April 23, 1929. S. J. HEINRICH 1,710,057

CONVERTIBLE LEVEL

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Fig. 1.

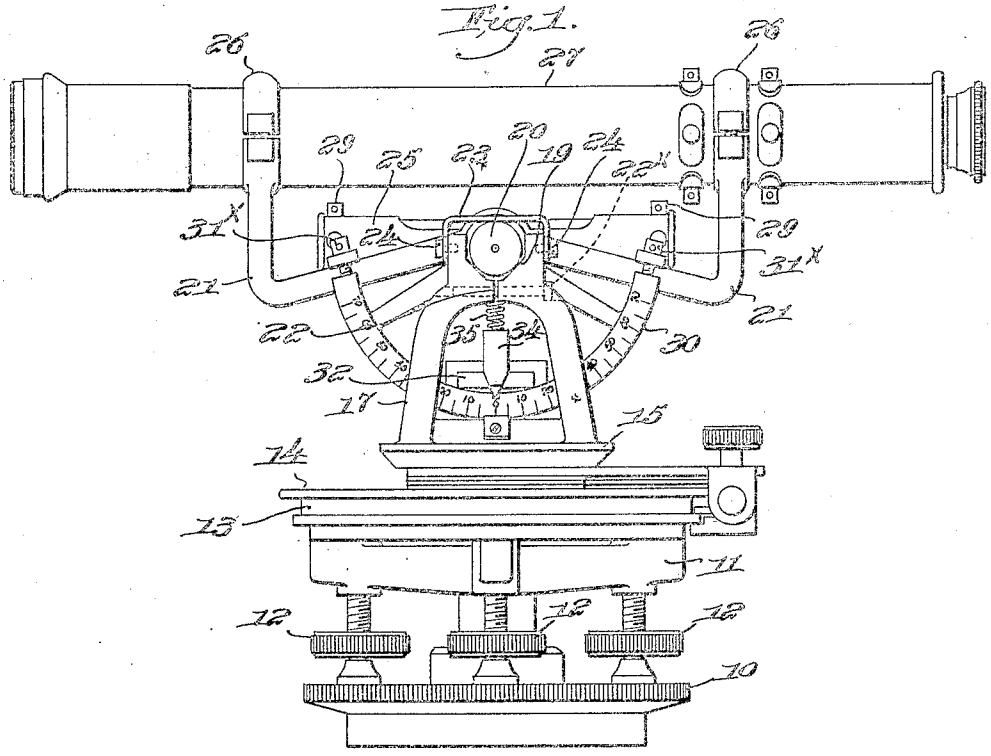
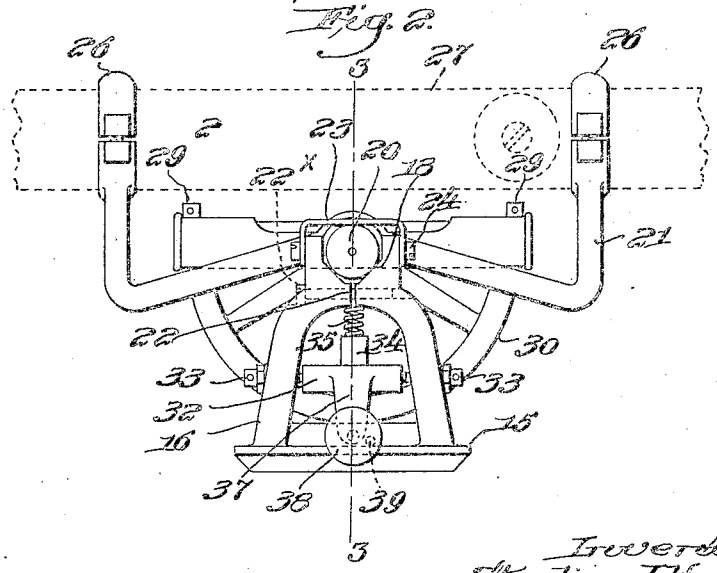


Fig. 2.



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Fig. 3.

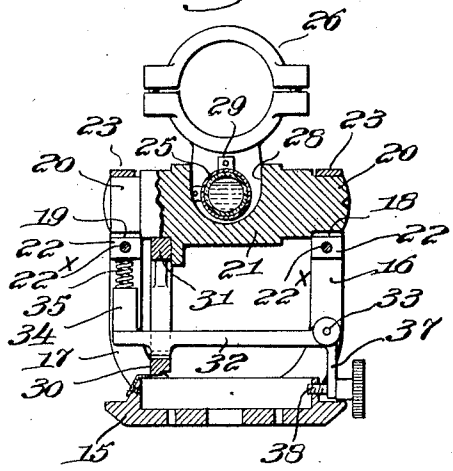


Fig. 4.

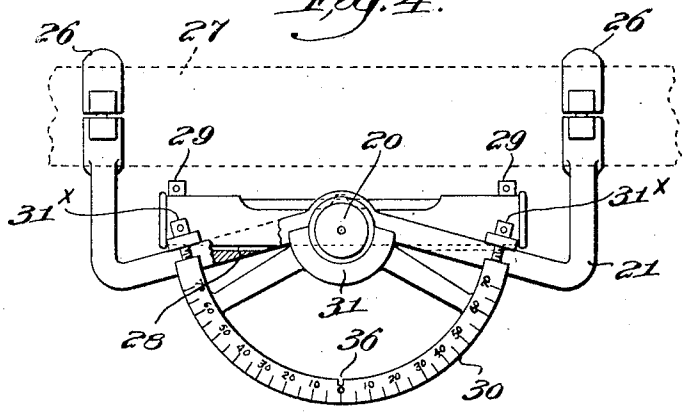
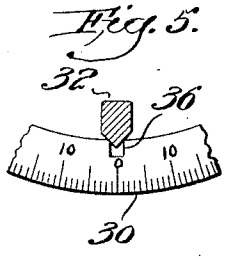


Fig. 5.



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Patented Apr. 23, 1929. 1,710,057

UNITED STATES PATENT OFFICE.

STEPHEN J. HEINRICH, OF NEWTON, MASSACHUSETTS, ASSIGNOR TO B. L. MAKEPEACE INC., OF BOSTON, MASSACHUSETTS.

CONVERTIBLE LEVEL.

Application filed August 27, 1926. Serial No. 131,895.

This invention relates to engineers' levels and more particularly to levels such as may be rapidly converted into transits.

It is an object of the present invention to reduce the cost of production of instruments of this class, and at the same time produce a sturdy, serviceable, and durable instrument which will withstand more rough usage than higher priced instruments of this class.

A further object of the invention is to so construct and arrange the parts of the instrument that the bubble level is inclosed and protected, and a compact, simple, durable and inexpensive organization is provided.

Another object of the invention is to so arrange the vertical arc and its co-acting detent that so far as the initial horizontal adjustment of the telescope is concerned they are fixed while the bar and telescope are made movable relatively thereto, to thereby ensure a perfect registration of the said detent and the co-acting notch or groove in the arc.

It is a further object of the invention to so arrange the detent that it may be instantly controlled to permit of the conversion of the instrument from a level to a transit or vice versa, and to cause its pressure, when exerted on the arc, to exert its power in the direction of the greatest strength and least flexibility.

A still further object of the invention is to provide sturdy lateral supports for the telescope to which end the present arrangement of the bar lends itself inasmuch as its trunnions project each side therefrom a comfortable distance which enables the standards, having the supporting bearings therefor, to be sufficiently separated laterally to provide bearings spaced more than ordinary in instruments of this type thereby eliminating to great extent the possibility of springing the horizontal axis of the instrument out of true.

Other objects of the invention will be fully understood from a description of the drawings and the claims hereinafter given.

Of the drawings:

Figure 1 represents a left side elevation of the convertible level.

Figure 2 is a right side elevation of certain portions of this level shown in Figure 1.

Figure 3 is a section in the line 3—3 Figure 2 a portion of one of the trunnions being shown in elevation.

Figure 4 is a view showing a right side elevation of the bar which supports the level and telescope and to which the vertical arc is adjustably attached.

Figure 5 is a detail showing a portion of the vertical arc and a section through the portion of the detent which co-acts with it.

Like characters represent like parts throughout the several figures of the drawings.

Referring to the drawings:

The drawings herewith illustrate a simple, compact and durable convertible compound level wherein a cap like base portion 10 is arranged to support a levelling piece 11 which may be adjusted with relation thereto by the screws 12 as usual in instruments of this general type.

The usual horizontal circle 13, indicated herein but not shown in detail, is mounted in a well known manner, and has a cover plate 14 mounted to turn with a pin or center, not shown, to which is secured a base portion 15 having upstanding therefrom the side frame or standards 16 and 17.

The said standards are arranged to provide flat faced bearings 18 and 19 for the trunnions 20 of a telescope-supporting frame herein shown as a bar 21, the said standards having their top portions separated by a saw cut as at 22, the said top portions of each of the standards being made adjustable towards and from each other by the screws 22× for the purpose of horizontally levelling the trunnions 20 and consequently the parts carried thereby.

The trunnions 20 are prevented from being removed from the said bearings 18 and 19 by the straps 23 secured to the standards by screws 24 the holes for which in the straps being slightly elongated in practice to permit of movement thereof when the trunnions are adjusted.

The bar 21 is of novel structure and is arranged to aid in accomplishing a plurality of new results viz: it provides its own pivot trunnions which extend laterally therefrom to such extent that vertical lateral twist is practically impossible even under unusual conditions of hard usage, a partial housing is provided for the bubble level 25 which could not be obtained in such a compact and simple manner if a pivot pin were used intsead of the trunnions 20, and a longer radius of vertical arc having graduations thereon which are

separated more than usual in levels of this class, and therefore more easily read, is made possible.

The bar 21 is also provided with cap bearings 26 arranged to receive and firmly grip the telescope cylinder 27, and is arranged to provide a groove 28 centrally and longitudinally thereof for the reception of the said level 25 to thereby permit of a more snug and compact assembly, and to aid in the protection of the said level from harm or injury.

The said level is held to the said bar by the screws 29 which are so arranged that the initial or subsequent adjustments necessary to true up the level and the line of sight may be easily and rapidly made.

The novel arrangement of the bar with its trunnions make it possible to provide a sort of nest for the level 25, and by so doing considerable valuable space is available which is utilized to increase the radius of the vertical arc of graduated sector 30.

The said arc 30 is provided with a segmental hub 31 which is machined to fit a like portion of one of the trunnions 20 against which it is arranged to be snugly held and between which relative movement may take place at the time of making the initial adjustment between the arc and the said bar 21.

In the present instance the arc 30 is adjustably held to the bar 21 by the capstan screws 31^{x} which provide the means for adjusting it with relation to the bar.

To normally retain the telescope 27 in position for use when the instrument is being used as a level a detent 32 is provided which takes the form of a bell crank lever pivoted to the standard 16 at 33, and having an upstanding socket 34 for the reception of a spring 35 which is arranged to bear against the arched portion of the standard 17.

The said detent is shaped at its underside to enter a notch 36 in the inner periphery of the arc 30 to normally yieldingly lock the said arc, and consequently the bar 21, and the parts carried thereby, in position for use as a level.

It will be understood that the arrangement of the detent 32 and notch 36 with which it engages is such that if need be the said detent may be disengaged from the notch by the use of slight upward or downward pressure on the end of the telescope 27 which will cause the top edges of the notch to cam the detent upwardly against the action of the spring 35 whereupon it will ride upon the smooth inner periphery of the arc and provide frictional means to retain the arc in any angular position in which it finds itself when at rest.

When the instrument is to be used as a transit it is preferred to so arrange the detent that it may be put out of engaging contact with the arc, and to that end the short arm 37 thereof is bored to receive a screw 38 having a smooth shank portion passing through the bore or hole, and a threaded end to engage a threaded hole in the base portion 15 as seen in Figure 3 of the drawings.

Preferably the threads or the screw 38 are left hand and coarse so that by turning the screw to the right the arc or notch engaging portion of the detent will be forced into engagement with the arc by the spring 35, and turning the screw to the left will force it upwardly and out of engaging position. A stop 39 extending from the head of the screw 38 is arranged to engage the top side of the base 15 in each direction of movement of the screw so that undue movement thereof is prohibited.

Having described the invention I claim:

1. A convertible level comprising a telescope; a level; a frame upon which said telescope and level are mounted to swing, said frame having bearings arranged to encircle said telescope, and having trunnions laterally extending from the sides thereof, and a depression longitudinally thereof for the reception of said level whereby said level is compactly assembled with said frame and protected thereby; a vertical arc having ends adjustably secured to said frame, and having a hub portion arranged to contact with and swing about a trunnion; and a detent arranged to normally yieldingly lock said arc and consequently said telescope, and level in a given angular position.

2. A convertible level comprising a telescope; a level; a frame upon which said telescope and level are mounted to be swung; a vertical arc adjustably secured to said frame; and a detent for said arc comprising a bell crank lever; means to normally retain said detent and arc in operative relationship; and means to retain said detent out of operative relationship with respect to said arc.

3. A convertible level comprising a telescope; a level; a frame upon which said telescope and level are mounted to swing in a vertical plane; a vertical arc adjustably secured to said frame; a bell crank lever arranged to move radially of said arc and to bear against the inner edge thereof; a spring arranged to normally retain said bell crank in contact with said arc; and a screw arranged to move said bell crank out of contact with said arc.

4. A convertible level comprising a base having standards upwardly projecting therefrom, said standards having bearings at the upper ends thereof; a telescope-supporting frame interposed between said standards and having a pivot laterally extended from each side thereof arranged to be pivotally supported in said bearings, said bearings being separated a distance approximately twice the width of said frame whereby a sturdy support against twist is afforded said frame; a level; said frame being arranged to receive said level between said pivots which furnish protection for said level; a telescope secured to said frame; a vertical arc secured to

said frame; and means to retain said frame in one of various angular positions thereof.

5. The combination with the telescope-supporting frame provided at opposite sides thereof with trunnions, of a vertically disposed graduated sector made with a hub segment fitting against one of said trunnions, and means connecting said sector with said frame so as to hold said segment fitted against said trunnion.

6. In an instrument of the character described, the combination with the telescope-supporting frame provided at opposite sides thereof with trunnions, of a vertically disposed graduated sector made with a graduated arcuate bar and with a hub segment fitting against one of said trunnions; screws adjustably connecting the opposite ends of said sector with said frame so as to normally hold said segment fixedly against said trunnion, and a spring pressed detent engaging the periphery of said arcuate bar in all positions of the latter to yieldingly hold said frame in adjusted position.

7. In an instrument of the character described, the combination of a telescope; a longitudinally disposed telescope-supporting frame having upwardly extending arms to which said telescope is fixed and having trunnions at opposite sides of its lower portion; a bubble level disposed longitudinally between said frame and said telescope and also between said trunnions; a vertically disposed graduated sector having a hub portion fitting against one of said trunnions; means adjustably connecting said sector with said frame so as to normally hold said hub portion fixedly against said trunnion, said connecting means being operable to rotate said sector on said trunnion; a yoke base having bearings in which said trunnions are journaled, and a spring pressed detent on said yoke base engaging said sector to yieldingly hold said frame in horizontal position.

Signed by me at Boston, Massachusetts, this 26th day of August 1926.

STEPHEN J. HEINRICH.