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(54) KEY BOARD TRANSDUCER

(71) We, KUREHA KAGAKU KOGYO KABUSHIKI KAISHA, a Japanese Company, of No. 1—8, Horidome-cho, Nihonbashi, Chuou-ku, Tokyo, Japan, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to a key board transducer comprising as a stress transducer element a piezoelectric polymer film element having a plurality of piezoelectric unit portions and adapted so that changes in the stress signals applied to the piezoelectric unit portions are converted into changes in piezoelectric electric field.

A key board transducer has been proposed in Japan wherein a piezoelectric polymer film element comprises a piezoelectric film, for example, or polyvinylidene fluoride rendered piezoelectric through polarization and a plurality of piezoelectric unit portions distributed in the film having electrodes on both surfaces of the film. Mechanical stress signals can be applied to each of the unit portions to produce changes in the piezoelectric field across the stressed portion and the changes in the piezoelectric field are used for signal output.

In the example of the foregoing paragraph when a stress is applied to a unit portion of the key board transducer, this stress is also transmitted more or less to other unit portions adjacent thereto resulting in the generation of a piezoelectric field in the other unit portions but that such a piezoelectric field can easily be distinguished from the piezoelectric field generated from the unit portion to which the stress is applied since the level of the former is usually of the order of one tenth of the latter. If the stress applied to the elements is always constant, the piezoelectric output from the unit portion to which the stress is applied and the piezoelectric output from the other unit portions adjacent thereto can be distinguished and only the signals from the

former unit portion can be utilized for output by cutting the electric field below this constant value. When the values of the stress are varied significantly as in the case of touching a pushbutton with one's finger, the piezoelectric field generated from a unit portion by a low stress sometimes may be comparable to the piezoelectric field generated from the adjacent unit portions when a high stress is applied to the foregoing unit portion, and such an electric field in these adjacent unit portions forms undesirable noise.

A first object of this invention is to provide a key board transducer comprising a piezoelectric polymer film element in which the generation of noise from unit portions adjacent to the unit portion to which a stress is applied can be avoided.

Since piezoelectric polymer films with deposited electrodes are extremely thin, the films are often torn or the electrodes tend to peel off the films and they are not suitable for frequent use.

A second object of this invention accordingly is to provide a key board transducer capable of eliminating the foregoing defects.

This invention, accordingly, provides a key board transducer comprising a piezoelectric polymer film element having in the area of the polymer piezoelectric film, a plurality of piezoelectric unit portions satisfying the following conditions:

- said unit portions are portions of the polymer film and have electrodes on both surfaces thereof,
- the said unit portions of the polymer film have piezoelectric properties,
- any two unit portions are electrically independent from each other at least with respect to the electrodes on one surface of the polymer film;

and a substrate sheet on which the polymer film element is laid and having windows or recesses corresponding in position to each of the unit portions of the polymer film

element, each unit portion of the polymer film element being so secured to the substrate as to prevent a stress applied to one of the unit portions from being transmitted to another unit portion whereby the electric field generated from each of the unit portions is an independent output.

5 A development of this invention provides a key board transducer capable of eliminating the generation of noise where the piezoelectric polymer film element is covered with a protective sheet.

10 Areas of the polymer film between each of the piezoelectric unit portions may be secured to the substrate at an intermediate position between the windows or recesses so as to prevent a stress applied to one of the unit portions from being transmitted to other unit portions.

20 Electrical circuits may be provided for each of the unit portions.

The portions of the polymer film element forming the piezoelectric unit portions have the electrodes deposited on both sides thereof and at least the portion of the polymer film between the electrodes should have piezoelectric characteristics.

30 The polymer film can have uniform piezoelectric characteristics overall or it can be locally polarized and rendered piezoelectric in the portions for the piezoelectric unit portions. One electrode can be deposited substantially over one surface of the piezoelectric polymer film and electrodes can be deposited on the other surface in a spot like pattern, but the piezoelectric unit portions need be formed only in positions where the electrodes are deposited in this spot pattern. Similarly, where electrodes in a linear pattern are deposited on both surfaces of the film in such a manner that the electrodes on both surfaces cross each other, the piezoelectric unit portions need be formed only in these crossed portions.

45 Suitable electrodes include materials, for example, such as gold, platinum, silver, copper, aluminium, nickel, tin and other conductive substances and they are applied to both surfaces of a high polymer film using various means such as vapour deposition plating, printing, adhesion and the like.

50 The basic substrate sheet can be made with the necessary windows or recesses in suitable materials such as metals, synthetic resins, rigid rubbers, wood, litho plates, concrete, plaster board and other like materials.

55 The insides of the windows or the recesses need not always be empty and they can be filled with a liquid or a flexible solid substance such as foam rubber.

60 Any conventional means can be employed for securing the periphery of the piezoelectric unit portions to the substrate, such as adhesion and clamping so long as the stress, when applied to a unit portion, is not de-

livered substantially to adjacent unit portions.

These and other objects and advantages of this invention will be apparent from the following detailed descriptions of the specification and accompanying drawings, in which:—

Fig. 1 is a cross sectional view of one embodiment of a key board transducer according to this invention.

Fig. 2 is a plan view for a substrate of the key board transducer shown in Fig. 1.

Fig. 3 is a cross sectional view for another embodiment of a key board transducer according to this invention.

Fig. 4 is a cross sectional view for still another embodiment of a key board transducer according to this invention.

In Figs. 1 and 2, symbol A denotes a piezoelectric polymer film element comprising a polar polymer film 1, for example, of polyvinylidene fluoride, having electrodes 2 formed in a spot like pattern on one surface thereof and electrode 3 formed completely over the other surface thereof by vapour deposition. The portions of the film at least between both of the electrodes are piezoelectric. The polymer film element A is laid over a substrate B which has windows 4 in the positions corresponding respectively to those positions of electrodes 2 deposited in the spot-like pattern and having a surface area substantially equal to but slightly smaller than the surface area of the opposing electrodes. Electric contacts 5 are disposed in the periphery of the windows 4 for contact with the electrodes 2 and form an electrical connection therewith when the polymer film element A and the substrate B are layered, and a printed circuit is provided between each of the electric contacts 5 and terminals T correspondingly provided at the periphery of substrate B. Polymer film element A and substrate B are bonded together using adhesives, whereby the periphery of the spot electrodes and the electric contacts 5 are bonded with electro-conductive adhesives 7 and other portions are bonded with insulating adhesives 8.

Polymer film A and substrate B can be joined at the periphery of each window by the use of electroconductive adhesives only or they can be joined without using electroconductive adhesives by merely connecting them electrically through the contact in these portions. In the latter case, the electric contact between the contacts on substrate B and the periphery of the electrodes 2 contacted thereto should not be insulated by the insulating adhesives.

The printed circuit can be provided on the film element instead of on the substrate and, in this case, there is no need for an electrical contact between the polymer film element A and substrate B.

The device is grounded, for example, by way of electrode 3 deposited over the entire surface at 9 and is connected through each of the terminals T and by way of a FET (field effect transistor) 10 to an associated signal processing circuit 11. When a stress is applied to one, for example to P_1 , of the piezoelectric unit portions $P_1, P_2, \dots, P_n$, a piezoelectric field is generated at terminal T_1 , which is sent to its associated signal processing circuit 11 to perform an operation corresponding to the input signal from P_1 . Since the periphery of electrodes 2 of piezoelectric polymer film element A is secured to substrate B with insulating adhesives, adjacent piezoelectric unit portions are independent of each other with respect to stress since they are separated at the intermediate portion therebetween, and a stress applied on one unit element, for example P_1 is not transmitted to other unit portions $P_2, P_3, \dots, P_n$. Thus, no signals are developed at the other terminals $T_2, T_3, \dots, T_n$. Where the periphery of the electrodes is not secured to that of the windows 4, a stress applied to P_1 causes changes in the piezoelectric field for the entire film element A since this is not insulated with respect to the stress and, therefore, piezoelectric signal noise is inevitably generated more or less at other adjacent unit elements such as $P_2, P_3, \dots, P_n$, etc.

Another embodiment of a key board transducer according to this invention is shown in Figure 3, wherein a piezoelectric polymer film element A_1 is composed of a piezoelectric polymer film 1a having spot electrodes 2a and 3a deposited respectively on both surfaces thereof. A substrate B_1 is shown having windows 4a apertured there-through and small recesses 12 provided on the under surface thereof for securing the polymer film at the intermediate position between each of the unit elements, and a presser substrate B_2 has projections 13 in the positions corresponding to these recesses 12 and deep recesses 14 in the positions corresponding to the windows 4a in the substrate B_1 . The polymer film element A_1 is held between and thereby secured to substrate B_1 and B_2 and, as a result, each of the piezoelectric unit portions are separated from each other at the intermediate positions between them with respect to an applied stress.

The key board transducer shown in Figure 1 or one comprising a basic structure composed of the combination of $B_1-A_1-B_2$ shown in Figure 3 can be operated with the fingers and other means for applying a stress but when a hard stress application means is directly contacted to the electrodes, the electrodes tend to be damaged or the polymer film tends to be torn.

The key board structure shown in Figure

3 is constructed so that the stress can be transmitted to each of the unit devices by way of a fluid medium while avoiding a direct contact by the stress application means to the electrodes. In Figure 3, reference numeral 15 denotes a flexible rubber sheet or synthetic resin film attached to the upper surface of the substrate B_1 by adhesion or other suitable means. 16 designates push-buttons and 17 is an outer cover of the panel. As can be seen from the drawing, each of the windows 4a in the substrate B_1 is closed at one end with polymer film A_1 and with sheet 15 forms a reservoir for the operation fluid. As the operation fluid, air confined within said windows 4a is usually used but other gaseous or liquid tightly-sealed therein can be used. They are adapted so that the actuation of a pushbutton 16 depresses the sheet located beneath the button and generates a fluid pressure within the recesses 18, resulting in the generation of a piezoelectric field in the associated unit portion.

Instead of pressing the sheet 15 as shown in Figure 3, operation can also be performed by providing additional fluid conduits from reservoir (not shown) for the operation fluid and causing the fluid pressure in the conduit to change and the sheet 15 need not be flexible in this case.

A thin protection coating can be applied on the surface of the electrodes as another way for avoiding a direct contact of a means whereby a hard stress is applied to the piezoelectric polymer film element. This is extremely advantageous since such a coating can protect the electrodes not only against abrasion but also against moisture and corrosive atmospheres and it can be applied, if desired, also to the elements of the key board transducer shown in Figure 1 to Figure 3. It is, however, noted that the thickness of the coating should be restricted appropriately so that polymer film can be deformed by a small stress.

Where the piezoelectric polymer film element should be protected against greater mechanical shock, the polymer film can be covered with a flexible shock absorber sheet such as, for example, of rubber, foamed polyurethane, soft polyvinylchloride, polyethylene, etc. and the stress applied to the polymer film element through this shock absorber sheet. In the key board transducer, for example, shown in Figure 3, such a shock absorber material can be substituted for the operation fluid within the windows 4. A simple key board transducer structure employing the shock absorber sheet is shown in Figure 4, wherein a piezoelectric polymer film element is covered with a shock absorber sheet of about the same size.

In Figure 4, a piezoelectric polymer film element A_2 similar to the polymer film A

in Figure 1 is composed of a piezoelectric polymer film having spot electrodes on the lower surface and an over-all electrode on the upper surface thereof respectively, applied by vapour deposition. A substrate B_1 has recesses in the positions corresponding to the spot electrodes and printed circuits are formed either on the polymer film element A_1 or on the substrate B_1 . C is a flexible shock absorber sheet made, for example, of rubber, foamed polyurethane, etc. and D is a holding plate having operation windows 19 in positions corresponding to each of the piezoelectric unit portions. The embodiment shown is so adapted that by clamping B_1 and DD with a threaded stud 20, the periphery of each of the piezoelectric unit portions and the portions of the shock absorber material situated thereover are secured to the substrate B_1 and the peripheral area around the windows 19 in sheet D thereby separating the piezoelectric portions and other adjacent elements from each other with respect to stress, that is, stresses applied to these portions are not transmitted between each other.

The piezoelectric polymer film element used in this invention can be selected from piezoelectric films such as mono- or biaxially oriented poly- γ -methylglutamate film, or those films that are not piezoelectric as moulded but can be entirely or partially rendered piezoelectric through polarization under a high static electric field such as polyvinylfluoride, polyvinylidene fluoride, etc. and such polymer films can be provided with the required electrodes on both surfaces thereof. Films having thereon printed circuits can be used if desired.

For the piezoelectric polymer film, a higher piezoelectricity is desired since it provides higher sensitivity and facilitates noise separation. The piezoelectric polymer film having the highest piezoelectric property includes vinylidene fluoride polymers or copolymers consisting of vinylidene fluoride as an essential ingredient and a monomer or monomers copolymerizable therewith such as tetrafluoroethylene, trifluoroethylene, trifluoromonoethylenes, fluorochlorovinylidene, vinyl fluoride, hexafluoropropylene, ethylene, propylene and the like. Such polymer films are stretched and oriented to provide a β -type crystal structure and then subjected to polarization under a high static electric field below the withstand voltage of the film at a temperature above about 40°C and below the melting point of the film to result in a piezoelectric constant d_{31} at least about 1×10^{-8} cgsesu (1×10^{-8} cgsesu to 2×10^{-8} cgsesu).

The piezoelectric polymer film element can be formed by polarizing a polymer film between a pair of polarization electrodes to produce piezoelectric polymer film and

attaching thin film electrodes thereon by printing, adhesion and the like to form the piezoelectric unit portions. Alternatively, the polymer film portions can be formed by providing the necessary electrodes on the polymer film prior to polarization by vapour deposition, plating, printing, etc. and then polarizing by utilizing the electrodes as both electrodes for the polarization. Further, electrodes can be previously formed substantially over the entire surfaces of both sides of the films while leaving some margins around one or both surfaces so as to avoid short-circuit failures between both electrodes and, after the polarization, the electrodes on one or both surfaces of the polymer films are partially removed to form stripe or spot electrodes, in the case of stripe electrodes the stripes on one surface of the polymer film can be so arranged that they cross the stripes on the other surface.

Where the polymer film is excessively thin, a uniform thick film can not be obtained easily, often causing damage due to the high voltage applied in the polarization, which decreases the yield in the polarization. If the polymer film is too thick, the ratio of deformation to stress of the film is reduced and the application of a larger stress results in the transmission of that stress to adjacent unit portions causing disadvantageous noise. The preferred film thickness is in the range of about 3 μ to 200 μ , with the range of 10 μ to 100 μ being particularly preferred.

The thickness of the electrodes can be optionally selected so long as the electrodes conduct the current and allow the film to deform easily. Since the current flow through them is very small, even thin electrodes, for example, consisting of a transparent gold film with a thickness of less than about 100 μ and formed by vapour deposition can be used satisfactorily. An electroconductive adhesive tape of a thickness of about 35 μ laminated in two layers can also be used without difficulty.

The substrate sheet can be made of various materials without restriction provided that the sheet is not deformed by the application of the stress. These materials can be selected for the sake of electrical convenience, that is, where the substrate contacts the surface of the film on which the electrodes is provided overall, it may be convenient to use a metallic substrate and lead the substrate to ground, and where the substrate contacts the surface on which the spot electrodes are provided, the substrate desirably is made of an insulating material or of a metal coated with an insulating material.

The thickness of the substrate is so selected that the substrate can be formed with windows or recesses therein which are deep enough to allow the film to extend

locally and move freely perpendicular to the surface of the film when a stress is applied to the unit portions in the piezoelectric polymer film element. Usually, a thickness of more than about 100 μ is required on considering the strength but where the polymer film is deformed by a fluid medium as shown in Figure 3, it may be on the order of several tens of microns since the displacement of the film is small.

The size and the pitch of the windows or recesses provided in the substrate can be easily determined by those skilled in the art depending upon the structure and use of the key board switch. For example, for the embodiment to be operated with the fingers and pushbuttons, the windows or the recesses suitably have the size of about 5 mm to 30 mm and a pitch from about 1 mm to 50 mm, and for the embodiment operated by a fluid operated device they can have a smaller aperture diameter and pitch.

In addition to the printed circuit, FET, diodes, resistors, capacitors and the like can also be mounted on the substrate.

The key board transducer of this invention can be assembled easily since it can be achieved merely by securing the piezoelectric polymer film element to the substrate and the cost for the wiring operation can be reduced significantly because the wiring from the film element to the terminals can be completed together with the assembly of the key board transducer by providing a printed circuit either on the polymer film element or on the substrate. Moreover, since the operation is conducted without using electric contacts, no sparks, contact source and the like occur at the time of contact and stable operation for a prolonged period can be achieved.

The invention is further illustrated by reference to the following example.

Example

A monoaxially oriented polyvinylidene-fluoride film of a thickness of 20 μ was provided with an aluminum electrode entirely over one surface through vapour deposition and in a spot pattern, having a diameter and a pitch both of 10 mm, on the other surface through vapor deposition and a static electric field of 1.2 KV (electric field intensity 600 KV/cm) was applied to the film having the deposited aluminum electrodes across the electrodes on both surfaces for 30 minutes in a thermostatically controlled bath. Thereafter, it was allowed to cool to room temperature (about 20—30°C) while applying the above static electric field and then the electric field was removed. The film had a piezoelectric constant d_{31} of 5×10^{-7} cgsesu only in the portions to which the electric field had been applied.

The piezoelectric polymer film element using, as the piezoelectric portion, the foregoing polarized polyvinylidene-fluoride was assembled as shown in Figure 1 to a substrate a thickness of 2 mm having windows of a diameter of 8 mm in positions corresponding to the spot electrodes of the piezoelectric polymer film unit portions and provided with printed circuits as shown in Figure 2. On touching a piezoelectric unit portion over a window, an electric field of a signal having a peak of 1 to 30 volts developed at the corresponding terminal whereas no piezoelectric changes were found in the terminal corresponding to the adjacent unit portions.

The over all surface of the under side of the key board substrate was coated with adhesives and a 20 μ thick polyester film was bonded over it. On slightly touching the window portion from the side of the polyester film, an electric field of a signal of 100 to 1000 mV developed at the terminal.

As a comparison example, a key board transducer was assembled by forming a piezoelectric polymer film element through the polarization of the same polyvinylidene-fluoride film as above except that additional circuit wiring was provided from each of the spot electrodes to the side margins in the printed circuit. The periphery of the polymer film element was then bonded and secured to the frame and merely laid over the substrate with the windows. On slightly touching one of the unit portions of the key board transducer an electrical field of 1.2V developed at the corresponding terminal accompanied by an electric field of 50 to 90mV developed at the terminals corresponding to the adjacent unit portions. Then, on touching the same unit portion with a somewhat greater stress, the corresponding terminal showed an electrical field of about 8V accompanied by an electric field of 0.7 to 1.8 volts at the terminals corresponding to the adjacent unit portions.

While the invention has been particularly shown and described with reference to preferred embodiments thereof, it will be understood by those skilled in the art that various changes in form and details may be made therein without departing from the scope of the invention as defined in the following claims.

WHAT WE CLAIM IS:—

1. A key board transducer comprising a piezoelectric polymer film element having in the area of the polymer piezoelectric film, a plurality of piezoelectric unit portions satisfying the following conditions:

(a) said unit portions are portions of the polymer film and have electrodes on both surfaces thereof,

locally and move freely perpendicular to the surface of the film when a stress is applied to the unit portions in the piezoelectric polymer film element. Usually, a thickness of more than about 100 μ is required on considering the strength but where the polymer film is deformed by a fluid medium as shown in Figure 3, it may be on the order of several tens of microns since the displacement of the film is small.

The size and the pitch of the windows or recesses provided in the substrate can be easily determined by those skilled in the art depending upon the structure and use of the key board switch. For example, for the embodiment to be operated with the fingers and pushbuttons, the windows or the recesses suitably have the size of about 5 mm to 30 mm and a pitch from about 1 mm to 50 mm, and for the embodiment operated by a fluid operated device they can have a smaller aperture diameter and pitch.

In addition to the printed circuit, FET, diodes, resistors, capacitors and the like can also be mounted on the substrate.

The key board transducer of this invention can be assembled easily since it can be achieved merely by securing the piezoelectric polymer film element to the substrate and the cost for the wiring operation can be reduced significantly because the wiring from the film element to the terminals can be completed together with the assembly of the key board transducer by providing a printed circuit either on the polymer film element or on the substrate. Moreover, since the operation is conducted without using electric contacts, no sparks, contact source and the like occur at the time of contact and stable operation for a prolonged period can be achieved.

The invention is further illustrated by reference to the following example.

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As a comparison example, a key board transducer was assembled by forming a piezoelectric polymer film element through the polarization of the same polyvinylidene-fluoride film as above except that additional circuit wiring was provided from each of the spot electrodes to the side margins in the printed circuit. The periphery of the polymer film element was then bonded and secured to the frame and merely laid over the substrate with the windows. On slightly touching one of the unit portions of the key board transducer an electrical field of 1.2V developed at the corresponding terminal accompanied by an electric field of 50 to 90mV developed at the terminals corresponding to the adjacent unit portions. Then, on touching the same unit portion with a somewhat greater stress, the corresponding terminal showed an electrical field of about 8V accompanied by an electric field of 0.7 to 1.8 volts at the terminals corresponding to the adjacent unit portions.

While the invention has been particularly shown and described with reference to preferred embodiments thereof, it will be understood by those skilled in the art that various changes in form and details may be made therein without departing from the scope of the invention as defined in the following claims.

WHAT WE CLAIM IS:—

1. A key board transducer comprising a piezoelectric polymer film element having in the area of the polymer piezoelectric film, a plurality of piezoelectric unit portions satisfying the following conditions:

(a) said unit portions are portions of the polymer film and have electrodes on both surfaces thereof,





- (b) the said unit portions of the polymer film have piezoelectric properties,
 (c) any two unit portions are electrically independent from each other at least with respect to the electrodes on one surface of the polymer film;

and a substrate sheet on which the polymer film element is laid and having windows or recesses corresponding in position to each of the unit portions of the polymer film element, each unit portion of the polymer film element being so secured to the substrate as to prevent a stress applied to one of the unit portions from being transmitted to another unit portion whereby the electric field generated from each of the unit portions is an independent output.

2. A key board transducer according to Claim 1, wherein the piezoelectric polymer film element and the substrate are bonded with adhesive.

3. A key board transducer according to Claim 1 or 2, wherein the piezoelectric polymer film element is held between and secured to two substrates.

4. A key board transducer according to Claim 1, 2 or 3, wherein the piezoelectric unit portions laid over the windows form a reservoir for an operation fluid associated with each unit portion and the transducer is arranged to be operated by changes in the pressure of said operation fluid in a reservoir to thereby change the electric field generated by its associated unit portion.

5. A key board transducer according to any one of Claims 1 to 4, including a shock absorber sheet held between one surface of the piezoelectric film element and a presser substrate and another substrate having operation windows in the positions corresponding to each of the piezoelectric unit portions covering the other surface of the piezoelectric polymer film element.

6. A key board transducer according to any one of Claims 1 to 5, including electrodes in a spot pattern electrically independent from each other on one surface of the piezoelectric polymer film element and a common electrode substantially over the entirety of the other surface of the piezoelectric polymer film element.

7. A key board transducer according to Claim 6, wherein the common electrode is grounded as a common buss and each of the electrodes in the spot pattern are provided with respective wiring for connection to an external circuit.

8. A key board transducer according to Claim 7, in which each of the electrodes are connected to the external circuit by way of an FET.

9. A key board transducer, according to any one of Claims 1 to 5, comprising contacts electrically connected to the electrodes in a spot pattern on the polymer film element, the contacts being provided on the periphery of each of the windows or recesses in the substrate laid over the said electrodes in a spot pattern and each of said contacts being provided with printed circuits leading to terminals at the periphery of the substrate.

10. A key board transducer according to Claim 9, wherein said printed circuits includes diodes, FET's and/or resistors.

11. A key board transducer according to Claim 9 or 10, wherein each of the terminals is connected by way of an FET to signal processing circuits.

12. A key board transducer according to any one of Claims 1 to 5, including electrodes in a spot pattern electrically independent from each other on both surfaces of the piezoelectric polymer film element.

13. A key board transducer according to any one of Claims 1 to 5, including band shaped electrodes in a stripe pattern on both surfaces of the piezoelectric polymer film element in such a manner that the stripes on both surfaces cross each other.

14. A key board transducer according to any one of the preceding Claims, wherein the piezoelectric polymer film element is piezoelectric over the entire surface.

15. A key board transducer according to any one of Claims 1 to 13, wherein the piezoelectric polymer film element is locally piezoelectric only in the portions that form each of the piezoelectric unit portions.

16. A key board transducer according to any one of the preceding Claims, wherein the piezoelectric film element comprises a polymer film of vinylidene fluoride having a β -type crystal structure.

17. A key board transducer according to any one of Claims 1 to 15, wherein the piezoelectric polymer film element comprises a copolymer film of vinylidene fluoride as an essential component and a monomer or monomers copolymerizable therewith having a β -type crystal structure.

18. A key board transducer substantially as hereinbefore described with reference to and as illustrated in the accompanying drawing.

GEE & CO.,
 Chartered Patent Agents,
 Chancery House, Chancery Lane,
 London, WC2A 1QU,
 and

39 Epsom Road, Guildford, Surrey.
 Agents for the Applicants.