April 3, 1962 H. GABLOFFSKY 3,027,958

BEAM BALANCES

Filed June 6, 1956 3 Sheets-Sheet 1

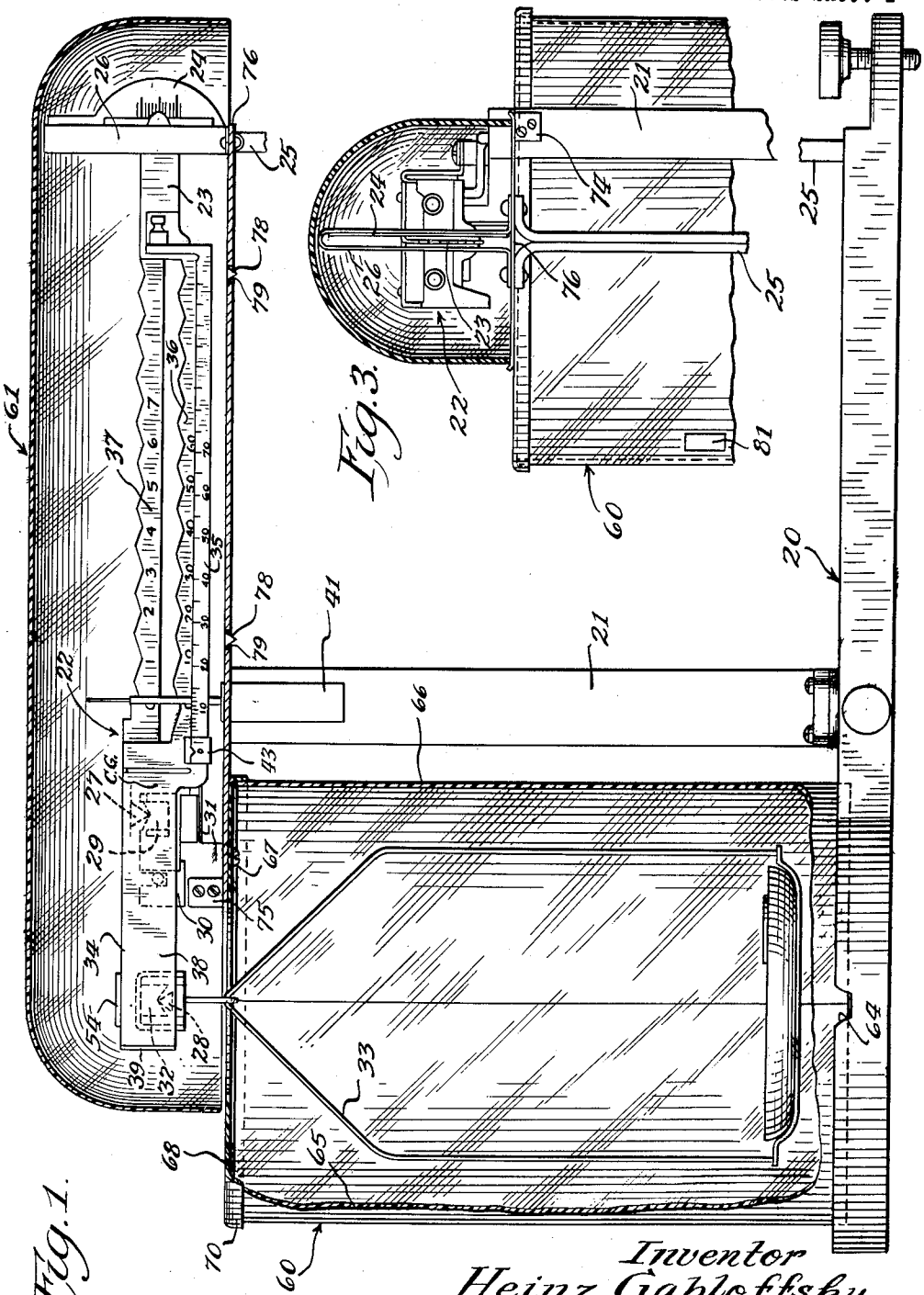


Fig. 1.

Fig. 3.

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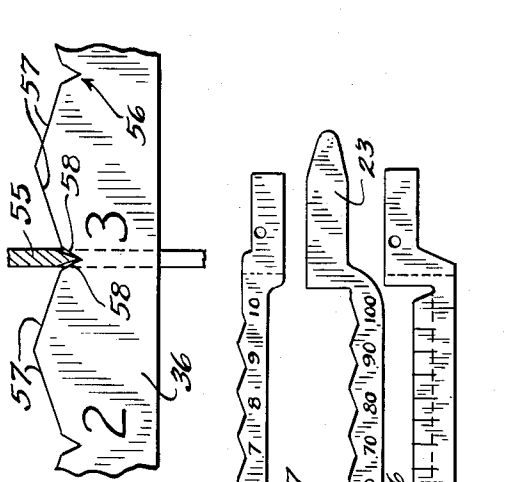


Fig. 5.

Fig. 4.

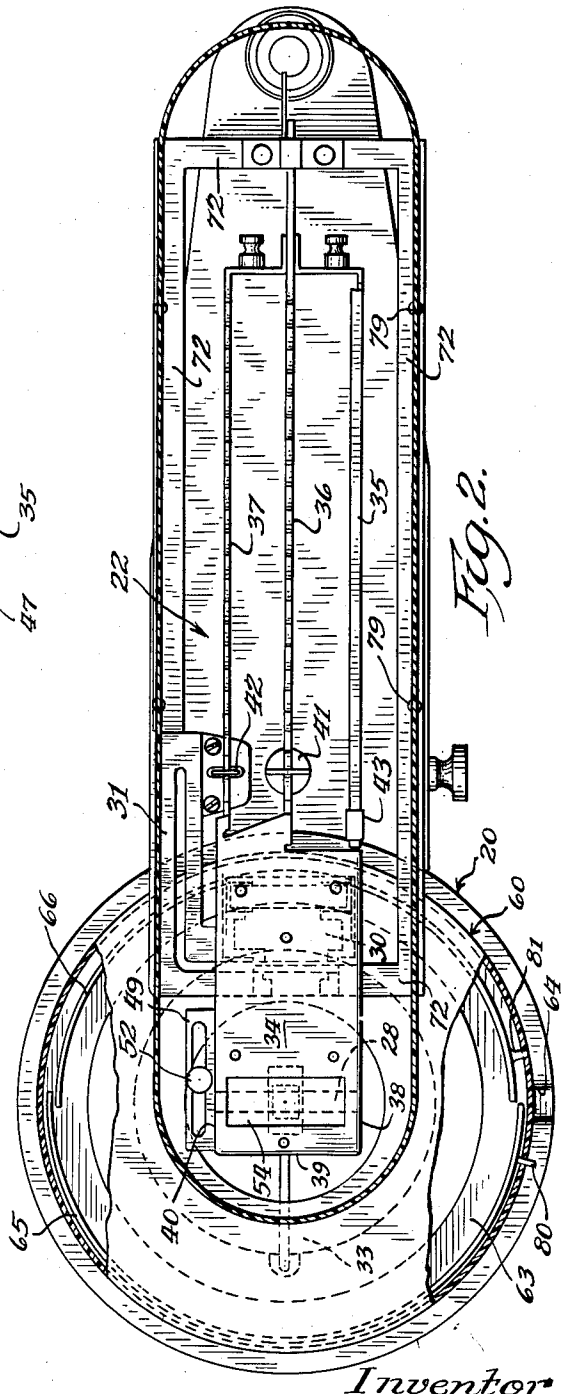


Fig. 2.

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Fig. 6.

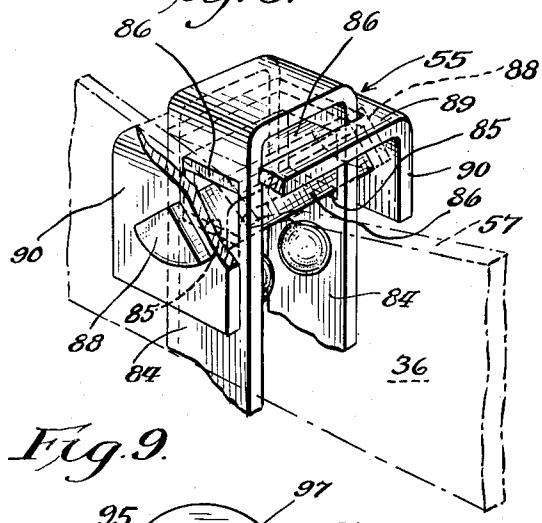


Fig. 7.

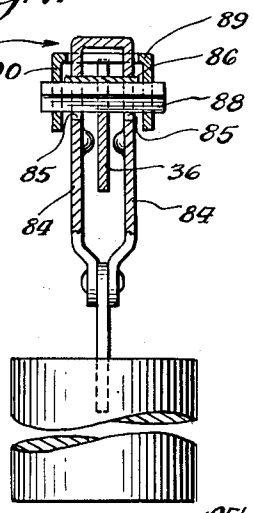
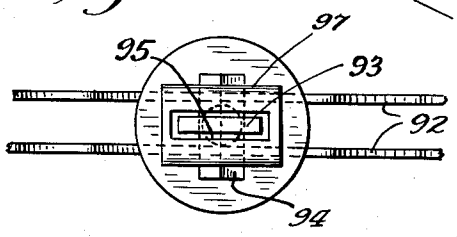


Fig. 9.



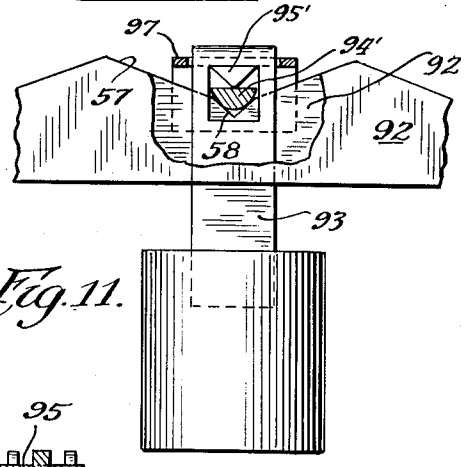
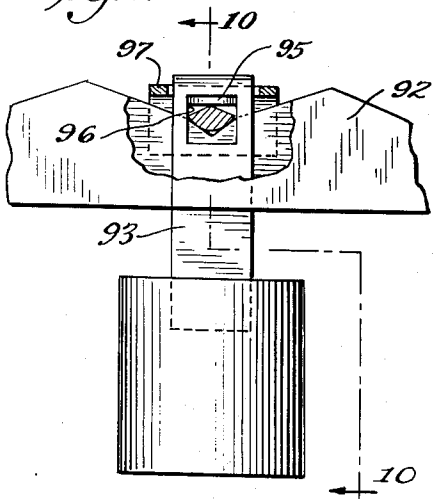


Fig. 11.

Fig. 8.



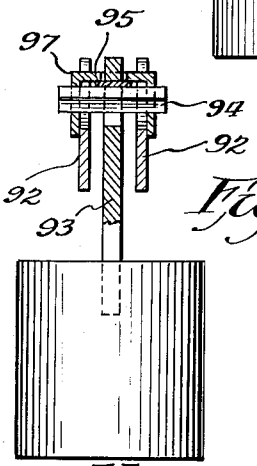


Fig. 10.

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United States Patent Office 3,027,958 Patented Apr. 3, 1962

3,027,958

BEAM BALANCES

Heinz Gabloffsky, Chicago, Ill., assignor, by mesne assignments, to Cenco Instruments Corporation, Chicago, Ill., a corporation of Delaware

Filed June 6, 1956, Ser. No. 589,728
6 Claims. (Cl. 177—247)

This invention relates to improvements in beam balances and more particularly is concerned with improved beam and poise hanger arrangements that improve the sensitivity, accuracy, and ease of manipulation of the balance.

The essential characteristic of beam balances is simplicity and since the primary design criteria in this old art have long been known, it has become well developed and relatively static. Improvements in accuracy and sensitivity have generally been confined to improvements resulting from the use of lighter weight materials having less inertia, the use of harder precision machined materials providing less friction and higher accuracy, and general improvement in manufacturing skills.

It is the principal object of the present invention to provide a novel beam balance arrangement of inherently high sensitivity and accuracy, and it is a further object to provide such an arrangement that is characterized by its ease of operation and the ease with which it may be enclosed during sensitive measurements.

Another object is to provide an improved beam construction that is permanently stabilized and relatively unaffected by differences in dimensions arising from manufacturing tolerances.

Still another object is to provide a novel beam scale construction that cooperates with improved poise hangers and provides a semi-automatic locating action for the hangers and reduces their bearing friction.

Other objects and advantages of the invention will be apparent during the course of the following description.

In the accompanying drawings forming a part of this specification and in which like numerals are employed to designate like parts throughout the same,

FIG. 1 is a front elevational view, partly in section, of a beam balance constructed in accordance with the present invention;

FIG. 2 is a plan view, partly in section, of the balance of FIG. 1;

FIG. 3 is a fragmentary side view of the balance;

FIG. 4 is a plan view of the sheet metal blank which is preferably employed in forming the beam for the balance of FIGS. 1, 2, and 3;

FIG. 5 is an enlarged fragmentary front view illustrating the detailed construction of the notched scales of the beam;

FIG. 6 is a perspective view of a modified form of poise hanger associated with a scale construction of the type shown in FIG. 5;

FIG. 7 is a side sectional view of the hanger and beam of FIG. 6;

FIGS. 8, 9, and 10 are sectional front, plan, and side views, respectively, illustrating an alternative poise hanger arrangement associated with a parallel armed beam; and

FIG. 11 is a front sectional view of a modified bearing arrangement for the hangers of FIGS. 6 through 10.

Referring now to the drawings and particularly to FIGS. 1, 2, and 3, there is shown a beam balance having an improved overall arrangement of the various parts of the balance and also having a beam of novel construction that is arranged to provide a balance of maximum sensitivity and to permit more convenient adjustment of the poise hangers.

Generally speaking, the balance includes a base **20**, an

offset center post **21** rigidly secured to the base and supporting a beam generally designated as **22**. The beam includes an indicator arm **23** that registers with a graduated plate **24** mounted on an end post **25** carried by the base **20**, the plate **24** being provided with a guide loop **26** for the indicator arm **23**.

The beam **22** is shown as being of the unequal-arm, triple-beam type and supports a main fulcrum knife edge **27** and pan fulcrum knife edge **28** in spaced parallel relationship; with the main knife edge **27** cooperating with suitable agates **29** mounted on a support pad **30** carried by a generally L-shaped support arm **31** (see FIG. 2) that is attached to and extends laterally from the center post **21**, and with the pan knife edge **28** supporting a pair of agates **32** which carry a conventional pan hanger **33**.

The base **20**, center post **21**, and supports **30** and **31** are preferably of cast aluminum while the end post **25**, beam **22**, and pan hanger **33** may be of stainless steel. Preferably the beam is formed from a sheet metal stamping and, as commonly known, this involves manufacturing tolerances which are detrimental to the function of the beam, unless the arrangement of the various portions of the beam are such that these tolerances do not affect the stability or accuracy of the beam within the required tolerances or specifications.

The overall arrangement of the triple beam is such that its center of gravity is located very close to or almost in coincidence with the main fulcrum both as respects equilibrium and as respects pendulum torque. For the particular arrangement shown in FIGS. 1, 2, and 3, this center of gravity is located at the point designated C.G. in FIG. 1. This desirable relationship is attained by reason of the fact that the left end of the beam is of box-like construction and carries the knife edges **27** and **28** underneath its upper surface **34** while the beam scales **35**, **36**, and **37** at the right end of the beam are correspondingly located beneath the plane of this surface. Surface **34** is substantially continuous and provides a cover plate portion that protects the bearing facilities of the main fulcrum and pan fulcrum from contamination. The cover plate portion extends beyond the lateral extremities of knife edges **27** and **28** and is provided with depending reinforcing flanges **38**, **39**, and **40** at its front, left, and rear edges respectively.

As respects equilibrium, it will be apparent that, while the left end or cover plate portion of the beam operates at an appreciably smaller lever arm in relation to the main fulcrum than do the beam scales, the resultant center of gravity of the beam is nevertheless quite close to the main fulcrum due to the increased weight of the box-like cover plate portion which compensates for the greater lengths of the beam scales.

It is important to note that this arrangement of the triple beam structure does not require additional dead weights for achieving stability as such additional weights adversely affect the inertia and friction of the beam which in turn are related to the SR (Sensibility Reciprocal). Sensibility Reciprocal is defined as the amount of weight added to or subtracted from the load pan to effect a movement of the indicator arm of one division on the indicator graduation **24**. The box-like form gives the beam desired strength and provides an effective cover for the bearings of the main and pan fulcrums and thus is not merely for balancing purposes but also eliminates parts required in prior art arrangements.

While in the present construction, the knife edges are located beneath their supporting structure rather than above it, as in prior art constructions, the center of gravity of the beam is maintained in substantial coincidence with the main fulcrum as respects pendulum torque

because the beam scales are also disposed somewhat lower than the knife edge supporting structure than is normally the case. As is conventional, the scales are staggered vertically from front to rear for ease of observation and the center scale **36** carries the heaviest weight **41**, the rear scale **37** carries an intermediate weight **42**, and the front scale **35** carries a fine adjustment **43**.

The construction of the weigh beam **22** may be best understood from an examination of the stamped blank, shown in FIG. 4 before it is bent. Corresponding portions of the stamping and of the finished beam are numbered identically and the bend lines are indicated by dashes.

It will be noted that scales **36** and **37** are located by bending downwardly along bend lines **45** and **46**, respectively. Similarly, scale **35** is located by bending down the front flange **37** and then subsequently bending scale **35** along the line **47**. The beam also includes at its left end a pair of reinforcing tabs **48** adapted, when bent, to overlie and secure portions of the end flange **38**. Finally, the beam includes a laterally projecting flange **49** formed by bending upwardly along bend line **50** after flange **39** has been formed by bending downwardly on bend line **51**. Flange **49** is slotted to receive a weight **52** (see FIG. 2) that is movable to provide a rough adjustment in stabilizing the beam. It should be noted that, as stamped (see FIG. 4), the cover plate portion **34** is provided with a rectangular opening **53** that facilitates the visual alignment of knife edge **28** with knife edge **27** and also the alignment of these knife edges with the zero positions of the three beam scales. Once the knife edges have been mounted on the beam, however, a suitable plate **54** (see FIGS. 1 and 2) is attached to cover plate **34** to close the opening **53**.

The disclosed beam construction has the advantage that it maintains the function of the balance independent of weight variations due to manufacturing tolerances since such variations are generally equally distributed over the area of a sheet metal stamping and hence balance out about the center of gravity which is in substantial coincidence with the main fulcrum. When a beam arrangement fails to bring the center of gravity into substantial coincidence with the main fulcrum as respects equilibrium and as respects pendulum torque, the changes in the weight of the beam due to manufacturing tolerances adversely affect these relationships and alter the function of the beam. Such changes affect both the accuracy and sensitivity of the beam balance.

FIG. 5 illustrates an enlarged portion of one of the beam scales having a novel scale construction wherein the hanger locating notches **56** are connected by oppositely sloped guiding surfaces **57** so that inaccurate and approximate positioning of the poise hanger **55** is avoided and so that accurate positioning no longer requires close attention on the part of the operator. The arrangement develops a semi-automatic positioning action in that an approximate positioning of the poise hangers brings them under the influence of the guiding surfaces **57** and directs them into the intended notch.

While, in the prior art, sloped surfaces have been used previously for assisting in the positioning of a hanger, these same surfaces have also served to define the notch itself. In these prior art arrangements, one of the following manufacturing procedures has been employed. On the one hand, the guiding surfaces which are colinear with and serve as the locating surfaces are machined only to standard tolerances and while this minimizes manufacturing expense, it does so at the sacrifice of accuracy. Alternatively, these surfaces have been precision-machined over their entire length, in which case the machining operation is unduly expensive.

According to the present invention, separate notch locating surfaces **58** are formed to extend in angular relation to the guiding surfaces **57** such that the guiding surfaces may be machined to rough tolerance and only the notch locating surfaces need be precision-machined. This arrangement has the advantage of low manufacturing cost and high accuracy.

Reference should again be had to FIGS. 1, 2, and 3, wherein it will be noted that the center post is offset rearwardly and a relatively clear region is provided underneath the weigh beam **22** to afford the operator ease of access for handling the hanger weights and moving them along their supporting beams.

Since the notch construction is such that the operator need only approximately position the weights, there is no probability of error resulting from handling the weights from underneath. In fact, the arrangement facilitates such weight adjustments and appreciably reduces operator fatigue.

The novel organization of the structural elements of the present beam balance readily accommodates a simplified enclosure arrangement that effectively isolates the sensitive movable portions of the apparatus from air currents, dust, and accidental acid sprays and the like. The enclosure is preferably transparent and consists of a cover assembly **60** for the pan hanger and an elongated hood **61** for the beam **22**. For this purpose, the base of the balance is provided with a circular groove **63** having a clean-out slot **64** and adapted to receive a pair of semi-cylindrical side walls **65** and **66** in relative sliding relationship. Similarly, the support pad **30** is provided with a tapped hole (not shown) that receives a suitable fastener **67** for supporting a cover **68**. The cover is centrally apertured for passage of the pan hanger mounting assembly and is provided with a depending outer peripheral flange **70** that overlaps the adjacent upper ends of the side walls.

The hood **61** is supported on a generally rectangular framework **72** (see FIG. 2) that includes attaching flanges **74**, **75**, and **76**, respectively, secured to the center post **21**, support pad **30**, and end post **25**. The framework **72** is disposed slightly beneath the plane of the lowermost beam scale so that it does not obstruct the visibility of the scales nor does it impair access to the sacles for changing the position of the poises. In cross section, the hood has the shape of an inverted U and has smoothly curving closed ends. Preferably, a pair of nubs **78** project from the bottom edge of the hood for engagement in suitable apertures **79** provided in the frame.

It should be apparent that this enclosure arrangement is considerably simpler than the box-like isolating chambers that have previously been employed for housing an entire balance. Nevertheless, ease of operation is not sacrificed. Access to the hanger pan is achieved simply by shifting the side walls **65** and **66** relative to each other by means of suitable grips **80** and **81**, respectively, and they are controlled during such movement by the guiding action offered by the base groove **63** and cover flange **70**. Furthermore, the open-bottomed hood maintains full accessibility to the beam scales for shifting the adjustable weights and the semi-automatic locating action of the sloped sides of the scales facilitates handling of the weights from underneath.

The semi-automatic locating action of the sloped connecting surfaces of the beam finds practical application in connection with other poise hanger constructions such as shown at **55** in FIGS. 6 and 7. Here again, the beam **36** is provided with oppositely inclined locating surfaces **57** that merge into oppositely inclined guide surfaces **58** which form the locating notch.

The hanger includes a pair of arms **84** having aligned apertures **85**, and a plate **86** which may be of hardened spring steel, or hard crystal such as agate or sapphire, and which is secured to the hanger at the top of these apertures to provide a relatively hard bearing surface. A segmental rod **88** having a smoothly curved lower cylindrical or torical surface and an upper knife edge is adapted to engage the beam and provide a knife edge support for plate **86**. Rod **88** is preferably of hardened spring steel. Finally, a generally U-shaped yoke **89** telescopes

over the upper end of the hanger and includes apertured side arms **90** for receiving the rod **88** to retain the various components of the hanger in assembled relationship.

Thus, in the arrangement of FIGS. 6 and 7, the curved surface of rod **88** rides on the locating surfaces **57** during preliminary positioning of the poise hanger and ultimately cooperates with the guide surfaces **58** to provide a rough adjustment of the hanger. Since, in this instance, the guide surfaces cooperate with a curved bearing surface presented by the hanger these surfaces are necessarily somewhat larger than in the knife edge arrangement of FIG. 5.

It is worthy of note that the shocks set up during the positioning of the poise hanger are less severe in their effect since the curved surface of the rod distributes the forces along the beam while the knife edge bearing arrangement, being formed of hard material, is not damaged.

This arrangement has the further advantage of minimizing friction in the poise hanger system since the curved surface of the rod reacts with the V notch to provide the rough adjustment after which the hard knife edge bearing surfaces accommodate the smaller angular oscillating movements of the beam. It will be noted that sufficient endwise clearance is provided between the yoke and hanger to accommodate the desired relative pivotal movement therebetween.

In FIGS. 8, 9, and 10, an alternative poise hanger construction of this general type is shown. In this case, the beam is shown as consisting of a pair of arms **92** between which passes a single armed hanger **93**. Once again, a segmental rod **94** is formed with a cylindrical or torical lower surface and an upper knife edge that bears against a hardened spring steel or hard crystal washer **95** that is fixed in place within an opening **96** formed in the hanger arm **93**. A yoke **97** of the same general form described previously maintains the parts assembled. While it is readily possible to provide double arms for the scales of the triple-beam balance without departing from the general construction described hereinbefore, it should also be apparent that these poise hanger constructions are useful with any form of beam.

FIG. 11 illustrates an obvious modification of the poise hanger constructions wherein the segmental steel or crystal rod **94'** is formed with a flat upper surface and the spring steel or crystal washer **95'** is formed with a lower knife edge, and this arrangement offers identical advantages as the previous forms.

It should be understood that the description of the preferred form of the invention is for the purpose of complying with section 112, Title 35, of the U.S. code and that the appended claims should be construed as broadly as the prior art will permit.

I claim:

1. A beam balance arrangement comprising a longitudinally extending base having a generally circular platform at one end, a vertical end post mounted on the other end of said base substantially along the longitudinal center line of said base, a vertical center post mounted on said base intermediate said ends and adjacent the rear edge thereof, support means mounted on said center post and offset therefrom in a direction extending forwardly and towards said one end, a longitudinally extending beam pivotally mounted on said support means and carrying a pan hanger at one end overhanging said platform and movable poises adjacent its other end overhanging said base, a pan hanger enclosure comprising complementary curved side wall sections supported on said platform and an apertured cover telescoped over said hanger and overhanging said side wall sections, a rectangular frame supported from said center post and end post and disposed in a plane slightly beneath the plane of said beam, said frame being wider than said beam, and an open-bottomed hood supported on said frame and covering said beam such that clearance is provided underneath said beam for handling said poises from underneath said beam.

2. A beam balance arrangement comprising a longitudinally extending base, a vertical end post mounted on one end of said base substantially along the longitudinal center line of said base, a vertical center post mounted on said base intermediate its ends and adjacent the rear edge thereof, support means mounted on said center post and offset therefrom in a forward direction, a longitudinally extending beam pivotally mounted on said support means and carrying a hanger at one end overhanging said base and movable poises adjacent its other end overhanging said base, a rectangular frame supported from said center post and end post and disposed in a plane slightly beneath the plane of said beam, said frame being wider than said beam, and an open-bottomed hood supported on said frame and covering said beam such that clearance is provided underneath said beam for handling said poises from underneath said beam.

3. In a beam balance, a one-piece sheet metal beam member uniform in thickness and comprising a cover plate portion defined by a planar top wall and reinforcement flanges integrally connected to and depending from front and rear edges of said top wall, with a pan fulcrum and a main fulcrum attached to said cover plate portion in longitudinally spaced parallel arrangement beneath the top wall thereof, and a scale portion having its major structure located beneath the plane of the top wall to balance out pendulum torque about said main fulcrum and comprising a plurality of longitudinally extending parallel scale arms integrally connected to and extending from an end edge of said top wall adjacent said main fulcrum to provide said beam member with a center of gravity closely adjacent said main fulcrum substantially independently of thickness tolerance variations of the sheet metal from which the beam is formed.

4. The beam arrangement of claim 3 wherein the remote ends of said scale arms are rigidly connected together to provide the beam member with required rigidity.

5. A beam balance arrangement comprising a longitudinally extending base, a vertical end post mounted on one end of said base, a vertical center post mounted on said base intermediate its ends, support means mounted on said center post at the upper end thereof, a longitudinally extending beam pivotally mounted on said support means and carrying a hanger at one end and movable poises adjacent its other end, a rectangular frame supported from said center post and end post and disposed in a horizontal plane slightly beneath the plane of said beam to allow access for handling the poises from beneath the beam, said frame being wider than said beam, and an open-bottomed hood supported on said frame and covering said beam.

6. In a beam balance, a one-piece sheet metal beam of uniform sheet thickness and supporting a main fulcrum knife edge and a pan fulcrum knife edge in spaced parallel relation, said beam including a cover plate portion defined by an essentially planar top wall and reinforcement flanges integrally connected to and depending from front and rear edges of said top wall, and a scale portion comprising a plurality of longitudinally extending parallel scale arms integrally connected to and extending from an end edge of said top wall to provide said beam with a center of gravity closely adjacent said main fulcrum and substantially independent, from beam to beam, of thickness variations in sheet metal stock from which individual beams are formed.

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UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,027,958 April 3, 1962

Heinz Gabloffsky

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 8, line 1, for "1,230,341" read -- 2,230,341 --.

Signed and sealed this 17th day of July 1962.

(SEAL)
Attest:

ERNEST W. SWIDER
Attesting Officer

DAVID L. LADD
Commissioner of Patents