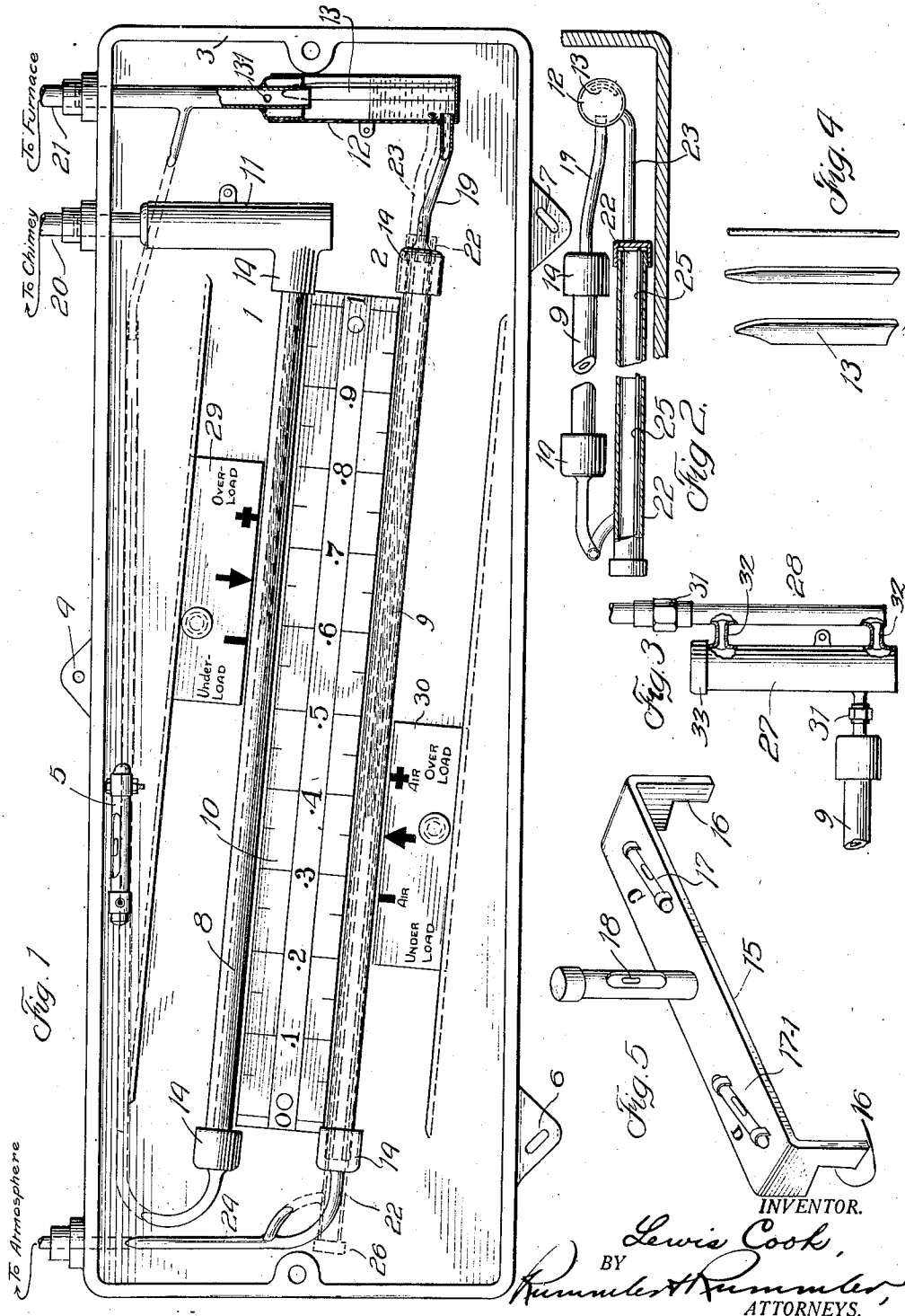


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DRAFT GAGE.

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DRAFT-GAGE.

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To all whom it may concern:

Be it known that I, LEWIS COOK, a citizen of the United States of America, and a resident of Oak Park, county of Cook, and State of Illinois, have invented certain new and useful Improvements in Draft-Gages, of which the following is a specification.

This invention relates to gages of the U-tube type, and particularly those which are used for indicating slight differences in pressure of gas or liquids, as for example, draft-gages for use in determining and indicating furnace efficiencies.

The main objects of this invention are to provide in gages of the U-tube type wherein the pressure is indicated by the position of the surface of a liquid in a glass tube, certain means whereby adjustments may be made to readily compensate for the variations of diameter that commonly occur in commercial glass tubes; to provide improved means for readily adjusting such gages to conform to a standard scale, thereby obviating the necessity of preparing a special scale for each gage where great accuracy is required or the alternative necessity of making the tubes conform exactly to predetermined dimensions; and to provide improved means for adjusting the relative angular disposition of the legs of the U-tube.

In gages of this general type where the gage leg of the tube is inclined to the horizontal in order to indicate minute differences of pressure, such leg must be of relatively small diameter in order to insure that the exposed surface of the liquid therein shall form a meniscus approximately at right angles to the axis of the tube instead of standing substantially horizontal as in a large tube. To this end, it is a further object of this invention to provide an improved construction whereby the gage-tube may be of small diameter and be supplemented by an additional tube, when the conditions are such as to require a larger sectional area for the respective leg of the tube, than would produce the right kind of a meniscus.

Referring to the drawings, Figure 1 is a front elevation of a specific embodiment of this invention as applied to a draft-gage of the type used in indicating furnace efficiency.

Fig. 2 is a detail in plan and partly in section, showing the arrangement of the aux-

iliary tube behind the gage-tube in the device shown in Fig. 1.

Fig. 3 is a detail of a modified form of U-tube.

Fig. 4 is a detail of a liner which is used for adjusting the area of the interior of the large leg or bottle.

Fig. 5 is a perspective view of an adjusting level which is used for accurately setting the gage-glass while the device is being assembled.

The form shown in the drawings is a draft gage of a type used in determining furnace efficiencies and in general comprises two U-tubes designated 1 and 2, the tube 2 being arranged for measuring the difference in pressures between the atmosphere and the inside of the furnace above the fuel bed, whereas the tube 1 is arranged for measuring the pressures between the inside of the furnace above the fuel bed and the chimney.

In the specific form shown, the U-tubes are mounted within a casing 3 which is secured to the outside of the furnace by means of a screw at 4, and after being leveled up by means of a level 5 is fixed by means of screws at 6 and 7.

The indicating legs 8 and 9 of the U-tubes are inclined at a slight angle from a horizontal position, and in order to indicate the small differences of pressure which the instrument is designed to measure, are provided with a scale 10 preferably graduated to read in tenths of an inch of water head. The scale 10 is of a standard construction so far as its use with devices of this kind and for this purpose is concerned. The tubes are partly filled with oil of suitable specific gravity, and the quantity of oil is exactly measured so as to bring the liquid levels in the indicating tubes at zero on the scale when both legs of the tubes are at atmospheric pressure.

The other legs of the tubes are preferably vertical and are of considerably larger diameter than the indicating legs, so as to insure a long range of movement of the indicating liquid level for slight differences of head.

It has been customary in the manufacture of gages of this general type to make the indicating legs and the vertical legs or bottles of the U-tubes out of a single piece of glass, which must be made with great accuracy in order to avoid the necessity of

preparing a special scale for each instrument, with the result that if a tube becomes accidentally broken, it is expensive to replace it. In the present construction, the bottles 11 and 12 which constitute the vertical legs of the U-tubes 1 and 2 respectively are made of metal of standard size, and the inclined legs 8 and 9 are glass tubes which may vary slightly in diameter, as in the case with commercial glass tubing.

The tubes leading upward from the bottles 11 and 12 are preferably extended into the bottles so as to serve to hold the liners 13 in upright positions against the sides of the bottles where they will not interfere with filling or emptying the bottles. Drain openings 13.1 are positioned so as to insure that none of the oil will be entrained when the device is inverted for emptying it.

The bottles 11 are made of slightly larger diameter than that which is correct for the particular size of glass tube which is used, and adjustment between the areas of the exposed surfaces in the two tubes is effected by inserting into the bottles vertically disposed liners or filler members 13 which are of uniform cross section throughout the range of movement of the liquid levels in the bottles. The filler members are preferably made of lead or other non-corrodible metal which can be readily bent to conform to the curvature of the walls of the bottle. The glass tubes are cemented into sockets 14 by means of an adhesive plastic composition, such as litharge and glycerin, which is insoluble in oil or water and makes an air-tight joint. It is, therefore, a simpler matter to replace a broken indicating tube and to adjust a U-tube to suit the particular diameter of the bore of the glass tube which is used. The same plastic composition may also be used for securing the gage in its casing and embedding all joints to make them liquid and air-tight.

Before assembling the device, a quantity of liquid is poured into the bottle until the level thereof in the glass tube is exactly at zero on the scale at atmospheric pressure, and the device is then calibrated for other pressures by inserting one or more fillers of suitable sectional area so that the liquid level will come to the highest reading on the scale, which in the device shown is one inch of water head when it is subjected to a corresponding difference of pressure. This calibrating is preferably done in a suitable testing apparatus after the bottle and gage tube have been connected together, but before the caps and pressure tubes are soldered or otherwise secured in place on the bottle. Once the device is calibrated for a certain range of pressures, there is no need of removing or changing the fillers. Where, however, it is desirable to have the same gage readily adjustable for different ranges of pressure, it

should preferably be of the form shown in Fig. 3 hereinafter described.

The slant of the indicating legs is predetermined in accordance with the specific gravity of the liquid used and the pressure range which is to be indicated. Therefore, one of the U-tubes is first fastened into the instrument case with its indicating leg parallel to the scale which is set at approximately the proper angle. A special leveling device 15, illustrated in Fig. 5, is then placed so that the seats 16 rest directly on the glass tube 8 and the level tube 5 in the casing is adjusted so that it will stand level when the bubbles in the level tubes 17 and 18 both stand at zero position. In the drawings the device 15 is shown equipped with an additional inclined level tube 17.1 for use when assembling meters in which the tubes have a different slant. The level tube 17 may, for example, have a slant corresponding to an instrument designed for natural draft furnaces whereas the slant of the level tube 17.1 may be for a gage designed for forced draft furnaces. Adjacent level tubes 17 and 17.1 are placed characters "C" and "D" respectively to enable the user to readily distinguish them.

The U-tube 2 is provided with a connection 19 of semi-rigid tubing made of soft metal which may be readily bent so as to bring the indicating tube 9 parallel with the indicating tube 8. To insure accurate setting of the glass tube 9, even though it be not exactly straight, the device 15 is again employed as above described. Thereafter, all that is necessary to set up the instrument is to hang the casing so that the bubble in the level tube 5 indicates that the same is level, and then to connect the pipes 20 and 21 with the chimney and furnace respectively.

The transparent indicating tubes should be of small enough diameter to insure that the exposed surface of the liquid therein will stand in the form of a meniscus substantially at right angles to the axis of the respective tube, so that the indication may be read with certainty upon the scale.

If the range of pressures is such that it is desirable to use a liquid column of greater sectional area in the indicating leg of the U-tube than the sectional area of the bore of a glass tube of the largest size that would have a proper meniscus, this may be accomplished by placing behind the indicating tube an auxiliary tube 22 which is exactly parallel with the glass tube and directly behind it at all points along the scale. This is connected with the bottle 12 by means of a bendable metal tube 23, and the tubes 9 and 22 are both connected at their opposite ends to the tube 24, which opens to the atmosphere if it is applied to a natural draft furnace or is connected to the ash-pit if it is applied to a forced draft furnace.

Exact adjustment may in this case be obtained by inserting fillers 25 or 13 respectively into the tube 22 or the bottle 12 as may be required until the combined sectional area of the tubes 9 and 22 will be correct with respect to the sectional area of the leg 12 of the U-tube. To facilitate this, one end of the tube 22 may be provided with a removable cap 26.

10 In Fig. 3, a modification is shown wherein the parts may be readily taken apart for cleaning or repairing and the vertical leg of the U-tube is made of two tubes 27 and 28 whereby adjustment of the sectional area of
15 said leg may be accomplished by fillers confined in the bottle 27 leaving the tube 28 clear for inserting a small brass tube used for removing oil to adjust the liquid level. Union fittings 31 may be employed at suitable points to enable the parts to be separated
20 for convenience in cleaning them. The tubes 27 and 28 communicate with each other both at the top and bottom through the tubular connections 32. This form of the invention
25 is particularly advantageous for use in instances where it may be desirable at times to change the instrument for use in connection with one range of pressures to another range. In this form, the bottle 27 would be
30 arranged in the instrument case in such a way that the cap 33 at the upper end thereof would be readily accessible to permit the removal and insertion of filler strips 13.

The device may be equipped with slidable
35 indicator plates 29 and 30 provided with arrows to indicate the normal position of the indicating column of liquid for maximum efficiency of the particular furnace to which the device is applied, and insufficiency or
40 superabundance of air flow is indicated thereon by means of minus and plus signs on the plates.

The use of liners or fillers for adjusting the range of movement of the oil in the indicator tube provides any desired degree of
45 adjustment since these fillers may range from fine wire up to large strips, as illustrated in Fig. 4. By this means it is possible to adjust the gage so that the entire length
50 of the scale, say ten inches, can be used to register a relatively low range of pressures such as $\frac{1}{16}$ of an inch of water head, or to register a relatively high range such as 10 inches of water head.

55 A specific embodiment and one modification of the invention have been herein shown and described, but it will be understood that numerous details of the construction shown may be altered or omitted without departing
60 from the spirit of this invention as defined by the following claims.

I claim:

1. A gage of the U-tube type comprising a transparent tube and a container disposed
65 at an angle to each other and connected to-

gether by a soft metal tube to form the legs respectively of the U-tube, said soft metal tube being bendable for accurately adjusting the angular disposition of said legs with respect to each other.

2. A gage of the U-tube type having one leg of relatively large sectional area and having a second leg made up of inclined parallel tubes of which the combined sectional area is relatively small and each of which is of substantially uniform sectional area throughout, one of said inclined tubes being transparent and of such diameter that the surface of liquid therein will provide a meniscus disposed substantially at right angles to the length of the tube.

3. A gage of the U-tube type wherein one of the legs consists of a transparent portion and an auxiliary portion extending in parallel relation to each other so as to have substantially the same range of movement of the liquid level therein whereby the transparent portion may be of small diameter compared with the total transverse area of said leg, and filler means insertible into said auxiliary portion for adjusting the free sectional area thereof throughout the range of the normal movement of the liquid level therein, said tubes and filler means being respectively of uniform sectional area throughout.

4. The method of adjusting a U-tube gage, one of the legs of which is made of commercial glass tubing, different lengths of which may have slightly different internal cross-sectional areas, such method consisting in making the other leg of greater internal cross-sectional area than would otherwise be required, and then reducing such area by inserting in such leg filler means, the cross-sectional area of which is constant throughout the range of movement of the surface of the liquid therealong and is such as to compensate for the deviation of the bore of the commercial tube from the standard demanded.

5. A gage of the U-tube type having the legs thereof of different diameters and each being of substantially uniform cross section throughout the range of the normal movement of the liquid levels therein, and filler means inserted into one of said legs for adjusting the relative transverse areas of said legs and thereby adjusting the range of movement of the liquid under variations of pressure, said filler means being of substantially uniform cross sectional area at all points throughout the range of movement of the liquid level in the leg in which the means are inserted, said one leg having a contracted opening at the top to permit liquid to be inserted into and removed from said leg, and means confining said filler means at one side of said contracted opening.

6. In a gage of the class described, a U-tube having one leg thereof in the form of

an upright bottle, a tube of smaller diameter than said bottle connected to the top thereof in alinement therewith, and extending below the mouth of the bottle, and filler means for adjusting the transverse area of said bottle and confined between the wall of said bottle and the part of said tube which extends into the same.

7. In a gage of the class described, a U-tube having one leg thereof in the form of an upright bottle, a tube of smaller diameter than said bottle connected to the top thereof in alinement therewith and extending below

the mouth of the bottle, and filler means for adjusting the transverse area of said bottle and confined between the wall of said bottle and the part of said tube which extends into the same, said tube having a drain-hole therein adjacent to the top of the bottle whereby when the bottle is inverted, the liquid contents thereof may be entirely drained out.

Signed at Chicago this 28th day of May, 1918.

LEWIS COOK.