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 [33] **Japan**
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[54] CONTACT SPRING SYNCHRONIZING SWITCH ASSEMBLY

6 Claims, 11 Drawing Figs.

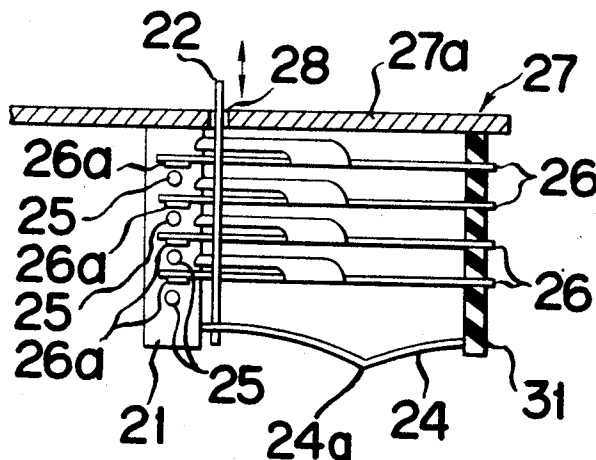
[52] U.S. Cl. 200/166,
 200/1
 [51] Int. Cl. H01h 1/28
 [50] Field of Search 200/1A,
 86.5, 166.1

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ABSTRACT: A synchronizing switch assembly involves a vertically movable operation member having a plurality of horizontally penetrating apertures, a plurality of stationary contact members corresponding to said apertures respectively and arranged parallel to the lengthwise direction of the operating member at a space, and a plurality of movable contact members of resilient material horizontally extending to the upper sides of the stationary contact members. Said movable contact members are respectively provided with upper and lower horizontally extending sections passing through the corresponding aperture to be pressed to the inner wall of said aperture by the elasticity prevailing therebetween.



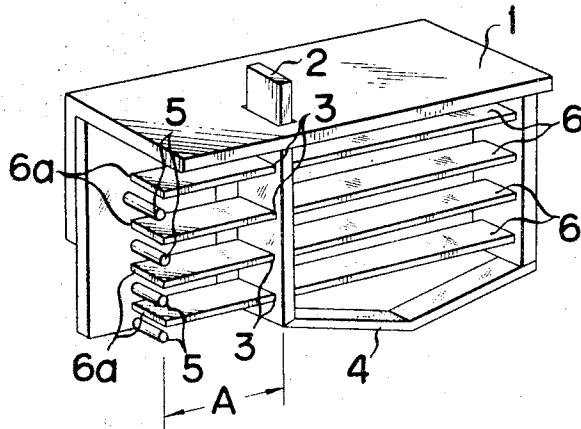


FIG. 1
(PRIOR ART)

FIG. 2

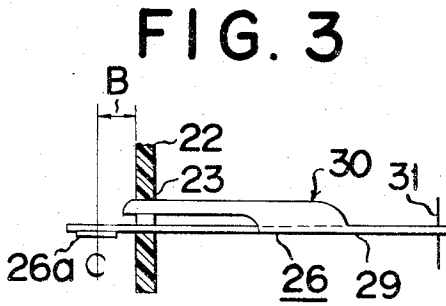
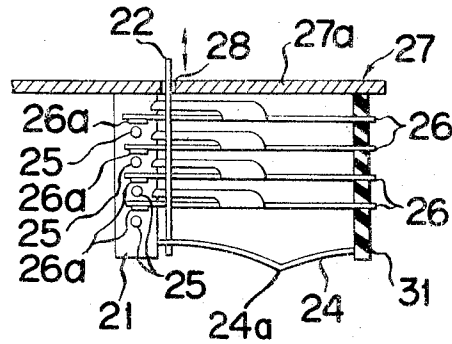


FIG. 3

FIG. 4

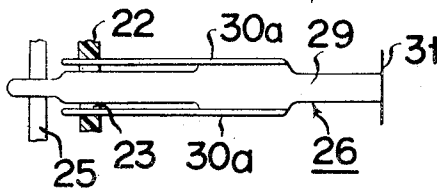


FIG. 5

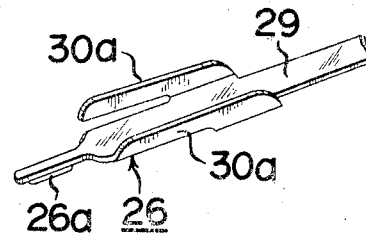


FIG. 6a

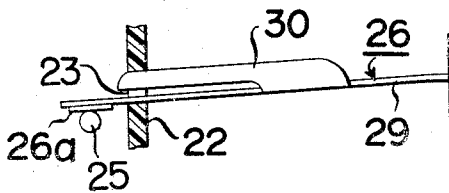
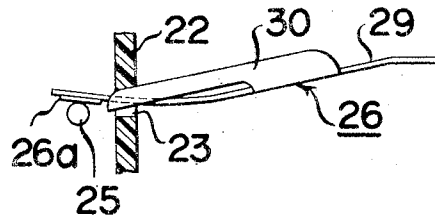


FIG. 6b



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FIG. 7

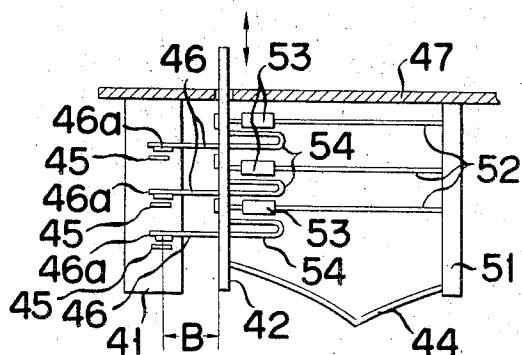


FIG. 8

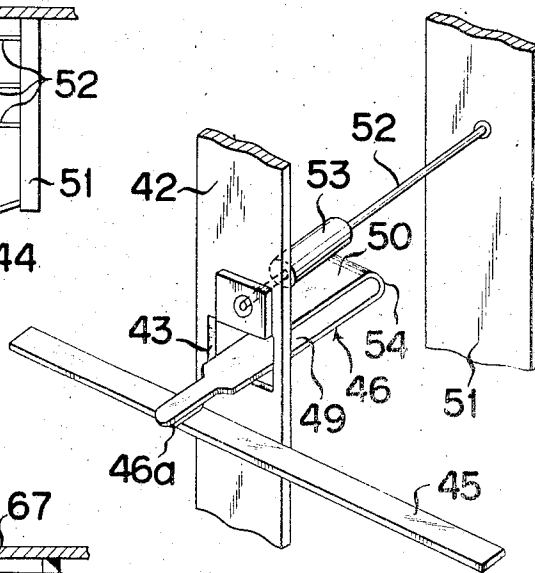


FIG. 9

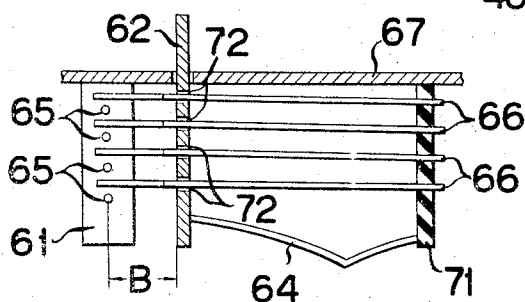
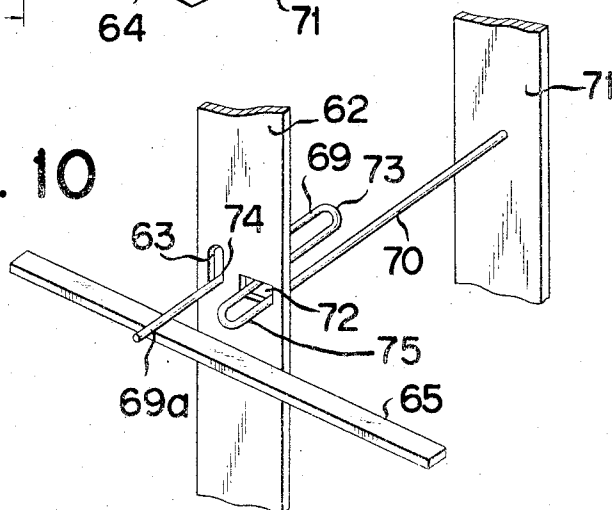


FIG. 10



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CONTACT SPRING SYNCHRONIZING SWITCH ASSEMBLY

This invention relates to a synchronizing switch assembly and more particularly to a synchronizing switch assembly mainly used in an electronic musical instrument.

The prior art synchronizing switch assembly shown in FIG. 1 comprises a base 1, an operating member 2 having a plurality of apertures 3 formed perpendicular to the direction of vertical movement of said operating member 2, a leaf spring member 4 for upwardly urging said operating member 2, a plurality of stationary contact members 5 disposed on said base 1 such that each of said stationary contact members 5 faces each of said corresponding apertures 3 at a space A and a plurality of movable contact members 6 corresponding in number to said plurality of said stationary contact members 5 and passing through the corresponding apertures 3 respectively. Each of said movable contact members 6 has a contact area 6a acting in engagement with the corresponding stationary contact member 5, when said operating member 2 is moved against the resistance of said urging member 4.

This arrangement involves such problems that if the space A is excessively large, it is difficult to cause the contact areas 6a of the movable contact members 6 synchronously to contact the stationary contact members 5, due to the increased difficulty of exactly locating the movable contact members with respect to the stationary ones, and if the space A is small, the force acting on the operating member is often likely to excessively urge the movable contact members 6 over the limit of their elasticity. Furthermore, said switch assembly involves movable contact members unavoidably contacting the corresponding stationary contact members without an initial contacting pressure.

An object of this invention is to provide a synchronizing switch assembly improved so that movable contact members synchronously contact stationary contact members corresponding thereto under a sufficient initial contacting pressure.

The synchronizing switch assembly of this invention wherein there are provided a base, an operating member having a plurality of apertures formed perpendicular to the direction of movement of said operating member, means for urging said operating member in one of its moving directions, a plurality of stationary contact members respectively face the corresponding apertures at a space and a plurality of movable contact members corresponding in number to said plurality of said stationary contact members and passing through the corresponding apertures respectively, each of said movable contact members having a contact area acting in engagement with the corresponding stationary contact member when said operating member is moved against the resistance of said urging means, is characterized in that each of said movable contact members includes a first section involving said contact area and a second section, and has a portion pressed to the inner wall of the corresponding aperture by the elasticity prevailing between both sections, at least one of said sections being elastically bendable in the direction of movement of the operating member and joined with the other section at such a point that the specified length of the first section defined between said point and contact area is larger than the above-mentioned space.

In this case, due to the specified length of the first section, the movable contact member is bendably constructed in sufficient strength and thus is prevented from being damaged by the force acting on the operating member.

This invention can be more fully understood from the following detailed description when taken in connection with reference to the accompanying drawings, in which:

FIG. 1 is a perspective view of an example of a prior art synchronizing switch assembly shown by way of comparison with that of this invention;

FIG. 2 is a side view of a synchronizing switch assembly embodying this invention;

FIG. 3 is an enlarged cross-sectional side view of a part of said switch assembly;

FIG. 4 is an enlarged cross-sectional plan view of a part of said switch assembly;

FIG. 5 is a perspective view of a movable contact member involved in said switch assembly;

FIGS. 6a and 6b are cross-sectional side views of a part of said switch assembly wherein the movable contact member contacts the corresponding stationary contact member;

FIG. 7 is a side view of another embodiment of this invention;

FIG. 8 is an enlarged perspective view of a part of the switch assembly of FIG. 7;

FIG. 9 is a side view of a further embodiment of this invention and

FIG. 10 is an enlarged perspective view of a part of the switch assembly of FIG. 9.

FIGS. 2 to 6b indicate a synchronizing switch assembly embodying the present invention. Said switch assembly comprises a base 21, an operating member 22 having a plurality of apertures 23, a leaf spring member 24 for upwardly urging said operating member 22, a plurality of stationary contact members 25 respectively facing the corresponding apertures at a space B, and a plurality of movable contact members 26 corresponding in number to said plurality of stationary contact members 25. As further detailed, said base 21 is made of electric insulating material such as bakelite and vertically disposed on a metal frame 27. Said metal frame 27 has a horizontal plate portion 27a in which is formed an aperture 28. The upper portion of the operating member 22 passes through said aperture 28 so as to be guided in a vertical direction. Said operating member 22 preferably consists of a vertically extending plate of electric insulating material such as bakelite. Said apertures 23 are formed perpendicular to the direction of vertical movement of said operating member 22 and preferably arranged in a vertical row on the plane of said operating member 22. Said stationary contact members 25 are made of electric conductive material, such as brass and copper, and arranged parallel to each other at an equal space and on a vertical plane in a manner to horizontally extend from the base 21, thus exactly facing the movable contact members 26 respectively. Preferably, the movable contact members 26 may extend through the apertures 23 perpendicular to the lengthwise direction of the stationary contact members 25. Each of said movable contact members 26 includes a first long section 29 involving a contact area 26a positioned at the forward end thereof, and a second long section 30. Said first long section 29 is elastically bendable in the direction of movement of the operating member, i.e. vertical direction. In order to be rendered elastic as described above, said movable contact member 26 may be made of elastic copper-alloy material such as phosphor bronze, which is, of course, electrically conductive. Said contact area 26a faces the top side of the corresponding stationary contact member 25 to act in engagement with it when said operating member is vertically and downwardly moved against the resistance of said spring member 24. Said second long section 30 extends parallel to the first long section and is interconnected with the latter section at a point, for example, the rear portion of said former section in such a manner that the specified length of the first section defined between said point and contact area is larger than the above-mentioned space B. Said second long section 30 preferably consists of a pair of raised sidewalls 30a integrally formed with the first long section by punching and bending a copper-alloy material. Said first section 29 extends over said point and is connected at the rear end with a supporting member 31 which downwardly extends from the horizontal plate portion 27a of the metal frame, said supporting member 31 being made of electric insulating material such as bakelite. Said first and second sections 29 and 30 are partly inserted into the corresponding aperture 23 in such a manner that the inserted portions of said sections are pressed to the opposite portions of the inner wall of said aperture respectively by the elasticity prevailing between said sections. Said leaf spring member 24 preferably has a downwardly turned bend 24a formed at the intermediate portion thereof and is con-

nected with the lower end of the operating member 22 at the forward end, and with the lower end of the supporting member 31 at the rear end.

In operation, the operating member 22 is downwardly moved against the urging force of the leaf spring member 24 when the top thereof is pushed downward. Then all the contact areas 26a of the movable contact members 26 first contact the corresponding stationary contact members 25 synchronously as shown in FIG. 6a, by being bent, mainly at that portion of the first section 29 defined between the point of said section inserted into the aperture 23 and the rear end thereof. At the moment said operating member 22 is further moved downward, preloads caused by elasticity prevailing between the first and second second sections, as well as by the bending of the first section, are imposed as initial contacting pressure on each of the stationary contact members 25 by being transferred from the inner wall of the aperture 23. The further downward movement of the operating member 22 after the application of said preload causes that portion of the first section 29 defined between the contact area 26a and the joint of the first and second sections to be bent as shown in FIG. 6b.

In this case, since the space B is smaller than that of the prior art synchronizing switch assembly, all of the contact areas 26a of the movable contact members 26 can be easily and exactly positioned with respect to the corresponding stationary contact members 25 when assembled. Though the space B is small, the movable contact member is bendably constructed with sufficient strength, because the movable contact member has a sufficient length as defined between the contact area and the joint of the first and second sections to absorb the bending stress caused by the downward movement of the operating member 22 and distribute it over said length. Accordingly, the movable contact member can be effectively prevented from being damaged.

Conversely to this embodiment, the first section 29 may include a rigid material, while the second section is formed of flexible material. In this case, the downward movement of the operating member will cause the second section to be bent.

FIGS. 7 and 8 indicated another embodiment of the synchronizing switch assembly of this invention. This embodiment is different from the first-mentioned embodiment in that it comprises movable contact members 46 prepared by bending electric conductive and elastic material such as elastic copper-alloy material, and lead wires 52 corresponding to said movable contact members 46, respectively. Each of the lead wires 52 horizontally extends from the corresponding movable member 46 to the supporting member 51 and involves a circuit element 53 such as a resistor disposed at an interval between the above-mentioned members 46 and 51. Of course, said lead wires 52 are preferably made of flexible and electrically conductive material.

The movable contact members 46 comprise a first long section 49 and a second long section 50. Both sections 49 and 50 are distinguished from those of the first-mentioned embodiment in that the rear end of the first long section 49 terminates at a point 54 at which said sections 49 and 50 are interconnected, while the forward end of the second section 50 is riveted to the portion of an operating member 42 adjacent to the upside of an aperture 43 formed in said operating member 42, and electrically connected with said lead wire.

Since the remaining parts of this embodiment except for those mentioned above are constructed in the same manner as the corresponding parts of the first-mentioned embodiment, a detailed description thereof is omitted for the sake of brevity, and they are only denoted by the same digits in the first place given in the corresponding drawings, i.e. FIGS. 7 and 8, though the digits of 2 and 3 in the second place involved in FIGS. 2 to 6b are changed to 4 and 5 respectively as shown in FIGS. 7 and 8.

In operation, the downward movement of the operating member 42 does not cause the second section 50 to be bent until the contact area 46a of the first contact section 49 con-

tacts the corresponding stationary contact member 45. The further downward movement of the operating member 42 after the contact area 46a contacts the corresponding stationary contact member 45 causes the movable contact member 46 to be operated substantially in the same way as that of the first-mentioned embodiment. During said further movement of the operating member 42, the second section 50 is also bent to cooperate with the first section 49, because the section 50 has the same elasticity as the section 49. This embodiment enables the movable contact member 46 to be more simply constructed by bending a strip steel member than the first-mentioned embodiment.

FIGS. 9 and 10 indicate still another embodiment of the synchronizing switch assembly of this invention. The synchronizing switch assembly of this embodiment is different from the first-mentioned embodiment in that it comprises movable contact members 66 consisting of meandering round-cross-sectional members of elastical and electric conductive material such as elastic copper-alloy material, and an operating member 62 provided not only with a plurality of vertically long apertures 63 arranged thereon in the same way as the apertures of the first-mentioned embodiment, but also with a plurality of rectangular apertures 72 corresponding to said apertures 63, respectively.

Each of said movable contact members 66 involves a first long section 69 having a contact area 69a positioned at the forward end thereof, and second long section 70 which is interconnected with said first section 69 at a turning point 73 in such a manner that the specified length of the first section defined between said point and the contact area 69a is larger than a space B defined between the contact area 69a and a portion 74 of the first section 69 penetrating the vertically long aperture 63. Said portion 74 is inserted into said aperture 63 in a manner to be pressed to the lower sidewall of said aperture 63 by torsional prestress applied to a turning portion involving the turning point 73. The second long section 70 has a turning portion 75 positioned at the forward side thereof, and is partly inserted into the corresponding aperture 72 at the position slightly backward from the turning portion 75 in a manner to be pressed to the opposite sidewalls of said aperture 72 by elasticity prevailing between said sections 69 and 70. In order to keep said torsional prestress, the aperture 72 prevents the second section 70 from being torsionally turned therein due to its narrow width in a vertical direction.

Since the remaining parts of this embodiment except for those mentioned above are operated in the same way as the corresponding parts of the first-mentioned embodiment, a detailed description thereof is omitted for the sake of brevity, and they are only denoted by the same digits in the first place given in the corresponding drawings, i.e. FIGS. 9 and 10, though the digits of 2 and 3 in the second place involved in FIGS. 2 to 6b are changed to 6 and 7, respectively, as shown in FIGS. 9 and 10.

In operation, the downward movement of the operating member 62 till the contact area 69 contacts the corresponding stationary contact member 65 causes the second section 70 to be bent. At the moment said operating member 62 is further moved downward, preload caused by elasticity prevailing between the first and second sections, i.e. the torsional prestress applied to the portion involving the turning point 73 is imposed as an initial contacting pressure on each of the stationary contact members 65 by being transferred from the lower sidewall of the aperture 63. The further downward movement of the operating member 62 after application of said preload causes the portion of the movable member 66 defined between the contact area 69a and the portion of the second section 70 inserted into the aperture 72 and extending straight to the interconnected point 73 to be bent.

The advantages of this embodiment will be accomplished essentially by the same technical operation as that of the first embodiment of this invention.

In the foregoing embodiments of this invention, the apertures formed in the operating member may be arranged in two

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or more rows in the direction of movement of said operating member. Said apertures may also be arranged in one or more rows perpendicular to the direction of movement of said operating member. In these cases, the corresponding stationary and movable contact members should, of course, be so arranged as to meet the positions of said apertures respectively.

I claim:

1. A synchronizing switch assembly comprising a base, an operating member having a plurality of apertures formed perpendicular to the direction of movement of said operating member, means for urging said operating member in one of its moving directions, a plurality of stationary contact members disposed on said base such that each of said plurality of stationary contact members faces each of said corresponding apertures at a space and a plurality of movable contact members corresponding in number to said plurality of stationary contact members and passing through the corresponding apertures respectively, each of said movable contact members having a contact area acting in engagement with the corresponding stationary contact member when said operating member is moved against the resistance of said urging means, said switch assembly being characterized in that each of said movable contact members includes a first section involving said contact area and a second section, and has at least one portion pressed to the inner wall of the corresponding aperture by the elasticity prevailing between both sections, at least one of said sec-

tions being elastically bendable in the direction of movement of the operating member and interconnected with the other section at a certain point in such a manner that the specified length of the first section defined between said point and contact area is larger than the space.

2. A synchronizing switch assembly claimed in claim 1 in which the sections have portions pressed to the opposite inner walls of the corresponding aperture.

3. A synchronizing switch assembly claimed in claim 1 in which the sections are interconnected with each other by the medium of a turning portion involving said interconnected point.

4. A synchronizing switch assembly claimed in claim 2 in which said first section rearwardly extends to, and is connected at the rear end, with a supporting member attached to said base.

5. A synchronizing switch assembly claimed in claim 1 in which said first section has a portion pressed to the lower side wall of the corresponding aperture by torsional prestress applied to a turning portion involving said interconnected point, and said second section is connected at the rear end with a supporting member attached to said base.

6. A synchronizing switch assembly claimed in claim 1 in which said apertures are arranged in one row in the direction of movement of said operating member.

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