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(54) COUNTERBALANCE TOUCH CONTROL

(71) We, SCM CORPORATION, a corporation of the State of New York, United States of America, of 299 Park Avenue, New York, State of New York, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to key-operated machines such as typewriters, adding machines and the like, and, more particularly, to apparatus for controlling the effort required to depress the keys of such machines.

Control of the effort, or touch, required to depress the key levers in key lever actuated machines is very important if operating personnel are to achieve maximum utilization of the machines. However, because most key-operated machines have intricate key lever mechanisms, it is difficult to effectively control the key lever depression touch of these machines.

The present invention provides apparatus for adjusting the effort required to depress keys of a key-actuated machine, comprising means for applying a force to said keys, said means being connected between said keys and a member which is movable to alter the force applied to said keys, torque applying means connected to said member for counterbalancing the force applied by said force applying means, and means arranged to simultaneously increase or decrease the force applied to the keys and the counterbalancing torque.

The present invention also provides apparatus for adjusting the effort required to depress keys of a key-actuated machine, comprising first spring holding means movably mounted in said machine; key lever spring means operatively connected to each key lever and to said first spring holding means for urging said first spring holding means to move in a given direction; second spring holding means mounted in said machine; counterbalance spring means operable by said second spring holding means to alter the torque on said first spring holding means as said key lever spring means changes in tension; and means to position said first spring holding means and said second spring holding means to simultaneously alter the tension of said counterbalance spring means in the opposite sense to the change in the tension of said key lever spring means and to alter the torque applied by said counterbalance spring means in the same sense as the change in the tension of said key lever spring means.

In a preferred form of the apparatus, the position of a spring bail is adjusted which simultaneously controls the tension of all the key lever springs. A manually operated control member, with attendant linkages, positions the spring bail and simultaneously adjusts the tension of counterbalancing spring means, to minimize the unbalanced spring forces acting on the spring bail, and the entire key depression force control apparatus.

The apparatus can be adjusted from one touch setting to another without substantially changing the unbalanced forces acting on the touch control apparatus, and does not require a variation of the forces exerted on the manually positioned control member when adjusting the key depression touch from one setting to another. In consequence, the setting does not tend to drift during operation of the machine.

Preferably a counterbalance spring means is provided which increases the force applied to the key lever springs as the counterbalance spring means decreases in length. With this arrangement, the manual control is highly sensitive due to having a substantial mechanical advantage to allow easy manual positioning of the control member when adjust-

ing the key depression touch setting and provides an infinite number of touch settings. In addition, it adjusts all keys simultaneously and uniformly.

The apparatus is compact and easily mounted within the housing of normal business machines, for example a typewriter. An advantage of the apparatus is that it has few parts, is cheap to manufacture, and is durable in operation.

Features and advantages of the present invention will be apparent from the following description of an embodiment thereof, given by way of example, when taken in conjunction with the accompanying drawings, in which:

Figure 1 is a perspective view of a portion of a typewriter showing a key depression force control apparatus according to the present invention;

Figure 2 is an enlarged perspective view of the apparatus shown in Figure 1;

Figure 3 is an exploded perspective view of the apparatus shown in Figures 1 and 2;

Figure 4 is a perspective view of the apparatus shown in the minimum effort position; and

Figure 5 is a perspective view of the apparatus shown in the maximum effort position.

Although the invention will hereinafter be described in connection with a typewriter, it will be understood that the invention can be applied to a wide variety of key-actuated business machines such as adding machines, teleprinters, and the like.

Referring to Figure 1, a typewriter, generally indicated at 10, has a frame 12, and a keyboard, generally indicated at 14, comprising a plurality of key buttons 16, each of which is connected to a key lever 18, which, through various linkages, actuates a typebar (not shown). As shown in Figures 2 to 5, each key lever 18 is connected by means of a key lever spring 20 to a spring bail 22 fixed to a shaft 24 which is rotatably mounted to the left and right-hand walls 26 and 28 respectively of frame 12. A spring lever 30 is attached at the left-hand end of bail shaft 24 extending beyond left-hand wall 26 for rotation with shaft 24. A first counterbalancing spring 34 is connected at one of its ends to a finger 32 on spring lever 30 and is connected at its other end to a finger 36 extending from the left-hand wall 26 of frame 12.

Similarly, a bell crank 38 is attached to the right end of bail shaft 24, extending beyond right wall 28 of frame 12 for rotation with shaft 24. A second counterbalance spring 42 is connected at one of its ends to a finger 40 on bell crank 38 and is connected to a finger 44 extending from right wall 28 of frame 12. The arrangement of spring 34 and spring 42 is such that their respective lines of force act transversely to the axis of shaft 24. Also, the spring 34 and the spring 42 are positioned in a side-by-side relationship with the row of springs 20 thus providing a compact and efficient counterbalance spring system. The bail crank 38 also includes an arm 46 to which is connected a swing arm 50 of a pivot member 52 by means of a translation link 48. Pivot member 52 is pivotally mounted to a leg 54, Figure 3, extending from the right wall 28 of frame 12 by means of a pivot pin 56 which extends through the upper and lower arms 58 and 60 of pivot member 52. A cam pin 62 extends upwardly from upper arm 58 of pivot member 52 to control the movement of the swing arm 50, as will now be described.

Pivot member 52 is controlled by manually positioning a control knob 64 rotatably mounted on the leg 54 of frame 12. A retaining pin 66 has a large cylindrical shank 68 extending through cylindrical passage 76 in the hub of the control knob 64 and a smaller threaded end 70 which engages threaded passage 72 in leg 54. The control knob 64 has a cam groove 74 in the underside of the knob which spirals outwardly from the central cylindrical passage 76 of the knob, about which the knob rotates. Cam pin 62 fits within the cam groove 74 so that rotation of the control knob in the counterclockwise direction, shown by the arrow in Figure 2, will tend to make cam pin 62 move radially away from the retaining pin 66, causing pivot member 52, including swing arm 50, to move in the clockwise direction, toward the position shown in Figure 4. Similarly, rotation of the control knob 64 in the opposite direction, i.e. clockwise, will tend to move cam pin 62 closer to the retaining pin 66 and, therefore, urge the pivot member 52 with swing arm 50 around pivot pin 56 in the counterclockwise direction toward the position shown in Figure 5.

A brake member 78 is placed between the leg 54 of frame 12 and the bottom of the control knob 64 to prevent random movement of the control knob. The brake member includes four contact feet 80 which are raised above and connected to the central portion of the brake member by bent arms 81. The brake member is held fixed in place by a shoulder 69 of the retaining pin 66 formed between the shank 68 and the threaded end 70 of the retaining pin. Threaded end 70 passes through the retaining pin passage 82 of the brake member. Additionally, an anchoring tab 84 extends from the central portion of brake member 78 and fits into an anchor slot 86 on leg 54 of the frame 12. The contact feet 80 of the brake member 78 frictionally engage the underside 88 of the control knob which forms

a brake surface for the control knob, so that the control knob will not drift after it is set at a particular position.

The effort required to depress a key lever is controlled by manually positioning the control knob which will position the spring bail to adjust the tension of the key lever springs 20 which, in turn, determine the amount of force necessary to depress the key lever buttons.

As shown in Figure 4, when the control knob 64 is rotated counterclockwise when viewed from above, the cam pin 62 will move in helical cam groove 74 of the control knob radially away from retaining pin 66 of the control knob so that the swing arm 50 of pivot member 52 will rotate clockwise when viewed from above, thereby pulling translation link 48 to the left to cause bell crank 38 to rotate counterclockwise when viewed from the right-hand side. The counterclockwise rotation of bell crank 38 will cause the end of spring bail 22 to move upward toward key levers 18, thereby allowing each key lever spring 20 to contract to a lower stressed condition. Thus, the key lever springs will exert a relatively light force on the key levers so that the amount of force or touch required to depress the key buttons on the key levers will be at a minimum.

When the spring bail 22 is in the raised position (Figure 4), the finger 40 of bell crank 38 is positioned with respect to finger 44 of right wall 28 of frame 12, so that counterbalance spring 42 connecting fingers 40 and 44 is extended to a maximum position and substantially crosses the axis of shaft 24. Similarly, finger 32 of spring lever 30 on the left end of bail shaft 24 is positioned so that the counterbalance spring 34 connecting spring lever finger 32 with finger 36 of left wall 26 of the frame is also at the maximum extension and substantially crosses the axis of shaft 24. Accordingly, the forces of both counterbalance springs 34 and 42 exert torques on spring bail shaft 24 which oppose the torques exerted on the spring bail shaft 24 by the key lever springs 20.

To move the control apparatus from a setting requiring light depression pressure to one requiring heavier pressure, the control knob 64 is rotated in the clockwise direction (opposite the arrow in Figure 2), so that the cam pin 62 will run in the helical cam groove 74 of the control knob 64 toward the centre of the control knob, thereby moving pivot member 52 counterclockwise and swing arm 50 toward the right, which motion is, in turn, translated through translation link 48 to arm 46 of bell crank 38 to rotate the bell crank 38 in the clockwise direction. If control knob 64 were turned the full range of travel clockwise, arm 46 of bell crank 38 would move upward to the vertical position shown in Figure 5, and fingers 32 of spring lever 30 and 40 of bell crank 38 would move closer to the frame to slightly shorten counterbalance springs 34 and 42. Having one end of spring 34 connected to finger 32 of spring lever 30 and one end of spring 42 connected to finger 40 of bellcrank 38, the torque applied by the springs 34 and 42 increases as the ends of the springs 34 and 42 are carried away from the axis of shaft 24, the increase in distance from the axis of shaft 24 compensating for the decreasing pulling force as the springs 34 and 42 slightly shorten. In the position shown in Figure 5, the spring bail 22 has been moved to a nearly vertical position extending the key lever springs 20, increasing the tension in these springs, and, therefore, increasing the force required to depress the key levers. While the extended key lever springs 20 exert a counterclockwise torque on the bail shaft 24, the left and right counterbalance springs 34 and 42, though shortened, still exert a counterbalancing clockwise torque on the bail shaft 24, which balances the torque exerted by the key lever springs 20. Accordingly, it can be seen that no matter what positions the spring bail 22 is placed in or being moved to by the control knob, there will be counterbalancing forces exerted on the bail shaft 24, so that the unbalanced force exerted on the bail shaft 24 will be of a relatively small value.

The apparatus of the above embodiment possesses many advantages. For example, the apparatus provides great sensitivity of adjustment because the helical cam in the control knob requires a large displacement to adjust the touch control over its full range. Similarly, the use of a helical cam groove in the rotatable control knob offers an extremely high mechanical advantage in positioning the spring bail, so that a minimum of force is necessary on the part of the operator of the machine to adjust the control knob. Additionally, because of the high mechanical advantage involved, the net forces which are fed back from the spring bail shaft to the control knob through the touch control apparatus are relatively small and can easily be handled by the brake mechanism described without the necessity for detents or other fixed stops in the control range. Therefore, the system will not have a tendency to drift from one position to another, but will tend to be more stable and not require continuous adjustment, as has heretofore been the case with many touch control systems. Since no detents are necessary to hold the control knob, an infinite number of settings for the control knob will be available to the operator.

It should also be noted that the apparatus has relatively few moving parts and requires a minimum of adjustment to ensure

proper operation. Therefore, the apparatus is relatively inexpensive to manufacture and is highly durable in service.

WHAT WE CLAIM IS:—

1. Apparatus for adjusting the effort required to depress keys of a key-actuated machine, comprising means for applying a force to said keys, said means being connected between said keys and a member which is movable to alter the force applied to said keys, torque applying means connected to said member for counterbalancing the force applied by said force applying means, and means arranged to simultaneously increase or decrease the force applied to the keys and the counterbalancing torque.

2. Apparatus for adjusting the effort required to depress keys of a key-actuated machine, comprising first spring holding means movably mounted in said machine; key lever spring means operatively connected to each key lever and to said first spring holding means for urging said first spring holding means to move in a given direction; second spring holding means mounted in said machine; counterbalance spring means operable by said second spring holding means to alter the torque on said first spring holding means as said key lever spring means changes in tension; and means to position said first spring holding means and said second spring holding means to simultaneously alter the tension of said counterbalance spring means in the opposite sense to the change in the tension of said key lever spring means and to alter the torque applied by said counterbalance spring means in the same sense as the change in the tension of said key lever spring means.

3. Apparatus according to claim 2 wherein said second spring holding means includes a rotatably mounted shaft; and a member extending substantially radially from said shaft, said member being operable to move said counterbalance spring means from a position substantially crossing the axis of said shaft to a position radially spaced from the axis of said shaft to increase the torque applied by said counterbalance spring means to said shaft as said key lever spring means increases in tension.

4. Apparatus according to claim 3, wherein said first spring holding means includes a rotatably mounted shaft and a bail extending outwardly from said shaft; and said second spring holding means includes a member extending outwardly from said shaft at an angularly spaced relationship to said bail whereby the pulling force of said key lever spring means and said counterbalance spring means exert counterbalancing torques on said shaft.

5. Apparatus according to claim 2, 3 or 4, wherein said first spring holding means includes means connected to said second spring holding means for movement by said second spring holding means.

6. Apparatus according to any one of claims 2 to 5, wherein said positioning means includes a linkage connected to said second spring holding means for simultaneously positioning said second spring holding means and said first spring holding means.

7. Apparatus according to any one of claims 2 to 6, further comprising brake means operatively associated with said positioning means to resist movement of said first spring holding means and said second spring holding means.

8. Apparatus according to any one of claims 2 to 7, wherein said positioning means includes a control knob rotatably mounted in said business machine; a cam surface in said control knob; and pivot means in contact with said cam surface and operatively connected with one of said first spring holding means and said second spring holding means to position said key lever spring means and said counterbalance spring means in response to manual positioning of said control knob.

9. Apparatus according to any one of claims 3 to 8, wherein said second spring holding means comprises a first spring anchor movable relative to a fixed further spring anchor for pivoting said counterbalance spring means in a direction to increase in torque as said key lever spring means increases in tension.

10. Apparatus for adjusting the effort required to depress key levers in a key lever actuated business machine, comprising spring holding means movably mounted in said business machine; key lever spring means operatively connected to each key lever and to said spring holding means for urging said spring holding means to move in a given direction; counterbalance spring means operatively associated with said spring holding means in a substantially side-by-side relationship relative to said key lever spring means and operable for urging said spring holding means to move in a direction opposed to the given direction of said key lever spring means; and means to position said spring holding means to simultaneously alter the tension of said counterbalance spring means in the opposite sense to the change in the tension of said key lever spring means and to alter the torque applied by said counterbalance spring means in the same sense as the change in the tension of said key lever spring means.

11. Apparatus for adjusting the effort required to depress keys of a key-operated machine, substantially as hereinbefore described with reference to the accompanying

proper operation. Therefore, the apparatus is relatively inexpensive to manufacture and is highly durable in service.

WHAT WE CLAIM IS:—

1. Apparatus for adjusting the effort required to depress keys of a key-actuated machine, comprising means for applying a force to said keys, said means being connected between said keys and a member which is movable to alter the force applied to said keys, torque applying means connected to said member for counterbalancing the force applied by said force applying means, and means arranged to simultaneously increase or decrease the force applied to the keys and the counterbalancing torque.

2. Apparatus for adjusting the effort required to depress keys of a key-actuated machine, comprising first spring holding means movably mounted in said machine; key lever spring means operatively connected to each key lever and to said first spring holding means for urging said first spring holding means to move in a given direction; second spring holding means mounted in said machine; counterbalance spring means operable by said second spring holding means to alter the torque on said first spring holding means as said key lever spring means changes in tension; and means to position said first spring holding means and said second spring holding means to simultaneously alter the tension of said counterbalance spring means in the opposite sense to the change in the tension of said key lever spring means and to alter the torque applied by said counterbalance spring means in the same sense as the change in the tension of said key lever spring means.

3. Apparatus according to claim 2 wherein said second spring holding means includes a rotatably mounted shaft; and a member extending substantially radially from said shaft, said member being operable to move said counterbalance spring means from a position substantially crossing the axis of said shaft to a position radially spaced from the axis of said shaft to increase the torque applied by said counterbalance spring means to said shaft as said key lever spring means increases in tension.

4. Apparatus according to claim 3, wherein said first spring holding means includes a rotatably mounted shaft and a bail extending outwardly from said shaft; and said second spring holding means includes a member extending outwardly from said shaft at an angularly spaced relationship to said bail whereby the pulling force of said key lever spring means and said counterbalance spring means exert counterbalancing torques on said shaft.

5. Apparatus according to claim 2, 3 or 4, wherein said first spring holding means includes means connected to said second spring holding means for movement by said second spring holding means.

6. Apparatus according to any one of claims 2 to 5, wherein said positioning means includes a linkage connected to said second spring holding means for simultaneously positioning said second spring holding means and said first spring holding means.

7. Apparatus according to any one of claims 2 to 6, further comprising brake means operatively associated with said positioning means to resist movement of said first spring holding means and said second spring holding means.

8. Apparatus according to any one of claims 2 to 7, wherein said positioning means includes a control knob rotatably mounted in said business machine; a cam surface in said control knob; and pivot means in contact with said cam surface and operatively connected with one of said first spring holding means and said second spring holding means to position said key lever spring means and said counterbalance spring means in response to manual positioning of said control knob.

9. Apparatus according to any one of claims 3 to 8, wherein said second spring holding means comprises a first spring anchor movable relative to a fixed further spring anchor for pivoting said counterbalance spring means in a direction to increase in torque as said key lever spring means increases in tension.

10. Apparatus for adjusting the effort required to depress key levers in a key lever actuated business machine, comprising spring holding means movably mounted in said business machine; key lever spring means operatively connected to each key lever and to said spring holding means for urging said spring holding means to move in a given direction; counterbalance spring means operatively associated with said spring holding means in a substantially side-by-side relationship relative to said key lever spring means and operable for urging said spring holding means to move in a direction opposed to the given direction of said key lever spring means; and means to position said spring holding means to simultaneously alter the tension of said counterbalance spring means in the opposite sense to the change in the tension of said key lever spring means and to alter the torque applied by said counterbalance spring means in the same sense as the change in the tension of said key lever spring means.

11. Apparatus for adjusting the effort required to depress keys of a key-operated machine, substantially as hereinbefore described with reference to the accompanying

* C L M S *

drawings.

12. A key-operated machine including apparatus for adjusting the effort required to depress the keys of the machine according to any preceding claim.

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