Oct. 28, 1952 G. W. HOPKINS ET AL 2,615,548

KEYBOARD KEY

Filed Oct. 28, 1949 3 Sheets-Sheet 1

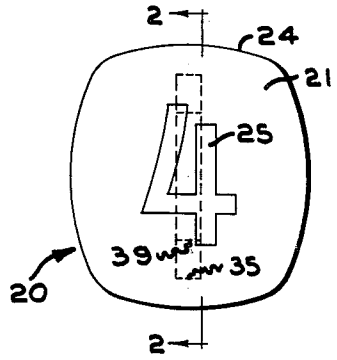

FIG_1

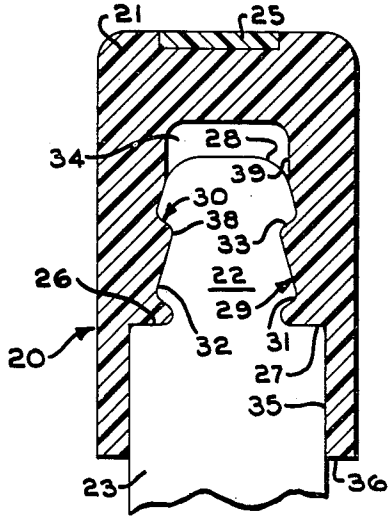

FIG_2

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KEYBOARD KEY

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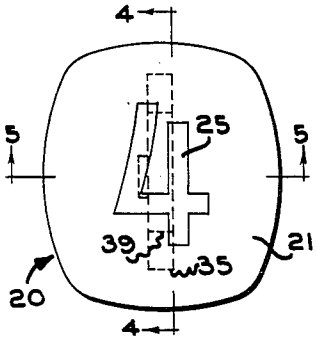

FIG_3

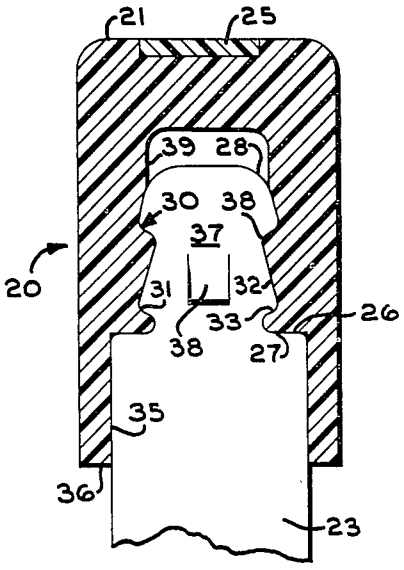

FIG_4

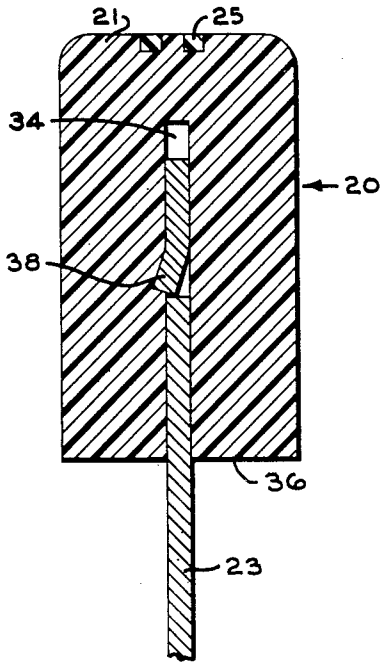

FIG_5

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KEYBOARD KEY

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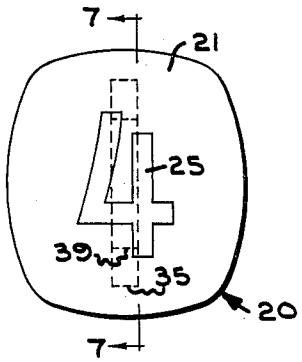

FIG_6

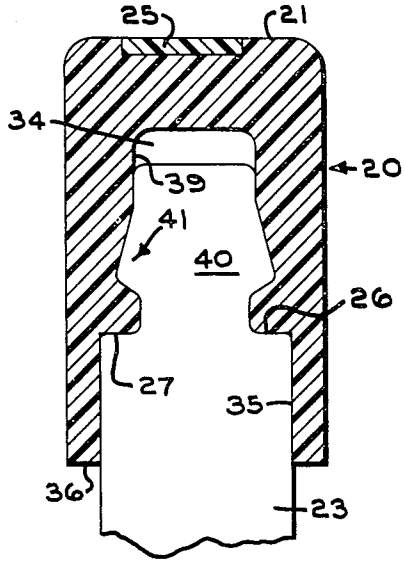

FIG_7

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2,615,548

UNITED STATES PATENT OFFICE

2,615,548

KEYBOARD KEY

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Application October 28, 1949, Serial No. 124,074

12 Claims. (Cl. 197—102)

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This invention relates to an improved method and means of fastening plastic finger buttons to their supporting key stems, and more particularly to a method and means of affixing such operating buttons to the amount keys of business machines and the like.

In the construction of automatic calculators and other types of business machines having a plurality of manually operable key stems conveniently spaced apart in a keyboard arrangement, it has often been the practice to improve the appearance of such machines by providing plastic finger buttons of generally cylindrical shape and sufficient depth to conceal from view a substantial portion of the upper extremities of the key stems. This practice makes the keyboard easier to operate but frequently increases the mass of the operating buttons to such an extent that keystones and other conventional means of affixing the buttons to the key stems are not entirely satisfactory, particularly in instances wherein upwardly directed resilient pressure is applied to the base of each actuating button so as to assure the rapid and positive elevation of the individual key assemblies during release.

The problem of securely attaching such slightly elastic actuating buttons to their substantially non-elastic key stems becomes even more difficult to solve whenever the individual key assemblies are repeatedly actuated and released while subjected to relatively high operating temperatures tending to substantially reduce the strength of the thermoplastic material from which the actuating buttons are made.

It is an important object of the present invention to provide a method and means of securely bonding slightly elastic plastic finger buttons of relatively large mass to substantially non-elastic key stems on the keyboard of a business machine or the like without the necessity of moulding the finger buttons thereto, which bond is effective even though such manually depressible actuating buttons are rapidly returned to their inactive or raised position during release.

It is also an object of the instant invention to provide a method and means of establishing a self-locking engagement between a slightly elastic nonmetallic finger button and its associated substantially non-elastic key stem solely by the application of positive pressure tending to move the said button into a predetermined wedging engagement with the upper extremity of the key stem.

It is another object of the present invention to provide a method and means of pressure

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fitting a manually depressible plastic actuator finger button having a relatively low modulus of elasticity onto the upper extremity of a relatively non-elastic key stem in such a manner that the internal stresses induced within the button tend to establish a self-locking engagement operable to substantially prevent relative movement between such an actuating button and its corresponding key stem during release and rapid return of the key assembly to its inactive or fully raised position.

It is also an object of the present invention to form a self-locking engagement between a slightly elastic plastic keyboard button and a substantially non-elastic key stem without the use of supplementary securing means or the necessity of moulding the said button thereto, which engagement is adapted to substantially prevent relative movement between each button and its associated key stem whenever the key assembly is repeatedly subjected to inertial forces and upwardly directed resilient pressures tending to separate each button from its supporting stem.

Another object of this invention is to produce a method and means of pressure fitting a slightly elastic plastic finger button onto a preformed and substantially non-elastic key stem to establish a self-locking engagement therewith, which engagement is particularly adapted to compensate for the decreased structural strength of the plastic buttons at relatively high operating temperatures, as well as to effectively resist upwardly directed inertial and resilient forces tending to disengage the said self-locking engagement and to effect a progressive separation of the plastic button from the said key stem whenever the key assembly is rapidly and repeatedly reciprocated.

Further objects are to provide a construction of maximum simplicity, economy and ease of assembly and disassembly, also such further objects, advantages and capabilities as will fully appear and as are inherently possessed by the device and the invention described herein.

The invention further resides in the combination, construction, and arrangement of parts illustrated in the accompanying drawings, and while there is shown therein a preferred embodiment and two variants thereof, it is to be understood that the same is illustrative of the invention, and that the invention is capable of modification and change and comprehends other details of construction without departing from the spirit thereof, or the scope of the appended claims.

Referring to the drawings:

Fig. 1 is a plan view of a typical key assembly embodying the preferred form of the invention.

Fig. 2 is a cross-sectional view taken along the lines 1—1 in Fig. 1 showing the preferred means of securing a plastic finger button to the upper extremity of its associated key stem.

Fig. 3 is a plan view of the modified form of the invention.

Fig. 4 is a longitudinal cross-sectional view taken along the lines 4—4 in Fig. 3.

Fig. 5 is a transverse cross-sectional view taken along the lines 5—5 in Fig. 3.

Fig. 6 is a plan view of another modified form of the invention.

Fig. 7 is a longitudinal cross-sectional view taken along the lines 7—7 in Fig. 6.

Referring now more particularly to Figs. 1 and 2 of the drawings, there is shown a manually depressible key assembly for a calculating machine or similar business machine, which assembly includes a plastic finger button 20 of relatively large mass having a preformed vertical recess disposed interiorly therein and adapted to form a self-locking engagement with the preformed top or upper extremity 22 of the relatively nonelastic supporting key stem 23. This manually depressible finger button 20 is molded of a suitable plastic resin or other slightly elastic plastic material which has limited flow characteristics when subjected to relatively high pressures, and preferably possesses such limited flow characteristics at normal room temperatures. The modulus of elasticity of such a plastic material is substantially lower than that of key stem 23, and normally decreases substantially with increased temperature. Button 20 may be of generally elliptical cross section with flattened end portions 24 as illustrated in Fig. 1, or button 20 may be of circular or other ornamental cross section, if desired. A plastic inlay 25 in the form of a suitable identifying numeral or letter is cemented, molded or otherwise embedded within the upper contact surface 21 of button 20, key identifying inlay 25 preferably being formed of a colored plastic adapted to form a visual contrast with the body color of the button 20.

Key stem 23 preferably is punch formed from a thick sheet of metal or other relatively rigid material having a high modulus of elasticity, and has a shoulder 27 extending inwardly from each side thereof so as to form an upwardly extending tongue or key top 22 having a rounded upper crown portion 28 and preformed side portions 29 thereon. Each side portion 29 preferably is formed with a pair of vertically aligned wedges 30 or wedge-shaped protrusions extending laterally outwardly therefrom, each such wedge having a rounded nose 31 adapted to join the relatively long wedge engaging surface 32 thereof to the oppositely disposed and more sharply beveled locking surface 33 thereof. Thus, tendem pairs of oppositely and symmetrically disposed wedge-shaped protrusions 30 extend laterally outwardly from the side portions of key top 22, the wedges in each pair being joined by a rounded fillet 38 at the root or minor diameter of key top 22.

Actuating button 20 has molded, machined or otherwise formed therein a vertically disposed rectangular recess 34, the wider vertically disposed lower rectangular opening 35 serving to communicate the interior recess 34 with the lower surface 36 of the button 20. The thickness of recess 34 and of the opening 35 is slightly greater than that of key stem 23, and the width of the opening 35 is equal to or slightly greater than the width of the key stem. The width of the rectangular interior recess 34, however, is several thousandths of an inch less than the major diameter of key top 22 or the distance between the rounded noses 31 of the oppositely disposed wedges 30, the amount of interference being principally determined by the size of the key assembly components and the limited elastic properties of the plastic material from which the buttons 20 are formed.

In securely attaching the plastic buttons 20 to the key stems 23, the key assemblies preferably are placed in a suitable press so that sufficient downwardly directed longitudinal force may be applied to the top surface 21 of each button 20 to cause a force fit and produce a predetermined self-locking engagement between the wedges 30 on key top 22 and the coacting vertical end surfaces 39 of the interior rectangular cavity 34. During the press fitting operation, the entering surfaces 32 of the wedges 30 function to spread the adjacent plastic material within the button 20 without splitting it; and after the press fitting operation has been completed, the more sharply beveled locking surfaces 33 of the wedges 30 securely hold the button and key stem together. As a result of the local internal pressures which are produced during press fitting of the button 20 onto their coacting key tops 22, the interior plastic within each button 20 flows sufficiently under pressure to move into intimate contact with the coacting surfaces of the preformed sides 29 and produce a self-locking engagement with the wedges 30 as shoulder 27 of key stem 23 comes to rest in contact with the abutting interior surface 26 of the button 20.

Whenever the button 20 is seated on the key stem shoulder 27 as illustrated in Fig. 2, sufficient plastic material has flowed into the irregular depressions formed by the wedges 30 to effect a highly effective gripping engagement with key stem 23 without being moulded thereon, and button 20 is seated in such a position thereon that the lower surface 36 thereof extends sufficiently below the level of the shoulder 27 to form a shroud which conceals from view a substantial portion of the upwardly extending key stem 23.

Thus, there has been provided a key stem assembly wherein plastic actuating button 20 is securely affixed to key stem 23 without being moulded thereon and without the use of cements, adhesives, or detachable installation parts. Moreover, the self-locking engagement resulting from this force fitting operation produces a highly efficient bond between a slightly elastic plastic button and its relatively inelastic supporting key stem which effectively resists inertial forces tending to separate the finger button from the key stem during rapid and repeated reciprocation thereof, even though such an actuating button has a relatively large mass and auxiliary means such as compression springs are used to exert upward resilient pressure on the bottom surface 36 of the button for the purpose of imparting a positive and quick acting upward movement to the key stem whenever it is released from its depressed position.

In the modified form of the invention illustrated in Figs. 3, 4 and 5, plastic button 20 is pressure fitted onto a key stem 23 having an upwardly extending top 37 formed with a crown 28 and depending side portions 32 thereon so that

key stem **23** has the same shape and configuration as key top **22**. Means is provided on top **37**, however, to supplement the action of the wedges **30** in establishing a self-locking engagement with the plastic finger button **20**, such auxiliary securing means preferably being in the form of a downwardly extending barb or scarf **38** which has been punched or press formed in the central portion of top **37**. It will thus be seen that an auxiliary wedging engagement in a plane substantially at right angles to the general plane of the wedges **30** is accomplished whenever button **20** is pressed onto top **37** so that it comes to rest against the shoulder **27**. This form of the invention may be preferred in instances wherein inertia and other forces tending to sever the finger button **20** from its associated key stem **23** are unusually severe.

In the modified form of the invention shown in Figs. 6 and 7, the key top **40** which extends upwardly from key stem **23** has only one wedge **41** on each side thereof similar in general configuration to the wedges **30**, but of a size substantially larger than the tandem wedges **30** disclosed in the preferred form of the invention. This modified arrangement may sometimes be preferred in instances wherein the plastic material from which button **20** is fabricated has superior flow characteristics when subjected to high local pressures, and in instances wherein the auxiliary fastening and securing means illustrated in Figs. 4 and 5 is neither necessary nor desirable.

From the above description it will be apparent that this invention provides an improved method and means of establishing an effective and highly efficient pressure bond between a slightly elastic plastic finger button and its associated relatively non-elastic supporting stem without molding the components together or the use of adhesives or detachable installation parts. There has also been provided a method of rapidly and securely affixing plastic finger buttons, whose modulus of elasticity decreases substantially with increased temperature, to the key stems of business machines and the like, in such a manner that the efficiency of the bond will not be substantially reduced by continued exposure to relatively high operating temperatures. There has also been provided a method and means of establishing an efficient and highly effective self-locking engagement between a slightly elastic plastic button and its associated substantially nonelastic actuating stem, which engagement is particularly adapted to resist inertial forces and auxiliary resilient pressures tending to progressively displace the button from its predetermined position on the key stem when the key assembly is rapidly released from its depressed position.

We claim:

1. The method of pressure fitting a slightly elastic finger button onto a substantially nonelastic key stem which comprises forming a plurality of rounded obtuse protuberances on the opposing edges of the upper portion of the key stem, the protuberances on each such edge being interconnected by a fillet, forming a slightly undersized recess interiorly within the said button so that the same is adapted to be pressure fitted onto the upper portion of the said key stem, placing the thus formed button on the said upper portion of the key stem, and exerting sufficient downward pressure on the said button to symmetrically seat the same in a predetermined position on the said key stem by a self-centering action so as to induce cold flow of the slightly elastic material within the said button into the said fillets for establishing at normal room temperatures an effective shear-resisting bond with the said protuberances.

2. The method of pressure bonding a finger button composed of plastic material having limited flow characteristics under pressure to a key stem provided with a shoulder and having a substantially higher modulus of elasticity than the said plastic button, which comprises forming a plurality of interconnected and substantially S-shaped protuberances on opposing edges of the upper portion of the key stem, forming a slightly undersized vertical slot interiorly within the said button in such a manner that the same may be pressure fitted onto the said upper portion of the said key stem by the application of a predetermined positive pressure, placing the thus formed button on the top of the said key stem, and exerting sufficient downwardly directed pressure on the said button to progressively press the said button onto the top of the key stem and by a self-centering action to substantially symmetrically seat the said button in a predetermined position thereon and in predetermined contact with the said shoulder so as to cause cold flow of the slightly elastic material within the said button for establishing at normal room temperatures an effective self-locking engagement with the rounded depressions formed by the said protuberances.

3. In a key operated device, the combination which comprises a manually depressible key stem having an upwardly extending top portion composed of relatively inelastic material, a set of streamlined wedges on opposing edges of the top portion of the said key stem, the wedges in each set having a periodic and continuously curved contour, and a slightly elastic finger button having an upwardly extending recess therein interlockingly engaged with the wedges of the said top portion at normal room temperatures and securely retained in place on the said top portion without the necessity of moulding the said button to the said key stem.

4. In a key operated device, the combination which comprises a key stem having an upwardly extending top portion composed of relatively inelastic material, a plurality of cambered protuberances on opposing edges of the top portion of the said key stem, the said protuberances each having a rounded nose and being interconnected by a fillet, and a finger button of relatively large mass composed of slightly elastic plastic material and having an interior recess therein, the said button having been pressure fitted by a self-centering action onto the said top portion of the key stem at normal room temperatures and being securely retained in a predetermined position thereon by the interlocking engagement of the said slightly elastic plastic material with the said protuberances so as to effectively resist intermittently applied forces tending to sever the said finger button from the said key stem whenever the key assembly is rapidly and repeatedly released from its depressed position.

5. In a key operated device, the combination which comprises a manually depressible key stem of relatively inelastic material having a preformed top portion at the upper extremity thereof, at least one substantially S-shaped protuberance on each of two opposing edges of the top portion of the said key stem and integrally formed therewith, and a slightly elastic plastic button for the said key, the said button having

an upwardly extending recess disposed interiorly therein and engaging the top portion of the said key stem so as to cause the said slightly elastic material within the said button to flow substantially uniformly at normal room temperatures into the rounded depressions formed by the said protuberances in such a manner as to form an effective shear-resisting and self-locking engagement between each such button and its coacting key stem.

6. In a key operated device, the combination which comprises a manually depressible key stem having a preformed top portion, a plurality of rounded obtuse protuberances on opposite sides of the top portion of the said key stem and disposed substantially symmetrically about the vertical axis thereof, each of the said protuberances having a continuously curved irregular contour, and a plastic finger button for the said key having a modulus of elasticity substantially lower than that of the said key stem and snugly fitted thereon by a self-centering action so as to induce a substantially uniformly distributed plastic flow within the said button for establishing at normal room temperatures an effective self-locking and shear-resisting bond between the said button and the protuberances of the said key stem, the effectiveness of the said bond being substantially undiminished by continued exposure to relatively high operating temperatures.

7. In a key operated device adapted to be manually depressed and resiliently returned to its inactive position on release, the combination which comprises a key stem having a top portion at the upper extremity thereof, a plurality of connected semi-pear shaped curves integrally formed on opposite edges of the top portion of the said key stem and disposed substantially symmetrically about the vertical axis thereof, and a slightly elastic actuating button for the said key having an internal recess therein engaging with the said top portion of the key stem to induce plastic flow within the said button at normal room temperatures and move the slightly elastic material therein into effective shear-resisting engagement with depressed portions of the said connected curves to effectively secure the said button to the said key stem in a predetermined position thereon and in such a manner as to effectively withstand induced and externally applied forces tending to move the said button progressively upwardly during rapid release of the said key from its depressed position.

8. In a keyboard key assembly, the combination which comprises a key stem having an upwardly extending top portion composed of relatively inelastic material, a cambered obtuse protuberance integrally formed on each edge of the said top portion of the key stem and symmetrically disposed about the longitudinal axis thereof, and a slightly elastic key actuating button snugly fitting the top portion of the said key stem by a self-centering action in such a manner as to induce a substantially uniformly distributed cold flow of the material within the said button and establish an effective shear-resisting engagement between the said button and the said key stem solely by the self-locking action of the said protuberances.

9. The key assembly of claim 8 wherein a pair of tandem cambered protuberances are integrally formed on each edge of the said top portion of the key stem and disposed thereon in a substantially symmetrical pattern arrangement.

10. The method of pressure fitting a slightly elastic finger button onto a substantially inelastic key stem at normal room temperatures which comprises forming continuous irregular corrugations on the opposing edges of the upper portion of the key stem, each of the said corrugations having rounded alternate ridges and furrows, forming a slightly undersized recess interiorly within the said button so that the same is adapted to be pressure fitted onto the said upper portion of the key stem, and forcing the said unheated button and key stem into predetermined self-locking engagement by causing the said rounded ridges to produce cold flow within the said button and move a portion of the slightly elastic material therein into the said rounded furrows.

11. The method of pressure fitting a slightly elastic finger button onto a substantially inelastic key stem at normal room temperatures which comprises forming a plurality of irregular serpentine corrugations on the opposing edges of the upper portion of the key stem, each of the said corrugations having alternating rounded ridges and grooves, forming an extrusion on one side of the upper portion of the said key stem and in a position between the said corrugations to provide an auxiliary holding means, forming a slightly undersized recess interiorly within the said button so that the same is adapted to be pressure-fitted onto the said upper portion of the key stem, and forcing the said unheated button and key stem into locking engagement by inducing cold flow of the slightly elastic material within the said button and causing the same to form an effective shear-resisting bond with the irregularities formed by the said corrugations, and an auxiliary bond with the said extrusion on the said key stem.

12. The method of securing an effective bond between a finger button and key stem at normal room temperatures which comprises, forming a key stem having a plurality of rounded protuberances on opposing edges of the upper portion of the said key stem, the protuberances on each such edge being interconnected by a fillet, forming a slightly elastic finger button having a recess therein for receiving the said upper portion of the key stem, the recess in the said finger button being of a width equal to the mean width of the upper portion of the said key stem, and moving the said key stem and finger button relative to each other to seat the said key stem in said recess and cause the material within said button to flow into interlocking engagement with the said protuberances.

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