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 APPARATUS BASE CONFIGURATION FOR REDUCTION
 OF SLIDING AND TIPPING
 Filed Dec. 13, 1967

3,462,111

FIG. 1

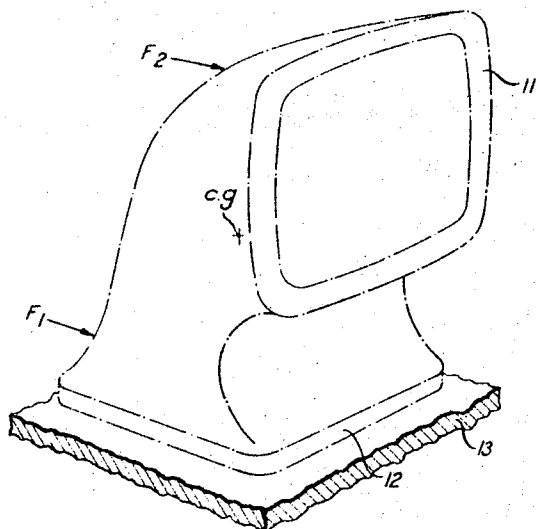


FIG. 6

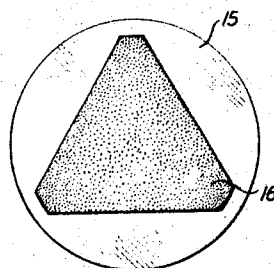


FIG. 3

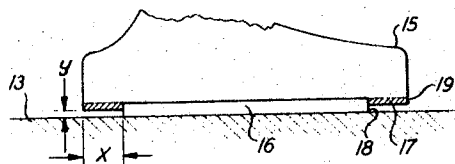


FIG. 2

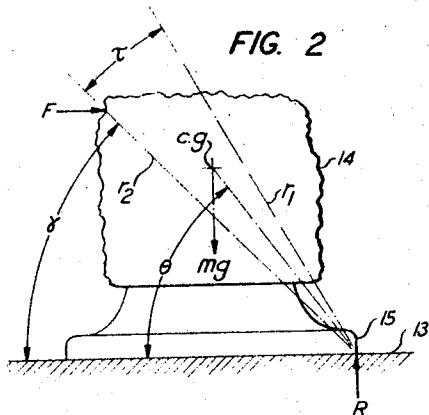


FIG. 4

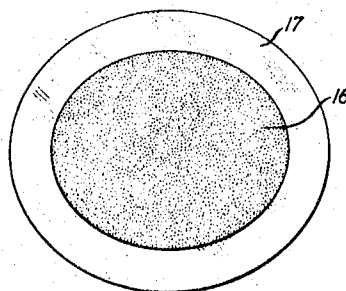
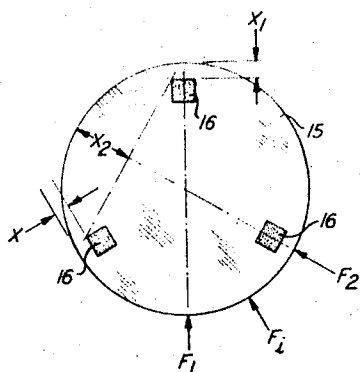


FIG. 5



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APPARATUS BASE CONFIGURATION FOR REDUCTION OF SLIDING AND TIPPING

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2 Claims

ABSTRACT OF THE DISCLOSURE

To reduce the tendency of apparatus to slide or tip in response to an applied force, two materials with diverse coefficients of friction are selectively affixed to the base of the apparatus. A material with a high coefficient of friction is affixed to a portion of the apparatus base area and contacts the desk or utility surface upon which the apparatus is placed. A second material which is affixed to the uncovered perimeter of the base, and has a relatively low coefficient of friction, is offset so that it only comes into contact with the utility surface upon incipient tipping of the apparatus, thereby preventing further tipping by allowing the apparatus to slide.

BACKGROUND OF THE INVENTION

Field of the invention

This invention pertains to equipment support apparatus and, more particularly, to base apparatus for supporting diverse equipments subject to sliding and tipping.

Description of the prior art

Desk or table top apparatus such as telephones, pen sets, ashtrays, etc., and other similar objects are occasionally subject to abusive treatment. The most common and, potentially, the most damaging type of abuse results from inadvertent striking, pushing or pulling of the apparatus in such a manner that the instrument or other device is propelled across the top of a table or desk on to the floor. To prevent this occurrence, devices, of the sort discussed, are generally supplied with base pads, affixed to the bottom of the instrument, which effectively reduce this predilection to slide. The underlying mechanism of this relatively simple preventive technique is based upon the principle that the resistive or frictional force exerted by a surface is directly related to the product of the reactive force of the surface, generally equal to the weight of the apparatus, and the coefficient of friction of the base pad affixed to the bottom of the device. Since the instrument will remain immobile when the applied force is less than the resistive frictional force, and will be accelerated only by a force equal to the difference between the applied and resistive forces, when the former exceeds the latter, it is desirable to make the resistive force as large as possible, consonant with the requirement that the surface upon which the apparatus rests not be damaged. Since the weight of the instrument is generally invariant, the desired effect is achieved by using a base pad with a relatively high coefficient of friction.

The taller the device becomes, the more susceptible it is to a second abusive action, namely, tipping. Tipping may be defined as the tendency of an instrument to rotate about one edge of its base and fall on its side in response to an applied striking force. Thus, for tipping to occur, the edge of the base must remain stationary. To prevent tipping, it is therefore desirable that the edge slide rather than remain immobile.

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It is, of course, apparent that the coefficients of friction required for the two conditions necessary to prevent sliding and tipping are mutually exclusive, i.e., the coefficient of friction should be high to prevent sliding and low to prevent tipping.

It is, therefore, an object of this invention to reconcile these conflicting criteria in a base pad configuration which simultaneously prevents sliding and tipping.

SUMMARY OF THE INVENTION

This object is accomplished, in accordance with the inventive principles described herein, by utilizing, simultaneously, two materials with diverse coefficients of friction which are selectively affixed to the base of an apparatus. More particularly, in one embodiment of the invention, a material with a high coefficient of friction is affixed to the central portion of an instrument base area and contacts the desk or utility surface upon which the instrument is placed. This centrally located material prevents sliding when a force is applied to the instrument. A second material which occupies the uncovered perimeter of the base, and has a relatively low coefficient of friction, is offset so that it only comes into contact with the utility surface upon incipient tipping of the instrument. Because of the low coefficient of friction of the perimeter material, the instrument slides rather than tips. As the instrument slows down, it rocks back into its original vertical position, bringing into play the increased frictional effect of the centrally located material. Thus, since there is a greater chance of breakage if the apparatus tips over, moderate sliding is induced, in accordance with this invention.

These and further features and objects of this invention, its nature and various advantages will be readily apprehended upon consideration of the attached drawings and of the following detailed description of the drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings:

FIG. 1 is a diagram of an illustrative instrument which is subject to sliding and tipping in response to applied forces;

FIG. 2 is a free body diagram which illustrates the mechanics of sliding and tipping;

FIG. 3 is an illustrative diagram of a base configuration, in accordance with this invention, which substantially reduces sliding and tipping of an attached instrument;

FIG. 4 is another view of the base configuration of FIG. 3;

FIG. 5 is an illustrative diagram of another embodiment of the base configuration of this invention; and

FIG. 6 illustrates yet another embodiment of this invention.

DETAILED DESCRIPTION

In the drawing of FIG. 1, there is illustrated an instrument, for example, a television transceiver 11, having a base 12 which rests on surface 13. (It should be noted, at the outset, that the principles of this invention are applicable to diverse and sundry apparatus including television receivers, lamps, racks, cabinets, telephones, pen sets, ashtrays and other miscellaneous desk top or floor mounted apparatus.) The center of gravity of device 11 is indicated by the designation c.g. Considering, first, force F_1 , which is applied at a point below the center of gravity of the instrument, one intuitively feels that if the force F_1 exceeds the frictional resistive force of the utility surface 13, instrument 11 will slide rather than tip. On the other hand, considering force F_2 , which is applied to instrument 11 at a point well above the cen-

ter of gravity, intuition leads one to feel that device 11 will tip rather than slide if the frictional force exerted on the edge of base 12, by the utility surface 13, exceeds the magnitude of force F_2 .

Turning now to FIG. 2, which is a free body diagram of a device 14 having arbitrarily selected contour dimensions, the frictional force exerted by utility surface 13 is directly related to the product of the reactive force R and the effective coefficient of friction, μ_1 , of the contact surface of base 15 of device 14. Force R, in the case where no rotation has occurred, is equal to the weight (mg) of device 14. Thus the frictional force may be expressed as:

$$f_{\text{resisting}} = \mu_1 R = \mu_1 (mg) \quad (1)$$

Since device 14 will not slide when the applied force, F, is less than the force, $f_{\text{resisting}}$, and will be accelerated only by the difference between these two forces, when the applied force exceeds the resisting force, it is desirable to make the resisting force as large as possible commensurate with not damaging the surface 13 upon which the device rests. This desired effect is generally achieved by affixing to the contact surface of base 15 a material or pad with a high effective coefficient of friction, μ_1 .

Having considered the mechanics of sliding, we turn now to the principles underlying the phenomenon of tipping. Assuming the applied force F is above the center of gravity and has rotated apparatus 14 through an angle τ , then by taking moments about a point of coincidence of the edge of base 15 and utility surface 13, i.e., the point of application of reactive force R, a state of equilibrium will exist when:

$$\bar{F} = (mg) \frac{r_1 \cos(\theta + \tau)}{r_2 \sin(\gamma + \tau)} \quad (2)$$

where r_1 is equal to the length of the radius vector to the center of gravity c.g., r_2 is equal to the length of the radius vector to the point of application of force F, θ is equal to the initial angle defined by radius vector r_1 and surface 13, and γ is equal to the initial angle defined by radius vector r_2 and surface 13, as illustrated. Taking moments about the point of application of force F, the reactive force R is defined by:

$$R = mg \left[1 - \frac{r_1 \{\cos(\theta + \tau)\}}{r_2 \{\cos(\gamma + \tau)\}} \right] \quad (3)$$

For rotation to occur, the edge of the base must remain stationary. If the force resisting sliding of the edge, i.e., that force maintaining the edge stationary, is less than the minimum applied force necessary to produce incipient rotation, the base edge will slide for moderate impacts and deter tipping. To satisfy this condition, the force $f_{\text{resisting}}$, which is equal to μR , must be less than the applied force F. By substitution, the frictional coefficient, μ_2 , necessary to achieve this condition may be derived as follows:

$$\mu_2 R < F \quad (4)$$

so that

$$\mu_2 < \frac{\frac{r_1 \left[\frac{\cos(\theta + \tau)}{\sin(\gamma + \tau)} \right]}{1 - \frac{r_1 \{\cos(\theta + \tau)\}}{r_2 \{\cos(\gamma + \tau)\}}}}{\quad} \quad (5)$$

Thus, it is seen that the requirements for the coefficient of friction of the base 15 of device 14, for the two conditions necessary to prevent sliding and tipping, are incompatible. That is, the frictional coefficient, μ_1 , should be as high as practical to prevent sliding and the frictional coefficient, μ_2 , should be as low as practical to prevent tipping. It should, of course, be apparent that although the above discussion was premised upon the analysis of a free body diagram of a relatively simple configuration, the principles derived are true in all cases.

FIGS. 3 and 4 illustrate an embodiment of the invention wherein these two incompatible requirements are reconciled in a base pad configuration which substantially reduces the tendency of an instrument or other apparatus to slide or tip in response to applied forces. Structure 15, which represents the supporting base of any arbitrarily configured apparatus, not shown, has affixed to its utility contact or supporting surface, by adhesive or any other well-known technique, two materials with diverse coefficients of friction. Material 16, which may comprise any well-known frictional material, e.g., a cellulose, rubber or felt composition, is affixed to the central portion of the instrument base area, as may be more clearly seen from the plan view of FIG. 4, and contacts the desk, floor or utility surface 13 upon which the apparatus rests. Material 16 has a high effective coefficient of friction, μ_1 , illustratively in the range of 0.8 to 1.0, sufficient to satisfy the requirement of Equation 1 for anticipated maximum applied forces. Thus, material 16 prevents sliding of the base when a force is applied to the apparatus mounted on base 15. A second material 17, affixed to the uncovered perimeter, represented by border dimension x, of base 15, has a coefficient of friction, μ_2 , which satisfies the requirement of Equation 5. In addition, material 17 is offset from surface 13 a predetermined distance represented by dimension y. The reduction in area of material 16, necessary to accommodate the perimeter material 17, is not significant since resistance to sliding is not a function of area. Consequently, for conditions of sliding, the base functions in a normal manner.

In the case of tipping, however, base 15 rotates about edge 18 until edge 19 touches surface 13. Of course, the amount of rotation may be controlled by the magnitude of the offset and border width dimensions y and x. Indeed, the angle of rotation τ necessary for edge 19 to contact surface 13 is defined by the arctangent of the ratio of y to x. In determining the maximum coefficient of friction for material 17, it is necessary to substitute into Equation 5 the maximum allowable value of τ determined by dimensions y and x. In one particular embodiment, having values for θ and γ of 59.8° and 56.8° , respectively, it was found that an initial rotation of 9.4° was obtained with dimensions of 0.02 inch and 0.12 inch for y and x, respectively, yielding a maximum coefficient of friction equal to 0.57. Since rotation is an inherent part of tipping, the low coefficient of friction material 17 is automatically brought into play. Thus, the instrument will commence sliding rather than tipping since the edge 19, which comes into contact with the utility surface 13, will not remain immobile. As soon as the instrument slows down sufficiently to rotate in the opposite direction, the high coefficient material 16 comes back into contact with surface 13, applying a braking action and bringing the instrument to rest. Of course, material 17 may, in appropriate cases, not comprise a separate and distinct frictional material but may, if it satisfies the constraint relationship of Equation 5, be the base utility contact surface material, itself. It has been found that the chrome plated edge of the base of an instrument which is 13.6 inches high and has a base dimension of 10.5 inches, performed satisfactorily. Of course, materials such as Teflon, or other similar compositions, may be used, if so desired.

FIG. 5 illustrates another embodiment of this invention wherein a plurality of frictional elements 16 are affixed to an instrument base 15 contact surface. By locating the material elements near the perimeter of the base but displaced therefrom, and utilizing the base contact surface itself for the low coefficient of friction material 17, as discussed above, a lower average tipping angle is achieved. For the case of a circular base, three equidistant elements have a decided advantage. The advantage of three-point mounting is that, on the average, the angle of rotation, τ , required to bring into play the lower coefficient of friction material is reduced. Since τ is defined by the arctan-

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gent of the ratio of y , the offset dimension, to x , the border dimension, τ is a maximum when x is a minimum. However, as shown in FIG. 5, the effective dimension x is a function of the location of the applied force. If the striking force occurs at F_1 , opposite a frictional element 16, the angle of rotation τ is the arctangent of y/x_1 . But, if the striking force occurs at F_2 , adjacent to a frictional element 16, the effective dimension x is equal to x_2 . Since the offset dimension y is the same in both cases, the angle of rotation is decreased. For an arbitrary point of application of the striking force F_1 , the base will revert to one or the other of the above tipping modes but, on the average, the angle of rotation is reduced.

FIG. 6 illustrates another embodiment of this invention where the advantages flowing from three-point mounting are obtained by using a frictional element 16, approximately triangular in shape, which is affixed to the base 15 of an apparatus. In environments where the frictional material may absorb airborne oils and greases, and become embedded with dirt, thereby reducing its effective coefficient of friction, the larger the area of the pad 16 the greater is the protection against undesired changes in the coefficient μ_1 .

It is to be understood that the embodiments shown and described herein are illustrative of the principles of the invention only and that further modifications of this invention may be implemented by those skilled in the art without departing from the scope and spirit of the invention. For example, the configuration or contour of the frictional material or materials affixed to the base of an apparatus may take many diverse forms including, for illustrative purposes only, rings, bars, disks, bands, et cetera.

What is claimed is:

1. Base apparatus comprising:

base means for supporting attached apparatus upon a utility surface, the edge of the utility contact surface of said base means having a predetermined coefficient of friction μ_2 which allows the edge of said base means to slide along said utility surface after a predetermined angle of rotation of said apparatus in response to an applied force, and

a frictional material affixed to the utility contact surface of said base means, displaced from the edge of said base means a predetermined distance, having an effective coefficient of friction μ_1 which exceeds the quotient of the maximum expected applied force to said apparatus and the weight of said apparatus.

2. An instrument, including a supporting base which is resistant to sliding and tipping comprising:

a first material affixed to the supporting surface of said base, displaced from the edge of said base a predetermined distance, having an effective coefficient of friction μ_1 which is greater than the quotient f/mg where f is the expected maximum applied force to said instrument and mg is the weight of said instrument, and

a second material, having a thickness less than that of said first material, affixed to the supporting surface of said base between said first material and the edge of said base having a coefficient of friction μ_2 which is less than the expression

$$\frac{\frac{r_1}{r_2} \left[\frac{\cos(\theta + \tau)}{\sin(\gamma + \tau)} \right]}{1 - \frac{r_1}{r_2} \left[\frac{\cos(\theta + \tau)}{\cos(\gamma + \tau)} \right]}$$

where r_1 is the length of the radius vector originating at a point of coincidence of the edge of said base and a supporting utility surface and terminating at the center of gravity of said instrument, r_2 is the length of the radius vector originating at said point of coincidence of the edge of said base and said utility surface and terminating at the point of application of an applied force to said instrument, θ is the angle defined by radius vector r_1 and said utility surface, γ is the angle defined by radius vector r_2 and said utility surface, and τ is a predetermined angle of rotation of said instrument in response to an applied force.

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