PATENT SPECIFICATION

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802,295

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COMPLETE SPECIFICATION

Improvements in or relating to Machine Alignment Detector

We, KING INSTRUMENT CO. a Corporation organized and existing under the laws of the State of Minnesota, United States of America, of 804, Northwestern Bank Building, Minneapolis, Minnesota, 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 detectors for determining the correctness of alignment of machine parts.

In many machines, such as lathes, milling machines, etc., beds are employed carrying ways which guide a movable superstructure and the surfaces of these ways must be in exact alignment relative to each other if accurate work is to be done by the machines. It is also necessary in certain machines, such as lathes, that rotatable parts, such as the chucks and spindles of the lathes, be in exact alignment with the various ways carrying superstructure for supporting the work and the working tool. During the time that such machines are being constructed, it is desirable to provide detectors which will accurately determine the accuracy of alignment of ways, channels, grooves, and other machine parts so that the surfaces of these parts can be originally accurately formed. Also after machines, such as referred to, have been operated for some time, such surfaces become worn or out of alignment and it is then necessary to true up these surfaces to put the machine back into condition to allow accurate work to be performed thereby.

It is an object of the present invention to provide a simple machine alignment detector which can be used with great ease to determine the relative alignment between the surface of machine parts, thereby enabling the truing of these parts with a minimum of labour.

A further object is to provide a machine alignment detector for determining the alignment of a machine surface regardless of its shape and position and which is readily adjustable for that purpose.

Accordingly, the present invention provides apparatus for determining the relative alignment of machine parts, the apparatus comprising a pair of spaced standards and a cross-bar extending therebetween, one of the standards being adjustable with respect to the cross-bar longitudinally thereof and the cross-bar being adjustable with respect to one of the standards longitudinally thereof, one of the standards having at one end means for providing a single point engagement with a plane surface and the other standard being provided at one end with a pair of supporting means engageable with a machine way of any one of a plurality of various types each of the pair of means being spaced from the other in a direction extending transversely of the cross-bar, and indicating means by which in the use of the apparatus the relative alignment of the machine parts is determined.

An embodiment of the present invention will now be described in greater detail by way of example only, with reference to the accompanying drawings, of which:—

Fig. 1 is a side elevational view of the embodiment being utilized to align a flat-way and a male V-way of a carriage bed;

Fig. 2 is a top plan view of the instrument shown in Fig. 1.

Fig. 3 is a vertical sectional view of the embodiment of Figs. 1 and 2 being used to align one side wall of a male V-way;

Fig. 4 is a perspective view of the slotted cylindrical base of one of the standards of the embodiment.

Fig. 5 is a sectional view along line 5—5 of Fig. 2;

Fig. 6 is a sectional view along line 6—6 of Fig. 2;

Fig. 7 is a sectional view along line 7—7 of Fig. 1;

Fig. 8 is a side elevational view of the embodiment of Figs. 1 and 2 being used to align one wall of a female dovetail way;

Fig. 9 is a side elevational view of the

embodiments of Figs. 1 and 2 being utilized to check a female V-way against a scored flat-way when it is desired to ignore the scores; and

Fig. 10 is a top plan view of the embodiment of Figs. 1 and 2 being utilised in conjunction with a test bar to check the alignment of the spindle of the machine in relation to the way.

As shown in the drawings, the apparatus includes a pair of spaced parallel standards 11 and 12 which have a cross-bar 13 extending therebetween and secured thereto by means of a pair of adjustable clamps 14 and 15. It will be seen that the arrangement is such that the cross-bar is adjustable with respect to each of the standards longitudinally thereof and the standards are each adjustable longitudinally of the cross-bar. These clamps 14 and 15 each have two passages extending at right angles to each other through their medial portions for receiving one of the standards and one end portion of the cross-bar 13. The end portions of these clamps have a slot formed therein which communicates with the passages to provide the necessary adjustability when their respective knurled tightening screws 16, 17, and 18, 19 are loosened. Threaded onto the lower end portion of the one standard 11 is a base in the form of a ball 20 which constitutes means for providing a single point engagement with a plane surface. Threaded onto the lower end portion of the other standard 12 is a split tubular member 21 having enlarged end portions 23. The gap 22 in the member 21, which is formed within what is normally its bottom surface along its entire length, is smaller between the adjacent free ends 23*a* of the end portions 23 than over the length of the remainder of the member 21 so that each pair of free ends 23*a* forms one of a pair of supporting means which are spaced from each other transversely of the cross-bar 13. The member 21 has an aperture 24 located in its medial portion and substantially opposite the gap 22. This aperture 24 has a thread formed within it which permits it to receive the standard 12 either from the top as shown in Fig. 1 or from the bottom and through the slot 22 as shown in Fig. 9. A second aperture 25 is formed laterally of the aperture 24 to permit the foot 21 to receive the standard 12 at an angle, as shown in Fig. 8.

Mounted on the cross-bar 13 for rotational movement relative thereto is a clamp 26 and a second clamp 27, as shown in Fig. 7, both of which can be tightened or loosened by means of a knurled tightening screw 28. The relative positions of the two clamps 26 and 27 provide universal movement for a dial indicator 29 which is mounted on a rod 30 carried by the clamp 27. The dial indicator 29 has a registering point 31 which is adapted to transmit indications of movement of the point 31 to the indicator which, in turn, registers the magnitude of the same on its dial. The position of the indicator 29 can be readily changed by loosening the tightening screw 28 and then moving the indicator 29 to its desired position.

Mounted on the medial portion of the cross-bar 13 is a bracket 32 which is held in place by a tightening screw 33. When the tightening screw 33 is loosened it is possible to move the bracket 32 longitudinally of the cross-bar 13 or to rotate it thereabout. The bracket 32 has one upwardly facing channel 34 which extends longitudinally of the cross-bar 13 and another upwardly facing channel 35 which extends transversely of the cross-bar 13. Each of the channels 34 and 35 are formed to receive a spirit level 36 and 37. These two spirit levels 36 and 37 are mounted in similar fashion within their respective channels 34 and 35 so as to be adjustable with respect to the cross-bar 13 such that the relative inclination of the longitudinal axis of the levels 36 and 37 and the longitudinal axis of the cross-bar can be adjusted. One end of each spirit level is secured by a knurled-tightening screw 38 to a pivot block 39 which is pivotally secured to the sides of the channel by a pinion 40 which extends therethrough and into the sides of the channel in apertures provided therefor. The opposite end of each of the levels is adjustably secured to the bottom of the opposite end of the channel by means of a knurled-tightening screw 41 which extends through a flange portion 42 having an aperture provided therein to receive the same and which engages the bottom of the channel in a threaded aperture provided therefor. The screw 41 extends through a compression spring 43 which is disposed between the bottom of the channel and the flanged portion 42.

For certain purposes an annular member 44 having plane end faces is used in cooperation with the ball 20 which, as shown in Fig. 3, is located in a pocket in the member 44 provided by the bore 52 which is of lesser diameter than the ball 20. The member 44 may be employed, as shown in Fig. 3, where one side wall of a male V-way 45 is being aligned relative to a second male V-way 46 and a flat-way 47. Fig. 9 shows the ring 44 being used to check a scored flat-way 48 relative to a female V-way 49.

Fig. 10 shows the apparatus being run along a test bar 50 to check the alignment of a chuck 51 or a spindle (not shown) relative to the bed-way.

The apparatus above described is easy and simple to operate. To align any two surfaces of a bed or way the user only has to place the ball 20 upon one of them and the member 21 on the other, as shown in Fig. 1. It is possible to adjust the spacing of this ball and member by loosening the screws 16 and 18. It is also possible to move the cross-bar 13 to

the desired approximate level position by loosening the screws 17 and 19. Once this has been accomplished the screws are all tightened and the finer adjustments can be made. To make the starting surface a reference surface both of the levels 36 and 37 are adjusted by means of their screws 41 until they indicate level position. Once this has been accomplished, the surfaces beneath the ball 20 and member 21 become reference surfaces and the instrument is ready to be moved along the way. As it is brought along the bed or way any misalignment of the surfaces contacted by the base 20 and member 21 relative to the reference surface will be reflected in the spirit levels 36 and 37. The extent of such misalignment is indicated by the extent to which the level bubbles are displaced toward either end of the levels. Any convex or concave shape in the surfaces will be reflected by the level 37. Any changes in elevation will be reflected in the level 36. Any twisting or curvature of the way will be reflected in the level 37. After the misalignment is located, it is a comparatively easy matter to hand-scrape the surface until it is aligned. It can be readily seen that the invention provides an easier and quicker means for aligning machine surfaces than methods previously known which required many hours of tedious labour. These prior methods are much less accurate since it is impossible with a single level to accomplish what the apparatus accomplishes. For example, it is impossible to place a level in one spot, move it to determine if the surface is level in the opposite direction, and then return it to its exact original position.

It should be noted that the apparatus provides essentially three-point support for the levels. Although actually four points touch at the corners of the member 21, it has essentially two-point support, since in reality it is merely two ends of the member which are supporting the standard. The ball 20 provides the third point of support. Any wear which occurs on these points of support is immaterial since it is all corrected for by the adjustment of the levels prior to movement of the device along the way.

Fig. 1 shows how the two side walls of a V-way can be trued against a flat-way. Any twist or curvature in the V-way will raise or lower one end of the member 21 and that will be reflected in the level 37.

Fig. 3 shows how the apparatus can be utilized to true up one side of a male V-way after a flat-way and a first V-way have been aligned relative to each other. The annular member 44 is utilized so as to eliminate the effect of any minor scores which may exist in the flat-way. The dial indicator 29 has its point 31 registering against the side wall of the V-way to be aligned. The dial indicator is then set at zero. Since the other two surfaces are aligned, any misalignment of the V-way which is to be aligned will be indicated by the dial indicator 29 as a plus or minus quantity and it can be eliminated thereafter by hand-scraping.

Fig. 8 show the apparatus being used to align one of the walls of a female dovetail way after the made V-way beneath the ball 20 and the flat-way beneath the member 21 have been aligned relative to each other. Since the flat-way in this instance has a vertical side the foot or base 21 has been mounted on the standard 12 in the aperture 25 which is not directly opposite the slot 22. The dial indicator 29 indicates whether the wall of the female dovetail way is true or not and the extent to which it is out of alignment.

Fig. 9 illustrates another method of utilizing the apparatus. Since the flat-way in this instance has been scored in a number of places and the user wishes to ignore these scores, since they will not affect the travel of the type of machine which is to be carried on the way if the higher surfaces are true, the annular member 44 is utilized beneath the ball 20 to true the flat-way against the female V-way, the standard 12 is threaded into the member 21 within the gap 22 so that the sides of the member 21 will travel along the walls of the V-way. The levels 36 and 37 will then register any misalignment of the flat-way relative to the V-way.

Fig. 10 illustrated the manner in which a chuck 51 or spindle (not shown) can be aligned with a bed-way so as to ensure that any article formed by a machine carried on the bed-way will be true. To accomplish this the bed-way is first trued up as described above and then a test bar 50 which is known to be perfectly formed is inserted in the chuck 51. The registering point 31 is then brought to bear against the test bar 50 and the dial indicator 29 is set at zero. Thereafter, as the apparatus is moved along the bed-way, the extent to which the spindle is out of alignment will be registered on the dial indicator 29. The setting of the spindle can be adjusted until the dial indicator 29 shows that the spindle is true relative to the bed-way. Thereafter any shaft or other piece of equipment cut out by tools carried along the bed-way on a carriage will be true and accurately formed, since it will be held while being formed in a position which is essentially an extension of the trued spindle.

Prior to the present invention, it has been practically impossible to parallel two V-ways accurately. With the present apparatus it is a simple procedure. First, the user aligns one of the V-ways with a flat-way with the apparatus as described above. Then the apparatus is positioned on the aligned V-way and the flat-way and the dial indicator 29 is utilized to align the other V-way. This latter operation is shown in Fig. 3.

It can be readily seen that the apparatus can

be utilized to align any type of way regardless of its structure or shape without any difficulty and with a great saving of time and effort. In addition, and even more important, the accuracy of the alignment attained is greatly increased.

WHAT WE CLAIM IS:—

1. Apparatus for determining the relative alignment of machine parts, the apparatus comprising a pair of spaced standards and a cross-bar extending therebetween, one of the standards being adjustable with respect to the cross-bar longitudinally thereof and the cross-bar being adjustable with respect to one of the standards longitudinally thereof, one of the standards having at one end means for providing a single point engagement with a plane surface and the other standard being provided at one end with a pair of supporting means engageable with a machine way of any one of a plurality of various types, each of the pair of means being spaced from the other in a direction extending transversely of the cross-bar, and indicating means by which in the use of the apparatus the relative alignment of the machine parts is determined.

2. Apparatus according to claim 1 wherein the standards are parallel one with the other.

3. Apparatus according to either of claims 1 and 2 wherein each standard is adjustable with respect to the cross-bar longitudinally thereof.

4. Apparatus according to any one of the preceding claims wherein the cross-bar is adjustable with respect to each standard longitudinally thereof.

5. Apparatus according to any one of the preceding claims wherein means for providing the single point engagement comprises a ball secured to the end of the standard.

6. Apparatus according to claim 5 wherein the apparatus also comprises a member having opposite faces one of which is plane and the other of which has a socket portion within which the ball can be located.

7. Apparatus according to claim 6 wherein the member is of annular shape, each of the end faces being plane and the bore of the annulus being of lesser radius than that of the ball secured to the standard so that the end of the bore provides the socket portion.

8. Apparatus according to any one of the preceding claims wherein there is secured to said one end of said other standard a split tubular member having enlarged end portions the free ends of which provide said pair of supporting means, the gap between the adjacent free ends of the enlarged portions being smaller than over the length of the remainder of the split tubular member.

9. Apparatus according to claim 8 wherein the tubular member is removably secured to said other standard.

10. Apparatus according to claim 9 wherein the gap over the length of the remainder of the split tubular member has a greater width than that of the portion of said other standard adjacent the end thereof to which the split tubular member is secured.

11. Apparatus according to any one of the preceding claims wherein the indicating means comprises a spirit level.

12. Apparatus according to claim 11 wherein the spirit level extends longitudinally of the cross-bar.

13. Apparatus according to claim 12 wherein the spirit level is mounted on the cross-bar and is adjustable with respect thereto such that the relative inclination of the longitudinal axis of the level and the longitudinal axis of the cross-bar may be adjusted.

14. Apparatus according to claim 11 wherein the spirit level extends transversely of the cross-bar.

15. Apparatus according to any one of claims 11 to 13 wherein the indicating means also comprises a second spirit level, the second spirit level extending transversely of the cross-bar.

16. Apparatus according to claim 15 wherein the two levels are mounted on a common bracket secured to the cross-bar.

17. Apparatus according to claim 16 wherein the bracket is rotatably mounted on the cross-bar means being provided for securing the bracket on the cross-bar in any one of a plurality of positions spaced angularly from each other.

18. Apparatus according to any one of claims 1—10 wherein the indicating means comprises a dial indicator.

19. Apparatus according to any one of claims 11—17 wherein the indicating means also comprises a dial indicator.

20. Apparatus according to either one of claims 19 and 18 wherein the dial indicator is adjustably mounted on the cross-bar.

21. Apparatus for determining the relative alignment of machine parts substantially as described with reference to and as illustrated in the accompanying drawings.

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Published at The Patent Office, 25, Southampton Buildings, London, W.C.2, from which copies may be obtained.

FIG. 1

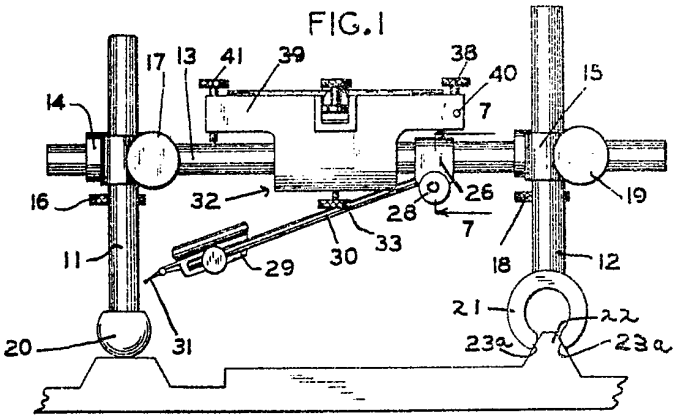


FIG. 7

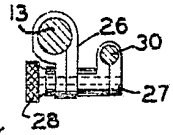


FIG. 2

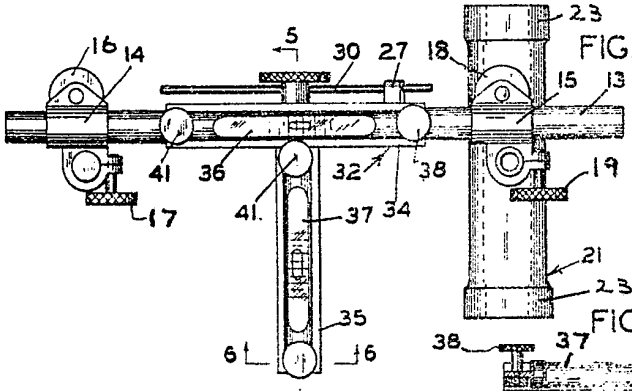


FIG. 5

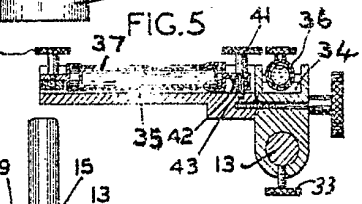


FIG. 3

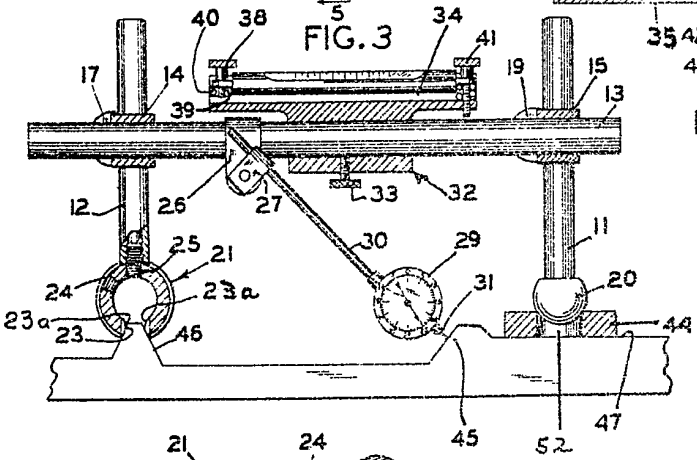


FIG. 6

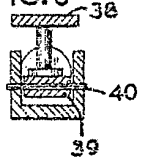
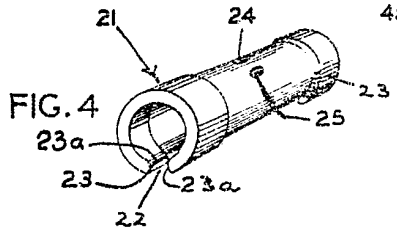


FIG. 4



802,295 COMPLETE SPECIFICATION

2 SHEETS

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SHEETS 1 & 2

FIG. 8

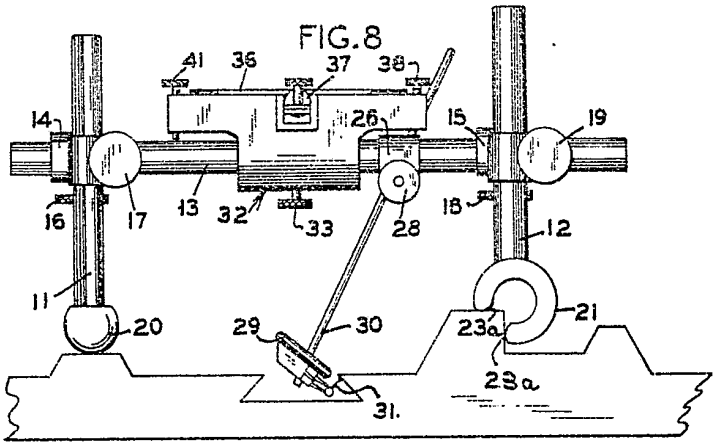

FIG. 7

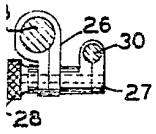

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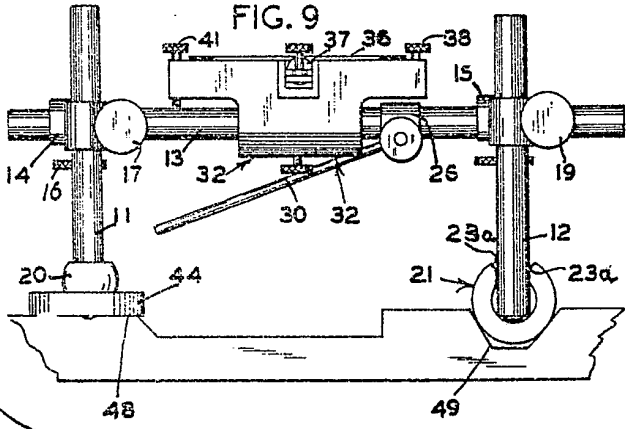
FIG. 9



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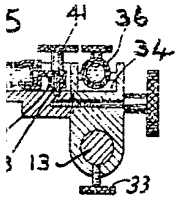
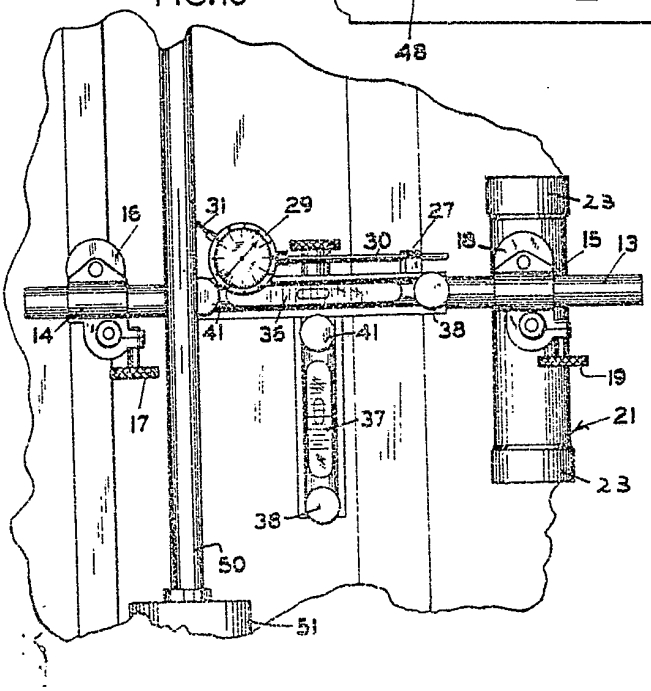
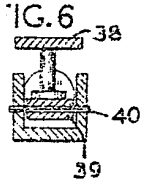


FIG. 10



IG. 6



802,295 COMPLETE SPECIFICATION
2 SHEETS

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SHEETS 1 & 2

FIG. 1

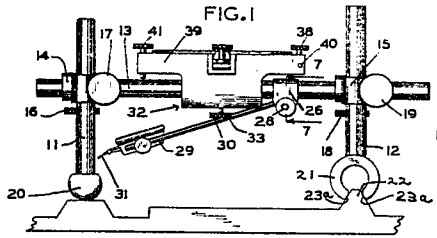


FIG. 7

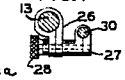


FIG. 2

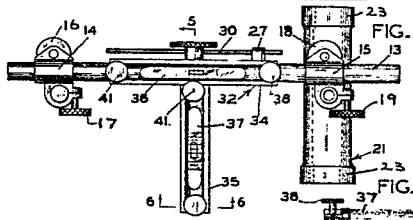


FIG. 5

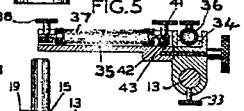


FIG. 3

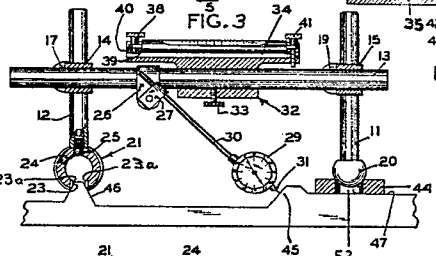


FIG. 6

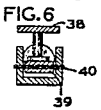


FIG. 4

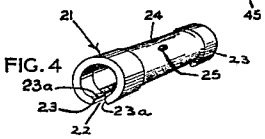


FIG. 8

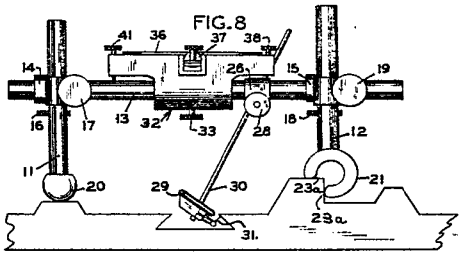


FIG. 9

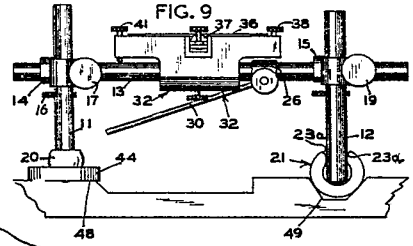
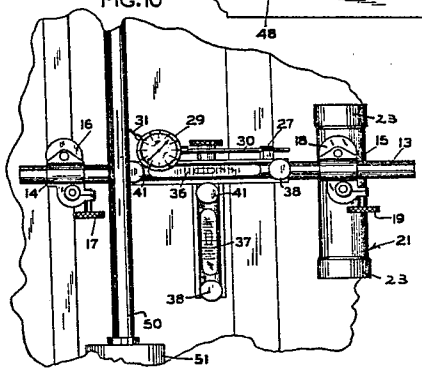


FIG. 10

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