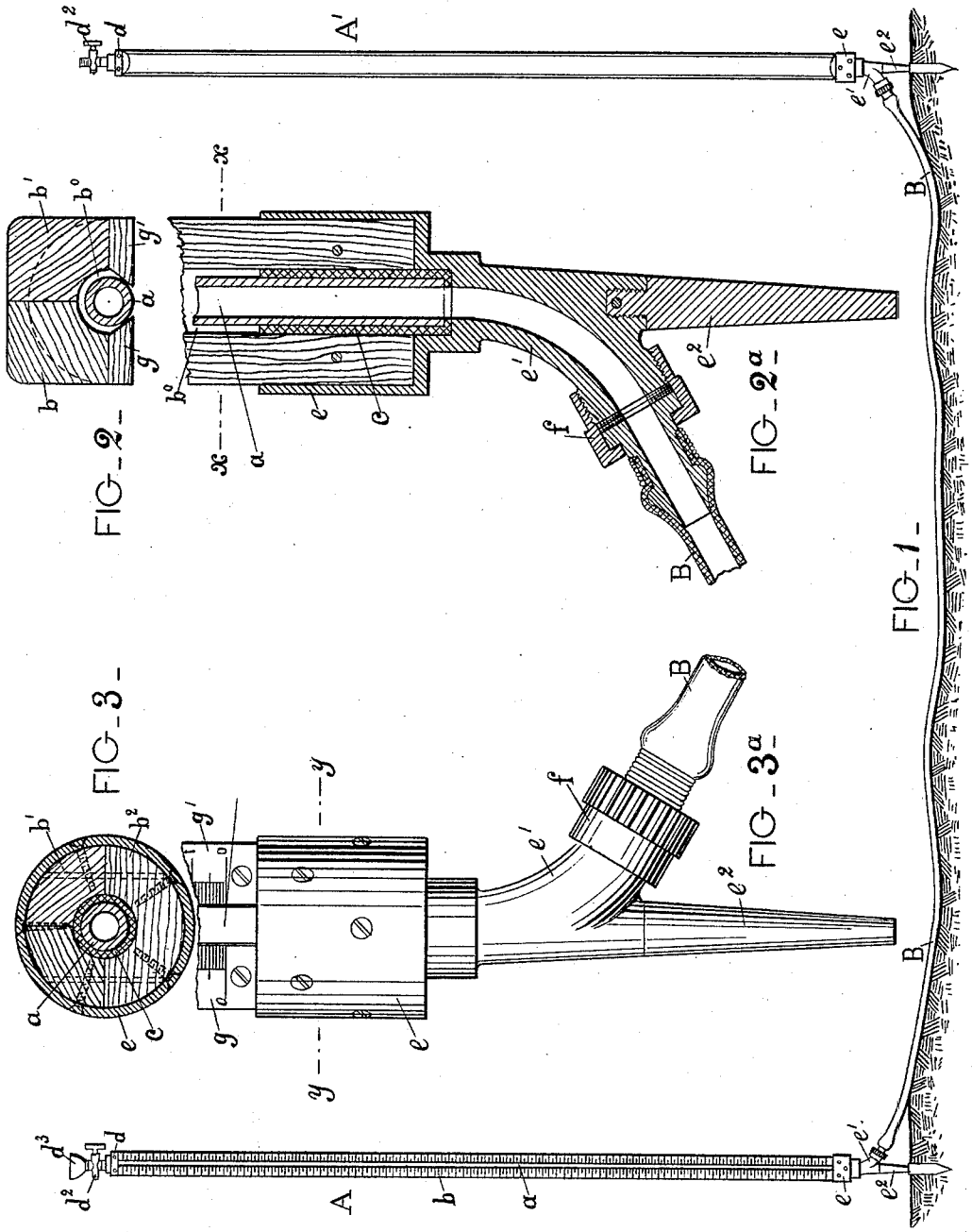
(No Model.) 2 Sheets—Sheet 1.

C. T. STRAUS.

LEVELING INSTRUMENT.

No. 413,103. Patented Oct. 15, 1889.



Witnesses:
E. C. Duffy
H. E. Peck.

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(No Model.) 2 Sheets—Sheet 2.

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FIG. 4.

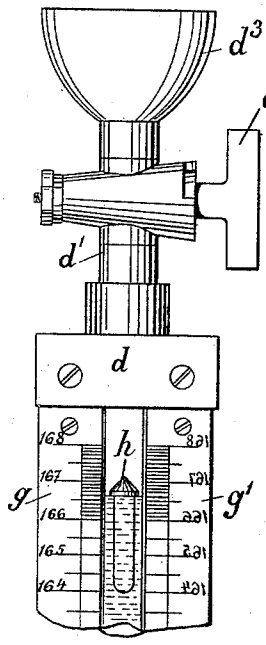
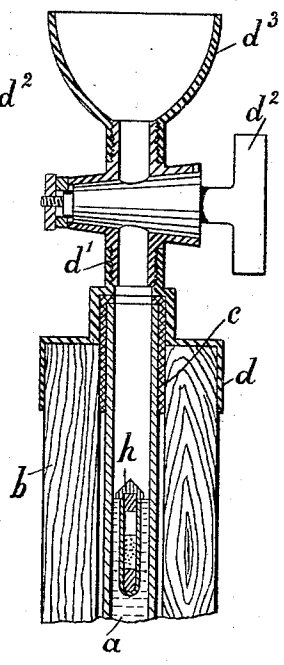


FIG. 4a.



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UNITED STATES PATENT OFFICE.

CARL THEODOR STRAUS, OF RIGA, RUSSIA.

LEVELING-INSTRUMENT.

SPECIFICATION forming part of Letters Patent No. 413,103, dated October 15, 1889.

Application filed May 3, 1889. Serial No. 309,464. (No model.) Patented in Belgium April 16, 1889, No. 85,853; in England April 16, 1889, No. 6,505; in France April 16, 1889, No. 197,535; in Switzerland April 16, 1889, No. 871; in Spain April 16, 1889, No. 9,487, and in Portugal April 17, 1889, No. 1,373.

To all whom it may concern:

Be it known that I, CARL THEODOR STRAUS, a subject of the Emperor of Russia, residing in the city of Riga, in the Empire of Russia, have invented certain new and useful Improvements in Leveling-Rods, (for which patents have been secured in Belgium, No. 85,853, April 16, 1889; England, No. 6,505, April 16, 1889; France, No. 197,535, April 16, 1889; Switzerland, No. 871, April 16, 1889; Spain, No. 9,487, April 16, 1889, and in Portugal, No. 1,373, April 17, 1889,) of which the following is a specification.

This invention relates to hydrostatic leveling-instruments by which the exact difference in heights of surfaces between two points may be directly read.

This invention is based upon the fact that the fluid contained in two vessels connected with each other by pipes into or from which there is no other flow or outflow stands always horizontal and at the same level in each vessel.

According to my invention two equal straight faultless glass tubes open at both ends are fastened into or onto wooden rods provided with divisions after the manner of a thermometer, and the lower ends of the tubes are connected together by a hose or pipe of the desired length—say from twenty to fifty inches. The instrument thus formed is filled with water, so that the level of the fluid reaches, say, to the middle of the tubes. The rods are set up in a perpendicular direction—the one at one and the other at the other of the two points of the surface the difference of the height of which is to be measured. The latter operation is effected by reading the height on the divisions of the two rods and subtracting the values thus obtained the one from the other.

In the accompanying drawings, Figure 1 shows a general view of a leveling-instrument constructed according to my invention. Figs. 2 to 4, inclusive, show various details, as hereinafter described.

In Fig. 1, A represents one and A′ the other of the two leveling-instruments, and B the hose pipe or tube which connects the lower ends with each other. The rods are similar to each other; thus the rod A, Fig. 1, on the left hand represents the front view, the rod A′, Fig. 1, on the right the back view. Each rod has a straight glass tube *a*, carried by a wood piece or support *b*, in the front of which there is a half-cylindrical longitudinal groove b^0, Fig. 2, which is a section on the line *x x* of Fig. 2^a, the latter being a vertical section of the lower portion of the instrument, both Figs. 2 and 2^a being drawn to an enlarged scale, and it will be observed that the glass tube *a* in those figures rests in the groove b^0. The support *b* is turned at the upper and lower ends to a half-round form, as shown in dotted lines in Fig. 2 and in full lines at Fig. 3, which is a horizontal section on the line *y y* of Fig. 3^a, the latter figure being an elevation of the part of the instrument, as shown in section at Fig. 2^a, and by the aid of suitably-formed blocks b^2 the support *b* is made round, so that the glass tube *a* at the ends of the support *b* is fully covered. At the upper and lower ends there is pushed onto the glass tube a short piece of india-rubber hose *c*, so that the expansion or contraction of the tube is allowed for in one or the other direction without fear of breakage. Over each of the round ends *b′* b^2 of the support is pushed a metal cap—marked *e* in Figs. 2^a and 3^a, and *d* in Figs. 4 and 4^a, which latter show elevation and sectional views of the upper part of the instrument. The upper cap *d*, Fig. 4^a, at the upper end of the tube *a*, is formed with a carrier *d′*, in which a cock d^2 is inserted. The lower metal cap *e*, Fig. 2, terminates in a bent conduit *e′*, the core of which communicates with the lower end of the tube *a*, and the free end of which is screwed to the end of the hose or tube B by means of a suitable nut. At the end of the conduit *e′*, in the prolongation of the tube *a*, a blunt point e^2 is provided, by which the rod is set on the ground. Finally, each rod carries on its front side, right and left of the glass tube *a*, two measuring-scales *g g′*, Figs. 2, 3, and 4, so that the various heights of the fluid may be read off. For this purpose there is a float *h*, Figs. 4 and 4^a, which is placed in the glass tube of each rod.

When the apparatus is prepared for use, the hose B, Fig. 1, is screwed onto the ends of the bent conduits e', and after opening both cocks d^2 at the upper ends of the rods water is poured into the tube a of one rod, for which purpose a funnel d^3, Figs. 4 and 4^a, is provided on the upper end of cock d^2. Water is continued to be poured in until the hose is filled and the fluid stands in both tubes in the middle of the measuring-rods; then both floats h are put into the tubes, which may be done by first unscrewing the cocks d^2.

Upon the filling of the apparatus with water it is advantageous at first to hold the hose high and then gradually to let it down, so that the air may be completely driven out of the hose.

If a regular leveling is to be made, the same preparatory operations as in leveling with the telescope or ordinary instrument must be executed. The lines must first be set out, then measured, and at, say, twenty, twenty-five, or fifty inches distance small stakes must be driven in the earth and numbered.

In leveling, each rod is carried by a man who has to set the same upon the center of one of the driven pegs and to hold it as vertically as possible. Each bearer is accompanied by a reader, who, after the setting up of the rod, opens the cock in the upper end of the carrier. Then after the float has come to a standstill the reader reads off the position of the float upon the scale and enters the result in a note-book. By very high or low position of the float the reading may be effected by the aid of a small mirror, which can be inserted in the cover of the note-book and set against the rod, so that the reflected sight-line falls vertically to the rod upon the float. For this purpose the numbers upon the scale g', Fig. 4, are arranged so that the reflected indication can be read. After the reading and notation the cocks of both rods are again closed, and both parties go to the next peg forward, in doing which both readers can assist in carrying the hose.

In case of the breakage of a tube, it can be easily replaced without the accuracy of the apparatus suffering thereby.

It may be further remarked that the expansion of the water has no influence upon the accuracy of the height measurements, because the level in each tube is increased by a half of the expansion, so that the same difference in height will result from the subtraction of the readings.

All loss in the body of the water occasioned by usage, leakage, or adhesion to the glass walls, moreover all doubling and bending of the hose, as well as all inequalities in the diameters of the glass tubes, of the hose, and of the connection parts, only cause an alteration in the height of the water-level in both tubes. The differences resulting therefrom are internally compensated by the subtraction of the readings.

The advantages which the described apparatus possesses over the instrument in common use are as follows:

First. Any person without technical knowledge or experience can carry out the desired leveling in the given direction.

Second. The leveling can be carried out with greater accuracy in a shorter time, particularly in mountainous lands.

Third. No open sight-line is necessary, on which account the apparatus is specially adapted for leveling in towns and in woods.

Fourth. The cost of the complete apparatus is small.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, I declare that what I claim is—

1. A leveling-instrument comprising a pair of tubes open at the top and bottom, a flexible tube connecting the lower ends of the tubes, and supports having grooves in their sides in which said tubes are secured, rings embracing the opposite ends of the supports, said supports being provided with vertical scales besides the tubes, and pins or bases on the lower ends of the supports, substantially as described.

2. In a leveling-instrument, the combination of a tube normally open at each end, a rod or support to which the tube is longitudinally secured, a cap on the lower end of the support surrounding the lower end of the tube, an arm or pointed base extending down from said cap to enter the ground, and a conduit forming a continuation of the lower end of said tube and extending downwardly and laterally through said arm, and provided with a nozzle to which the flexible pipe can be connected, substantially as described.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

CARL THEODOR STRAUS.

Witnesses:
J. R. FREGMAN,
BAR. A. VON TAULIE.