(No Model.) 3 Sheets—Sheet 1.

J. BOYER.

RECORDING VELOCIMETER.

No. 470,468. Patented Mar. 8, 1892.

Fig. 1.

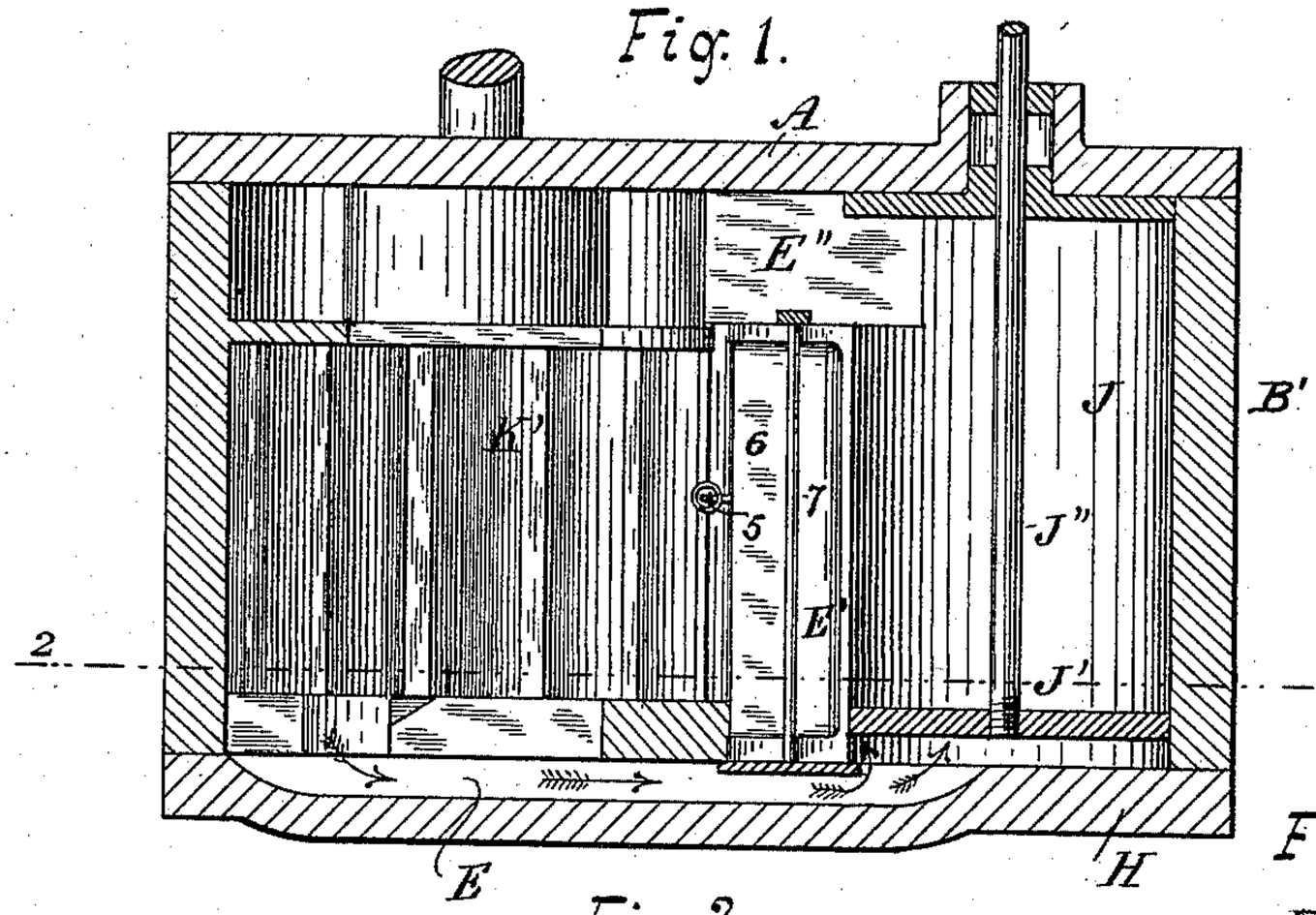


Fig. 2.

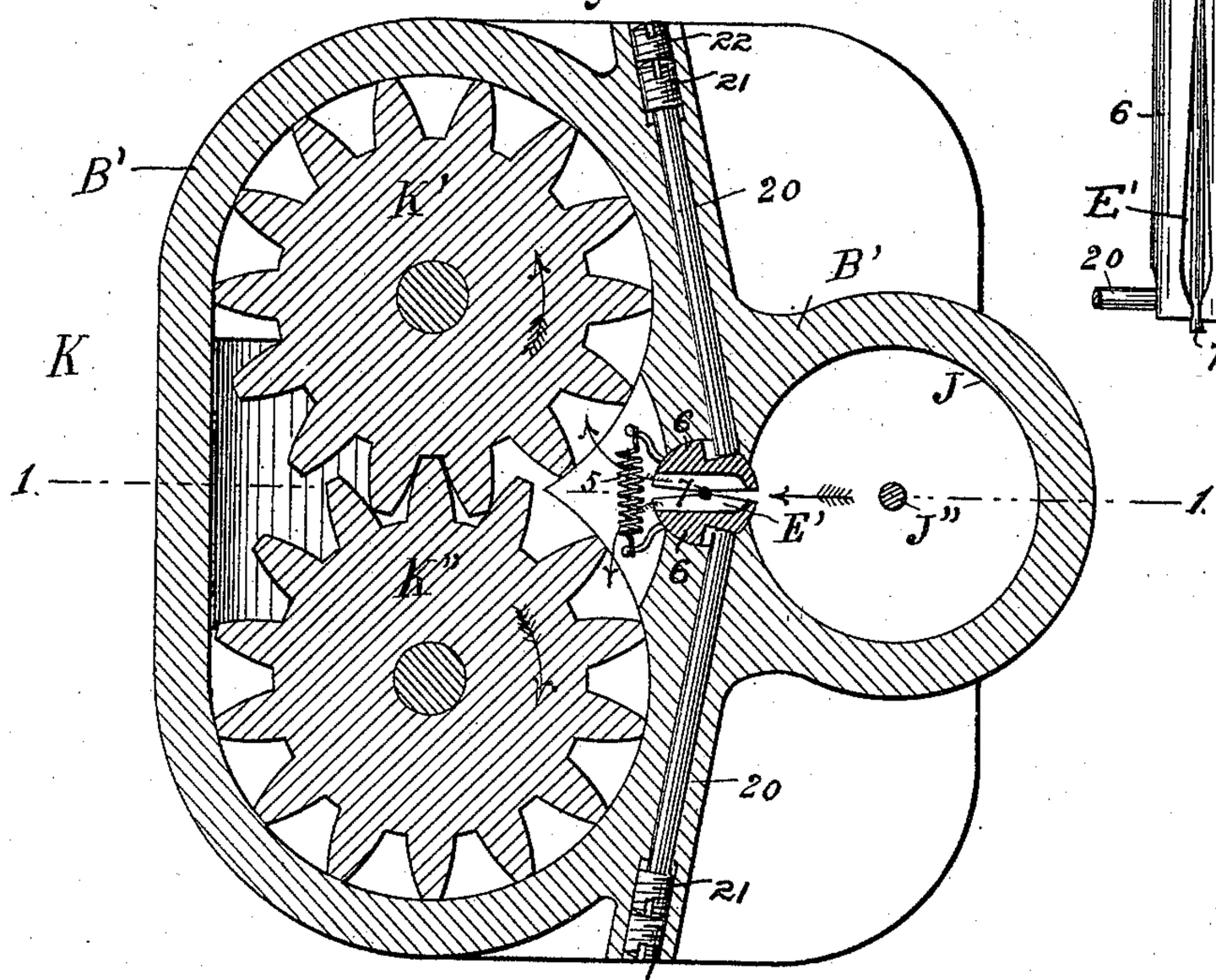
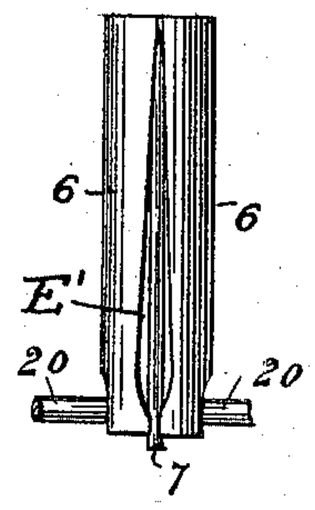


Fig. 3.



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(No Model.) 3 Sheets—Sheet 2.

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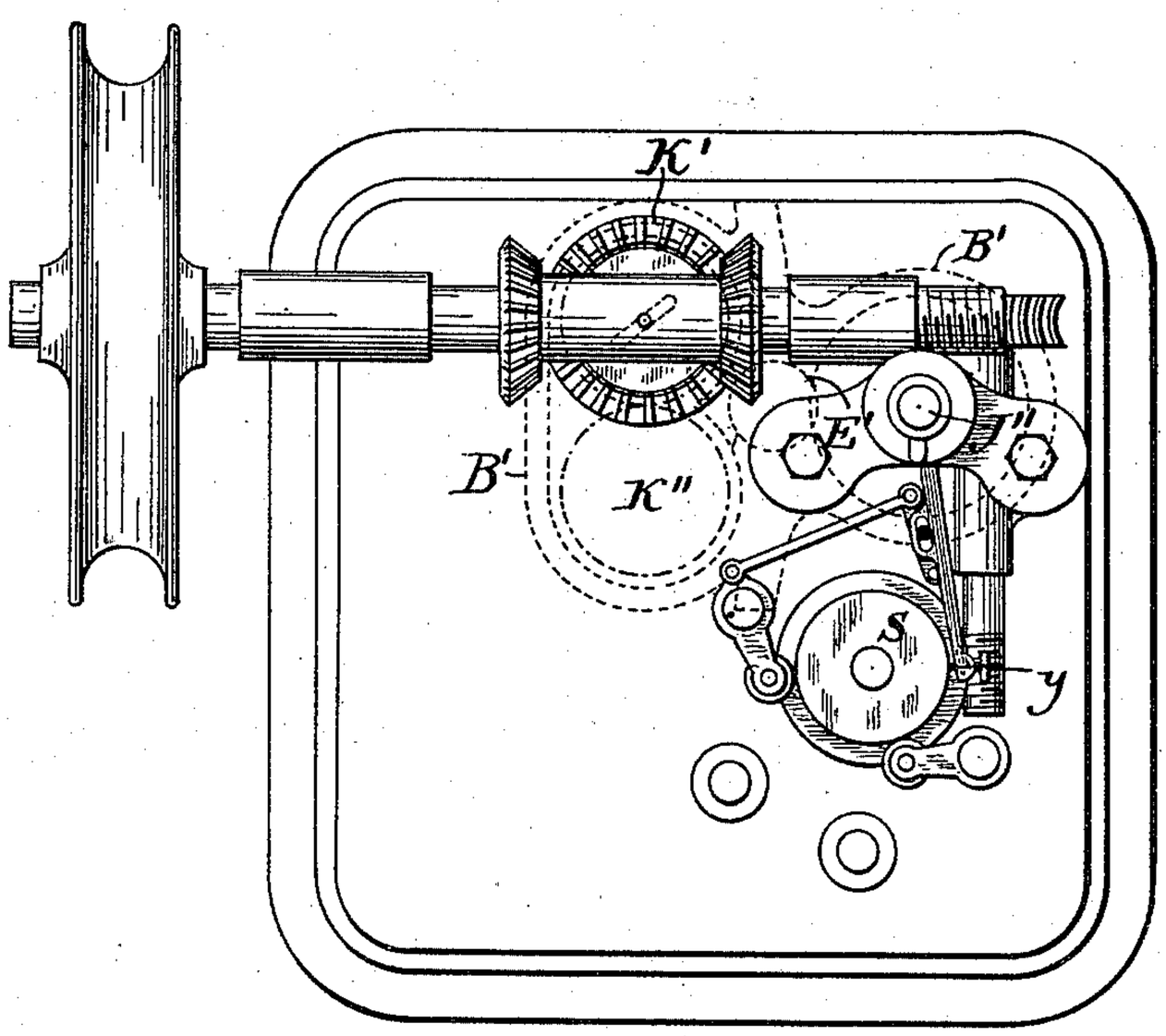
RECORDING VELOCIMETER.

No. 470,468. Patented Mar. 8, 1892.

Fig. 1a.



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(No Model.) 3 Sheets—Sheet 3.

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RECORDING VELOCIMETER.

No. 470,468. Patented Mar. 8, 1892.

Fig. 4.

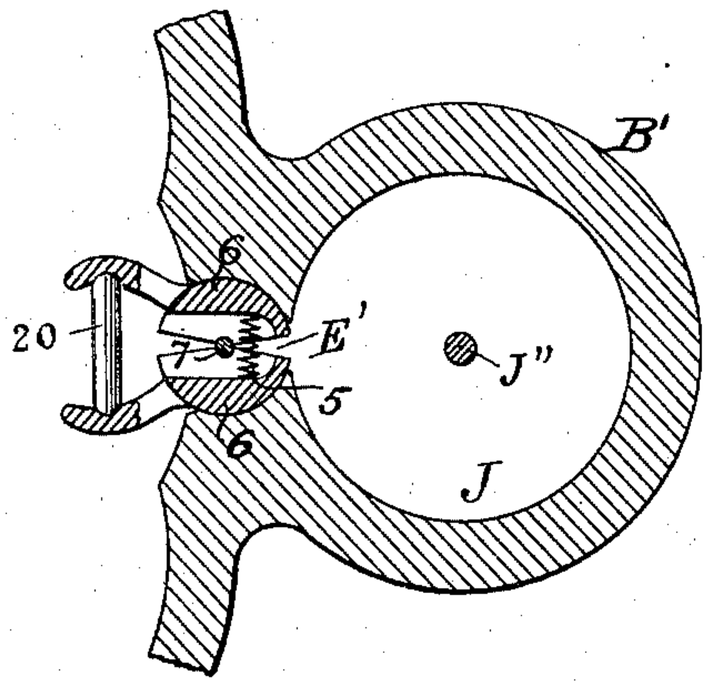


Fig. 5.

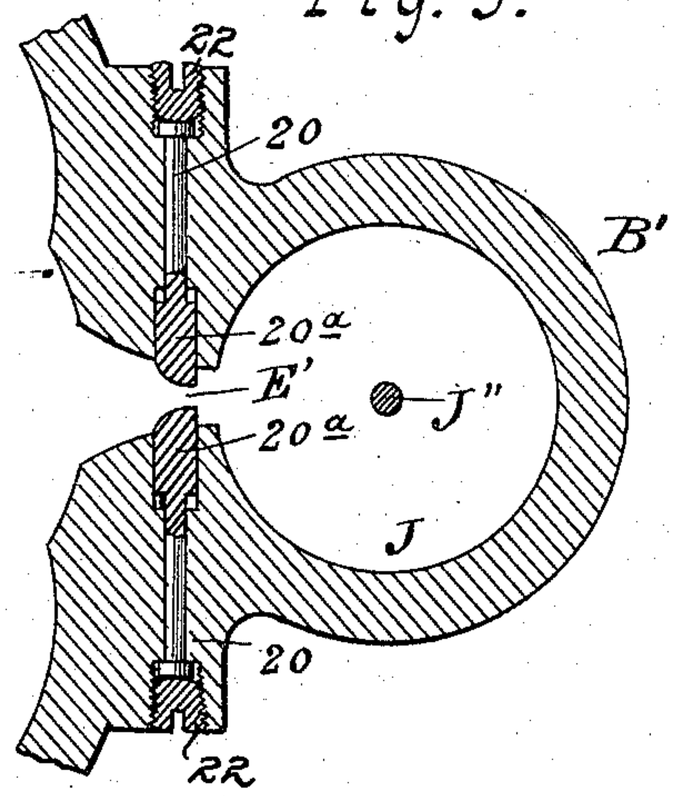


Fig. 6.

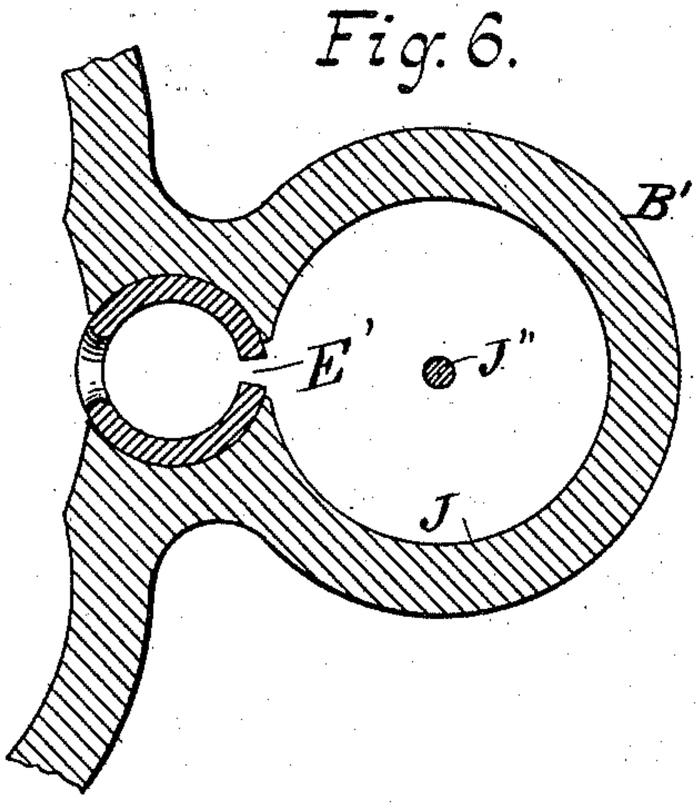


Fig. 7.

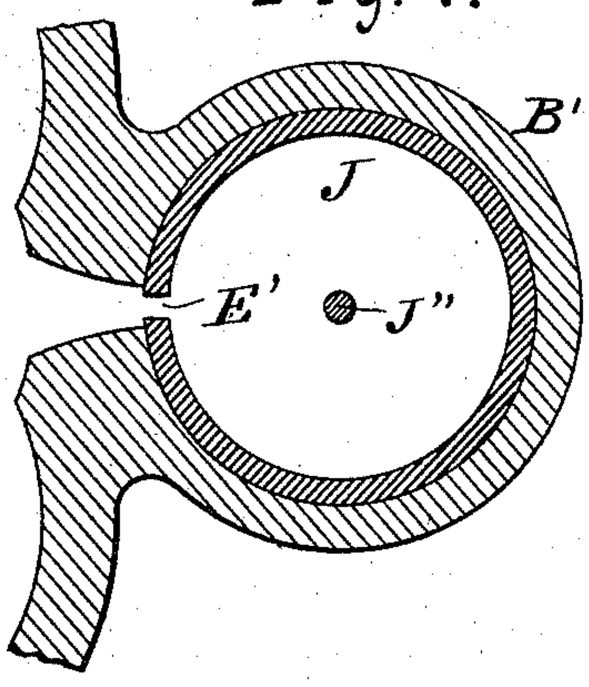
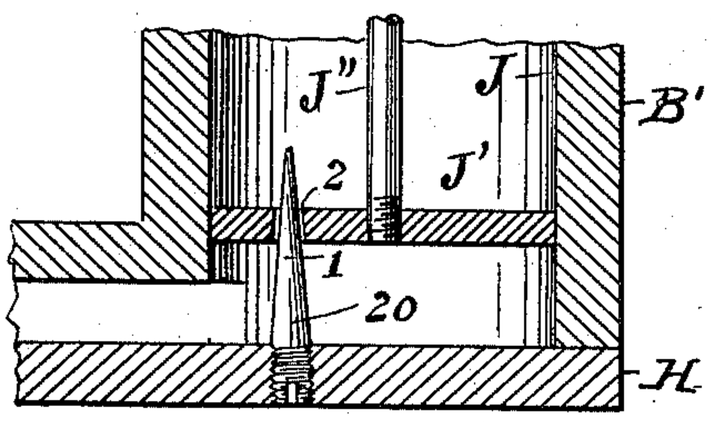


Fig. 8.



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UNITED STATES PATENT OFFICE.

JOSEPH BOYER, OF ST. LOUIS, MISSOURI.

RECORDING-VELOCIMETER.

SPECIFICATION forming part of Letters Patent No. 470,468, dated March 8, 1892.

Application filed June 17, 1891. Serial No. 396,538. (No model.)

To all whom it may concern:

Be it known that I, JOSEPH BOYER, a citizen of the United States, residing in the city of St. Louis, Missouri, have invented certain new and useful Improvements in Recording-Velocimeters, fully set forth in the following description and represented in the accompanying drawings.

This invention relates generally to a means for varying the size of a conduit, chamber, or passage for a fluid to accurately accord with any change in the temperature of the atmosphere or that of the fluid or the walls of the structure with which the fluid is in contact. It, however, particularly relates to means for automatically varying the size of a passage for the fluid in that class of apparatus termed "recording-velocimeter," patented to me February 1, 1887, No. 356,916. In said apparatus a pump, chamber, piston, and a fluid are so combined that the velocity of a moving part is translated into pressure, whereby the velocity is indicated, and it may be recorded. With these elements is also combined a passage for the fluid from the pressure side of the piston to the opposite side, which passage is of gradually-increasing size, so arranged with respect to the piston as to conserve or guard the power when the velocity is low, and as the power or speed-pressure increases the passage is proportionately increased in size for the escape of a portion of the fluid around or past the piston back to the well or suction side of the pump. In such prior structure the size of the passage and its degree of gradual increase was a fixed element formed in the first instance with regard to the normal or mean temperature of the atmosphere, and so long as there was no considerable variation in the temperature to which the fluid would be likely to be subjected, the apparatus worked accurately; but as soon as a considerable variation did occur the fluid would be influenced thereby, and would flow more or less easily as the case might be, whereby the resultant indication would vary from the true one to a greater or less extent.

The object of the present invention therefore, among other things, is to obviate this defective operation and to provide for an automatic compensation for any variation in the temperature of the atmosphere to which the fluid may be subjected; and to this end it consists in combining with a casing of metal containing the fluid having a low ratio of expansion of another metal having in respect thereto a high ratio of expansion, the expansion or contraction of which will compensate for the change in temperature of the fluid and more or less vary the volume of its flow.

A practical embodiment of the invention in one of its forms is shown in the accompanying drawings in connection with the recording-velocimeter constructed after my said patent.

In said drawings, Figure 1 is a sectional elevation of so much of the apparatus embodying the present improvement as is necessary to its understanding. Fig. 1ª is a view showing the connection of the apparatus with the indicator or recording device. Fig. 2 is a horizontal section of the same, taken on the line 2 2 of Fig. 1. Fig. 3 is an elevation of the compensating-valve removed from its seat. Fig. 4 is a detailed horizontal section of a modified form of the valve. Figs. 5 and 6 are similar views of other forms of the valve. Fig. 7 is a similar view of another mode of varying the size of the opening for the passage of the fluid. Fig. 8 is a vertical section of another modification for the same purpose.

As illustrated in said drawings, the recording-velocimeter, so far as it is necessary to show it, is of similar construction to that shown and set forth in my said patent, similar letters of reference herein indicating corresponding parts in said patent.

The apparatus is contained by a casing B′, having a top plate A and a base or bottom plate H. This casing, with its top and bottom plates, is preferably made of cast-iron or other similar metal having a low ratio of expansion, although, for a purpose to be hereinafter explained, distinct parts may be made of such metal while the major portion is formed of other material. The casing provides a chamber for a pump K of any of the usual forms—such as piston or diaphragm—being in the present instance a rotary one formed by a pair of rolls K′ K″, toothed or otherwise winged to intermesh and form propelling or forcing blades for the fluid, and to the shaft of one of which rolls the power is applied. The casing

provides another chamber acting as a cylinder J, in which is mounted a reciprocating piston J′, the piston-rod J″ of which extends outward through a stuffing-box in the top plate A, and is connected to cause a movement of the indicator or recording device *y* S, as in said patent, and as seen in Fig. 1ª. The pump-chamber or pump K is in communication with the cylinder J by two passages E E′, the former leading from the eduction side of the pump to the pressure or under side of the piston J′ and the latter passage leading to the well or induction side of the pump normally from the upper or non-pressure side of the piston. The passage E′ is interposed directly between the piston-cylinder and the induction side of the pump and extends substantially the vertical length of the cylinder. In this direct connection between the piston-cylinder and the pump while the passage is at all times open therebetween the piston acts to cut off more or less of the extent of opening to the pressure side and hence as it rises or falls correspondingly increases or diminishes the extent of opening to the fluid.

In order to properly conserve or proportionately restrict the flow of liquid from the cylinder J or back to the pump, the passage E′ (see Fig. 3) is formed with a vertical opening, which, starting from the bottom, is of a size that quickly increases to its maximum width and then gradually decreases in width as the top is approached. Thus the fluid forced by the pump by the passage E to the under side of the piston J′ will exert an upward pressure thereon sufficient to raise it to a more or less extent, according to the speed at which the pump is run and the freedom with which the fluid may escape past the piston by the passage E′. As the piston is raised a corresponding portion of the passage E′ is exposed below the piston and opened to the escape of the fluid back to the pump, the extent of the opening of which passage uncovered by the piston is such as to cause the proper extent of movement of the piston coacting with the speed with which the liquid is delivered by the pump.

To still further provide for the control of the flow of the fluid from the piston-cylinder J upon any change in the temperature of the atmosphere or of the fluid means is provided for automatically varying the size of the passage through which the fluid passes, and it is to be remarked in passing that while the means for this regulation or compensation for the variations in the temperature in itself is the same in the several modifications hereinafter suggested the particular manner in which it may be carried out in practice may be varied greatly. These means of compensation consist, broadly, in utilizing the difference in the ratio of expansion of two metals, as that between the ratio of expansion of the casing B′ of cast-iron, for instance, and the ratio of expansion of a piece of zinc controlling the size of the opening of the passage E′.

In Figs. 1 to 3 the preferred form of the invention is shown, in which the passage E′ is provided in a cylindrical valve formed by two hinged semicircular wings 6, acting as a two-part valve pivoted to a vertical stem 7, and both wings or two parts adapted to oscillate on the stem to vary the size of the opening to the passage. With each wing of this valve formed of a material of a low ratio of expansion, there is combined a piece of metal of a high ratio of expansion, such as zinc, in the form of a pin 20, that extends inwardly through a perforation in the casing with its end bearing against the rear of the wing of the valve. The outer end or head 21 of the pin is screw-threaded to engage with the threaded portion of the perforation, and to avoid any displacement and leakage of the fluid past the pins there may be provided a tapered jam-screw 22, screwed into the perforation tightly, and, it may be, forced against the head of the pin 20. From this construction it results that should the temperature of the atmosphere increase the zinc pins 20 will expand in length to a greater degree than the cast-iron casing of the valve, and being held firmly at their outer ends to the casing will act inwardly at their free ends to force the mouths of the wings of the valve together, more or less, according to the degree of expansion of the pins. This movement of the valve-wings will have narrowed the width of the passage or of its entrance so as to control the flow of the liquid from the piston-chamber back to the pump. In order to hold the valve-wings against the ends of the expansion-pins and to return them to their normal condition upon the retraction of the pins, a spring 5 is connected to the wings upon the opposite side of the pivot-stem for this purpose. Of course one of the wings of the valve might be fixed and its pin omitted, while the other is movable by the expansion of a single pin against the pressure of the spring.

In Fig. 4 the arrangement of the expansion-pin and returning-spring are reversed. As shown, the pin 20 (or a number of pins) is inserted between the pair of wings of the valve at one side of the pivot 7, so that upon expansion they will move the valve-wings to restrict the size of the passage E′, while the spring 5, arranged upon the opposite side of the pivot, opposes such movement and returns the wings upon the retraction of the expansion-pin.

In Fig. 5, instead of making the valve and expansion-pins of separate pieces, each pin is provided at its inner end with a vertical strip 20ª, located at the entrance to the passage E′ and operating upon the expansion or retraction of the pins to vary the size of said entrance or that of its passage.

In Fig. 6 the valve is of hollow cylindrical form, split on one side to provide the entrance for the passage E′, and the opposite side perforated to allow the free flow of the fluid

back to the pump. This valve is formed of metal having a high ratio of expansion, such as zinc, and being seated in a recess in the cast-iron casing will upon any increase in temperature expand in circular lines to a greater extent than the casing, thus bringing the edges of the split side together, so as to restrict or narrow the opening between them, as will be apparent.

In Fig. 7 a further modification of the invention is shown, wherein the piston-chamber J is formed with a lining of metal having a high ratio of expansion, such as zinc. This lining is of cylindrical form, divided at the passage E′ to form an entrance thereto. Upon the expansion of the expansible lining to a greater degree than the casing the edges of the division will approach nearer each other, and thus narrow the width of the entrance or of the passage E′. It is obvious that the pump-chamber could be similarly lined, and thus control the opening of the passage E′, into the well or suction side of the pump.

Another obvious modification of the invention is shown in Fig. 8, based upon the construction shown in Fig. 7 of my said patent, wherein the conical pin 1 is herein made of the expansion metal, such as zinc, and thus upon expansion more or less closes the opening 2 through the piston.

In each of the several examples of the invention the size of the passage or of its entrance (it may be its exit) is controlled automatically by the expansion of a metal having a high ratio of expansion with respect to the surrounding body of metal as the casing B′, which has a low ratio of expansion, whereby the flow of liquid from the piston-cylinder to the pump is automatically varied according as the temperature may vary. Of course it is not essential that the entire structure, other than the high-expansion metal, should be formed of one material of low expansion, as it is simply necessary that the low and high expansion metals should be associated, so that the differences of expansion of the one will have the controlling function.

What is claimed is—

1. A structure having a passage for the flow of the fluid and formed of material having a low ratio of expansion, in combination with a two-part valve controlling such passage, the movement of both parts of which is controlled by a metal having a high ratio of expansion, and acting directly upon the valve to vary the opening, substantially as described.

2. In a recording-velocimeter, the combination, with the piston-cylinder, the pump-chamber, and a passage between the two formed wholly or in part of a material having a low ratio of expansion, of a controlling means for said passage governed by a metal having a high ratio of expansion, substantially as described.

3. In a recording-velocimeter, the combination, with the piston-cylinder, the pump, and the passage between the two, formed of a material having a low ratio of expansion, of a valve interposed in said passage, the movement of which is controlled by a metal having a high ratio of expansion, substantially as described.

4. The combination, with the piston-cylinder, the pump, and the passage between the two, of a valve interposed in said passage, and an adjustable metal pin controlling the movement of said valve and having a high ratio of expansion, substantially as described.

5. The combination, with the piston-cylinder, the pump, and the passage between the two, of a valve composed of two hinged wings interposed in said passage, and a pair of metal pins abutting said wings having a high ratio of expansion, substantially as described.

6. The combination, with the piston-cylinder, the pump, and the passage between the two, of a valve composed of two-hinged wings interposed in said passage, a pair of metal pins abutting said wings having a high ratio of expansion, and a spring for holding the wings against the pins, substantially as described.

7. In a recording-velocimeter, the combination of the piston-cylinder, the pump, and a passage between the two, the opening of which commencing at one end quickly increases to its maximum width and gradually decreases as it approaches the opposite end, substantially as described.

8. In a recording-velocimeter, the combination of the piston-cylinder, the pump, and a passage for the liquid interposed directly between the piston-cylinder and the pump, the extent of opening of which passage is governed by the extent of movement of the piston, substantially as described.

In testimony whereof I have set my hand, this 16th day of May, A. D. 1891, in the presence of two witnesses.

JOSEPH BOYER.

Witnesses:

STEPHEN F. SULLIVAN,

JOHN P. PRIMEAU.