N° 24,616 A.D. 1896

Date of Application, 4th Nov., 1896—Accepted, 19th Dec., 1896

COMPLETE SPECIFICATION.

A Slide-rule for Indicating and Facilitating Regulation of Quantities of Water Flowing over Gauge Weirs.

I, JOHN AMBROSE MCPHERSON, of the Engineers Department, Water Works, Bristol, Civil Engineer, do hereby declare the nature of this invention, and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement :—

This invention consists in a slide-rule for indicating and facilitating regulation of quantities of water flowing over gauge weirs such as are commonly used in connection with water supply works, drainage, irrigation and like works.

The slide-rule which constitutes this invention has fixed upper and lower members between which is a central member or slide which is free to slide longitudinally between the upper and lower members. The upper member is graduated for quantities of water into major graduations each indicating, in the case of a rule graduated as for gallons per 24 hours, 1 million gallons per 24 hours in respect of a weir of a given width. The major graduations are subdivided into minor graduations. The central sliding member of the slide-rule is differentially graduated for depths in major divisions each indicating, in the case of a rule graduated in inches, one inch as for a weir of the given width referred to in respect of the graduations for quantities aforesaid of the upper member.

The graduations in the upper member are read from left to right; as also are the graduations on the central or sliding member.

The lower member is graduated into exactly similar divisions as the central member, but the graduations of the lower member are read from right to left.

When the slide-rule is closed, that is to say, when the slide is fully home, the instrument serves as a table indicating the quantity of water passing over the weir for any depth indicated on the slide-rule.

Another use of the slide-rule, when the slide is fully home, consists in the indication thereon of the depths of water required over two or more weirs to make a total volume of water equal to the same quantity when flowing over one weir. Conversely, the volumes of water flowing over two or more weirs in respect of given depths may be read on the rule and the equivalent depth for the total volume as for one weir ascertained.

By the provision of the sliding central member of the slide-rule the instrument is adapted to regulate the depth of water where two or more gauge weirs are used in conjunction, so that when a change is made in the volume passing over one weir, the alterations necessary in respect of the other weir or weirs to provide for such change without affecting the original volume are indicated.

The instrument is adapted also for use in regulating the flow of water in cases where it is supplied in part over a weir or weirs, and in part by pumping.

The leading feature of the invention consists in the graduations for depths being divided differentially and in opposite directions upon the slide and the lower member so that they correspond for varying depths of water with the quantity graduations of the upper member according to the formula for the flow of water.

As is obvious, the measures of volume and depth appearing on the instrument may be expressed according to the metrical or other system.

In the accompanying sheet of drawings, Fig. 1 represents, in face view, a slide-rule made according to this invention and graduated in accordance with the system

[Price 8d.]

appertaining thereto. The instrument consists of an upper member *a*, a lower member *b*, and a central member *c*. The members *a* and *b* are fixed. The member *c* is free to be slid longitudinally between the members *a* and *b*. The instrument illustrated is graduated in British measures and to adapt it for use in respect of a weir of a width of 3 feet. For a different width of weir the graduations would require to be re-set. Each major graduation on the member *a* indicates a million gallons per 24 hours. These are subdivided into tenths of a million. Each major graduation on the central member *c* indicates an inch. These are subdivided into halves and again into quarters. The member *b* is similarly graduated, but the graduations are read from the opposite end.

With the slide *c* closed, as shown in Fig. 1, the instrument serves as a table from which to read the quantities of water flowing over the weir at the depths corresponding, as indicated by the position of the graduations on the member *a* in relation to those on the member *c*. For example, it will be seen that the quantity of water flowing over the weir at a depth of 7 inches is indicated on the instrument as 2,500,000 per 24 hours—which is correct.

Another use of the slide-rule when the slide *c* is closed in, as shown at Fig. 1, consists in the indication thereon of the depths of water required over two or more weirs to make a total quantity of water equal to that flowing at a given depth over one weir. For example, if the depth of water flowing over one weir be 12 inches the quantity is read off as 5,600,000 gallons. If it be desired to divide this flow in equal quantities over two weirs, that is to say, 2,800,000 gallons over each, it will be seen from the instrument that the depth of water for each is slightly over 7½ inches.

Conversely, the depths of water flowing over two or more weirs having been ascertained, the equivalent depth of water necessary in respect of one weir to give the same total quantity is indicated.

At Fig. 2 is shown a face view of the instrument in which the slide *c* is partly drawn out towards the right. It is shown thus drawn out to illustrate the application of the instrument in its use for regulating the depth of water where two or more gauge weirs are used in conjunction, so that on a change being made in the quantity passing over one weir the alterations necessary in depth of water in respect of the other weir or weirs can be found from the instrument.

For example, in a case where the depth of water flowing over one weir is 9½ inches, and it is required to increase it to 12 inches and make an equivalent reduction over another weir over which the depth of water is 6¼ inches, the slide *c* is drawn towards the right until the graduation thereon indicating 6¼ inches is brought opposite the graduation on the lower member *b* indicating 9½ inches. It will then be seen, as shown at Fig. 2, that the graduation on the lower member *b* indicating 12 inches is opposite the graduation on the slide *c* indicating 2¼ inches which is the depth of flow required over the second weir.

Similarly, if it be required to decrease, to a given amount, the quantity flowing over one weir, the equivalent necessary increase in depth over a second weir can be readily ascertained, being simply the converse of the example last described.

If the quantities set out in the top member *a* be disregarded, the instrument serves as a guide for regulating alterations over two weirs of any similar widths when dividing the total quantity to give the same aggregate.

At Fig. 3 the slide *c* is shown drawn out towards the left for the purpose of illustrating the application of the instrument to cases where the supply of water is in part over a weir and in part by direct pumping.

For this application the upper member *a* bears, in addition to the graduations aforesaid and the numerals at the major graduations, other lines, numerals, and asterisks. In the example shown in the drawings, the numerals 1-120 ; 1-150 ; 2-120 and 2-150 appear. These refer respectively to one pumping engine of 120 horse power, one engine of 150 horse power ; two engines of 120 horse power, and two engines of 150 horse power. The asterisks are placed upon lines which indicate in gallons per 24 hours the quantities pumped by the respective engines.

Assuming that while the water to the depth of 9½ inches is flowing over a gauge weir, an engine of 150 horse power is started to pump. Now in order to ascertain the depth to which the water flowing over the gauge weir must be reduced, the slide *c* is drawn out to the left until the graduation 9½ inches is opposite the line corresponding to 1-150, as shown at Fig. 3. It will then be seen that opposite the zero of the upper member *a* is the graduation indicating 6½ inches which is the depth to which the water must be reduced to balance.

Conversely, in cases of cessation of pumping, if the depth of water flowing over the weir be set opposite the zero of the upper member *a*, the proper depth to which the water should be increased will be that opposite the line indicating the engine.

At Fig. 4 is shown a modification of the instrument. According to this modification the members *a*, *b*, and *c*, are arranged concentrically as a circular disc. The member *c* is free to be rotated between the other two which are fixtures. The instrument being graduated as for a weir of 3 feet in width, the graduations in each member are of the same value as those shown in the example at Figs. 1, 2 and 3. The instrument is shown as set to the same position as in Fig. 1 and illustrates the same example.

The central member *c* is turned between the other members by a pinion carried on a spindle *d* turned by the means of the milled head *e*. This pinion gears with a rack secured to the central member *c*. The mechanism for turning the member *c* is analogous to that employed for winding the spring in a "keyless" watch.

As before stated, the instrument hereinabove described and shown in the accompanying drawings is graduated for use in respect of a weir of 3 feet in width.

For different widths the graduations must be differently set. The system of differential graduation in opposite directions of the members *c* and *b* so that they correspond for varying depths of water with the quantity graduations of the upper member according to the formula for the flow of water is however maintained in varying widths of weirs. Similarly, the graduations may be set on the same system for any form of discharge weir or opening.

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

(1.) A slide-rule for indicating and facilitating regulation of quantities of water flowing over gauge weirs ; consisting of a fixed member *a* graduated to indicate quantities of water in respect of a weir of a given width, and members *b* and *c* of which *b* is fixed and *c* free to slide, both *b* and *c* being differentially graduated from opposite ends to indicate depths of water flowing over a weir of the said given width according to the formula for the flow of water, the slide *c* being situated between the other two members, substantially as hereinbefore described with reference to Figs. 1, 2 and 3 of the accompanying drawings.

(2.) The modification under which the members graduated after the same principle as in the instrument claimed in the foregoing claim are arranged in the form of rings concentrically disposed, the inner and outer rings or members being fixed and the intermediate ring or member free to turn between them, substantially as described with reference to Fig. 4 of the accompanying drawings.

Dated this 3rd day of November 1896.

NICHOLAS WATTS,
Bristol, Chartered Patent Agent.

London : Printed for Her Majesty's Stationery Office, by Darling & Son, Ltd.—1897

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McPHERSON'S Complete Specification.

SHEET 2

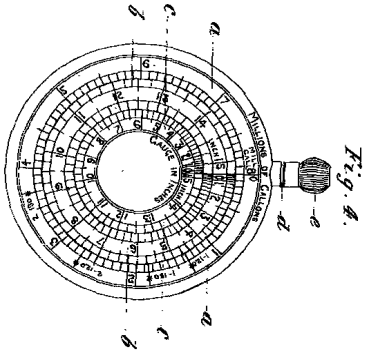

Fig. 4.

SHEET 1

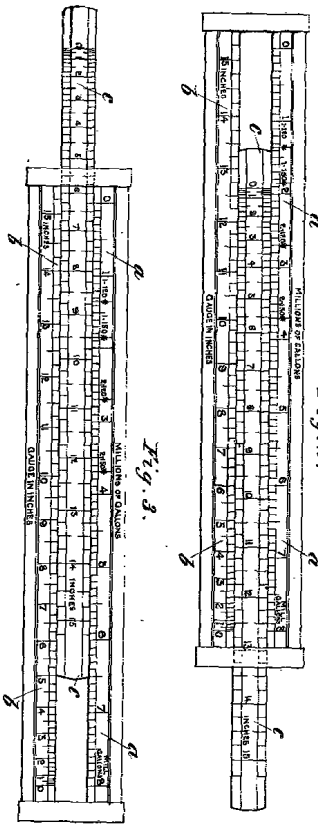

Fig. 3.

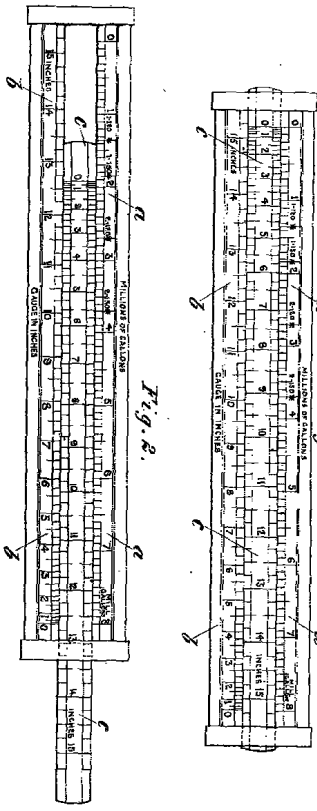

Fig. 2.

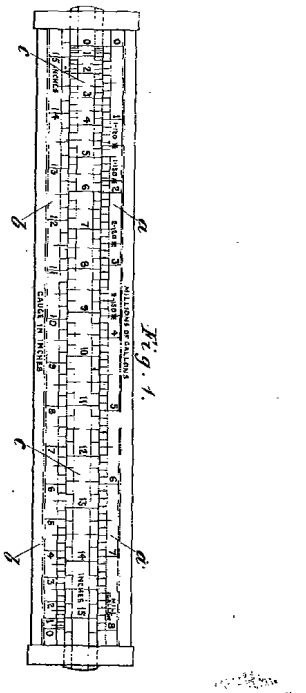

Fig. 1.

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McPHERSON'S Complete Specification.

SHEET 2.

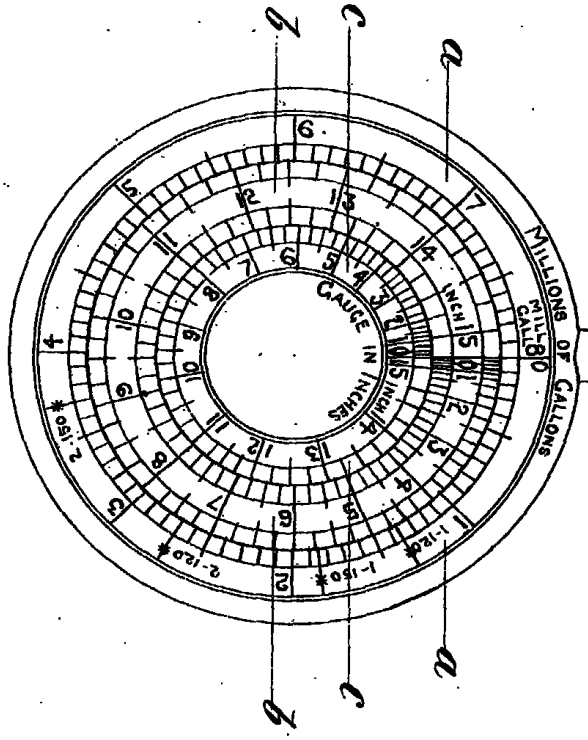

Fig. 4.

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(2 SHEETS) SHEET 1.

Fig. 1.

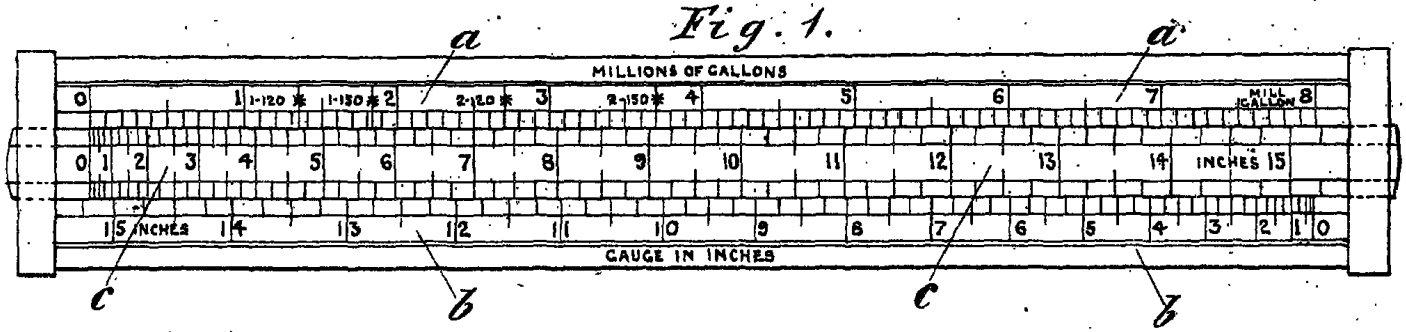


Fig. 2.

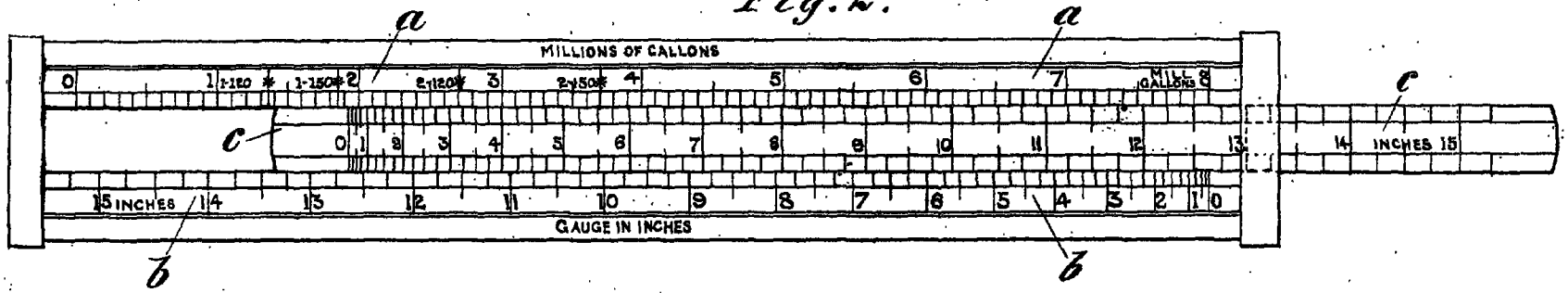
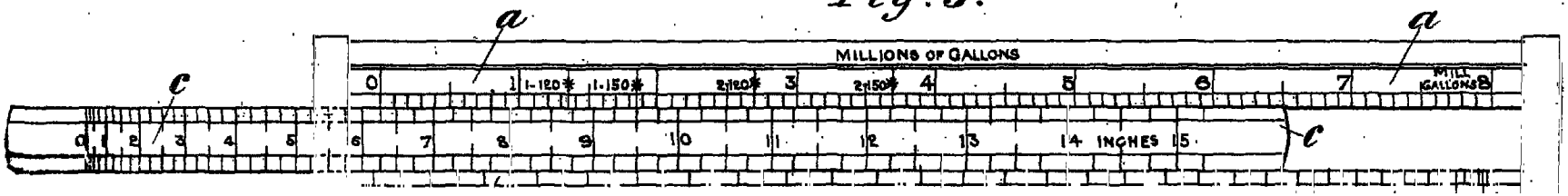


Fig. 3.



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