

United States Patent

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[56]

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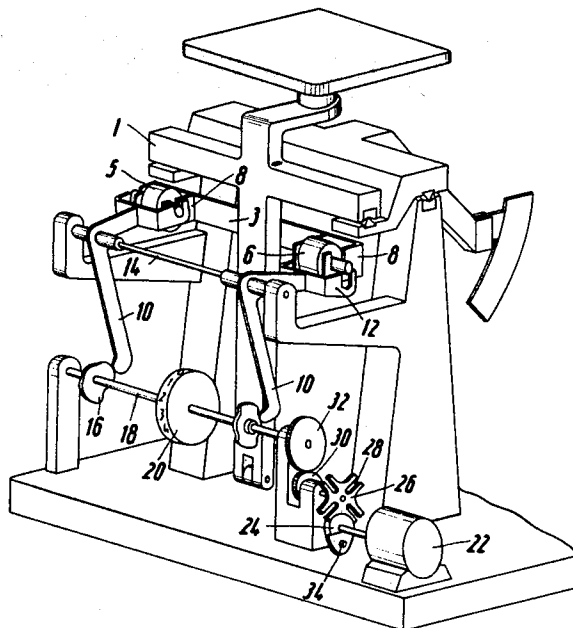
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[54] **BALANCE COMPRISING CAPACITY WEIGHTS**
5 Claims, 5 Drawing Figs.

[52] U.S. Cl. **177/237,**
177/191, 177/248, 177/252
[51] Int. Cl. **G01g 1/28**
[50] Field of Search. **177/191,**
237, 248, 252

ABSTRACT: Shifting camshaft means are operable to selectively apply any of a plurality of capacity weights to and to remove it from a weighing mechanism. A self-locking stepping mechanism comprises an output member operatively connected to said shifting camshaft means and an input member operatively connected to a drive motor and operable thereby to impart predetermined successive stepping movements to said output member and arranged to idle in response to an operation of said motor between successive stepping movements.

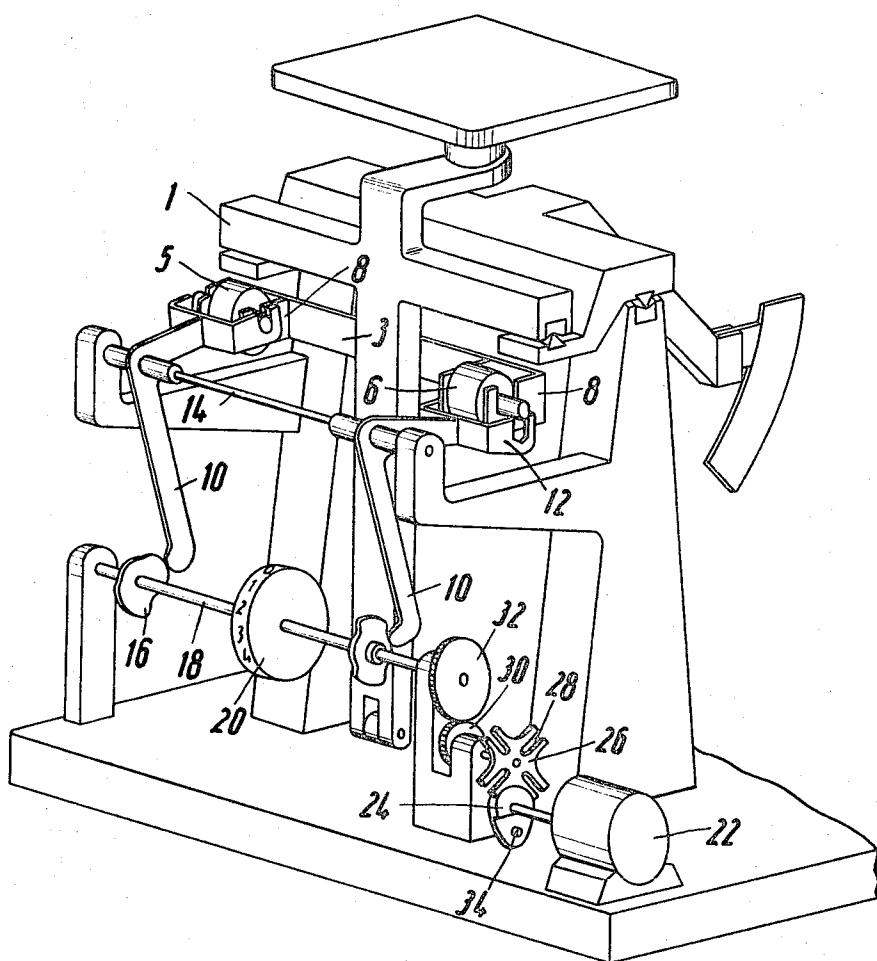


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Fig. 1



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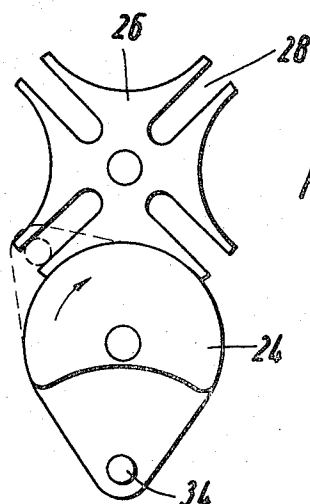


Fig. 2

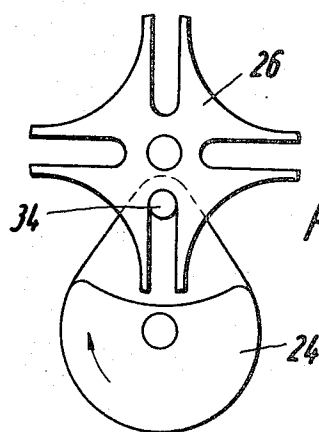


Fig. 3

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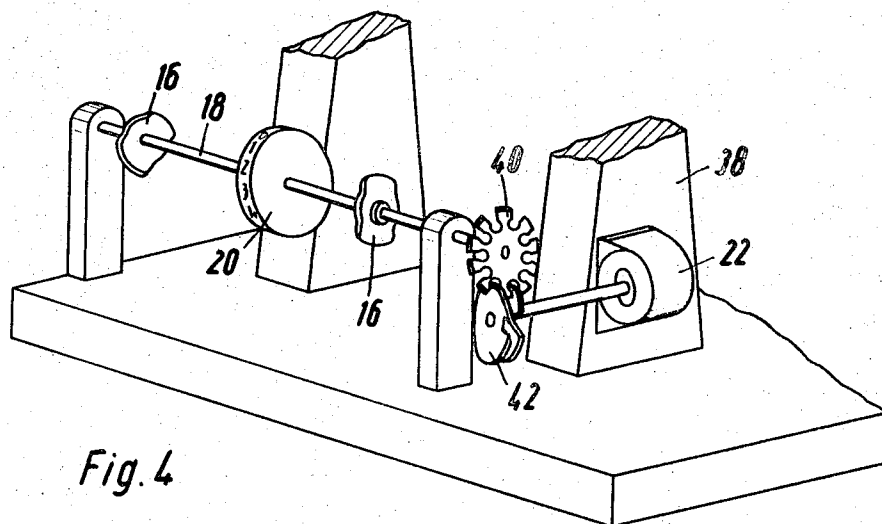


Fig. 4

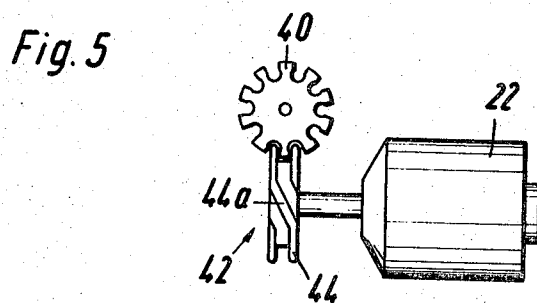


Fig. 5

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BALANCE COMPRISING CAPACITY WEIGHTS

SPECIFICATION

This invention relates to a weight-shifting device in a balance having one or more motor-driven shifting camshaft(s).

In the weight-shifting device disclosed in the U.S. Pat. No. 3,055,444 to Chyo, the capacity weights are applied and lifted by shifting arms, which are operated by cams of shifting camshafts. The latter are driven by an electric motor, which is energized by electric contacts at both ends of the balance beam whenever the beam has been deflected to the end of its range of inclination.

In accordance with the provisions of the German Regulations for Gauging Weights and Measures, a standstill of the shifting camshaft in positions intermediate the shifting positions must be reliably prevented because in such intermediate positions at least one capacity weight would not be sufficiently lifted from its support mounted on the pan carrier or the suspension for the balance beam. As a result, the weight or weights which are incompletely lifted would bias the balance beam only within part of its range of inclination so that the balance would not indicate the correct weight.

To meet this requirement, the or each shifting camshaft of known balances carries a detent cam, which is intended to prevent a standstill of the shifting camshaft in positions other than predetermined locked positions.

This arrangement, however, cannot reliably prevent a standstill of motor-driven shifting camshafts in intermediate positions, particularly if each shifting camshaft is to assume ten different shifting positions during one revolution, as is required for applying and removing the weights of one decade. If the shifting positions are regularly spaced around a complete revolution of the shifting camshaft, the angular spacing between two shifting positions will amount only to 36° . It will then be virtually impossible to arrest the shifting motor after a movement of the shifting camshaft with such an accuracy that the shifting camshaft is arrested in a locked position. Before the motor has stopped, it will move the shifting camshaft somewhat beyond its locked position. Even a brake applied when the motor is deenergized cannot reliably prevent a continued movement of the shifting camshaft. Besides, the brake involves a considerable increase in expenditure.

According to the invention, a reliable stopping of the shifting camshaft(s) exactly in its or their shifting positions will be enforced in that a self-locking stepping mechanism, which is adapted to idle between the stepping movements, is interposed between the drive motor and the shifting camshaft(s).

There are various stepping mechanisms in which the input member idles between the actual steps, which means that the input member continues to move but blocks rather than drives the output member of the stepping mechanism. With such stepping mechanism, the motor can perform a certain movement within the idling range after each stepping movement whereas the shifting camshaft will not be moved thereby. As a result of the blocking function of the stepping mechanism, the shifting camshaft is locked in its desired shifting positions so that there is no need for a brake.

In a development of the invention, the stepping mechanism may consist of a Maltese cross movement. After each stepping movement, the cam wheel of the Maltese cross movement can perform more than one-half of a revolution without initiating a new step. During this continued rotation of the cam wheel, the shifting camshaft is locked in its shifting position by the cylinder ratchet of the Maltese cross movement.

The Maltese cross movement has the additional advantage that each shifting movement of the shifting camshaft begins slowly, increases in velocity to a maximum, and is retarded thereafter. As a result, the capacity weights, which constitute considerable masses, are gently lifted and applied so that particularly the knife edges and knife edge bearings of the balance are protected.

The number of the guide slots formed in the Maltese cross may be as large as the number of shifting positions of the shifting camshaft per revolution thereof. If the shifting camshaft has ten shifting positions, the Maltese cross must then have ten slots.

If the reliability of the stepping operations is to be increased by the use of Maltese crosses having fewer slots, these Maltese crosses may be succeeded by a reduction gearing which is designed so that the product of the number of slots and the reduction ratio equals the number of shifting positions of the shifting camshaft per revolution thereof. For instance, a Maltese cross having four slots will be combined with a reduction gearing having a reduction ratio of 2.5:1 if the shifting camshaft has ten shifting positions.

In a development of the invention, the stepping mechanism may consist of a modified worm gearing rather than a Maltese cross movement, which modified worm gearing comprises a worm having a helical tooth, which has a lead only around part of its periphery and has no lead in the remaining part of its periphery. This design has the advantage that the worm wheel may easily be provided with teeth and tooth spaces which are equal in number to the desired number of shifting positions of the shifting camshaft, e.g., with ten teeth and ten tooth spaces. As a result, there is no need for a separate reduction gearing. The transition from the no-lead part to the lead part of the screw thread may be so gradual that the stepping movements begin and terminate gradually and there is nevertheless a sufficiently large part of the periphery available for the idling of the input shaft. Finally, a worm gearing has crossing input and output shafts so that the drive motor can be conveniently accommodated in a balance within a small space.

Two embodiments of the invention will now be described more fully and by way of example with reference to the accompanying drawings.

FIG. 1 is a perspective view showing an inclination balance having a pan above the beam, a capacity weight mechanism, and a drive therefor.

FIGS. 2 and 3 show a four-slot Maltese cross movement in different positions.

FIG. 4 shows in a view similar to FIG. 1 a portion of a balance provided with a modified worm gearing.

FIG. 5 shows only the worm gearing and its drive motor.

FIG. 1 shows a known inclination balance having a pan above the beam. This balance need not be described in detail. A weight bracket 3 is rigidly secured to the pan carrier 1 of the balance and comprises a forked support 8 for each capacity weight 5, 6. For the sake of clarity, only two capacity weights and their supports are shown whereas four capacity weights and supports are normally required for each capacity decade.

Weight-shifting levers 10 serve to lift the capacity weights 5, 6 and comprise each a fork 12 for engaging and lifting the capacity weight. The weight-shifting levers 10 are rotatable about a fixed axle 14 and are operable by cams 16, which are secured to the shifting camshaft 18 for rotation therewith. The shifting camshaft carries also a digit wheel 20, which carries ten digits for the applicable weights of a decade.

The shifting camshaft is driven by an electric motor 22, which drives the cam wheel 24 of a Maltese cross movement. In the example shown, the Maltese cross 26 has four guide slots 28. The Maltese cross 26 is secured to a gear 30 for rotation therewith. The gear 30 is in mesh with a gear 32, which is secured to the shifting camshaft 18 for rotation therewith. The gears 30 and 32 form together a reduction gearing. The pitch-circle diameter of gear 32 is 2.5 times the pitch-circle diameter of gear 30 so that the reduction ratio is 2.5:1.

FIGS. 2 and 3 show details of a known Maltese cross movement. These details will be discussed here only with a view to their desirable effects on the weight-shifting device.

In FIG. 2, the movement is indicated in solid lines in a locked position, in which the cylindrical portion of the cam 24 and one of the concave recesses of the Maltese cross 26 form a cylinder ratchet. The position at the beginning of a stepping movement is indicated in dotted lines in FIG. 2, where the

striker pin is shown as it moves into the outer end of a guide slot 28, which extends tangentially to the path of movement of the striker pin 34 so that the movement of the Maltese cross begins gradually. The Maltese cross 26 assumes its maximum velocity in the position according to FIG. 3 and is then gradually retarded until the striker pin 34 tangentially leaves the guide slot 28. The acceleration and retardation of the shifting camshaft are thus gradual rather than sudden.

The motor 22 can be operated in both directions of rotation. When the balance beam reaches the limit of its inclination range, the motor is energized by a switch, particularly by a light-operated switch, to move in one direction or the other. One revolution of the motor shaft causes the Maltese cross 26 to perform one-quarter of a revolution and the shifting camshaft to perform one-tenth of a revolution. As a result, one or more capacity weights are applied or lifted. When the motor 22 has performed one or more revolutions, as required, it is deenergized as soon as the striker pin 34 leaves the guide slot of the Maltese cross 26. The motor can then continue to move as much as three-quarters of a revolution until it stops. A motor can easily be stopped reliably within such large angular range.

In addition to the one shifting camshaft 18 which is shown, additional shifting camshafts for weights of additional decades may be provided.

If the Maltese cross 26 has ten guide slots 28, the reduction gear 30, 32 can be eliminated. The Maltese cross 26 is then directly carried by the shifting camshaft 18.

In the embodiment shown in FIG. 4, all parts not shown are identical to those of FIG. 1. The shifting camshaft 18 is also driven by the electric motor 22, which is secured to a standard 38 of the balance. The motor drives the shifting camshaft 18 by means of the modified worm gearing 40, 42. The modified worm 42 has a single tooth 44, which has a lead only in a small part of its periphery and in the remaining part of its periphery has no lead. This no-lead part is shown at the top and bottom in FIG. 5 and extends throughout the rear side of the worm, which rear side is not shown in FIG. 5.

The number of teeth and the number of tooth spaces of the worm wheel are each equal to the desired number of shifting positions of the shifting camshaft 18, which in the present case has ten shifting positions.

It is understood that this invention is susceptible to modification in order to adapt it to different usages and conditions and, accordingly, it is desired to comprehend such modifications within the invention as may fall within the scope of the appended claims.

We claim:

1. A balance, which comprises a weighing mechanism, a plurality of capacity weights, shifting camshaft means operable to selectively apply any of said capacity weights to and to remove it from said weighing mechanism, a drive motor, and a self-locking Maltese cross movement stepping mechanism drivingly connecting said motor and shifting camshaft means and comprising an output member operatively connected to said shifting camshaft means and an input member operatively connected to said motor and operable thereby to impart predetermined successive stepping movements to said output

member and arranged to idle in response to an operation of said motor between successive stepping movements.

2. A stepping mechanism as set forth in claim 5, in which;

said shifting camshaft means comprises a rotatable shifting camshaft, which is adapted to assume during each revolution thereof a predetermined number of shifting positions and to shift at least one of said capacity weights relative to said weighing mechanism as said camshaft reaches each of said shifting positions;

said worm gearing comprises a worm wheel, which constitutes said output member and has a circular series of teeth in mesh with said screw thread, and tooth spaces between adjacent ones of said teeth; and

the number of said teeth and the number of said tooth spaces are each equal to said predetermined number.

3. A balance as set forth in claim 1, in which said shifting camshaft means comprises a rotatable shifting camshaft, which is adapted to assume during each revolution thereof a predetermined number of shifting positions and to shift at least one of said capacity weights relative to said weighing mechanism as said camshaft reaches each of said shifting positions, and said output member comprises a Maltese cross having slots equal in number to said shifting positions during each revolution of said camshaft, and said input member comprises a striker pin, which is engageable with each of said slots in succession to impart said stepping movements to said Maltese cross.

4. A balance as set forth in claim 1, in which said shifting camshaft means comprises a rotatable shifting camshaft, which is adapted to assume during each revolution thereof a predetermined number of shifting positions and to shift at least one of said capacity weights relative to said weighing mechanism as said camshaft reaches each of said shifting positions, said output member comprises a Maltese cross having a plurality of slots, said input member comprises a striker pin, which is engageable with each of said slots in succession to impart said stepping movements to said Maltese cross, said Maltese cross is operatively connected to said camshaft by a reduction gearing having a predetermined reduction ratio, and the product of the number of said slots and said reduction ratio equals said predetermined number.

5. A balance which comprises a weighing mechanism, a plurality of capacity weights, shifting camshaft means operable to selectively apply any of said capacity weights to and to remove it from said weighing mechanism, a drive motor, and a self-locking stepping mechanism which comprises an output member operatively connected to said shifting camshaft means and an input member operatively connected to said motor and operable thereby to impart predetermined successive stepping movements to said output member and arranged to idle in response to an operation of said motor between successive stepping movements, said stepping mechanism comprising a worm gearing having a worm, which constitutes said input member and is formed with a helical tooth, and said helical tooth having a lead in one part of the periphery of said worm and no lead in the remaining part of the periphery of said worm.