(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 441 993 A1**

(12) EUROPEAN PATENT APPLICATION

(21) Application number: **90102672.4**

(22) Date of filing: **12.02.90**

(51) Int. Cl.5: **H01H 13/70**

(43) Date of publication of application:
21.08.91 Bulletin 91/34

(84) Designated Contracting States:
DE FR GB IT

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(54) Actuator plate for keyboard.

(57) The present invention concerns an actuator plate (1) with integrated short-stroke keys (7, 3, 5, 25, 28, 32) in particular for keyboards of outdoor automatic teller machines. The relatively inflexible actuator plate (1) is completely flat and has one or several key fields (9) forming a continuous part with the actuator plate. From the plane of the actuator plate, the individual key field (9) may be deflected downwards, conveying to the user actuating the key a tactile key stroke. This is achieved by a first arrangement (11) of a series of slots (12) surrounding the key field (9). At a greater distance therefrom, a second arrangement (15) is positioned, the slots (16) of which are arranged so that the spacing between the first and the second slot arrangement (11, 15) is defined in such a manner that the area of actuator plate (1) enclosed by the two slot arrangements (11, 15) functions as a spring (19) on which the key field (9) is suspended. The actuator plate (1) with the integrated short-stroke keys, designed according to the invention, combines the advantages of mechanical keyboards consisting of individual keys with those of foil and diaphragm keyboards, without displaying the disadvantages of the latter.

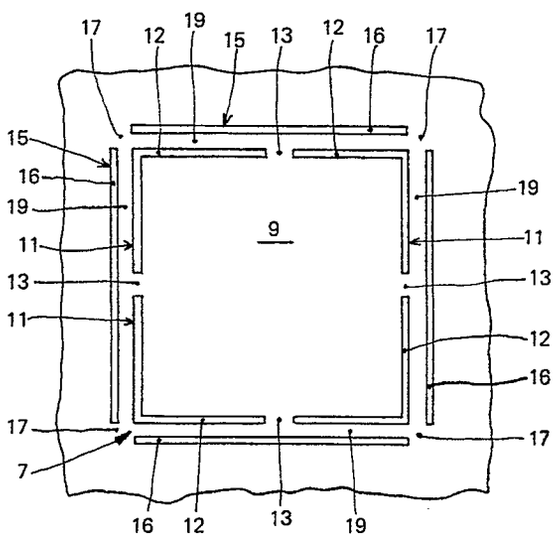

FIG. 2

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ACTUATOR PLATE FOR KEYBOARD

The present invention concerns an actuator plate with integrated short-stroke keys, in particular for keyboards of outdoor automatic teller machines, according to the preamble of claim 1.

Keyboards of automatic teller machines, of which at least operating components are positioned outdoors, have to be extremely robust, as they must be accessible to everyone and are exposed to any weather conditions. This necessitates in particular that the keyboard should withstand shock, heat, cold, rain, snow, ice, etc. and any kinds of vandalism. On the other hand, the keyboard must be designed to cope with operating faults. This means in particular that the user entering information should receive feed-back to the effect that within a given field a key may be pressed at any arbitrary location, that the switching force must be low, that the keyboard must be adaptable to special user requirements without design changes, and that faulty operation of the keyboard by tools or other objects is largely prevented.

These requirements are met only partly by currently marketed keyboards. Although keyboards with mechanically acting single keys are user friendly with regard to the low switching force and the tactile key stroke, their design is elaborate and their manufacture and assembly are very expensive. In addition, they are not suitable for outdoor use involving changing weather conditions, such as cold, heat, moisture, and the risk of vandalism. Compared with mechanical keyboards, foil keyboards have the advantage that their design is simple, that, consequently, they are inexpensive to produce and assemble, and that they are highly unsusceptible to weather conditions. Their disadvantage is however that they have a rigid user surface, that they are unelastic, and that no tactile switching action is conveyed to the user. As a result, the user tends to exert excessive force on the keyboard's actuating surface or to employ additional means, such as a pencil or ball-point pen. This frequently leads to improper use with the consequence of a greatly reduced service life of the diaphragm keyboard.

Other foil keyboards try to remedy these disadvantages by providing the actuating surface with relatively elastic raised or projecting keys with integrated snap-action switches. This conveys to the user a tactile switch action, but there is the disadvantage that such raised keys are relatively unprotected against improper use or deliberate destruction.

A further type of keyboard is described in IBM Disclosure Bulletin Vol. 13, No. 7, December 1970, p. 1943; Vol. 14, No. 3, August 1971, p. 767; and Vol. 12, No. 11, April 1970, p. 1923. The actuator plate takes the form of one or several diaphragms that or more or less elastic and that are actuated by finger force or a special actuating mechanism. The function of these diaphragms may be described such that they are deformed in response to being depressed, closing a contact triggering a signal.

A disadvantage of this kind of diaphragm keyboard is that no tactile switch action is conveyed to the user entering data, so that such a keyboard is not user friendly.

A further disadvantage of the diaphragm keyboard is that the elastic properties of the diaphragms required for its function may be adversely affected by outdoor use, since the keyboard is largely unprotected against deliberate destruction.

In IBM Technical Disclosure Bulletin Vol. 24, No. 1B, June 1981, p. 734, a finger-actuated elastic diaphragm is described which consists of an actuator plate with two semicircular recesses that are positioned to one another such that a flexible septum is formed. By depressing this septum a contact triggering a signal is closed. The design of this diaphragm is not very user friendly either, as there is no tactile key stroke, the diaphragam being deformed downwards. In addition, this kind of diaphragm is not very resistant to improper handling or deliberate destruction. This holds in particular for the septum and the semicircular recess.

It is the object of the present invention to provide a keyboard combining the advantages of keyboards consisting of individual keys with those of foil or diaphragm keyboards, without having the disadvantages of the latter.

This object is accomplished in principle by the features contained in the characterizing part of claim 1. Further advantageous developments and special embodiments of the invention may be seen from the subclaims.

The advantages obtained by the invention essentially consist in the key integrated in the actuator plate being highly user friendly, in particular with regard to the fact that a tactile key stroke is conveyed to the user.

The key functions satisfactorily even if it is not depressed exactly in the center. The key is self-restoring and the switching force is low. The actuator plate is designed such that it is highly resistant to improper handling, vandalism or weather conditions.

The shape of the keys and their arrangement on the actuator plate may be chosen arbitrarily. As key and actuator plate form one integrated compo-

nent, the overall height of the actuator plate is very small. Manufacture and assembly are simple and inexpensive. The design and the colour of the foil covering the keyboard may be chosen at random and be adapted to customer requirements.

The invention is described in detail below by means of several embodiments with reference to drawings, in which

- Fig. 1 is an embodiment of the actuator plate designed according to the invention with specially designed single and double keys;
- Fig. 2 is a key designed according to the invention in the form of a square single key with angular and longitudinal slots;
- Fig. 3 is a key modified over the embodiment of Fig. 2 with long angular slots;
- Fig. 4 is a key designed according to the invention in the form of a rectangular double key with angular and crimped longitudinal slots;
- Fig. 5 is a key designed according to the invention with another slot shape modified over the embodiment of Fig. 4 with slots extending across two corners;
- Fig. 6 is a key designed according to the invention in the form of a circular key with crimped slots;
- Fig. 7 is a key designed according to the invention in the form of a triangular key with diagonally changing slots;
- Fig. 8 is a key designed according to the invention in a form modified over Fig. 6 with staggered circular segment slots;
- Fig. 9 is an exploded view of the design of a keyboard comprising an actuator plate according to the invention;
- Fig. 10 is a detail sectional view of the single key of Fig. 3 designed according to the invention;
- Fig. 11 is a detail sectional view of the double key of Fig. 4 according to the invention, and
- Fig. 12 is an exploded view of the design of a keyboard comprising the actuator plate according to the invention with insertable foils.

Fig. 1 shows the actuator plate 1 designed according to the invention with single keys 3 and double keys 5. The actuator plate 1 preferably consists of a relatively rigid plastic material, such as nylon, and preferably has a thickness of about 1 to 1.5 mm. Another conceivable material would be, for example, steel CR NI 188. The plastic actuator plate is preferably made by injection molding; a steel actuator plate would be produced by etching.

Fig. 2 shows a key designed according to the invention in the form of a square single key 7. The square single key 7 is designed such that the key field 9 is surrounded by an inner slot arrangement 11. The individual inner slots 12 are preferably positioned on the circumference of the respective geometric shape of the key 7. With the square shape of the key 7 according to the invention, the inner slot arrangement 11 is positioned on the circumference of a square. The inner slot arrangement 11 consists of four angular slots. The four angular slots define the corner areas of the square key field 9. The inner slots 12 are preferably arranged relative to each other such that each slot 12 and its respective adjacent slot 12 on the circumference are separated by a relatively short inner bar 13. The inner slot arrangement 11, confining the key field 9, is surrounded by an outer slot arrangement 15. The outer slot arrangement 15 consists of four outer longitudinal slots defining the outer circumference of the square key 7. The outer slots 16 are preferably arranged to each other such that each outer slot 16 and its respective adjacent outer slot 16 on the outer circumference are separated by a relatively short outer bar 17. The outer bars 17 define the corner regions of the outer circumference of the square key. Outer slots 16 and inner slots 12 are preferably positioned parallel to each other. The outer slots 16 and the inner slots 12, positioned opposite each other, form relatively thin bars 19 which function as spring arms and which are hereafter referred to as spring arms 19. These spring arms 19 form a movable connection between the key field 9 confined by the inner slot arrangement 11 formed by the inner slots 12 and the actuator plate 1. The bars 17 formed by the outer slots 16 function as supports, i.e., the spring arms 19 rest against them.

The inner slots 12 and the outer slots 16 in this embodiment are preferably positioned relative to each other such that several interconnected spring arms 19 are formed. The number of spring arms 19 may vary depending upon the size of the key field 9. This is to keep the deflection force at a minimum. As a result of this outer slot arrangement 15 and the inner slot arrangement 11, the key field 9 is deflectable from the plane of the actuator plate, e.g., downwards in stroke fashion. The spring arms 19, formed by the outer slots 16 and the inner slots 12, represent a suspension of the key field 9 with the special feature that each point of the key field 9 allows tactile deflection. An advantage of this is in particular that proper functioning is also ensured if key field 9 is depressed off-center. The width of the slots 12 and 16 is preferably such that there is no friction between the slot edges when a key

stroke occurs. The thickness of the material of spring arms 19 is preferably thinner than the remaining thickness of the key 7.

Fig. 3 shows a further embodiment of the key 7 according to the invention, as illustrated in Fig. 2. This embodiment of Fig. 3 differs from that of Fig. 2 in that, by means of a connector slot, only one end 21 of each inner slot 12 and only one end 22 of each outer slot 16 are connected to each corner of the key field 9. The inner slots 12 and the outer slots 16 are preferably arranged relative to each other across the key field 9 such that the connector slots 23 form four spring arms 19 which are separated from each other. As a result of this arrangement of the connector slots 23 four spring arms 19 of maximum length are obtained which are positioned relative to each other such that each pressure point on the key field 19 is associated with a sufficiently long spring arm 19, ensuring a uniform key function also in the peripheral areas of the key field 9. The key field 9 is deflectable in stroke fashion at each point, i.e., the operation of the key according to the invention corresponds to that of a mechanical key. The number of connector slots 23 determines the number of spring arms 19.

Fig. 4 shows yet a further embodiment of a key according to the invention in the form of a rectangular double key 5 which in principle is made up of two single keys 3 (Fig. 3) of the invention. In comparison with the single key 3 of Fig. 3, the key field 9 of the double key 5 is suspended on six spring arms 19 and is about twice as large. With the double key 5, the inner slot 12 continues in the outer slot 16 staggered in parallel thereto by means of a connector slot 23, so that two spring arms 19, which are separated from each other, are formed on the long side of the double key 5.

Fig. 5 shows a further embodiment of the key according to the invention in the form of a rectangular double key 25. The inner slot arrangement 11 consists of two U-shaped slots 12 and two longitudinal slots 12. The two U-shaped slots 12 define the corner regions of the rectangular key field 9 and the two longitudinal slots the long sides of the rectangular key field 9. Four inner bars 13 are positioned on the circumference of the rectangular key field 9. As there are no connector slots 23 between the inner slots 12 and the outer slots 16, this embodiment requires a higher deflection force for actuation.

Figs. 6, 7 and 8 show different embodiments of the key 3 according to the invention. The key 3 designed according to the invention and as shown in Figs. 6, 7 and 8 is not confined to a particular geometric shape. The keys in Figs. 6 and 7 are designed according to the same principle as the keys in Figs. 3 and 4. As shown in Figs. 6 and 7, the circular key 28 and the triangular key 30 are each suspended on three spring arms 19. The outer slots 12 and the inner slots 16 are diagonally connected by means of connector slots 23, at a particular point, the inner slot 12 continuing in the outer slot 16. With these embodiments, the number of spring arms 19 may be increased. A further embodiment of the actuator plate 1 according to the invention consists in the slots 12 being replaced by 16 perforations which are produced by punching.

Fig. 8 shows an embodiment of the key according to the invention which follows the same design principle as the key of Figs. 2 and 5. In view of the fact that the outer slots 16 and the inner slots 12 are not interconnected by a connector slot 23, the deflection of the key field 9 is limited and a higher deflection force is required for actuating the key 32.

Fig. 9 shows by way of an exploded view the design of a keyboard using the actuator plate 1 according to the invention. The actuator plate 1 is provided with a plurality of square single keys 3 and double keys 5 and is covered by a flexible foil 36. The covering foil 36 serves a double function, it carries the relevant key symbols 41 and it weatherproofs the keyboard and the keys 3, 5 of the actuator plate 1 against rain, snow, ice, in addition to protecting keyboard and keys against improper handling. The actuator plate 1 rests planely on the holding foil 46. Underneath the holding foil 46, the metal domes 40 on the switching foil 44 are positioned in recesses 51 of the spacer foil. From the switching foil 44, a connector cable 33 links up with the microprocessor. The actuator plate 1 with the different foils is supported on the carrier plate 34.

Fig. 10 shows a detail sectional view of a keyboard with the actuator plate 1 designed according to the invention and comprising a single key of Fig. 3. The keyboard is preferably made up of the following segments or parts of single elements: carrier plate 34, switching foil 44, spacer foil 45, holding foil 46, metal domes 40, actuator plate 1 and covering foil 36. The switching foil 44 rests on the carrier plate 34. The spacer foil 45 is positioned on the switching foil 44. The spacer foil 45 is provided with recess 51 in which the metal domes 40 are arranged. The holding foil 46 rests on the spacer foil 45. The holding foil 46 serves to position the metal domes 40 relative to the key 3. In its plane facing the holding foil 46, the key 3 is provided with preferably step-shaped recesses 57. The deepest recess 57 is arranged in the region of the slots 12 and l6 of the key 3. Recesses 57 decrease stepwise in the direction of the center of the key 3, thence continuing in the support face 55. Support face 55 contacts the metal domes 40 through holding foil 46. When the key 3 is depressed, the support area 55 is displaced down-

wards, bending the holding foil 46 downwards. As a result, the metal domes 40 snap, i.e. the round surface of the metal dome 40 folds abruptly inwards so that contact to the switching foil 44 is established, triggering a key signal. When the key 3 is released, the metal dome 40 resumes its original position, exerting in addition to the spring-dependent restoring force, an additional restoring force on key 3, returning the latter to its original position. The support face 55 is arranged opposite the metal domes 40, ensuring a reliable operation and a tactile and audible snap-action of the metal domes 40 which occurs also if the key is depressed off-center.

Fig. 11 is a detail sectional view of the actuator plate 1 comprising a double key of Fig. 4. In comparison with the single key 3, the double key 5 has two raised portions or projections 53 with two support faces 55 in the area facing the holding foil 46. The support faces 55 contact the two metal domes 40, provided for a double key, through the holding foil 46. As a result, an adequate tactile key stroke is exerted over the full length of the key at a low switching force.

Fig. 12 shows an exploded view of a keyboard with the inventive actuator plate 1 comprising insertable foils 58. As shown in Fig. 12, the actuator plate 1 is provided with single keys 3 as well as with double keys 5.

In the region of the keys 3 and 5, the actuator plate 1 comprises recesses 59 of different width to accommodate the insertable foils 58. Different and exchangeable foils 58 suiting particular customer requirements may be used at any time. The insertable foils 58 may be arranged directly above the key field 9 without impairing the switch function of the keys. The inscription and colours for the respective key symbols are provided on the insertable foils 58. By using the material LISA, produced by Bayer, the key fields 9 and the inscriptions of the insertable foils 58 may be illuminated. The back sides of the insertable foils 58 are printed or engraved and the portion of the insertable foil 58 projecting from the key is illuminated, so that the key is suitable for night use. The covering foil 36, fixed to the actuator plate 1, is transparent in this case. In addition, foil 36 may be provided with a raised key edge 60. The actuator plate 1 with the insertable foil 58 and the covering foil 36 is fixed on the holding foil 46 in this case.

The actuator plate 1 according to the invention has all the essential advantages of a mechanically acting single key board, is user friendly, has a tactile key stroke, a low switching force, functions even if the key is depressed off-center, without having the disadvantages of the mechanically acting keyboard, such as a complicated design and thus being expensive to produce and assemble, a relatively large overall height of the keyboard, being susceptible to destruction and vandalism, and being adaptable to customer requirements only to a limited extent.

In addition, the actuator plate of the invention has all the essential advantages of the foil keyboard, such as a low overall height, being inexpensive and simple to produce and assemble, having an arbitrarily designable keyboard, without displaying the disadvantages of the foil keyboard, such as being susceptible to destruction and being user unfriendly.

Claims

1. Actuator plate (1) for use in a keyboard, in particular in a keyboard for entering data in outdoor automatic teller machines, wherein the actuator plate (1) has one or several partial areas movable under the influence of force, said partial areas functioning as key fields (9), and the actuator plate and the key fields (9) form a continuous part, characterized in that

the key fields (9) are designed by means described below such that a tactile short stroke is obtained,

a first arrangement (11) of a series of - inner - slots (12) arranged at a relatively short spacing from each other and passing through the thickness of the actuator plate (1) is positioned on the actuator plate (1) such that it limits a particular geometric area,

surrounding this first arrangement (11), a second arrangement (15) is provided comprising a series of - outer - slots (16) arranged at a relatively short spacing from each other and passing through the thickness of the actuator plate so that the spacing between the first and the second slot arrangement (11, 15) is defined such that the area of the actuator plate (1) enclosed by the two slot arrangements (11, 15) and referred to as spring arm (19) functions as a spring so that the area of the actuator plate enclosed by the first arrangement (11) and

functioning as a key field (9) is suspended on this spring arm (19), and

from the plane of the actuator plate, the key is deflectable, say, downwards in stroke fashion to be restored to its original position by spring arm (19).

2. Actuator plate (1) as claimed in claim 1,

characterized in that

one or several slots (12) of the first slot arrangement (11) are in each case connected to an associated slot (16) of the second arrangement (15) by a connecting slot (23) such that several separate spring arms (19) are obtained by means of the connecting slots (23).

3. Actuator plate (1) as claimed in claim 1 or 2, characterized in that

the slots (12, 16) of the first and the second slot arrangement (11, 15) are arranged parallel to each other, limiting the key field (9) preferably in the form of a square (3), a rectangle (5, 25), a circle (28, 32) or a triangle (30).

4. Actuator plate (1) as claimed in claim 1, 2 or 3, characterized in that

instead of the slots (12, 16), perforations are provided in the actuator plate (1).

5. Actuator plate (1) as claimed in claim 1, 2, 3 or 4,
characterized in that

the actuator plate (1) consists of a relatively inflexible material not deformable by finger force.

6. Actuator plate (1) as claimed in claim 1, 2, 3, 4 or 5,
characterized in that

the material of the actuator plate (1) is preferably plastic, such as nylon, or steel.

7. Actuator plate (1) as claimed in any one of the preceding claims,
characterized in that

the actuator plate (1) on the surface facing the user is provided with one or several flat recesses (59) accommodating foils (58).

8. Actuator plate (1) as claimed in any one of the preceding claims,
characterized in that

the surface of the actuator plate facing the user is provided with a thin elastic protective foil (36).

9. Actuator plate (1) as claimed in any one of the preceding claims,
characterized in that the movable parts (keys) of the actuator plate (1) forming the key field (9) are provided with a projection (53) which is preferably largest in the center area of the respective key field (9) so that a support face (55) is formed.

10. Actuator plate (1) as claimed in any one of the preceding claims,
characterized in that

the projection (53) preferably decreases stepwise (57) in the direction of the slots (12, 16) provided on either side, so that the thickness of the actuator is smallest in the area of the slots (12, 16).

11. Actuator plate (1) as claimed in any one of the preceding claims,
characterized in that

in the case of a double key (5), the movable parts of the actuator plate forming the key field (9) are provided with two projections (53) on the surface facing the user, said projections being largest in the center area of the respective key field (9), so that two support faces (55) are formed which decrease stepwise (57) in the direction of the slots (12, 16) provided on either side, so that the thickness of the actuator plate is smallest in the area of the slots (12, 16).

12. Actuator plate (1) as claimed in any one of the preceding claims,
characterized in that

it is used in a keyboard, in particular the keyboard of an automatic teller machine, the keyboard essentially comprising the following components:

a carrier plate (34), a switching foil (44) arranged on the carrier plate (34), a spacer foil (45) with recesses (51) for accommodating the metal domes (40), a holding foil (46), said actuator plate (1), and a covering foil (36).

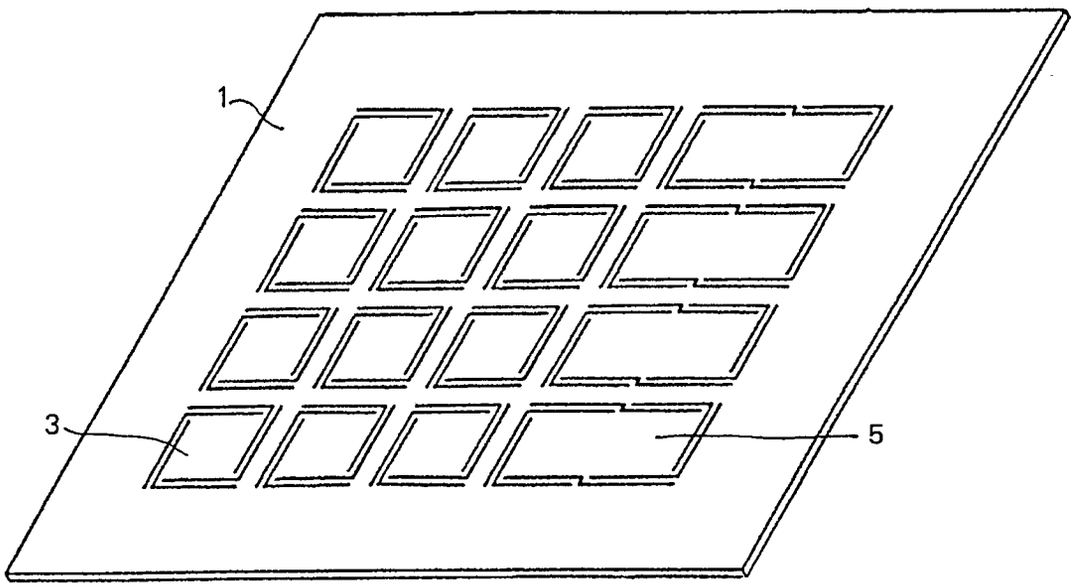
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FIG. 1

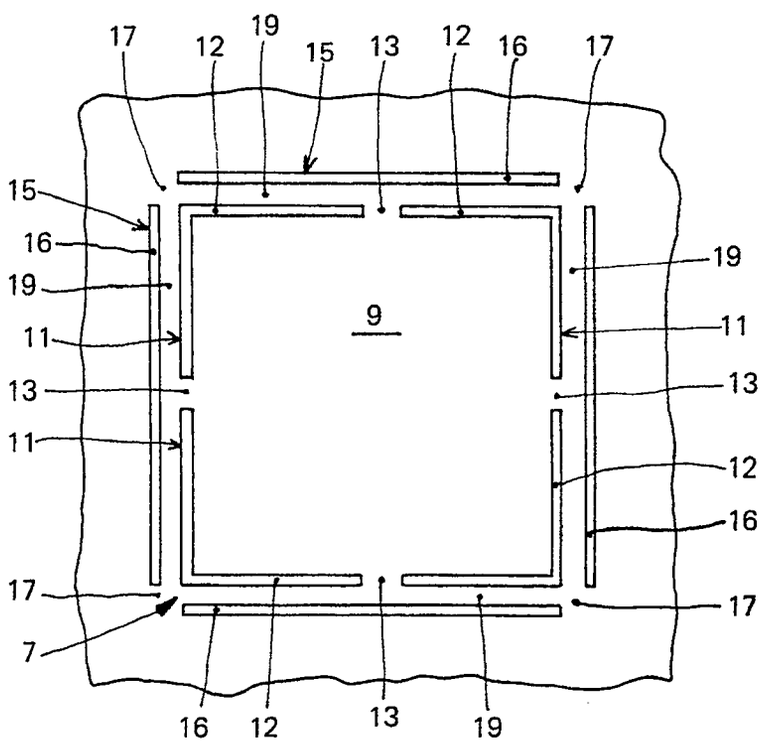
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FIG. 2

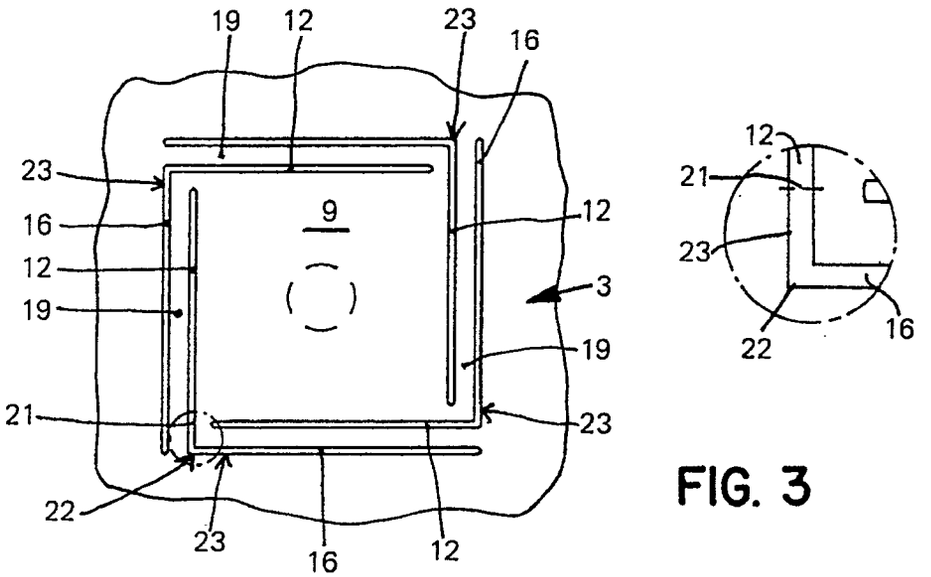

FIG. 3

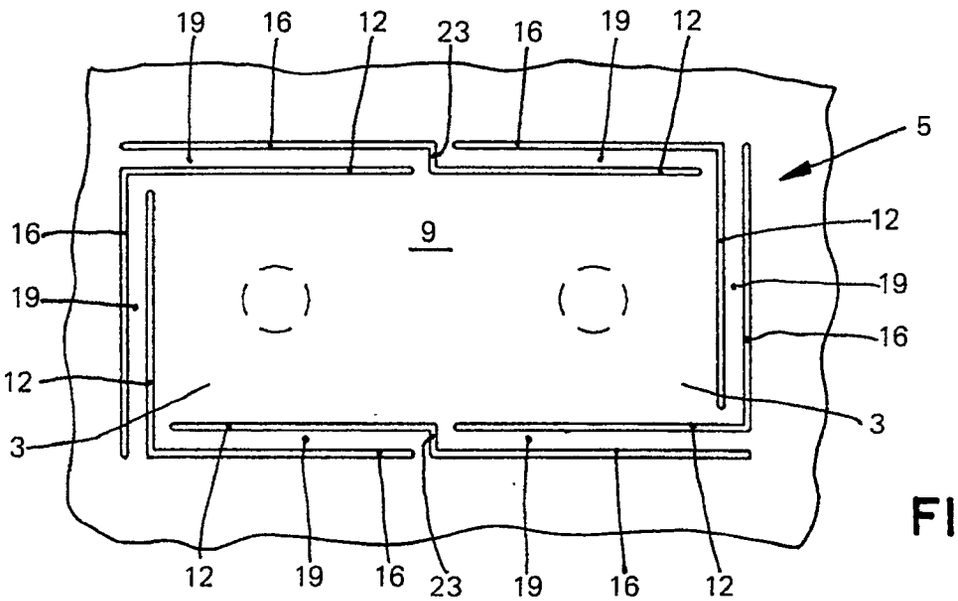

FIG. 4

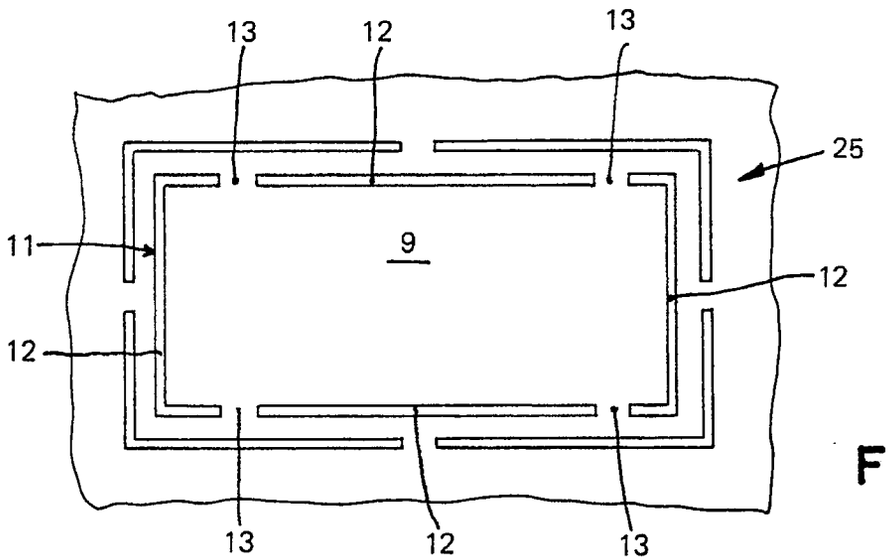

FIG.5

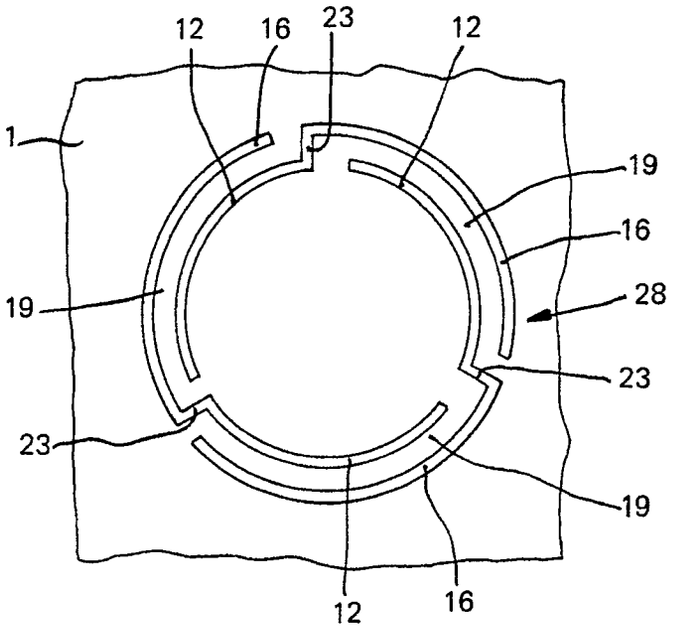

FIG. 6

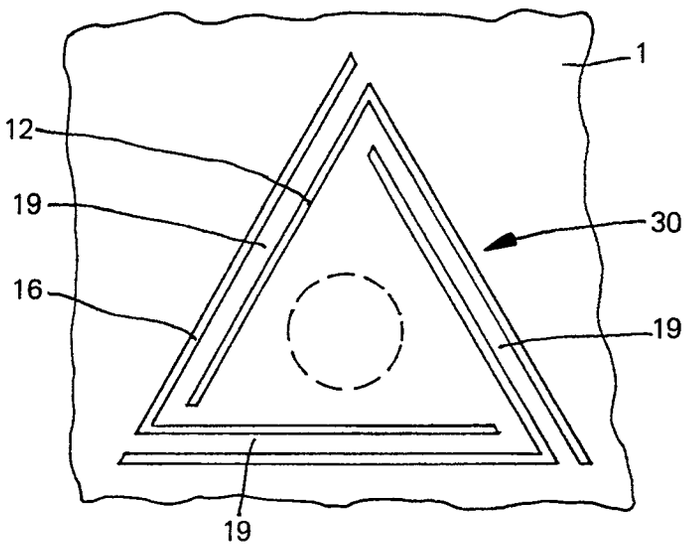

FIG. 7

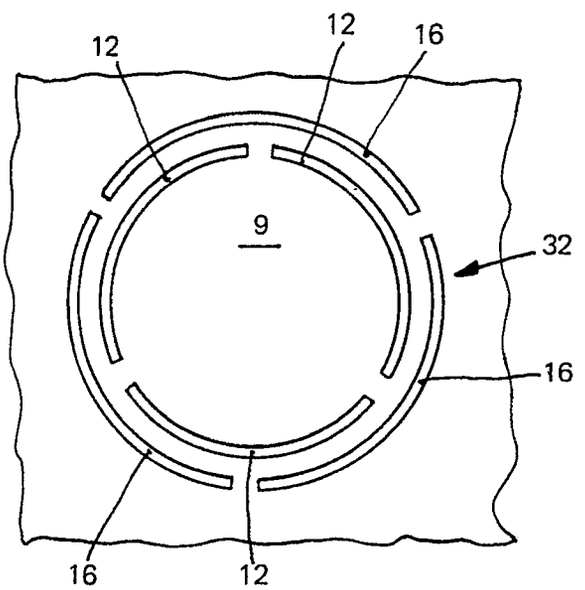

FIG. 8

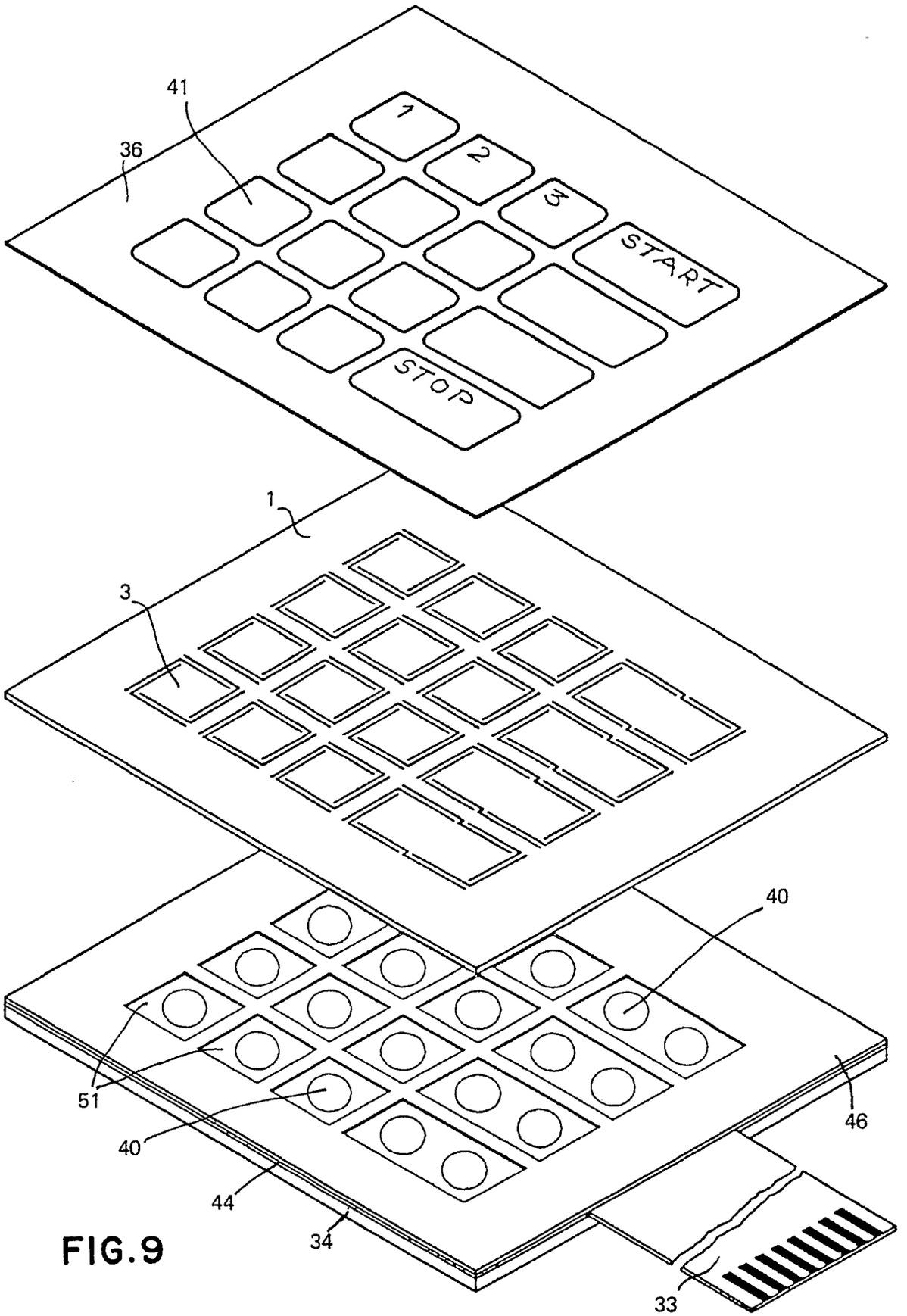

FIG.9

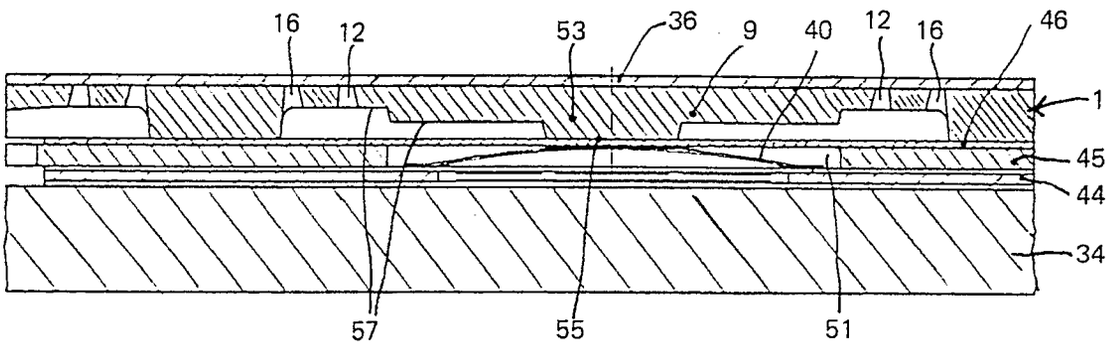

FIG. 10

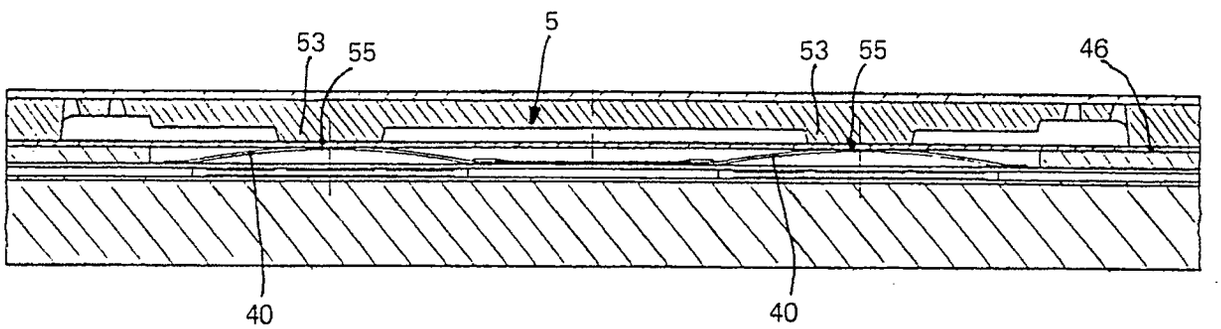

FIG. 11

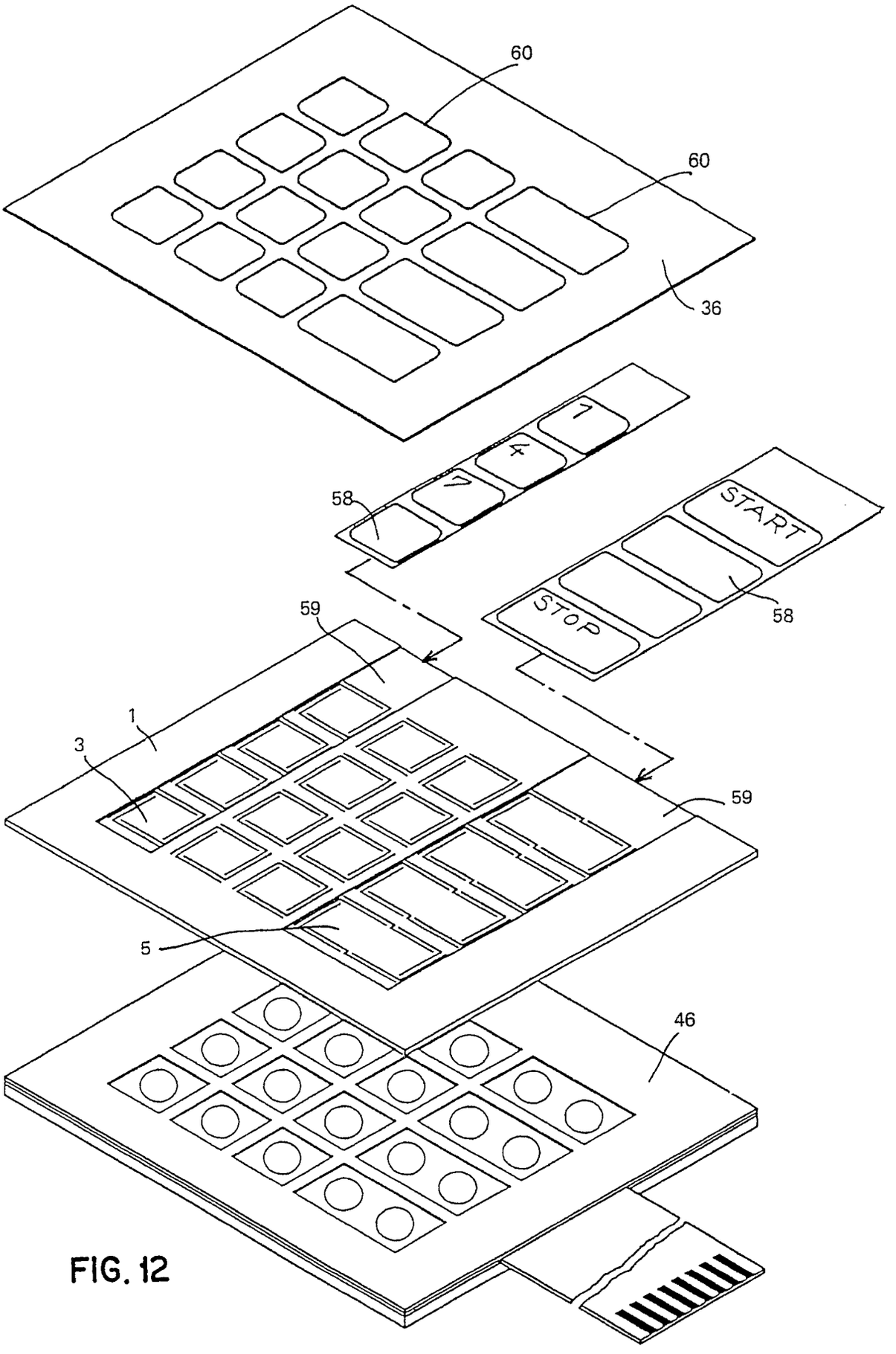

FIG. 12

European Patent Office

EUROPEAN SEARCH REPORT

Application Number

EP 90 10 2672

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
X Y	DE-A-3618131 (SHARP) * the whole document *	1, 4-6, 8, 9, 12 2, 3, 9, 10	H01H13/70
Y A	DE-A-2046612 (LEMATEX) * page 8, paragraph 3 - page 9, paragraph 1 * * page 11, paragraph 4 - page 12, paragraph 3; figures 10-18 *	9, 10 3	
Y	DE-A-3108183 (MATSUSHITA) * page 10, paragraph 3 - page 11, paragraph 1; figures 6, 7 *	2, 3	
D,A	IBM TECHNICAL DISCLOSURE BULLETIN. vol. 24, no. 1B, June 1981, NEW YORK US pages 734 - 735; SEBROSKI: "Long life, finger-actuated elastic diaphragm switch assembly" * the whole document *	1	
D,A	IBM TECHNICAL DISCLOSURE BULLETIN. vol. 14, no. 3, August 1971, NEW YORK US page 767 SEDARIS: "Elastic diaphragm switch" * the whole document *	1	TECHNICAL FIELDS SEARCHED (Int. Cl.5) H01H
D,A	IBM TECHNICAL DISCLOSURE BULLETIN. vol. 12, no. 11, April 1970, NEW YORK US page 1923 BARKER: "Elastic diaphragm switch" * the whole document *	1	
D,A	IBM TECHNICAL DISCLOSURE BULLETIN. vol. 13, no. 7, December 1970, NEW YORK US page 1943 GEIL: "Elastic diaphragm switch" * the whole document *	1	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	12 JULY 1990	SALM R.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
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O : non-written disclosure
P : intermediate document

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D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

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