To all whom it may concern:

Be it known that I, AUGUSTUS H. GILL, a citizen of the United States, and resident of Belmont, county of Middlesex, Commonwealth of Massachusetts, have invented an Improvement in Direct-Reading Solution-Indicators, of which the following description, in connection with the accompanying drawings, is a specification, like characters on the drawings representing like parts in each of the several views.

This invention relates to devices for indicating the character and strength of solutions such as mixtures of alcohol and water which are largely employed to prevent freezing in radiators for automobile and other internal combustion engines. Devices of this character of a hydrometer type as employed hitherto have required more or less elaborate computation and development from the data given by the hydrometer to determine what, if any, addition of alcohol should be made to bring the solution to a proper strength to prevent freezing, this having involved a constant likelihood of errors particularly by inexperienced or careless persons that would result in either adding too much alcohol with the resulting boiling off and waste thereof or else too little which would cause the solution to freeze and crack the engine jackets or burst the radiator. In the development of the present device and invention I have first determined a definite standard strength of solution which it is desirable to maintain as closely as possible in radiators of this kind and this I have established at a ten per cent. (by volume) mixture of alcohol. This is somewhat more than twice the alcoholic strength really required, since I have found by experiment that a mixture containing as little as four and one tenth per cent. by volume of ethyl alcohol at 60° F. (denatured with methyl and 1% kerosene) will not break ordinary glass vessels when exposed to a temperature of 38° F. below zero. I have therefore established a standard strength of ten per cent. so as to allow for a substantial range of evaporation of the alcohol as might occur on a long automobile trip before the danger point is reached. The principal object of the invention is to provide a device of the hydrometer type that is adapted and designed for a direct reading to indicate how much alcohol should be added to the solution as it is tested to bring the solution up to standard strength, i.e., to the ten per cent. limit. To this end I provide a device preferably in the form of a hydrometer with a stem graduated and marked to indicate the number of unit volumes of alcohol that should be added for a given reading to bring the solution up to standard strength. The invention also preferably includes provision for testing the strength of the alcohol used. The foregoing and other objects and advantages of the invention will more fully appear from the following detailed description, and the distinctive features of novelty will be pointed out in the appended claims.

Referring to the drawings:

Figure 1 is an elevation showing the device from one side;

Fig. 2 is an elevation showing the device from the opposite side; and

Fig. 3 is a transverse section on line 3—3 of Fig. 2.

The device may be produced of any suitable material such as glass or metal, preferably the latter as being less fragile and it is shown as of a usual hydrometer form with a body 10 having a gravity bulb 11 at the bottom thereof and a graduated stem 12 at the upper end thereof. This stem is preferably about five inches in length and it is graduated with indicating marks to denote the quantity of alcohol that should be added to bring the solution up to a standard strength for any given reading. Since the specific gravity of the solution varies with the temperature I produce these graduations with reference to the condition at a given temperature which for the scale in Fig. 1 is shown as for 60° F., as being most nearly a normal temperature. To produce this scale I lay off one graduation indicated at 13 a short distance above the body 10 and at a point to which the stem will sink when a maximum addition of alcohol is required which in the present illustrative instance is designated as four gills per gallon of the solution. This mark is hence designated 4. I then lay off near the top of the stem another graduation 14 which is the reading when the full ten per cent. strength of de-
natured ethyl alcohol is present in the solution and this is marked zero. The space between these two limiting marks is divided into four equal parts and the three intermediate scale marks are designated 1, 2, 3, respectively, these denoting, as will be understood, the number of gills of alcohol per gallon of solution that should be added at these respective readings to bring the solution up to standard. The top of the stem preferably is inscribed with a legend 15 denoting the liquid units employed for measurement and comparison of the solution with the alcohol component thereof, it being of course understood that the reference to "gallons" and "gills" for the solution and the alcohol is merely illustrative and that other units of measure such as metric units may be substituted if desired, the essential 20 point being the provision of a direct reading, requiring no computation or complication and eliminating the possibility of mistakes in making up the solution. In using the device with solutions at temperatures varying considerably from the temperature of 60° F. taken as a basis, I may provide another graduated division on the stem above the zero point with notations according to increases in temperature of the liquid tested, but preferably and in furtherance of the provision for a direct reading to denote the requirements of the liquid tested I equip the stem with a scale on another side thereof with graduations similar to those already described but applicable to the testing of a liquid at a certain different temperature from that connoted on the first described scale. Preferably this second scale which is indicated in Fig. 2 as located on the opposite side of the stem from the scale of Fig. 1 is connoted for a temperature higher than that to which the first scale relates and as indicated this scale is made with reference to a temperature of 90° F. The liquid being somewhat lighter at this temperature the limiting scale marks 13°, 14° corresponding to the marks 13, 14, and also the intermediate marks are somewhat higher on the stem than in the first described form. Thus 25 a direct reading denoting the requirements of the radiator solution may be taken for any solution approximating either of these temperatures. In cases where the solution is between these temperatures the requirements as to addition of alcohol may be readily determined without any particular calculation by comparing the reading with the marks on both scales and having in mind the relative nearness of the given temperature 30 to 60° F. and 90° F., respectively. It is also practicable to employ the present device for testing the purity and normal strength of any given samples of alcohol. For this purpose the sample of alcohol to be tested may be made into a ten per cent. solution with water and if the alcohol is of a standard strength the reading will be at the zero point at the temperature indicated. If the alcohol were not of full or standard strength the reading will be more or less beneath the zero point and may be denoted by a scale 16 formed on the stem for a requisite distance below the zero point. I am aware that the invention may be embodied in other specific forms without departing from the 40 spirit or essential attributes thereof, and I therefore desire the present embodiment to be considered in all respects as illustrative and not restrictive, reference being had to the appended claims rather than to the foregoing description to indicate the scope of the invention. Having described my invention, what I claim as new and desire to secure by Letters Patent is: 45 1. A direct reading solution indicator, comprising a gravity bulb with a stem extending therefrom, equipped with a scale having one mark corresponding with the point of submergence of the indicator in a solution of standard strength and another mark similarly corresponding with a maximum deviation therefrom, with other intermediate marks, said marks each having associated therewith indicia arranged and adapted for direct reading to indicate the unit volumes of a liquid required to be added to a predetermined volume of the solution indicated by such mark to bring it to said standard strength. 50 2. A hydrometer having a stem equipped with a mark near the upper end thereof to denote standard strength of a solution and with another mark near the bulb thereof to denote a solution of maximum deviation from standard strength, and with intermediate marks, said marks being so located and designated as to permit a direct reading of the number of gills per gallon of alcohol requiring to be added to a solution of the same with water to bring the solution to a ten per cent. strength. 55 3. A hydrometer having scales on two sides thereof each referring to a different temperature of a solution to be tested, each of said scales having near its upper end a graduation to denote a standard strength of solution, and other graduations beneath the same to denote different degrees of deviation from such standard strength, said graduations being so located and having indicia associated therewith arranged and adapted by direct reading to indicate the amount of liquid requiring to be added to the solution to bring it to a given strength. 60 4. In a measuring device for aqueous solutions of two or more ingredients, a graduated scale, one extremity thereof denoting the non-freezing strength for a known volume of such solution, the opposite ex-
tremity thereof denoting the maximum deviation from non-freezing strength, the intermediate graduations being arranged proportionate the density of such solution so as to indicate by direct reading, upon manipulation of the device, the volume of an ingredient to be added to the solution to bring the same to non-freezing strength.

In testimony whereof, I have signed my name to this specification.

AUGUSTUS H. GILL.