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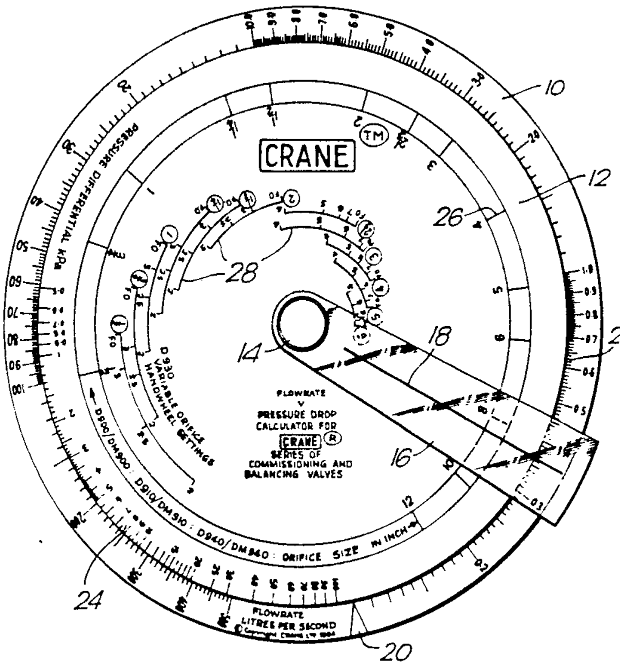
GB 1456688 GB 0700910 GB 0396533
GB 0923979 GB 0549529

(58) Field of search
G4B

(54) Calculator for determining flowrate through a valve

(57) A calculator for calculating the flowrate of a fluid through a valve from the pressure differential thereacross, or vice versa. In one preferred form, the calculator is a slide-rule having a first part (10) on which is marked a logarithmic flowrate scale (22), and a second part (12) which is slidable in relation to the first part and on which is marked a logarithmic pressure differential scale (24). There is a square law relationship between the two scales (22 and 24) such that the pressure differential increases with the square of the flowrate. At least one of the two parts is marked at positions relating respectively to valves of different types or sizes, or to different valve settings.

Fig.1.



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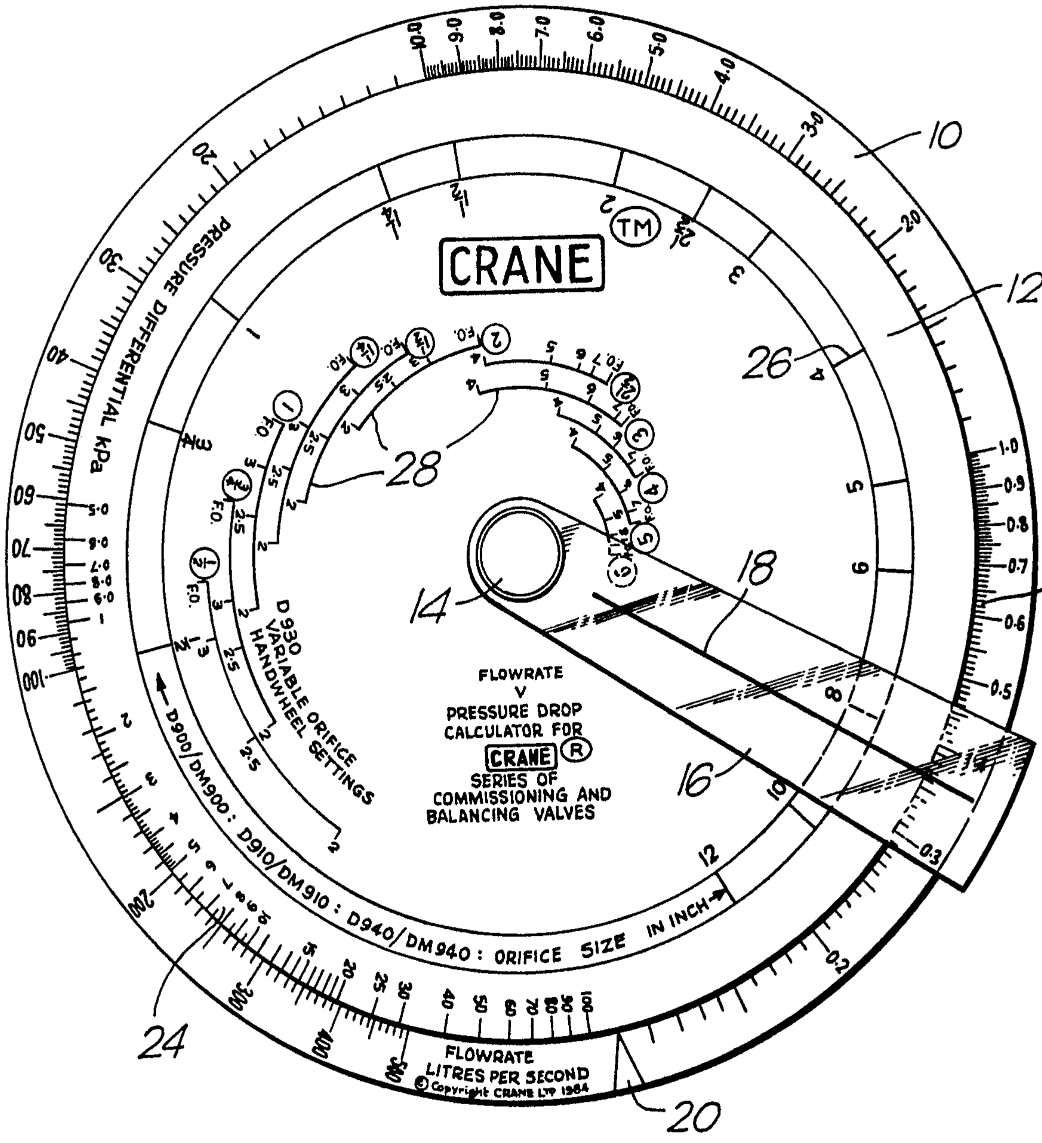
The drawings originally filed were informal and the print here reproduced is taken from a later filed formal copy.
The claims were filed later than the filing date within the period prescribed by Rule 25(1) of the Patents Rules 1982.

Fig.1.


CRANE
TM
PRESSURE DIFFERENTIAL kPa
D930 VARIABLE ORIFICE HANDWHEEL SETTINGS
FLOWRATE
V
PRESSURE DROP
CALCULATOR FOR
CRANE R
SERIES OF
COMMISSIONING AND
BALANCING VALVES
D900/DM900 : D910/DM910 : D940/DM940 : ORIFICE SIZE IN INCH
FLOWRATE
LITRES PER SECOND
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10
12
14
16
18
20
22
24
26
28

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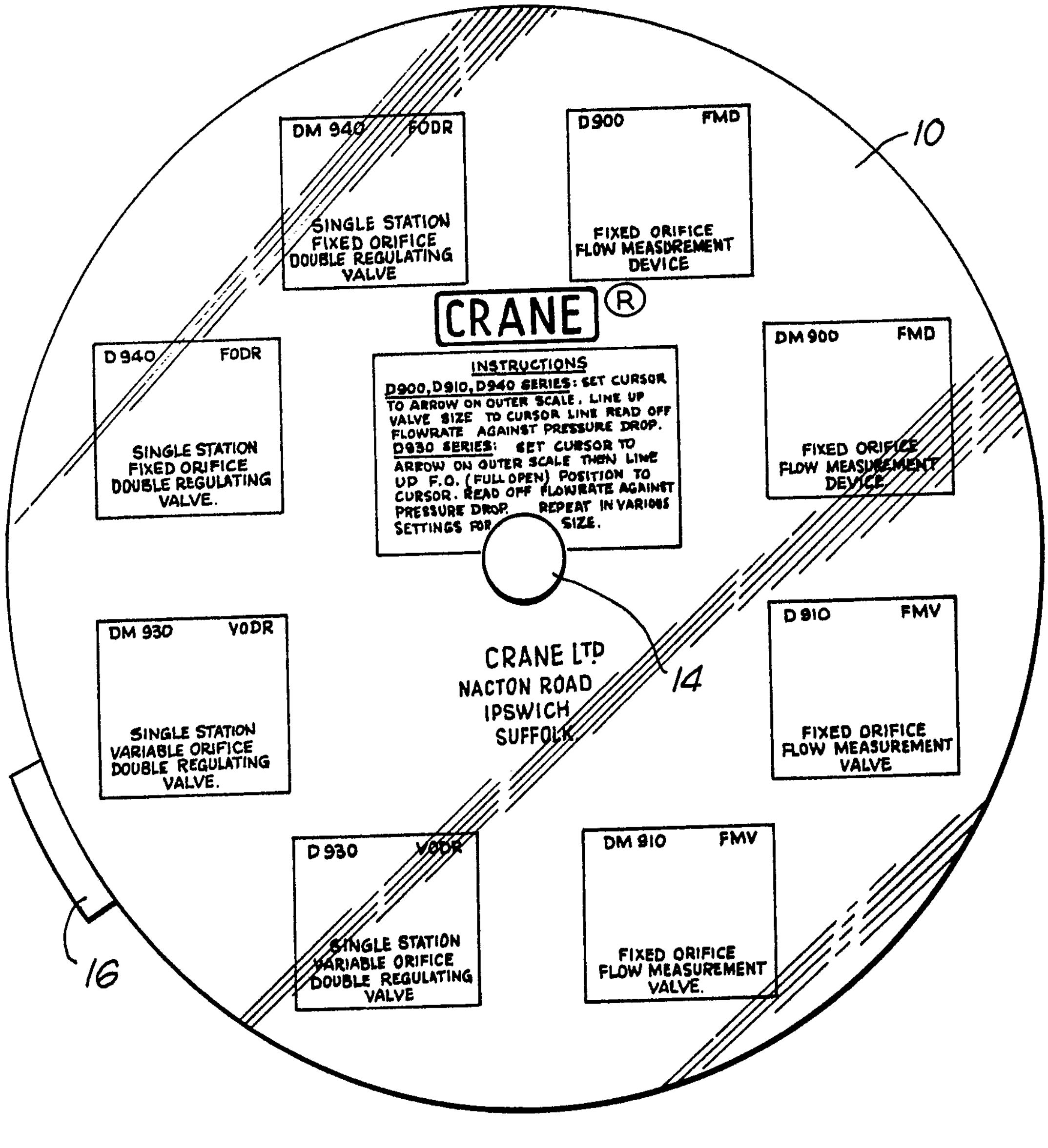
Fig.2.



SPECIFICATION

Means for determining flowrate through a valve from the pressure differential thereacross

The present invention relates to means for determining flowrate through a valve from the pressure differential thereacross.

In a heating or chilled water circuit system there is a need to adjust the fluid flow rate within the various loops of the circuit to achieve predetermined flow conditions. For this purpose flow measuring devices normally in the form of valves each fitted with two pressure tappings on respective sides of a valve closure member are included in the circuit. Measurement of flow through a given valve is typically achieved by attaching a differential type manometer to the pressure tappings on the valve and converting the differential reading thus obtained into a flow measurement by means of a calibration chart. This established form of valve is characterised by a set of calibration curves. It may therefore suffer the shortcoming that interpolation between curves may be necessary in order to establish the correct valve setting to achieve a predetermined flow. There are different curves for valves of different internal dimensions, and if the valve has a variable orifice, there are different curves for the different settings of one valve. Thus an engineer may have to carry with him a whole set of calibration curves, and search through these for the one relating to the particular valve or valve setting which he is dealing with at any particular instant. This is cumbersome and complex, and introduces a significant risk of error.

An aim of the present invention is to obviate the need for a set of curves or graphs for different valves or different valve settings.

Accordingly, the present invention is directed to a calculator of slide-rule construction which enables the flowrate of a fluid through a valve to be calculated from the pressure differential thereacross, or vice versa, for valves of various different types and sizes, or for different valve settings.

Thus the present invention may be directed to a calculator for calculating the flow rate of a fluid through a valve from the pressure differential thereacross, or vice versa, in which the calculator is in the form of a slide-rule having a first part on which is marked a logarithmic flowrate scale, and a second part which is slidable in relation to the first part and on which is marked a logarithmic pressure differential scale, in which there is a square law relationship between the two scales such that the pressure differential increases with the square of the flowrate, and in which the two parts are marked at positions relating respectively to valves of different types or sizes, or to different valve settings.

The square law relationship allows an immediate and direct reading of the flowrate from the pressure differential for a given setting of the calculator. With the correct settings the desired value for flowrate is in direct registration with the given value of pressure differential.

Preferably, the calculator is circular, the two parts of which are themselves circular with coinciding centres so that they are rotatable relative to one another about their common centre.

A quicker reading is obtainable if the two scales are immediately adjacent to one another, so that the one is in juxtaposition with the other.

The valve size or setting markings may be part of a logarithmic scale, and/or a series of scales for respective different valves, each scale having marks according to different settings of the valve concerned. Such scales may overlap.

An example of a calculator made in accordance with the present invention is illustrated in the accompanying drawings, in which:

Figure 1 is a top view of the calculator, and

Figure 2 is an underneath view of the calculator.

The calculator shown in Figs. 1 and 2 is of circular slide-rule construction. Thus it comprises first and second plastics discs 10 and 12, one behind the other, their centres being substantially coincident, and an upper one 12 of which has a smaller radius than the underneath one 10. The two discs 10 and 12 are held together by means of a pin, rivet, or other bearing 14 which allows the discs to be rotated relative to one another about their common centre. An elongate plastics cursor 16 is held at one end thereof by the bearing 14 in a manner allowing it to be rotated thereabout. The cursor 16 is transparent and is marked with a line 18 which passes through the centre of the two discs 10 and 12. The upper side of the underneath disc 10, of which an annular peripheral portion is visible in Fig. 1, is marked with an arrowhead 20 at a position on that visible peripheral annular portion. Proceeding from that point in an anti-clockwise direction around the annulus is a logarithmic flowrate scale 22, bordering on the edge of the inner upper disc 12.

Around the periphery of the inner upper disc 12, there is marked a logarithmic pressure differential scale 24. This scale bears a square law relationship with the flowrate scale, such that the pressure differential increases with the square of the flowrate. Thus in this illustrated example, if a pressure differential value of 1.0 is positioned in registration with the 1.0 value on the flowrate scale, a pressure differential of 100.0 will be in registration with the value 10.0 on the flowrate scale.

Inwardly of the pressure differential scale on the disc 12, and concentric with the common centre of the two discs 10 and 12, there is marked on the upper disk 12, a circular logarithmic "orifice size" scale 26. Inwardly of this, there are a number of overlapping arcuate scales 28, with their centres of curvature coinciding with the common centre of the two discs. Each of these overlapping scales relates to a particular variable orifice valve, and has a number of positions marked along it which represent different settings of the valve concerned.

In the particular calculator illustrated, flowrate is given in litres per second, pressure differential is given in kPA (kiloPascal) units, and "orifice size" is given in terms of the nominal pipe size for which a particular valve is made. For example, a 0.5 inch nominal pipe size has a 0.843 inch mean outer diameter and a 0.636 inch mean inner diameter according to British Standard 1387 relating to pipes. The relative positions of the "orifice size" scale and the pressure differential scale, the values given for these scales, and the size of the scales is such that the calculator can be used in the following manner to calculate the flowrate of the fluid through a valve of given size from the pressure differential across the valve:—

(1) the cursor 16 is rotated until the line 18 coincides with the arrowhead 20 on the lower disc 10;

(2) with the cursor 16 held in this position relative to the lower disc 10, the inner upper disc 12 is rotated relative to the lower disc 10 until the size of the valve ("orifice size") concerned is precisely underneath the line 18 on the "orifice size" scale;

(3) with the two discs 10 and 12 held in that fixed position relative to one another, the cursor 16 is now rotated until the line 18 coincides with the pressure differential across the valve on the pressure differential scale;

(4) with the cursor 16 now held in that fixed position relative to the lower disc 10, the value of the flowrate scale which coincides with the line 18 gives the desired value of the flowrate.

The same procedure is used for a valve of variable orifice, except that step (2) involves rotation of the inner upper disc 12 until the setting of the valve on the relevant one of the overlapping scales coincides with the line 18.

It will be appreciated that the calculator can equally be used to calculate the pressure differential across the given valve from the flowrate therethrough.

It will also be appreciated that various modifications can be made to the illustrated calculator whilst keeping it within the scope of the present invention. For example, the pressure differential scale can be put on the lower disc 10, and the flowrate scale on the inner upper disc 12. The orifice scales can be put on the outer disc 10 and can be made larger for this purpose, instead of the inner upper disc 12.

The "orifice size" scales illustrated are appropriate for proprietary valves of Crane Limited. They take account of the particular coefficient of flow (usually expressed as the Kv coefficient of flow in cubic metres per hour per 1 bar pressure drop) of the different valves concerned. Nonetheless, an appropriate scale may be marked for any valve once the Kv coefficient is known for that valve. Once so marked, the calculator may be used very simply to obtain flowrate through that valve from the pressure drop across it.

As is clear from Fig. 2, the reverse side of the lower disc 10 can be used to provide instructions as to how to use the calculator, and information on various different valves in conjunction with which the calculator may be used.

Although the overlapping scales for variable valves on the illustrated calculator are positioned progressively inwardly towards the centre of the inner upper disc 12, some of the scales could be positioned further outwardly than shown. For example, the scale shown for a variable one and a quarter inch valve could be the same distance from the centre of the calculator as the scale for a variable half inch valve. This will offer greater resolution, with consequential greater accuracy, to the user.

CLAIMS

1. A calculator of slide-rule construction which enables the flowrate of a fluid through a valve to be calculated from the pressure differential thereacross, or vice versa, for valves of various different types and sizes, or for different valve settings.

2. A calculator for calculating the flowrate of a fluid through a valve from the pressure differential thereacross, or vice versa, in which the calculator is in the form of a slide-rule having a first part on which is marked a logarithmic flowrate scale, and a second part which is slidable in relation to the first part and on which is marked a logarithmic pressure differential scale, in which there is a square law relationship between the two scales such that the pressure differential increases with the square of the flowrate, and in which at least one of the two parts is marked at positions relating respectively to valves of different types or sizes, or to different valve settings.

3. A calculator according to claim 2 which is circular, the two parts of which are themselves circular with coinciding centres so that they are rotatable relative to one another about their common centre.

4. A calculator according to claim 2 or claim 3, in which the two scales are immediately adjacent to one another, so that the one is in juxtaposition with the other.

5. A calculator according to any one of

claims 2 to 4, in which the valve size or setting markings are part of a logarithmic scale, and/or a series of logarithmic scales for respective different valves, each scale having marks according to different settings of the valve concerned.

6. A calculator according to claim 5, in which there are scales for respective different valves, and in which those scales overlap.

7. A calculator substantially as described herein with reference to the accompanying drawings.

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