Nov. 7, 1944. R. H. COLE ET AL 2,362,050

SPRING COUNTERBALANCE FOR DRAFTING MACHINES

Filed Sept. 16, 1941 2 Sheets-Sheet 1

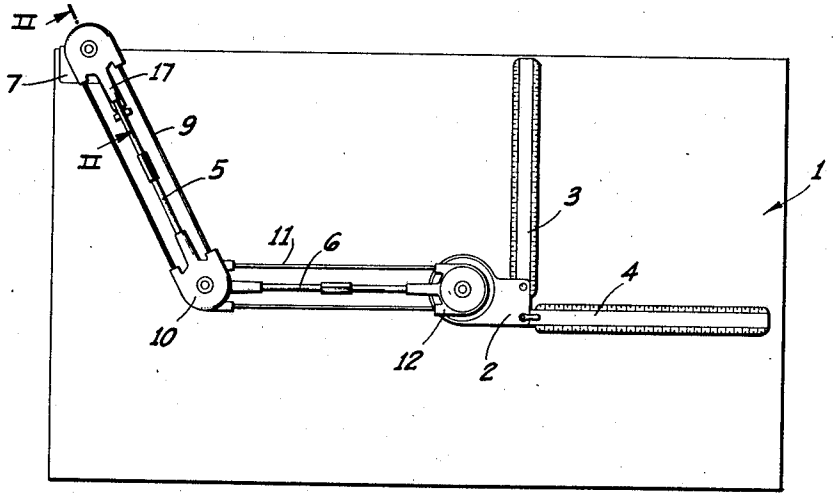



FIG. 1.

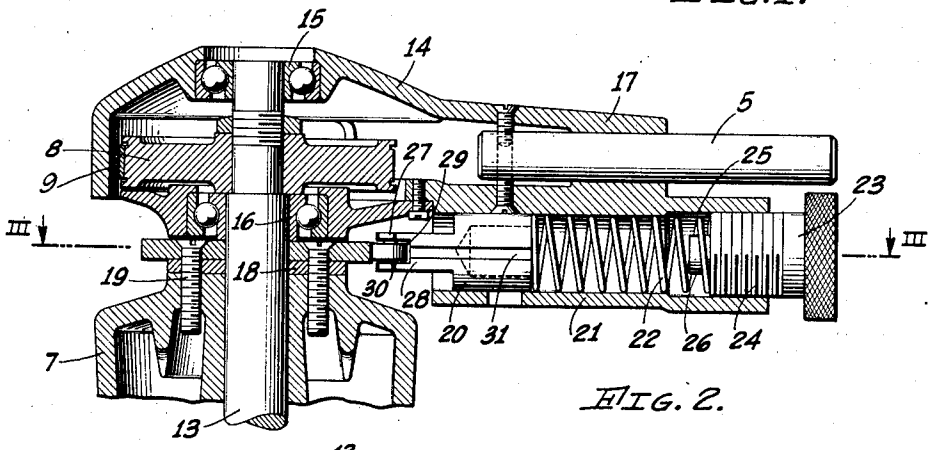



FIG. 2.

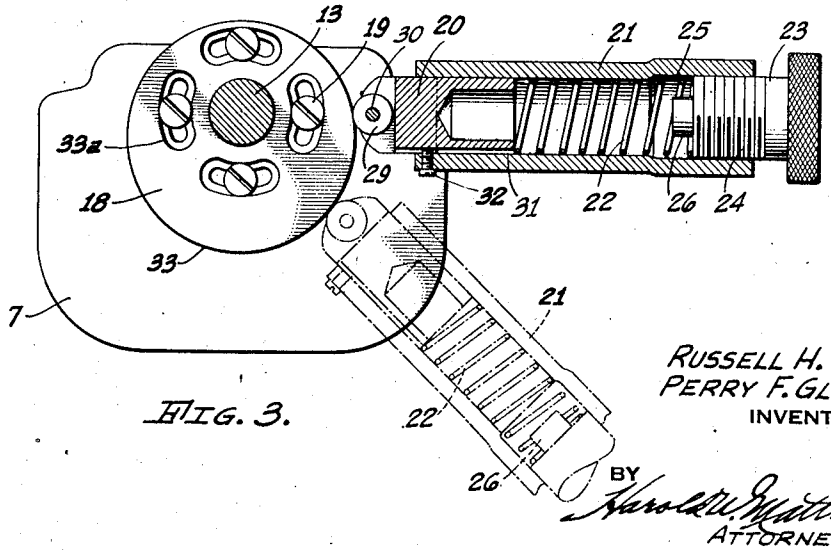



FIG. 3.

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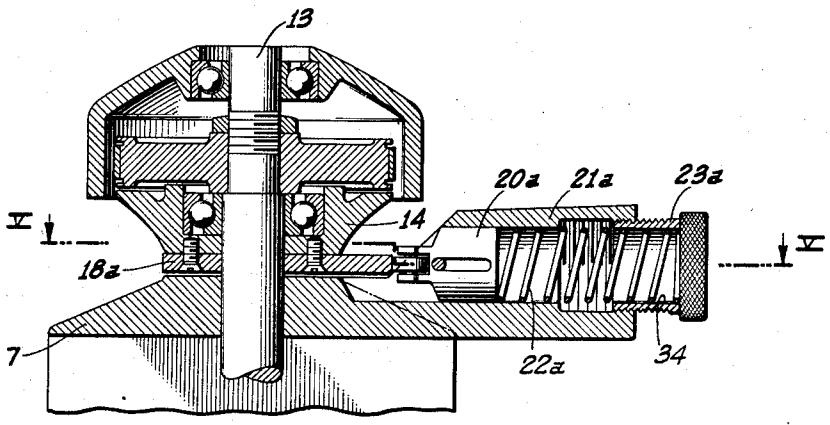



FIG. 4.

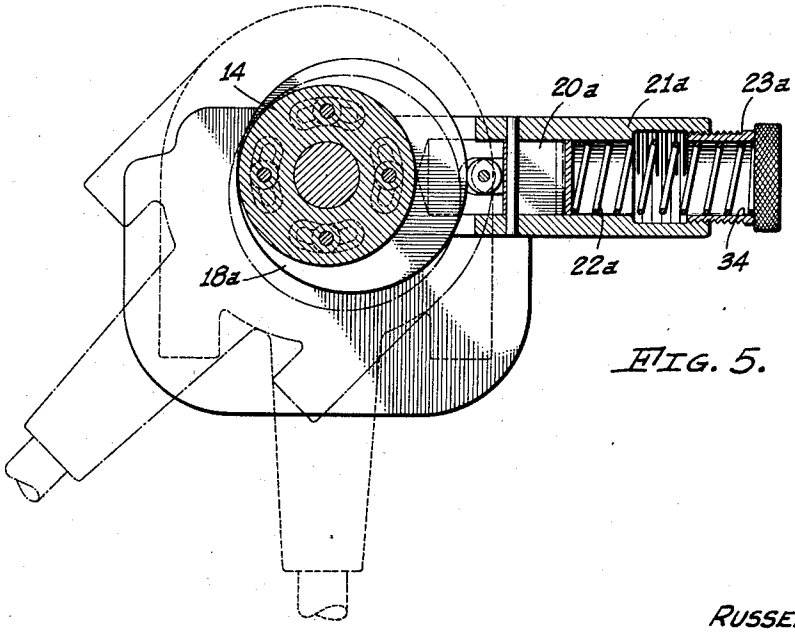



FIG. 5.


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## SPRING COUNTERBALANCE FOR DRAFTING MACHINES

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Application September 16, 1941, Serial No. 410,996

8 Claims. (Cl. 33—79)

Our invention relates to drafting machines and has particular reference to a spring counterbalance device adapted to counterbalance the weight of the drafting machine head and parallel motion mechanism on which the head is carried, the device finding particular utility when employed on drafting machines used on inclined drawing boards or tables.

Considerable difficulty has in the past been encountered in the use of drafting machines on inclined drawing boards or tables due to the weight of the machine tending to swing the same downwardly about the anchor. Various and complicated counterweight systems have been devised to overcome this tendency, but such systems have the disadvantages of being costly and cumbersome and requiring careful adjustment to adapt the system to different inclinations of the drawing board.

Attempts to avoid these disadvantages by the use of spring counterbalancing systems have not been entirely successful. The spring counterbalance used prior to our invention either substituted a spring for the weight employed in the older counterweight systems and so were characterized by the same disadvantages or employed a spring connected between a fixed anchor and one of the arms or the flexible band of the parallel motion mechanism. Such a connection tended to impair the accuracy with which the parallel motion mechanism guided the movements of the drafting machine head and also subjected the pivots, pulleys, bearings and the like to additional and unbalanced loads tending to cause such parts of the device to rapidly wear and become mal-adjusted.

It is, therefore, an object of our invention to provide a spring counterbalance for drafting machines which overcomes the above noted disadvantages by reason of its simple and inexpensive construction.

It is also an object of our invention to provide a spring counterbalance for drafting machines which includes a spring device tending normally to overcome the tendency of the parallel motion mechanism to swing downwardly about the anchor pivot.

It is a still further object of our invention to provide a device of the character set forth in the preceding paragraph in which the spring is associated with the anchor and operates independently of the flexible bands of the parallel motion mechanism to provide the desired counterbalancing torque.

It is an additional object of our invention to provide a device of the character set forth in the preceding paragraphs in which a spring pressed member is positioned to engage a cam, the spring pressed member and the cam being moved relative to each other by movement of the parallel motion mechanism about its fixed anchor.

It is also an object of our invention to provide a device of the character set forth hereinbefore which includes a simple and readily operable mechanism for adjusting the magnitude of the counterbalancing torque produced, thereby providing for the ready adaptation of the device to drawing boards of different inclinations.

Other objects and advantages of our invention will be apparent from a study of the following specification, read in connection with the accompanying drawings, wherein:

Fig. 1 is a plan view illustrating a drafting machine employing a parallel motion mechanism of the endless band type, the machine shown in Fig. 1 being provided with a spring counterbalancing device constructed in accordance with the preferred embodiment of our invention;

Fig. 2 is a vertical sectional view taken substantially along the line II—II of Fig. 1 to illustrate the details of construction of the counterbalancing device;

Fig. 3 is a horizontal sectional view taken substantially along the line III—III of Fig. 2 to illustrate additional details of construction and illustrating also, by means of dotted lines, the manner in which the device operates to produce the desired counterbalancing torque;

Fig. 4 is a sectional view similar to Fig. 2 but illustrating the construction of a modified form of our invention; and

Fig. 5 is a horizontal sectional view taken substantially along the line V—V of Fig. 4 to illustrate additional details of construction and illustrating also, by means of dotted lines, the manner in which the device operates.

Referring to the drawings, we have illustrated in Fig. 1 a drafting machine of the endless band type as being employed upon a drawing board or drawing table 1. The drafting machine includes a drafting machine head 2 adapted to support rulers or scales 3 and 4. The head 2 is mounted for free translatory movement over the surface of the board 1 to permit the scales 3 and 4 to be positioned as desired on the board. The head 2 is supported from a parallel motion mechanism which includes interconnected jointed arms 5 and 6, the head 2 being supported upon one end of the arm 6 while the free end of the arm 5 is pivotally secured to the upper edge

of the drawing board 1 as by means of an anchor clamp 7. The jointed arms 5 and 6 also include a parallel motion mechanism which operates to maintain the angular position of the scales 3 and 4 relative to the drawing board 1 constant irrespective of movement of the head 2 over the surface of the board.

The parallel motion mechanism illustrated in Fig. 1 comprises the well known flexible band and pulley type, this mechanism including a fixed pulley 8 associated with the anchor 7 and about which a flexible band 9 is passed. The band 9 also encircles an elbow pulley enclosed and pivotally supported within the elbow housing 10, this pulley engaging also a second flexible band 11 which surrounds a pulley enclosed within the housing 12 associated with the head 2 and fixed to such head. The interconnection of the bands 9 and 11 by virtue of the elbow pulley causes the head 2 to maintain a fixed angular position irrespective of pivotal movement of the arms 5 and 6 about the anchor 7 and about the elbow 10.

Ordinarily in using drafting machines such as that illustrated in Fig. 1, it is desirable for convenience in drafting work to incline the drawing board 1 at a slight angle (up to 15 or 20°), the upper edge of the board to which the anchor 7 is secured being disposed at a higher elevation than is the opposite edge of the board. When the board is thus inclined, the weight of the scales 3 and 4, the head 2 and the parallel motion mechanism tends to continually cause the drafting machine to swing downwardly about the anchor 7. The preferred embodiment of our invention includes a spring counterbalancing means associated with the anchor 7 and tending to normally resist this tendency of the drafting machine to swing about the anchor pivot. The anchor clamp 7 is best illustrated in Fig. 2 and includes a means for fixedly securing the clamp to the edge of the board 1 and supports a fixed upwardly extending pivot shaft 13. Upon this shaft the pulley 8 is secured, the same being enclosed by a housing 14 which is pivotally mounted upon the shaft 13 as by means of suitable bearings 15 and 16. The housing 14 includes a neck-like extension 17 into which the end of the arm 5 is secured.

The spring counterbalancing device includes a cam member 18 which, in the form illustrated in Fig. 2, is secured to the anchor clamp 7 as by means of suitable clamping screws 19. The periphery of the cam member 18 is engaged by a spring pressed member 20 which is slidably supported within a tubular housing 21 secured to or preferably formed integrally with the neck portion 17 and disposed on the underside of such portion. Within the housing 21 is positioned a compression spring 22, one end of the spring 22 bearing against the innermost end of the member 20 and the opposite end of the spring 22 being engaged by the inner end of an adjusting screw 23, the screw 23 being adjustably movable axially of the housing 21 by virtue of a threaded engagement therewith afforded by external threads 24 formed on the member 23 and internal threads 25 formed on the interior of the housing 21. The spring 22 may be held centralized in the housing 21 by providing an inwardly projecting stub 26 on the adjusting member 23.

Friction resulting from the engagement of the member 20 with the periphery of the cam 18 may be reduced to a minimum by bifurcating the end of the member 20 to define a pair of arms 27 and 28 between which is positioned a small roller 29, the same being supported upon a suitable axle or pivot shaft 30 extended between the arms 27 and 28. When such a construction is employed it is necessary that the member 20 be held against pivotal movement about the axis of the housing 21 while being permitted sliding movement axially thereof. For this purpose a keyway 31 is formed in one side of the member 20 and a small screw or pin 32 is secured to the housing 20 in a position to extend into the keyway 31.

It will be noted that as the arm 5 is pivotally moved about the axis of the anchor shaft 13, the spring pressed member 20 will be moved about the periphery of the cam member 18. As is clearly illustrated in Fig. 3, the cam member 18 is preferably of circular form, being disposed eccentrically with respect to the shaft 13. Thus, as the arm 5 is moved about the pivot 13 in such manner as to move the housing 21 from the position illustrated in solid lines in Fig. 3 to the position illustrated in dotted lines in that figure, the distance between the point of engagement of the spring pressed member with the surface of the cam and the axis of the pivot shaft 13 will change, thus causing the member 20 to be moved inwardly or outwardly in the housing 21 either against the force of the spring 22 or in the direction of the force of the spring, depending upon the direction of movement of the arm 5.

Preferably the cam member 18 is so positioned that the point of greatest radius, identified by reference character 33 in Fig. 3, lies directly below the center of the anchor shaft 13. When the parts are thus positioned, movement of the spring pressed member 20 from the position illustrated in solid lines in Fig. 3 to the position illustrated in dotted lines in that figure will cause the member 20 to be moved inwardly into the housing 21 against the force of the spring 22. Thus the spring 22 provides a counterbalancing torque tending to resist this movement of the arm 5. The magnitude of this counterbalancing torque may be adjusted at will by screwing the adjusting member 23 inwardly or outwardly of the housing 21 to further compress the spring 22 or to reduce the pressure exerted thereon. Thus the counterbalancing force developed by the spring 22 may be adjusted to suit the particular inclination of the drawing board 1.

It will be noted that if the arm 5 is pivotally moved a distance sufficient to shift the spring pressed member 20 to the opposite side of the point 33 from that illustrated in Fig. 3, the direction of the counterbalancing torque will be reversed so that instead of tending to produce a counter-clockwise movement of the device the spring will now tend to produce a clockwise movement of the device. As hereinbefore stated, the illustrated location of the point 33 is preferred. However, under certain circumstances it may be desired to position the point 33 other than as illustrated and our invention contemplates mounting the cam member 18 upon the anchor member 7 in an adjustable manner as by providing suitable arcuate slots 33*a* in the cam member 18 so that the point 33 may be positioned as desired to suit particular or unusual drafting requirements.

Attention is directed to the fact that by providing the cam 18 with a circular form, the magnitude of the restoring torque varies with the position of the arm 5. This is an advantage for the reason that the torque produced by the

weight of the drafting machine and tending to cause the same to swing about the anchor 7 also varies with the position of the arm 5. It may, however, be desirable to employ a cam 18 of a form other than circular, and it is within the scope of our invention to employ cams of non-circular form, it being the intention of the present invention to provide a cam which will coact with the spring pressed member 20 to produce a counterbalancing torque of such type that the tendency of the drafting machine to swing under the influence of its own weight is reduced to a minimum.

We have illustrated in Figs. 4 and 5 a modified form of our invention. In this form of the device the cam member identified by reference character 18a is secured to the pulley housing 14 so as to be rotatable by pivotal movement of the arm 5 about the anchor pivot shaft 13. Similarly, the spring pressed device identified by reference character 20a is slidably supported within a housing 21a which is secured to or formed integrally with the anchor 7.

It will be noted that in both forms of the invention, pivotal movement of the arm 5 about the shaft 13 causes relative movement between the spring pressed member and the peripheral surface of the cam member. The device illustrated in Figs. 4 and 5 operates in precisely the same manner as has been previously described in connection with the preferred form of our invention to provide a counterbalancing torque which will prevent the drafting machine from swinging about its anchor as a result of the inclination of the drawing board.

In the form illustrated in Figs. 4 and 5 an alternative construction of the housing 21a is illustrated. It will be noted that the housing 21a is somewhat shorter than the housing 21 previously described, this shortening being obtained by forming the adjusting member 23a with an axial counterbore 34 in which the compression spring 22a is seated.

It will be noted that we have provided a spring counterbalancing for drafting machines which is associated with the anchor end of the parallel motion mechanism.

It will also be noted that the device is small and compact and is of simple construction permitting it to be readily and speedily manufactured at low cost.

Attention is directed to the fact that the counterbalancing torque produced by the device is applied to the jointed arms 5 and 6 independently of the parallel motion mechanism comprising the endless bands 9 and 11 and the associated pulleys. Thus the device does not tend to produce any unusual or unbalanced loads upon the device and so does not cause undue or rapid wear of the various parts of the drafting machine.

The provision of the adjusting members 23 and 23a permits the magnitude of the counterbalancing torque to be readily adjusted, thereby adapting the device for use on drawing boards of different or varying inclinations.

While we have shown and described the preferred embodiment of our invention, we do not desire to be limited to any of the details of construction shown or described herein, except as defined in the appended claims.

We claim:

1. In a spring counterbalance for a drafting machine including an anchor member defining a fixed axis pivotally supporting an arm member of a parallel motion mechanism, the combination of: a cam secured to one of said members and defining a cam surface eccentrically disposed relative to said fixed axis; means on the other of said members defining a tubular housing directed toward said cam surface; a cam engaging element slidably mounted in said housing and extending out of one end thereof to engage said cam surface; closure means closing the other end of said housing; and compression spring means confined in said housing between said element and said closure means for forcing said element into engagement with said cam surface, said closure means being threadedly engaged with said housing whereby rotation of said closure means adjusts the force exerted by said compression spring means.

2. In a spring counterbalance for a drafting machine including an anchor member defining a fixed axis pivotally supporting an arm member of a parallel motion mechanism, the combination of: a cam secured to one of said members and defining a cylindrical cam surface extending about said fixed axis with the axis of said surface disposed parallel to and offset from said fixed axis; means on the other of said members defining a tubular housing directed toward said cam surface; a cam engaging element slidably mounted in said housing and extending out of one end thereof toward said cam surface; roller means carried by said cam engaging element and engaging said cylindrical cam surface; closure means closing the other end of said housing; and compression springs means confined in said housing between said element and said closure means for forcing said element into engagement with said cam surface.

3. In a spring counterbalance for a drafting machine employed on an inclined drawing board and including an anchor member secured to said board and defining a fixed axis pivotally supporting an arm member of a parallel motion mechanism, the combination of: a cam secured to one of said members and defining a circular cam surface extending about said fixed axis and disposed eccentrically relative thereto; means on the other of said members defining a tubular housing directed toward said cam surface; a cam engaging element slidably mounted in said housing and extending out of one end thereof to engage said cam surface; means closing the other end of said housing; and compression spring means confined in said housing between said element and said closure means for forcing said element into engagement with said cam surface, said cam and said housing being so positioned that the force of said spring tends to pivotally move said arm member upwardly over said inclined drawing board.

4. In a spring counterbalance for a drafting machine employed on an inclined drawing board and including an anchor member secured to said board and defining a fixed axis pivotally supporting an arm member of a parallel motion mechanism, the combination of: a cam member carried by said anchor member and defining a circular cam surface extending about said fixed axis and disposed eccentrically relative thereto; means on said arm member defining a tubular housing directed toward said cam surface and disposed with its length parallel to the length of said arm member; a cam engaging element slidably mounted in said housing and extending out of one end thereof to engage said cam surface; and com-

pression spring means in said housing for urging said cam engaging element into pressure engagement with said cam surface, said cam member being so positioned on said anchor member that said cam engaging element is moved by said cam surface to its maximum distance from said fixed axis when said arm member is moved to a position extending downwardly in the direction of inclination of said drawing board.

5. In a spring counterbalance for a drafting machine employed on an inclined drawing board and including an anchor member secured to said board and defining a fixed axis pivotally supporting an arm member of a parallel motion mechanism, the combination of: a cam member carried by said anchor member and defining a circular cam surface extending about said fixed axis and disposed eccentrically relative thereto; means on said arm member defining a tubular housing directed toward said cam surface and disposed with its length parallel to the length of said arm member; a cam engaging element slidably mounted in said housing and extending out of one end thereof to engage said cam surface; compression spring means in said housing for urging said cam engaging element into pressure engagement with said cam surface; and means adjustably securing said cam member to said anchor member to permit moving said cam member to different angular positions relative thereto to thereby permit adjustment of the position of said arm member at which said cam engaging element is moved by said cam surface to its maximum distance from said fixed axis.

6. In a spring counterbalance for a drafting machine employed on an inclined drawing board and including an anchor member having an upper board engaging flange clamped against the upper surface of said drawing board and supporting a pivot shaft pivotally supporting an arm member of a parallel motion mechanism, the combination of: a plate-like cam member surrounding said pivot shaft secured to said arm member for pivotal movement therewith and defining a circular cam surface eccentrically disposed relative to said pivot shaft; a tubular housing formed integrally with said upper board engaging flange and disposed in a position extending the length of said housing toward said cam member; a cam engaging element slidably mounted in said housing and extending out of one end thereof to engage said cam surface; closure means closing the other end of said housing; and compression spring means confined in said housing between said element and said closure means for forcing said element into engagement with said cam surface, said cam and said housing being so positioned that the force of said spring tends to pivotally move said arm member upwardly over said inclined drawing board.

7. In a spring counterbalance for a drafting machine including an anchor member defining a fixed axis pivotally supporting an arm member of a parallel motion mechanism, the combination of: a cam secured to one of said members and defining a cam surface; means on the other of said members defining a tubular housing directed toward said cam surface; a cam engaging element slidably mounted in said housing and extending out of one end thereof to engage said cam surface; closure means closing the other end of said housing; and compression spring means confined in said housing between said element and said closure means for forcing said element into engagement with said cam surface.

8. In a spring counterbalance for a drafting machine including an anchor member defining a fixed axis pivotally supporting an arm member of a parallel motion mechanism, the combination of: a cam secured to one of said members and defining a cam surface axis; means on the other of said members defining a tubular housing directed toward said cam surface; a cam engaging element slidably mounted in said housing and extending out of one end thereof to engage said cam surface; closure means closing the other end of said housing; and compression spring means confined in said housing between said element and said closure means for forcing said element into engagement with said cam surface, said closure means being threadedly engaged with said housing whereby rotation of said closure means adjusts the force exerted by said compression spring means.

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