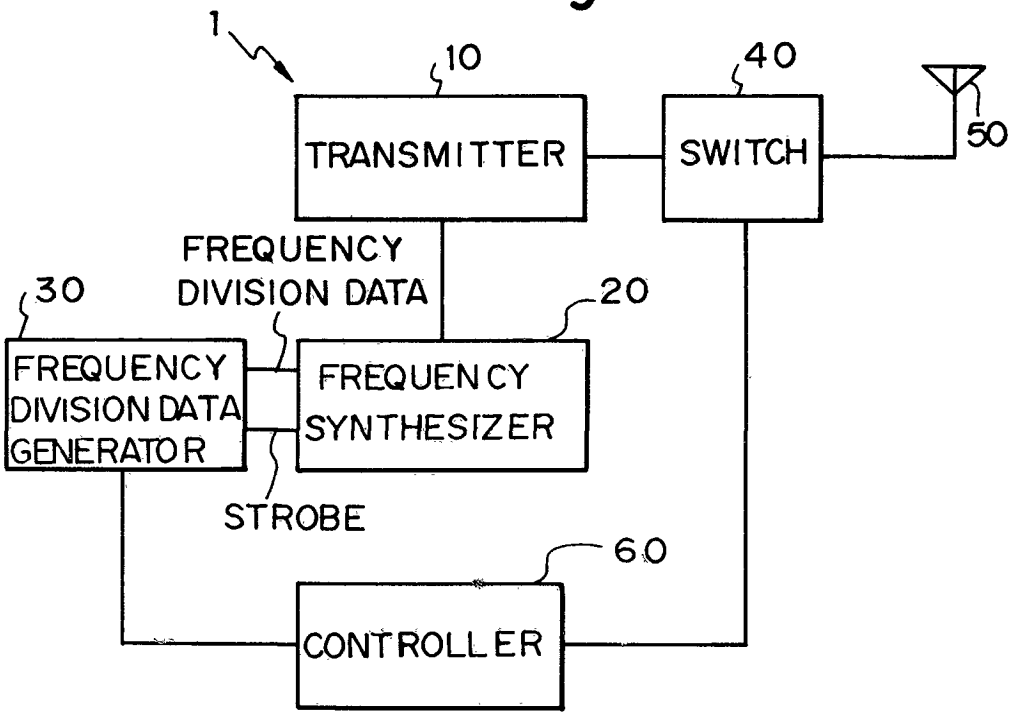

1
10
40
TRANSMITTER
SWITCH
50
FREQUENCY
DIVISION DATA
30
20
FREQUENCY
DIVISION DATA
GENERATOR
FREQUENCY
SYNTHESIZER
STROBE
60
CONTROLLER

Fig. 3

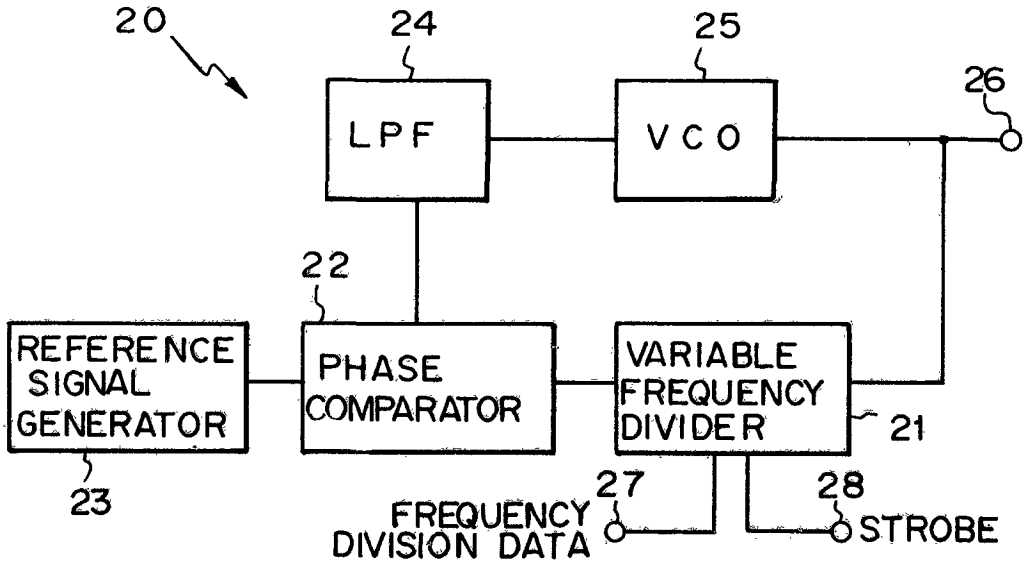

20
24
25
26
LPF
VCO
22
REFERENCE
SIGNAL
GENERATOR
PHASE
COMPARATOR
VARIABLE
FREQUENCY
DIVIDER
21
23
27
28
FREQUENCY
DIVISION DATA
STROBE

Fig. 4

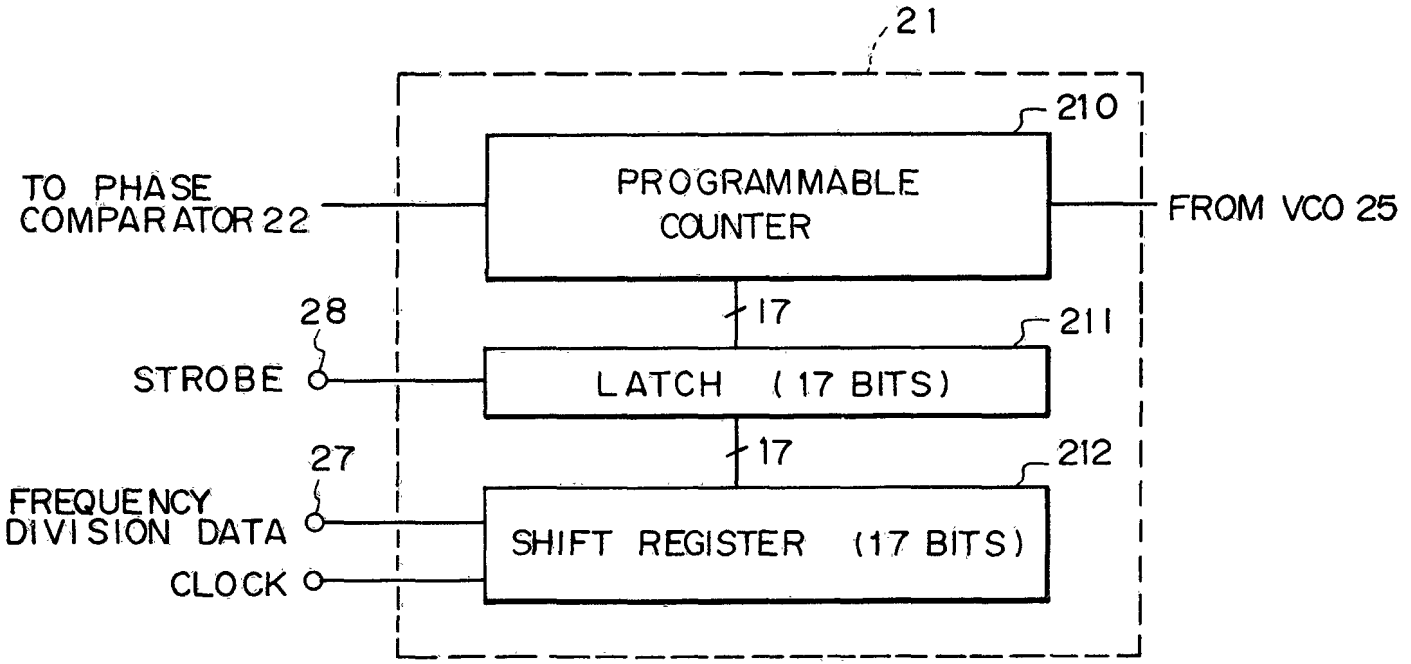

21
210
PROGRAMMABLE COUNTER
TO PHASE COMPARATOR 22
FROM VCO 25
17
28
STROBE
211
LATCH (17 BITS)
17
27
212
FREQUENCY DIVISION DATA
SHIFT REGISTER (17 BITS)
CLOCK

Fig. 5

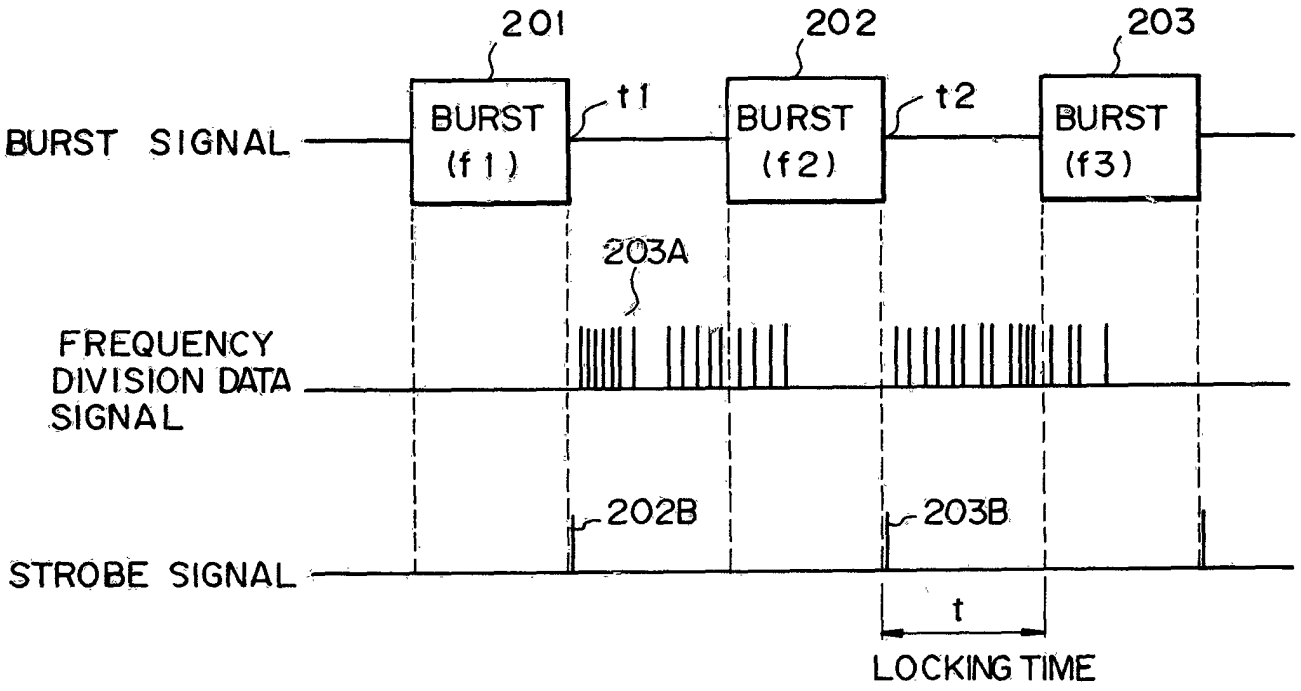
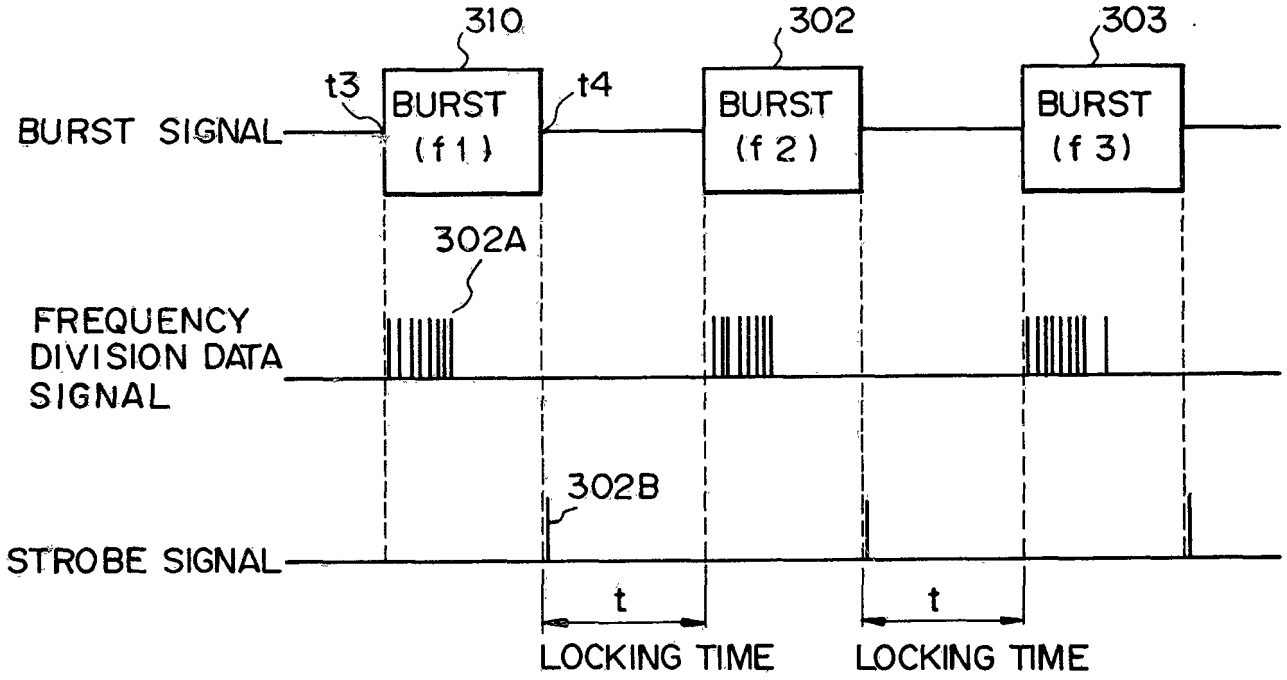

201
202
203
BURST SIGNAL
BURST (f1)
t1
BURST (f2)
t2
BURST (f3)
203A
FREQUENCY DIVISION DATA SIGNAL
202B
203B
STROBE SIGNAL
t
LOCKING TIME

Fig. 6


310
302
303
t3
t4
BURST SIGNAL
BURST (f1)
BURST (f2)
BURST (f3)
302A
FREQUENCY DIVISION DATA SIGNAL
302B
STROBE SIGNAL
t
t
LOCKING TIME
LOCKING TIME