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[56]

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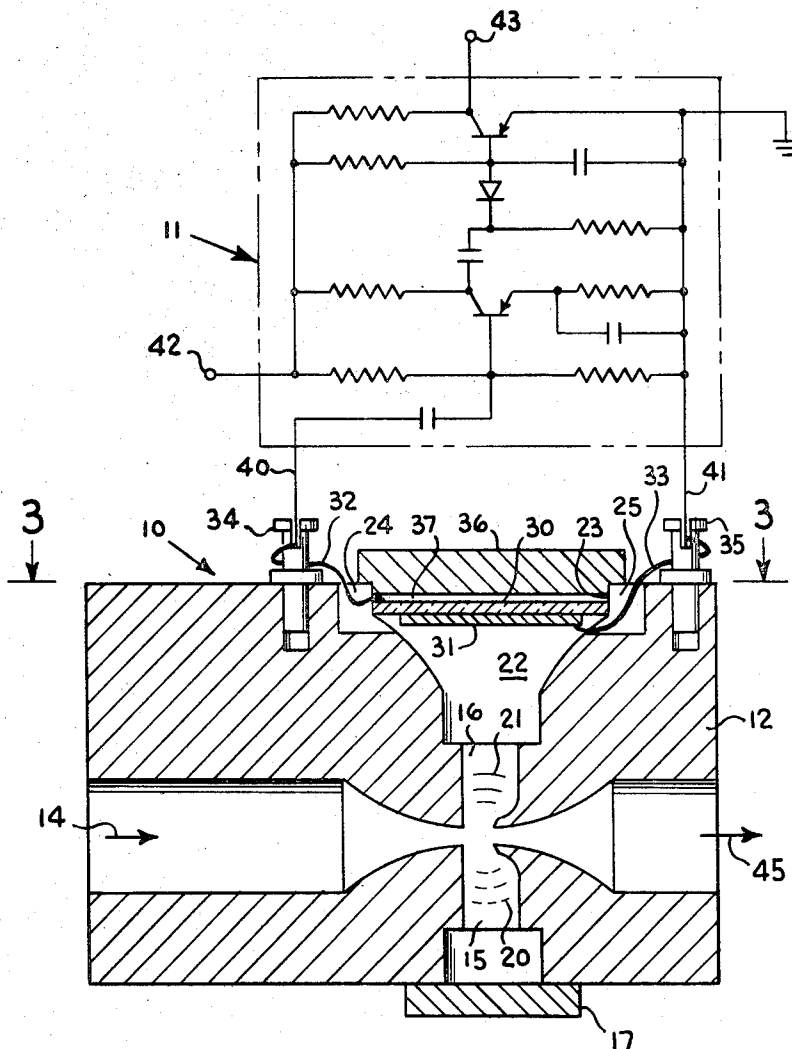
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[54] **TRANSDUCER**
3 Claims, 3 Drawing Figs.

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ABSTRACT: Transducing of a fluidic signal to an electric signal is accomplished in two steps by causing the fluidic signal to operate a whistle and then directing the resultant acoustical energy against a piezoelectric crystal that in sympathetically vibrating produces a low voltage output signal which can be used to control a suitable amplifying and rectifying electric circuit.



TRANSDUCER

TRANSDUCER

This invention relates to an improved fluid to electric transducing method and apparatus. More particularly the invention relates to a novel fluid to electric transducing system wherein the signal conversion is accomplished by the use of an intermediate acoustical energy form.

Several proposals have been previously made with respect to simplified fluid to electric transducers. These proposals for the most part involve the use of moving mechanical parts such as electrical contacts, pistons, diaphragms, plungers etc.; however these arrangements are not entirely satisfactory in some systems, such as fluidic circuits and the like, wherein the high speed and/or long life requirements exceed the normal capabilities of such moving-part mechanical arrangements. The instant invention contemplates overcoming these difficulties by providing a transducing system which has substantially no moving parts and which has very high speed and long life operating characteristics.

The primary object of the instant invention is to provide a novel fluid pressure to electric transducing system wherein a fluid pressure signal is first converted to an acoustical signal which is in turn converted to an electrical signal.

Another object of the instant invention is to provide an improved fluid to electric transducer wherein a whistle and a piezoelectric crystal are combined to effect a two-stage energy form conversion.

A further object of the invention is to provide an improved fluid to electric transducer that is rugged, reliable and has substantially no moving parts.

Other objects of the invention will become apparent as the disclosure progresses.

In the drawings:

FIG. 1 shows a cross-sectional plan view of the instant transducer apparatus (taken along section line 1-1 of FIG. 2) together with an exemplary electrical output circuit therefor.

FIG. 2 is front elevational view of the transducer apparatus illustrated in FIG. 1.

FIG. 3 is a diagrammatic sketch illustrating the slot-recess configuration in the instant transducer body.

Referring to FIGS. 1 and 2 there is shown a composite transducer body or whistle device 10 that is operatively adapted to control an electrical circuit 11. The body unit 10 comprises a grooved lower plate 12 and a cooperating cover plate 13 which are suitably secured together so as to define said whistle device that is capable, when supplied with air as indicated at 14, of generating ultrasonic sound waves at frequencies above 18,000 Hertz and preferably in the order of 50,000 Hertz. Except as otherwise described herein the construction and operation of the instant whistle device is substantially the same as that illustrated and described in my prior U.S. Pat. Nos. 3,500,952 and 3,432,804. Briefly here an airstream indicated by arrow 14 in passing longitudinally through the whistle produces high frequency sound waves in the two lateral chambers 15 and 16. The outer end of chamber 15 is blocked by any suitable means such as plate 17 so that the sound waves 20 in chamber 15 are reflected and tend to reinforce the sound waves 21 in chamber 16. The outer end of chamber 16 communicates with a coextensive and diverging bell-shaped chamber 22 formed in the composite body 10. A cylindrical recess 23 is formed in the outer side (upper side as seen in FIGS. 1 and 2) of the composite body 10, this recess being coextensive with and substantially axially aligned with the said bell-shaped chamber 22. Body 10 is further formed with narrow diametrically opposed slots 24, 25 (note in FIG. 3) which communicate with said recesses 22 and 23. Mounted in the cylindrical recess 23 is a brass disc 30 on the inner face

of which is secured, as by means of a suitable adhesive, a slightly smaller disc shaped piezoelectric crystal 31 which is vibrationally resonant at the frequency of the acoustical waves generated by the above noted whistle device and preferably at about 50,000 Hertz. Two lead connector wires 32, 33 are electrically connected between the brass disc 30 and crystal 31 and the terminal posts 34 and 35 respectively; the posts 34, 35 being secured in any suitable manner to the body 10 that is defined by the electrically nonconducting plastic plates 12 and 13. A disc cover 36 secured by any suitable means to the composite body 10 closes the end of recess 23 and has an inner face that is normally spaced a short distance from the adjacent surface of the brass disc 30, such spacing 37 allowing for unimpeded vibratory motion of the crystal and brass disc. The terminal posts 34, 35 are respectively connected to the control lines 40, 41 of the said electrical circuit 11 which constitutes any suitable circuit that appropriately amplifies and rectifies the voltage output signal from the crystal 31. Terminals 42, 43 designate the output connections from said circuit 11.

The operation of the instant apparatus will now be described. With no air flowing through the whistle device 10 there will be no acoustical wave energy impinging on the piezoelectric crystal 31 and under these conditions there will be no vibratory flexing of and hence voltage output from said crystal 31. When however air or other fluid is caused to flow as at 14, 45 through the whistle acoustical waves will be thereby generated and reinforced in chamber 16 and in passing through the divergent chamber 22 will impinge on said crystal and will cause the latter, together with the brass disc, to sympathetically vibrate and thus generate a corresponding low voltage output signal at leads 32 and 33. This output signal will thereafter be amplified and rectified by circuit 11 so as to constitute a practical usable control voltage at the output terminals 42 and 43.

As will be seen the instant method of transducing a signal involves first converting the fluid pressure signal to an acoustical signal and then converting the acoustical signal to an electrical signal at leads 32, 33 (and output terminals 42, 43). This two-stage energy conversion system has substantially no moving parts and thus is very rugged and reliable and offers a very accurate and uniform electrical output in response to fluid pressure signals having a wide range of power levels.

I claim:

1. A two-stage fluid to electric transducer:

comprising a whistle adapted to receive a pneumatic pressure signal and to generate acoustical waves above a frequency of 18,000 Hertz in response to said signal; conduit means for directing said acoustical waves along a predetermined path;

said whistle and conduit means being effectively defined by a block means having a longitudinal passage formed therethrough, said passage having a restricted portion intermediate the ends thereof, said block means also being formed with at least one laterally disposed acoustical wave conducting chamber which communicates at one end thereof with said restricted portion of said passage and at the other end thereof with a divergent chamber; a piezoelectric crystal adapted to sympathetically vibrate in response to said acoustic waves; and

mounting means for mounting said piezoelectric crystal adjacent the outer end of said divergent chamber and along said path whereby said pneumatic pressure signal may be converted to acoustical signal which in turn is converted to electrical signal.

2. Apparatus as defined by claim 1 wherein said conduit means includes a divergent chamber disposed between said whistle and said crystal.

3. Apparatus as defined by claim 2 wherein said whistle is formed with a throat portion and with at least one laterally extending resonating chamber.