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MAGNETIC KEYBOARD

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Fig. 1.

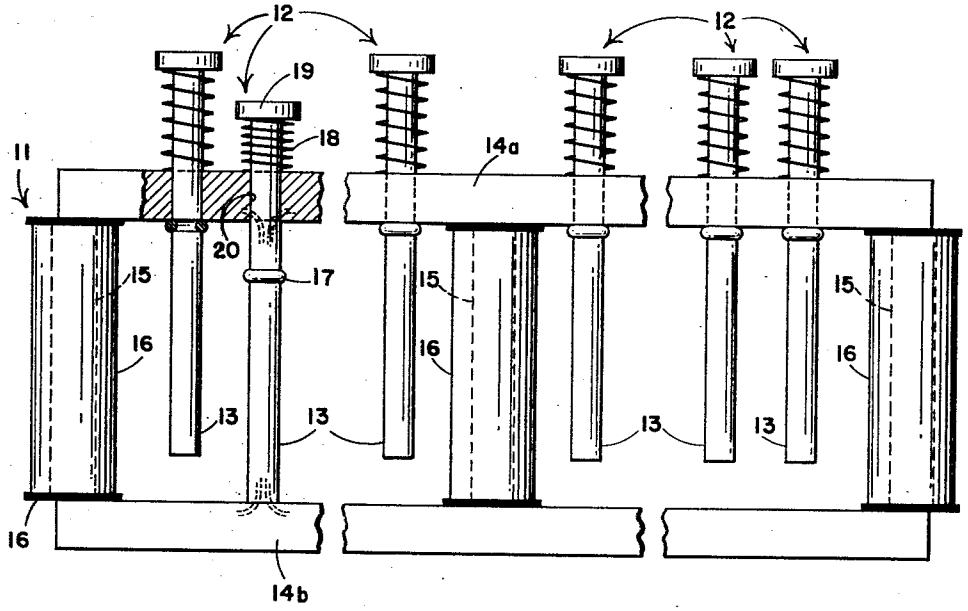
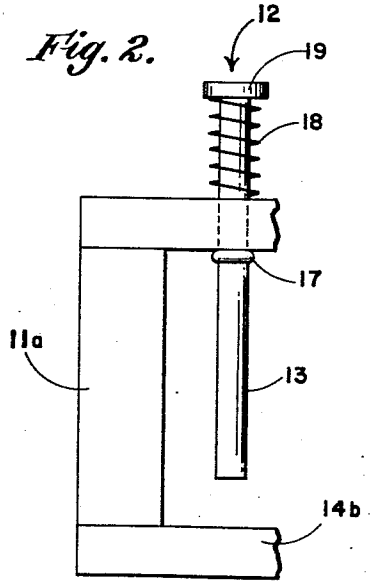


Fig. 2.



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MAGNETIC KEYBOARD

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This invention relates to keyboard mechanisms and particularly to a magnetic keyboard which provides the type of action wherein one or more keys are released only after one or more other keys are depressed.

Although innumerable keyboard mechanisms of one kind or another have been devised in the past for use in typewriting machines, calculating machines, tabulating machines, and the like, none of these, so far as I am aware, operates as simply and yet effectively as the keyboard which I have invented. Briefly, according to the invention, I provide a plurality of key actuated members of magnetically permeable material, each being adapted to be moved from one position to another when the key associated therewith is depressed. Tending to maintain each key actuated member in the actuated position, by magnetic attraction, is a flux-limiting flux generator magnetically connected thereto, the actuated member forming, when in its said actuated position, a part of a complete low reluctance magnetic circuit including the flux generator; while tending to return each key actuated member to its original position, thereby disestablishing the magnetic circuit formed with the flux generator to release the key, is a biasing device, such as a spring. The individual springs, however, are not so strong as to overcome the magnetic holding force on a single key actuated member, or on any predetermined number of these members less than all of them, when placed in circuit with the flux generator. Rather, it is only when additional keys are depressed, and the magnetic flux produced by the flux generator, which is limited as aforesaid, is distributed among more than the predetermined number of key actuated members that the springs will be able to overcome the magnetic holding force.

Accordingly, in one embodiment of the invention with only one key depressed, a single series flux path, including the flux generator and the one key actuated member, is formed, providing sufficient magnetic force to maintain the key actuated member in position. When a second key is depressed, however, a second flux path, in parallel with the first path, is created, diverting roughly half of the flux from the first key actuated member to the second. As a result, the magnetic holding force on the first key actuated member will be materially decreased, permitting the biasing spring to return it to its original position thereby releasing the key associated therewith. Since there remains only a single flux path through the second key actuated member, substantially all the flux in the saturable member passes therethrough providing a holding force greater than the force of the spring as was the case initially with the first key actuated member. Only after another key is depressed will the second key actuated member be released, and so forth.

It will be understood, of course, that the key actuated members may be connected in operative relation to appropriate elements (not shown) of adding machines, computers, electric typewriters, or other business machines, etc. Indeed the novel device of the invention is useful wherever a keyboard may be employed and it is

desired that the depression of succeeding keys should release previously depressed keys.

It is an object of this invention, therefore, to provide a keyboard based on magnetic principles to the end that a greatly simplified structure is afforded. The novel features of this invention, together with further objects and advantages thereof, will become more readily apparent when considered in connection with the accompanying drawing wherein:

Fig. 1 is a view in elevation of a keyboard according to my invention employing an electromagnetic flux generator; and

Fig. 2 is a fragmentary view of a single key assembly and flux generator similar to that in Fig. 1, but employing a permanent bar magnet as the source of flux.

Referring now more specifically to Fig. 1 of the drawing, wherein like elements are designated by the same reference characters, it will be observed that in the particular embodiments shown the keyboard of my invention comprises, in the main, three flux-limiting flux generators **11**, a plurality of key assemblies **12**, including magnetically permeable key actuated members **13** adapted to be coupled to the flux generators **11** by means of coupling members or pole pieces **14***a* and **14***b*. Each of the flux generators **11** is made up of a magnetically saturable member **15** surrounded by a magnetizing winding or coil **16** to produce, when energized, an amount of flux in the saturable member sufficient to cause saturation. Coupling members **14***a* and **14***b* magnetically intercouple the saturable members **15** to which they are joined, and, in addition, serve to guide the flux in the saturable members through key actuated members or rods **13** when the latter are appropriately positioned. To this end, the coupling member **14***a* is apertured, as at **20**, to receive the various key actuated members or rods **13** for axially slidable movement between a released position and a depressed position wherein they engage the other coupling member **14***b* forming parallel magnetic circuits with flux generators **11**. Each key assembly **12** includes besides the rod **13**, a key tab **19** and a biasing spring **18** between tab **19** and the apertured coupling member **14***a*. A stop ring **17** on each rod **13** limits its upward travel whereas engagement of the lower face of rod **13** with the lower coupling member **14***b* limits its downward travel.

In operation, when one of the key actuated members or rods **13** is depressed, so that it engages the lower coupling member **14***b* (as the next from the left rod shown in Fig. 1), there is provided for each of the flux generators **11**, a low reluctance path entirely through magnetically permeable members, namely members **14***a*, **14***b*, **15** and the depressed member **13**. As a result, members **15** become saturated, since their permeabilities and cross-sectional dimensions relative to the number of turns on the coils **16** and the amounts of current passed therethrough are chosen to insure that saturation takes place. On the other hand, the permeabilities and cross-sectional dimensions of coupling members **14***a* and **14***b*, and key actuated members **13** are such that they do not become saturated. In fact, it is most desirable to make coupling members **14***a* and **14***b* quite large in cross section to minimize their reluctance so that the amount of flux present in a particular depressed key actuated member will be substantially independent of its position with respect to flux generators **11**. Due to the presence of the flux in the depressed member **13**, there is created a magnetic holding force tending to maintain member **13** in engagement with coupling member **14***b*, and by properly designing the various magnetically permeable members in accordance with well known magnetic principles, this magnetic force can be made just large enough to prevent its being overcome by spring **18**. If however, a second key actuated member **13** is depressed, a second low re-

luctance path will be created for the flux in saturable members **15**, and since substantially no more flux can emanate from members **15**, as they are saturated, a portion of the flux that was in the first key actuated member to be depressed, roughly half, is diverted therefrom to the second key actuated member. In this way, the flux density in the first key actuated member is materially reduced, as is the corresponding magnetic attraction or holding force, so that now the force exerted on the first key actuated member by spring **18** is sufficient to disengage it from coupling member **14*b***, and to return it to a released position wherein the magnetic circuit therethrough is effectively broken by the creation of a substantial air gap. All of the flux in the saturable members **15** will now flow in the second key actuated member to be depressed, thereby providing a holding force sufficient to maintain it in a depressed position, as was initially the first key actuated member. As each succeeding key is depressed, the same operations will of course take place.

In Fig. 2 I have illustrated the invention substituting a permanent bar magnet **11*a*** for the saturable core and magnetizing winding of flux generator **11** of the previous embodiment. The bar magnet **11*a*** is so chosen with respect to size and strength as to be substantially incapable of delivering more flux than is present when only one of the members **13** is depressed and therefore only one magnetic circuit between the poles of the magnet is established. Hence, the depression of an additional member **13**, doubling the permeance of the path from pole to pole of the magnet **11*a***, does not cause any appreciable increase in the total flux generated by the magnet but rather serves to redistribute the flux between the depressed members **13** with the result that the first member **13** will be released by the action of its biasing spring and the second additional depressed member **13** will then be magnetically held. Thus, the operation of the embodiment of Fig. 2 is the same as that of Fig. 1, just described.

Although only a single row of keys has been illustrated by way of example, it will be apparent that any number of rows may be provided according to my invention as the use to which the keyboard is put may warrant. Also, depending on the number of keys to be accommodated, as few as one flux generator or more than three flux generators may be utilized. Various other modifications, particularly modifications of the simplified structural embodiment of my invention illustrated, will occur to those skilled in the art, and therefore, it should be understood that I do not wish to limit my invention to the precise embodiment illustrated. Rather the invention should be deemed to be limited only by the scope of the appended claims.

What is claimed is:

1. A magnetic keyboard comprising a flux limiting flux generator, a plurality of key actuated members of magnetically permeable material, each being adapted for movement between a first position to establish a closed magnetic circuit including said flux generator and a second position to disestablish said circuit, and biasing means tending to move said key actuated members out of said first position, the maximum amount of flux said flux generator is capable of delivering being so related to the reluctance of said key actuated members and the force of said biasing means that the magnetic holding force caused by the magnetic flux in said key actuated members is sufficient to maintain only a predetermined number of them in said first position simultaneously.

2. A magnetic keyboard comprising a flux limiting source of flux, a plurality of key actuated members of magnetically permeable material movably mounted in operative relation to said source, each of said key actuated members being movable between a first position wherein a low reluctance path including said source and the key actuated member is established, the flux in the key actuated member tending to maintain it in said first position, and a second position wherein the reluctance of said path is greatly increased by the presence of an air gap, and biasing means urging each of said key actuated members out of said first position, the magnetic characteristics of said members and the maximum flux characteristic of said source being so chosen with respect to the strength of said biasing means that only a predetermined number of said key actuated members will be held in said first position simultaneously.

3. A magnetic keyboard comprising a flux limiting flux generator, pole pieces individually coupled to the poles of said flux generator, a plurality of key actuated members of magnetically permeable material movably mounted in operative relation to said flux generator, each of said key actuated members being movable between a first position where it is in contact with said pole pieces and a second position where it is out of contact with at least one of said pole pieces; and biasing means urging each of said key actuated members out of said first position, the maximum amount of flux said generator is capable of delivering being so related to the magnetic characteristics of said members and the strength of said biasing means that only a predetermined number of said members will be held in said first position simultaneously by the magnetic flux therein.

4. A magnetic keyboard according to claim 3 wherein said key actuated members are in slidable engagement with the other one of said pole pieces.

5. A magnetic keyboard according to claim 4 wherein said key actuated members consist of rods, said other of the pole pieces being apertured to receive said rods.

6. A magnetic keyboard comprising a magnetically saturable member, magnetomotive means associated therewith to generate an amount of flux therein sufficient to cause saturation thereof, pole pieces individually coupled to the poles of said saturable member, a plurality of key actuated members of magnetically permeable material movably mounted in operative relation to said saturable member, each of said key actuated members being movable between a first position where it is in contact with said pole pieces and a second position where it is out of contact with at least one of said pole pieces, and biasing means urging each of said key actuated members out of said first position, the magnetic characteristics of said members and the strength of said magnetomotive force being so chosen with respect to the strength of said biasing means that only a predetermined number of said key actuated members will be maintained in said first position simultaneously by the magnetic flux therein.

7. A magnetic keyboard comprising a permanent magnet, pole pieces individually coupled to the poles of said magnet, a plurality of key actuated members of magnetically permeable material movably mounted in operative relation to said magnet, each of said key actuated members being movable between a first position where it is in contact with said pole pieces and a second position where it is out of contact with at least one of said pole pieces, and biasing means urging each of said key actuated members out of said first position, the magnetic characteristics of said members and the strength of said magnet being so chosen with respect to the strength of said biasing means that only a predetermined number of said elements will be maintained in said first position simultaneously by the magnetic flux therein.

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