July 15, 1969 W. K. R. WATSON ET AL 3,456,062

MUSICAL INSTRUMENT

Filed May 21, 1965 2 Sheets-Sheet 1

FIG. 1.

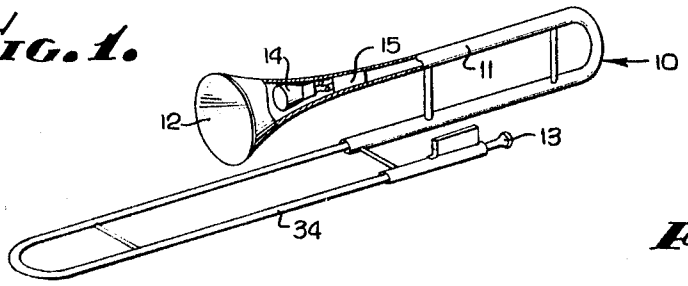


FIG. 3.



FIG. 2.

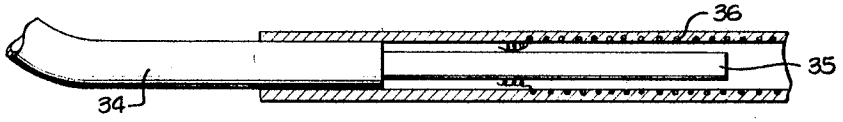


FIG. 4.

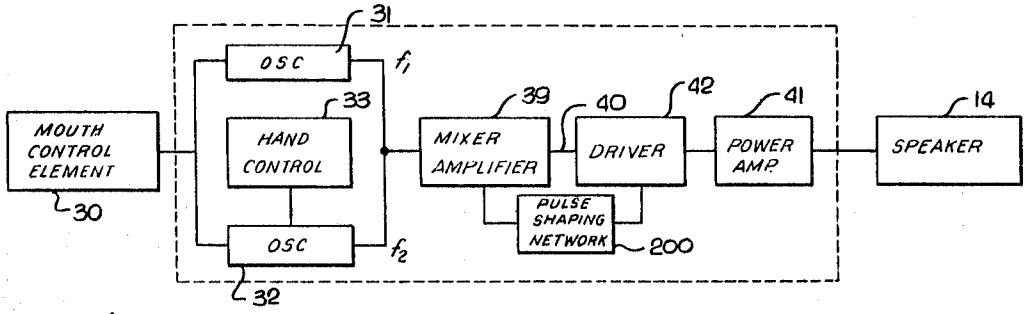
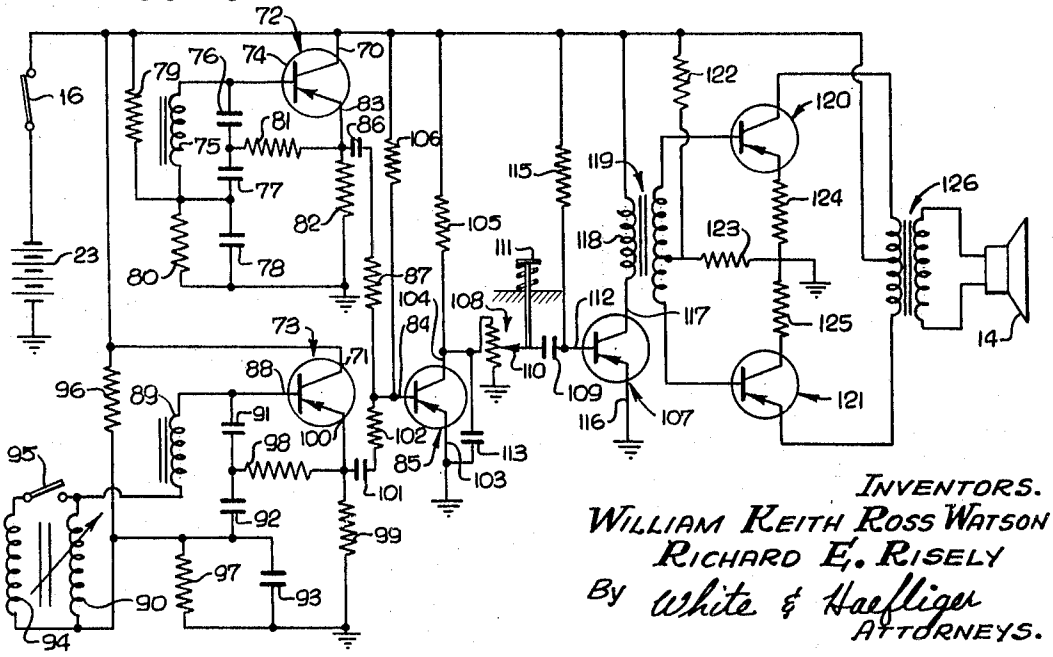


FIG. 5.



INVENTORS.
WILLIAM KEITH ROSS WATSON
RICHARD E. RISELY
By White & Haefliger
ATTORNEYS.

July 15, 1969 W. K. R. WATSON ET AL 3,456,062

MUSICAL INSTRUMENT

Filed May 21, 1965 2 Sheets-Sheet 2

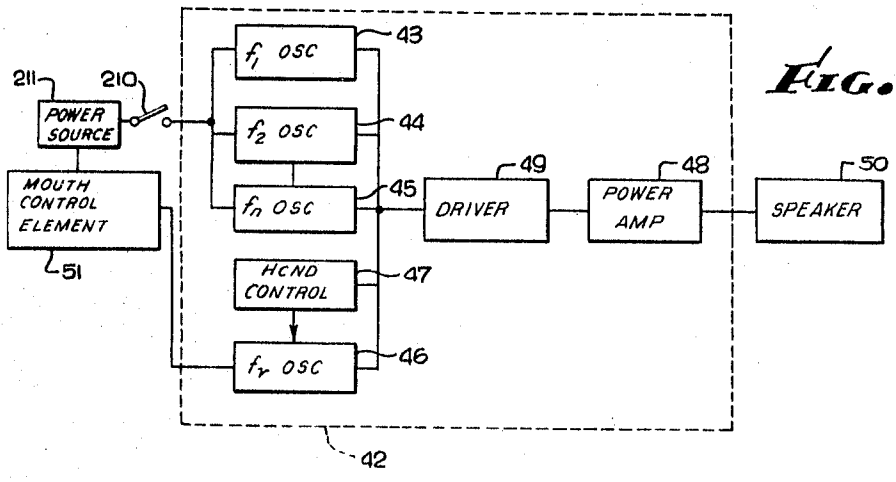


FIG. 6.

FIG. 7.

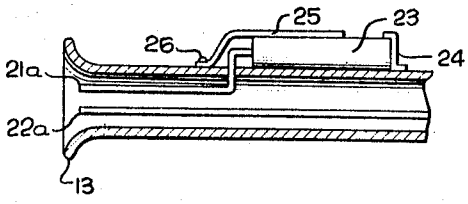


FIG. 8.

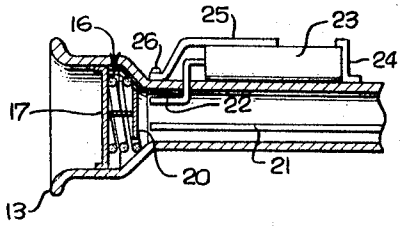


FIG. 9.

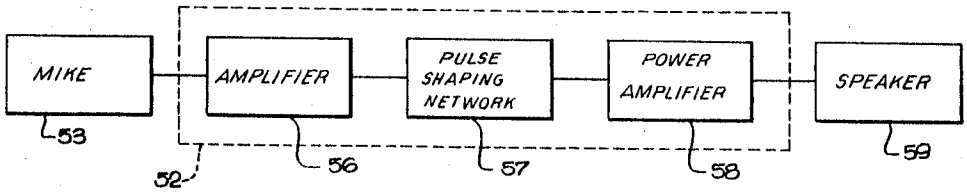
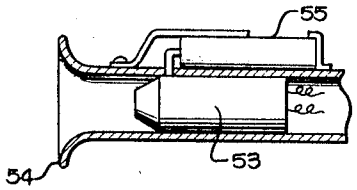


FIG. 10.



INVENTORS.
WILLIAM KEITH ROSS WATSON
RICHARD E. RISELY
By White & Haefliger
ATTORNEYS.

United States Patent Office

3,456,062
Patented July 15, 1969

3,456,062

MUSICAL INSTRUMENT

William Keith Ross Watson, Corona del Mar, and Richard E. Risely, Riverside, Calif., assignors to Astrodata, Inc., Anaheim, Calif., a corporation of California

Filed May 21, 1965, Ser. No. 457,575
Int. Cl. G10h 1/00, 1/02
U.S. Cl. 84—1.01 11 Claims

ABSTRACT OF THE DISCLOSURE

The disclosure concerns a musical instrument that combines hand and mouth operations to control an electrical circuit to produce musical tones.

This invention relates generally to musical instruments, and more particularly concerns electrically operable wind type instruments for producing musical sounds in an unusually effective and simple manner.

Conventional wind type instruments such as the brasses and reeds are constructed to require blowing thereof in such manner that the blown air sets up an acoustic vibration in the instrument, and resulting in the characteristic sound output thereof. One important reason why a beginner finds such instruments difficult to play is the necessity of training the lips or mouth to vibrate or otherwise act upon the instrument mouthpiece in a required manner to produce the desired quality output tone or sound.

The present invention has as its major object the provision of a wind instrument that obviates the above difficulty in an unusually advantageous and novel manner, greatly simplifying the manner of playing the instrument and adapting it especially for use by children either as a toy or a high quality instrument. Basically, the apparatus comprises a body having the configuration of a wind instrument with a mouthpiece, an electrical signal responsive speaker on the body, electrical circuit means having electrical connection with the speaker to supply it with an oscillatory signal for producing musical sound emission from the speaker, and an element operable by the player to control energization of the circuit, that element typically being mouth operable and located at the instrument mouthpiece. In this regard, the element may comprise an air pressure responsive electrical switch, or a mouth bite sensitive switch, or it may even comprise a microphone. Also, the body configuration typically forms a hollow bell, and the speaker may be contained by the body to direct sound to travel from within and to the exterior of the bell.

Another object of the invention is to provide in such an instrument a circuit that includes electrical oscillator apparatus operatively connected between the mouth operable element and the speaker, that apparatus including multiple oscillators at least one of which has a fixed output frequency and another of which has a variable impedance element operable to vary the other oscillator output frequency, there also being a manually operable control to variably displace the impedance element. As will appear, the control may comprise a trombone slide to vary an inductive impedance either smoothly or in stepwise relation to facilitate ease of instrument playing. The fixed and variable frequency outputs of the above mentioned oscillators are typically applied to a mixer to produce a reduced or beat frequency which is amplified and applied to the speaker.

Other objects of the invention include the provision for octave shifting of the sound output in an unusually effective manner; the provision of multiple oscillators of fixed but differing frequencies in the audio range together with a variable frequency oscillator in that range to simulate a bagpipe instrument; and the provision in the circuit between the mouth element and speaker of a pulse shaping network to control the tone of sound emission from the speaker.

These and other objects and advantages of the invention, as well as the details of an illustrative embodiment, will be more fully understood from the following detailed description of the drawings, in which:

FIG. 1 is a side elevation showing the invention adapted to a trombone type instrument;

FIG. 2 is an enlarged section taken through the slide of the FIG. 1 trombone to show manual slide control of a variable impedance element;

FIG. 3 illustrates a modification of the slide;

FIG. 4 is a block form diagram of the electrical circuit which may be incorporated in the FIG. 1 instrument;

FIG. 5 shows one way of mechanizing the FIG. 4 block diagram;

FIG. 6 illustrates another circuit incorporating the invention;

FIG. 7 shows a mouth control element which may be used in the FIG. 6 circuit;

FIG. 8 illustrates another modified mouth control element, which may be used in the instrument shown in FIG. 1;

FIG. 9 illustrates still another block diagram form circuit for use in the invention; and

FIG. 10 shows the mouth control element usable in conjunction with the FIG. 9 circuit.

Referring first to FIGS. 1 and 2, the musical instrument may take the form of a trombone **10**, either of a toy or a higher quality variety, and comprising a body **11** provided with a bell **12** and a mouthpiece **13**. The body carries an electrical signal responsive speaker, which may for example be contained by the body to direct sound to travel from within to the exterior of the bell. In FIG. 1 the speaker **14** is contained within the bell, and the numeral **15** designates the electrical circuit means having electrical connection with the speaker to supply an oscillatory electrical signal thereto for producing musical sound emission from the speaker. In this regard, there is a mouth operable element at the mouthpiece **13** to control energization of the circuit means **15**.

While different types of mouth operable elements at the mouthpiece **13** are contemplated, one form of such element is seen in FIG. 8 to include an air pressure responsive electrical switch designated at **16**. The switch is contained within the mouthpiece **13** and may comprise an air pressure responsive actuator disc **17** which is spring urged at **18** toward the entrance **19** to the mouthpiece, whereby when the player blows against the disc **17** it is urged inwardly of the mouthpiece. The disc may carry a contact **20** adapted when urged inwardly to contact a

pair of electrical terminals **21** and **22**, thereby effecting electrical energization of the circuit. Terminal **22** may project outwardly from the mouthpiece to engage an end terminal of a removable battery **23**, the opposite end terminal of the battery being grounded to the mouthpiece by a clip contact **24**. A holder **25** is pivotally attached at **26** to the mouthpiece to retain the battery in position. The other electrical terminal **21** is seen to expand inwardly for leading the current to the circuit means **15**. It will thus be seen that the player may effect operation of the instrument by merely blowing into the mouthpiece in any manner, as contrasted with the critical and difficult to master blowing technique required to operate a conventional wind instrument.

Referring to FIG. 7, the modified mouth control element is further simplified in that the terminals **21***a* and **22***a* are lengthened to project outwardly of the mouthpiece **13**. They are then adapted to be urged into contact with each other in response to biting by the player, thereby to effect energization of the circuit. Note in this regard that the parts **17–20** of FIG. 8 are denoted, while the parts **23–26** thereof are incorporated into the FIG. 7 device.

Referring now to FIG. 4, the electrical circuit means is shown in block form within the broken line block **15**. Generally speaking, the circuit includes electrical oscillator apparatus operatively connected between the mouth control element **30** and the speaker, the oscillator apparatus including multiple oscillators at least one of which, as for example oscillator **31**, has a fixed output frequency f_1, and another of which, as for example oscillator **32**, has a variable output frequency f_2. Further, oscillator **32** is characterized as having a variable impedance element operable to vary the output frequency f_2 thereof, there also being a manually operable control **33** to variably displace the impedance element in oscillator **32**. One form of such a control is shown in FIG. 2 as a trombone slide **34** for moving a core rod **35** in relation to an induction coil **36**, the latter comprising the variable impedance element of the oscillator **32**. The modified form of FIG. 3 shows the slide **34***a* connected to a rod **37** mounting spaced core bodies **38**, as for example ferrite, and of different size corresponding to the desired discretely different musical notes to be emitted from the speaker. Accordingly, when the slide is operated, the core bodies **38** are brought successively into such inductance varying relation to the coil **36** that the notes of the musical scale are emitted from the speaker, in ascending or descending order as desired.

Referring back to FIG. 4, the circuit **15** includes a mixer section **39** connected to receive the outputs of the oscillators **31** and **32**, and to produce a beat frequency output at **40** to be varied in response to operation of the manual control **33**. The circuit also includes a power amplifier **41** and a driver **42** therefor connected to receive the mixer output, and to drive the speaker **14**. A pulse shaping network may be provided between amplifier **39** and driver **42**, as indicated at **200**, connection **40** then being omitted.

Before referring to the detailed circuit of FIG. 5, reference will be made to FIG. 6 circuit means **42** which vary somewhat from the FIG. 4 block diagram. In FIG. 6 a series of paralleled oscillators **43–46** are provided, with oscillators **43–45** having fixed output frequencies in the audio range, and which are spaced in a selected relationship. A switch **210** controls energization of these oscillators, as from a power source **211**. On the other hand, the oscillator **46** has a variable output frequency which may be hand controlled at **47** by the player. The outputs of the oscillators are fed to the power amplifier **48** through the driver **49**, and the circuit is connected to the speaker **50** as before. With the oscillators also incorporating suitable pulse shaping networks, the instrument may provide music resembling the sound of a bagpipe. The mouth control element **51** for turning on the oscillator **46** may take the form of the element shown in FIG. 7, for example.

Referring now to FIG. 9, the circuit **52** there shown has its input connected to a mouth operable element comprising a microphone **53**. One form of such a microphone is shown in FIG. 10 as contained by the mouthpiece **54** and powered by the battery **55**. The circuit **52** includes a first amplifier **56**, the pulse shaping network **57** and a power amplifier **58** connected in series for driving the speaker **59**. Accordingly, whatever sound made by the player at the mouthpiece provides a vibration resulting in an oscillatory signal transmitted from the microphone, an amplified version thereof being transmitted to the pulse shaping network. The latter suitably shapes the signal to a form such that the speaker **59** emits a sound closely resembling the sound of the particular musical instrument desired, i.e. one of the brass or reed instruments. In this regard, the frequency of the speaker output is determined by the frequency of the humming or other sound picked up by the microphone **53**, whereby the player may for example, hum the musical scale, and the instrument will emit a trombone or other instrument sound ascending or descending through the musical scale.

Turning now to FIG. 5, the detailed circuit there shown illustrates one way in which the FIG. 4 diagram may be mechanized. The power source, as for example battery **23**, is connected through switch **16** with the collector terminals **70** and **71** of the two oscillator transistors **72** and **73**. The frequency determining network placed in the base circuit of transistor **72** having base terminal **74** includes inductance **75** and capacitors **76** through **78**. Bias conditions are provided by resistors **79** and **80**, and feedback and load resistors are provided at **81** and **82**. The oscillator output is taken from the emitter at **83** and coupled to the base terminal **84** of the mixer-amplifier transistor **85** via coupling capacitor **86** and resistor **87**.

Referring to the variable oscillator transistor **73**, the frequency determining network connected with the base electrode **88** thereof includes fixed inductance **89**, variable inductance **90**, capacitors **91–92**, and by-pass capacitor **93**. An added inductance coil **94** may be connected across coil **90** through a switch **95** to give an octave change in the musical tone emission from the speaker. Bias conditions are provided by resistors **96** and **97**, while feedback and load resistors are provided at **98** and **99**. The variable frequency oscillator output is taken from the emitter at **100** and coupled to the base terminal **84** of the transistor **85** via coupling capacitor **101** and resistor **102**. In this regard, the two oscillators may be alike as regards their components and the values thereof, excepting for the two inductances **90** and **94**, whereby the frequency output from the variable oscillator may be centered at and varied from the frequency of the fixed oscillator.

Mixer-amplifier transistor **85** has a grounded emitter **103** and a collector **104** connected to the battery through load resistor **105**. Base bias is provided by resistor **106**. The output from the transistor **85** is coupled to the base **112** of the driver stage transistor **107** via potentiometer **108** and coupling capacitor **109**. Wiper arm **110** of the potentiometer may be displaced by the player, as indicated by the actuator **111** (which may be mouth or finger actuated), to vary the loudness or intensity of sound emission from the speaker. Capacitor **113** filters out the fundamental oscillator frequency at the collector terminal **104** leaving only the audio difference frequency as the signal.

Driver transistor **107** has a base bias resistor **115**, a grounded emitter **116**, and its collector **117** is connected to the primary **118** of transformer **119**. The push-pull power amplifier includes transistors **120** and **121**, voltage divider resistors **122** and **123** and stabilizing resistors **124** and **125**. The collector outputs are applied across the primary of the output transformer **126**.

Purely illustrative values for the circuit elements in FIG. 5 are as follows:

All transistors	2N652
Resistors:	Ohms
79	1K
80	2K
81	150
82	1K
87	1K
96	1K
97	2K
98	150
99	1K
102	1K
105	1K
106	91K
115	27K
122	7.5K
123	150
124	18
125	18
Capacitors:	Microfarads
76	.1
77	.1
78	.1
86	.1
91	.1
92	.1
93	.1
101	.1
109	100
Battery ---volts--	9
Inductance:	
75 ---mh--	1
89 ---mh--	1
90 ---μh--	50
94 ---μh--	40
Speaker ---ohms--	8

We claim:

1. A musical instrument, comprising a body having the configuration of a wind instrument with a mouthpiece, an electrical signal responsive speaker on the body, electrical circuit means having electrical connection with the speaker to supply an oscillatory electrical signal thereto for producing musical sound emission from the speaker, a mouth operable switching element at said mouthpiece to control on-off energization of said means, a manually operable sliding control on the body for controlling said means to vary the sound tone, said control being in the form of a trombone slide and having a linear range of positions corresponding to a predetermined tone range, said circuit means including electrical oscillator apparatus operatively connected between said element and said speaker, and said apparatus including multiple oscillators at least one of which has a fixed output frequency and another of which has a variable impedance element operable to vary the other oscillator output frequency, said manually operable control connected to variably displace said impedance element.

2. The instrument as defined in claim 1 in which said circuit means includes a mixer connected to receive the outputs of said oscillators and to produce a beat frequency output to be varied in response to operation of said manual control, said circuit means also including a power amplifier and driver therefor connected to receive said beat frequency output.

3. The instrument as defined in claim 1 in which at least two oscillators have fixed oscillation frequencies in the audio range and which are different.

4. An instrument as defined in claim 1 in which said element comprises an air pressure responsive electrical switch.

5. An instrument as defined in claim 1 in which said element comprises a microphone, and said circuit means includes a shaping network to control the tone of the sound emission from the speaker.

6. An instrument as defined in claim 1 in which said body configuration forms a hollow bell, and said speaker is contained by said body to direct sound to travel from within to the exterior of said bell.

7. An instrument as defined in claim 1 in which said circuit means includes a pulse shaping network to control the tone of the sound emission from the speaker.

8. An instrument as defined in claim 7 in which said element comprises a microphone, and said circuit means includes electrical signal amplification apparatus.

9. An instrument as defined in claim 7 in which said element includes an electrical switch, and said circuit means includes electrical oscillator apparatus connected in series between said switch and said pulse shaping network.

10. The instrument as defined in claim 2 in which said other oscillator also includes a step impedance and manually operable switch means therefor for shifting the output frequency of said other oscillator sufficiently to secure an octave shift in said beat frequency output of the mixer.

11. A musical instrument, comprising a body having the configuration of an instrument with a mouthpiece, an electrical signal responsive speaker on the body, electrical circuit means including oscillator apparatus having electrical connection with the speaker to supply an oscillatory signal thereto for producing musical sound emission from the speaker, said apparatus adapted to receive energization from a power supply, said mouthpiece including an electrical switch which when bitten effects energization of the oscillator apparatus from said power supply, said oscillator apparatus including an inductance tuner in the form of relatively movable coil and core elements, said core element comprising multiple ferrite bodies to be brought successively into such inductance varying relation with the coil that tones of the musical scale are emitted from the speaker in predetermined sequence corresponding to said relative movement.

References Cited

UNITED STATES PATENTS

1,823,716	9/1931	Young	84—1.01
1,823,724	9/1931	Carlson	84—1.01
2,301,184	11/1942	Arnold	84—1.01
2,514,490	7/1950	Hanert	84—1.01
3,126,436	3/1964	Hyden	84—1.01
2,370,714	2/1945	Carlson	334—76
2,528,167	10/1950	Pan	334—76

ARTHUR GAUSS, Primary Examiner

H. A. DIXON, Assistant Examiner

U.S. Cl. X.R.

84—1.2