No. 716,997. Patented Dec. 30, 1902.

C. FLETCHER.

EXPANSION STEAM TRAP.

(Application filed Mar. 10, 1902.)

(No Model.) 3 Sheets—Sheet 1.

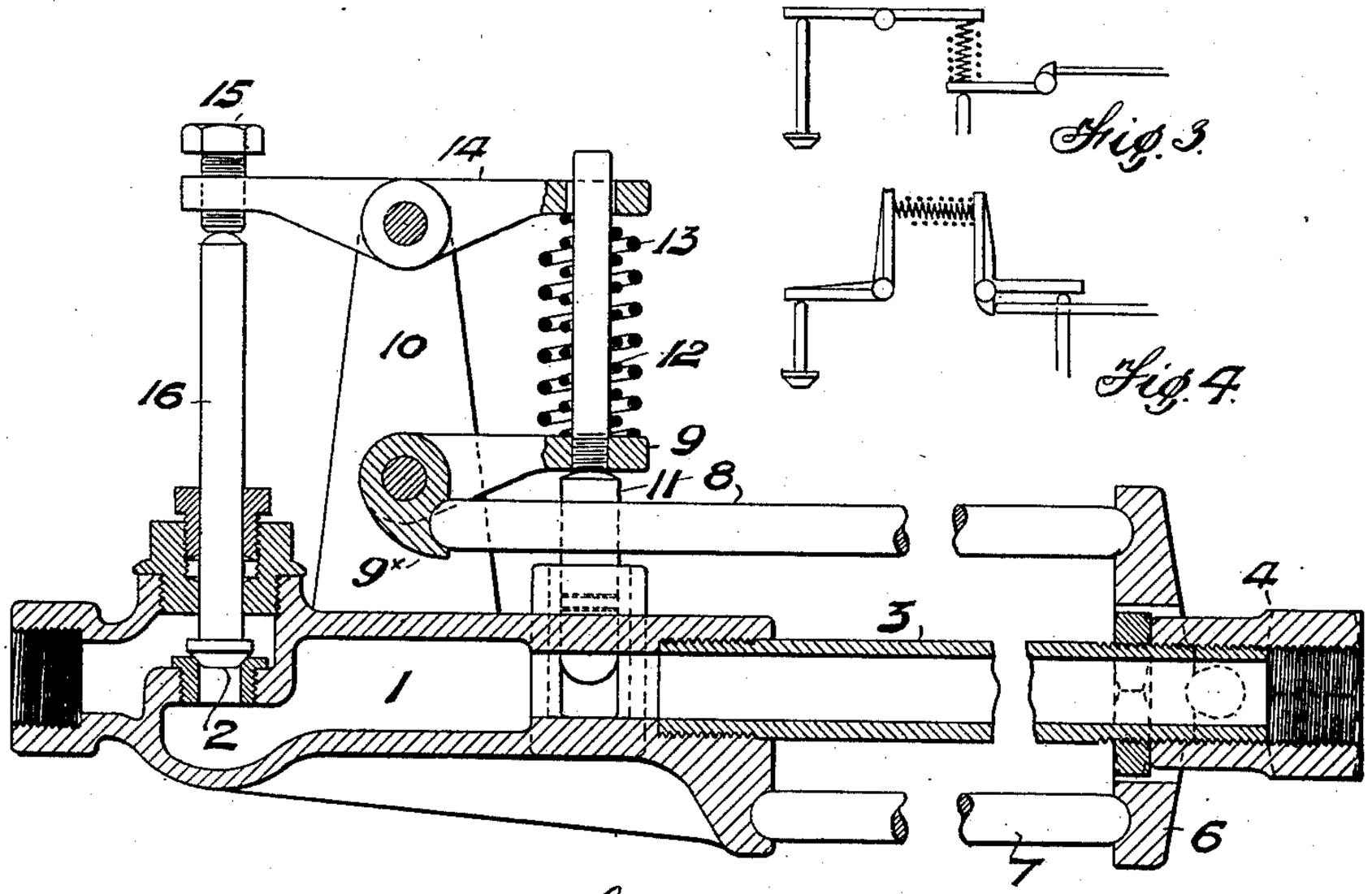

Fig. 1.

Fig. 3.

Fig. 4.

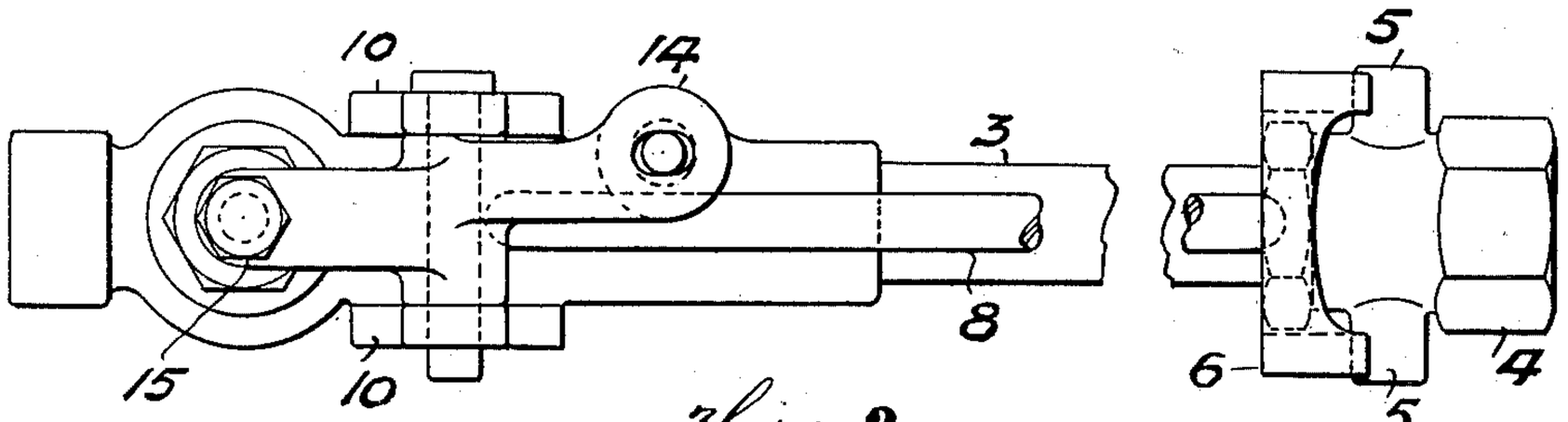

Fig. 2.

Witnesses:
John Camp.
Cilily Ross.

Inventor.
Charles Fletcher
Walter Gwinn

By his Attorney.

No. 716,997. Patented Dec. 30, 1902.

C. FLETCHER.

EXPANSION STEAM TRAP.

(Application filed Mar. 10, 1902.)

(No Model.) 3 Sheets—Sheet 2.

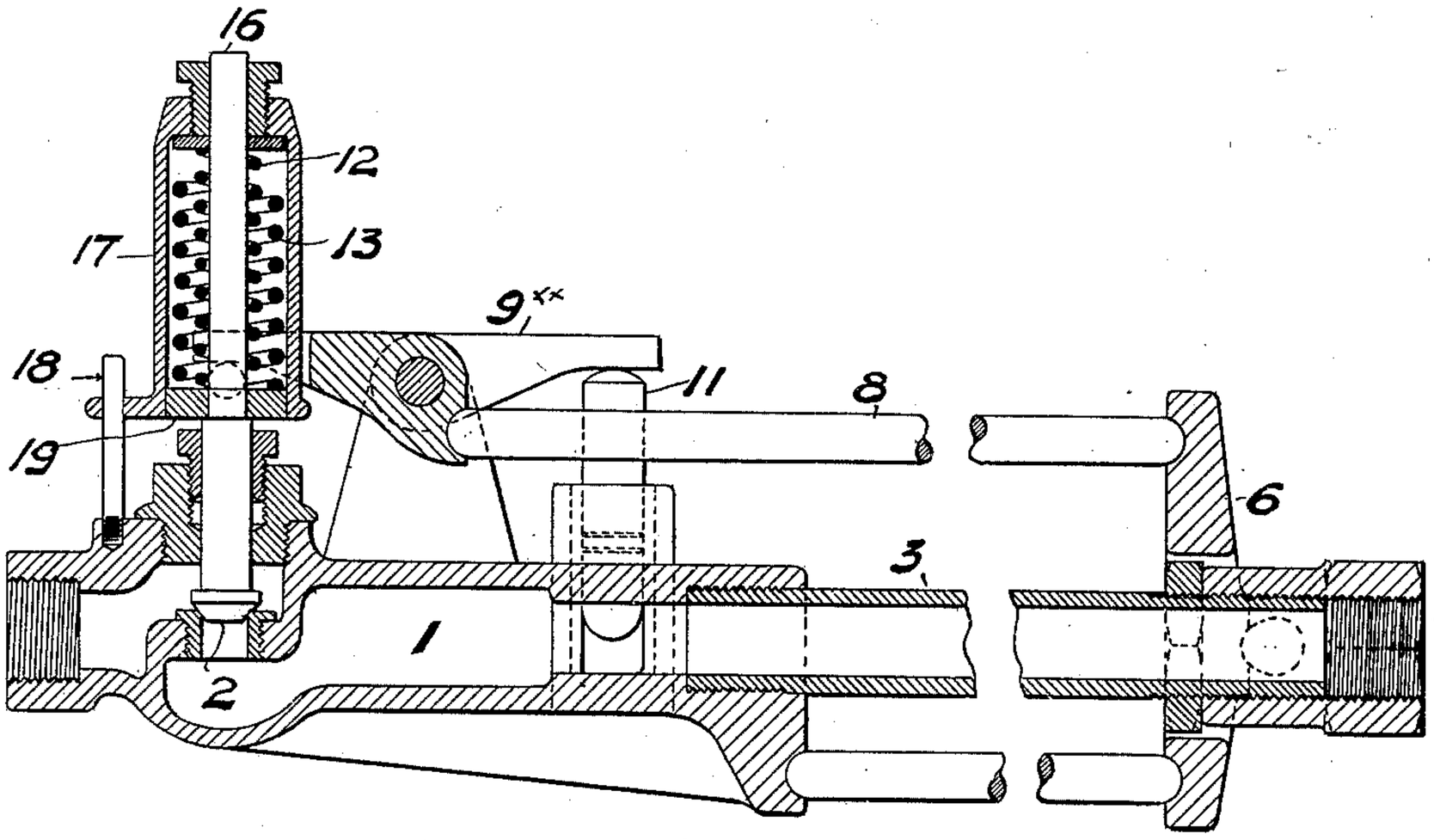

Fig. 5.

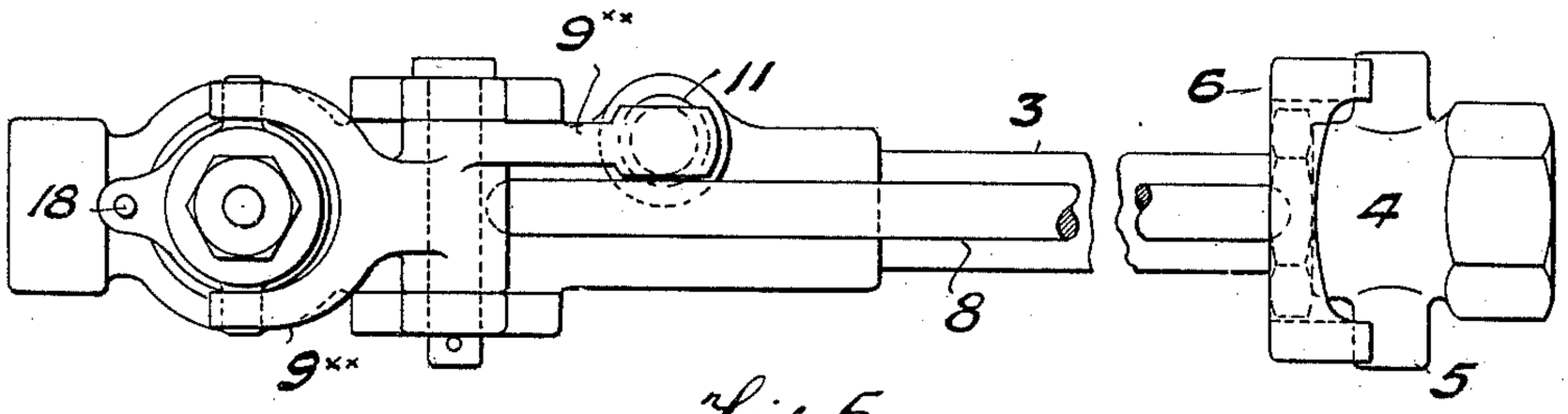

Fig. 6.

Witnesses:
John Camp.
Emily Ross.

Inventor:
Charles Fletcher
By his Attorney:
Walter Gunn.

No. 716,997. Patented Dec. 30, 1902.

C. FLETCHER.

EXPANSION STEAM TRAP.

(Application filed Mar. 10, 1902.)

(No Model.) 3 Sheets—Sheet 3.

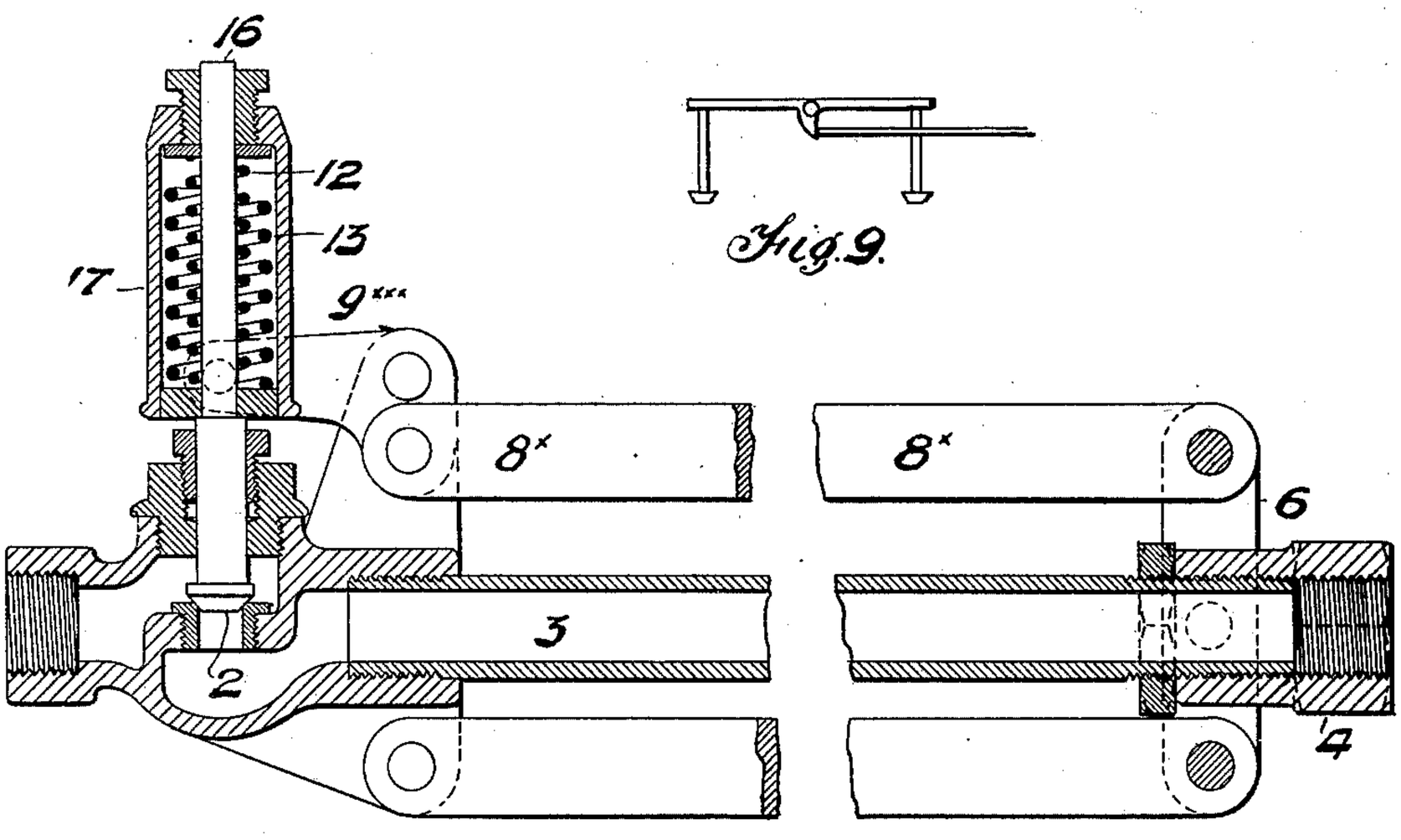

Fig. 7.

Fig. 9.

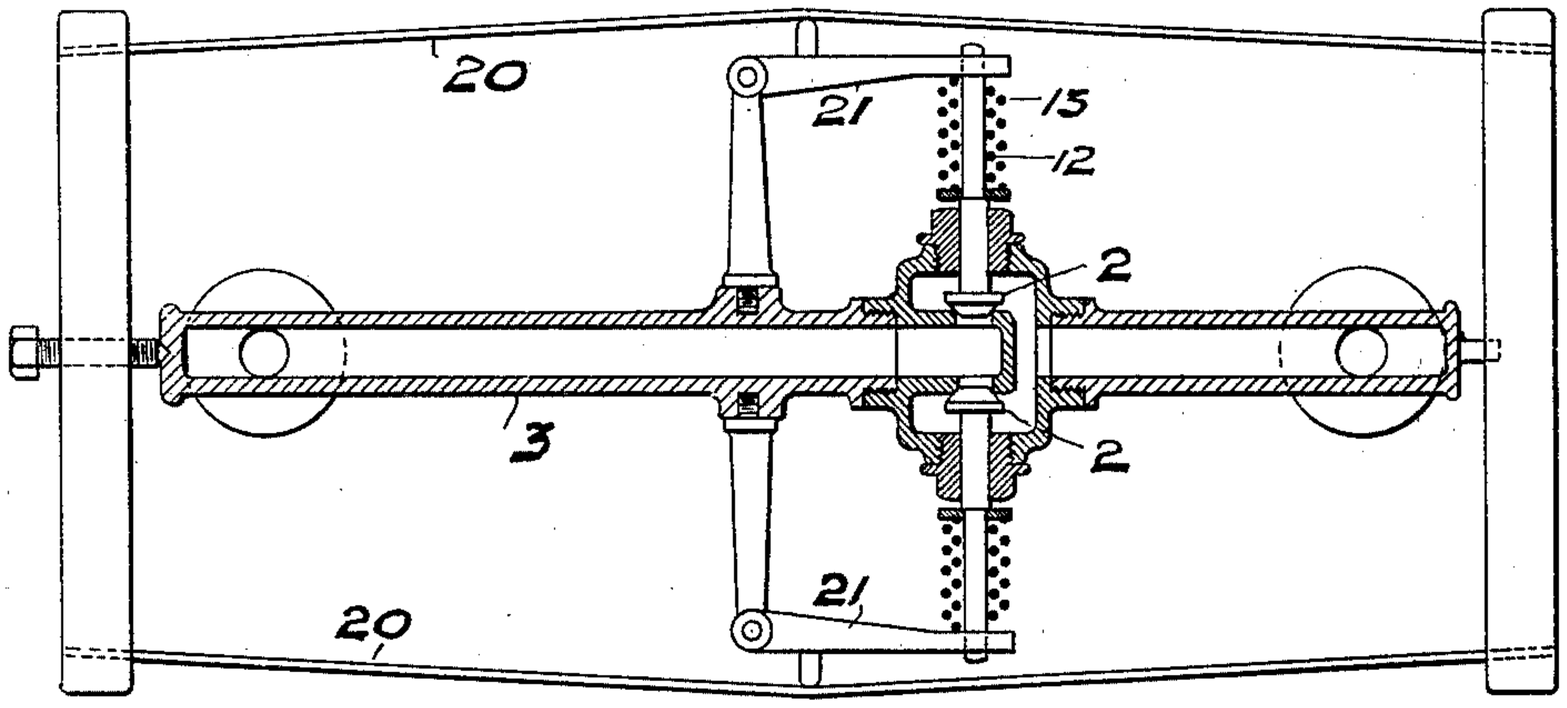

Fig. 8.

Witnesses:
John Camp.
Emily Rods.

By his Attorney: Walter Gunn.

Inventor:
Charles Fletcher

UNITED STATES PATENT OFFICE.

CHARLES FLETCHER, OF MANCHESTER, ENGLAND.

EXPANSION STEAM-TRAP.

SPECIFICATION forming part of Letters Patent No. 716,997, dated December 30, 1902.

Application filed March 10, 1902. Serial No. 97,544. (No model.)

To all whom it may concern:

Be it known that I, CHARLES FLETCHER, a subject of the King of Great Britain and Ireland, and a resident of Manchester, in the county of Lancaster, England, have invented certain new and useful Improvements in Expansion Steam-Traps, of the which the following is a specification.

This invention relates to steam-traps of the type in which the expansion and contraction of a metal serve to automatically control the discharge of water of condensation from steam apparatus. As usually made such traps only work satisfactorily at a set steam-pressure, no provision being made for enabling the trap to automatically adjust itself to work at other pressures and the trap requiring to be adjusted by hand for such other pressures. The chief difficulty in providing for automatic adjustment or causing the trap to work over a wide range of pressures is the fact that the temperature of steam due to pressure does not vary in the same ratio as the pressure of the steam. Hence an automatic adjustment which depends on the steam-pressure must be such as equates the rise and fall of temperature due to pressure with the rise and fall of the pressure. To this end I provide the construction of trap hereinafter described, the main feature of which is the use of means whereby the load on the outlet-valve varies with the fluctuations of steam-pressure.

A further feature of my invention is that the trap is or may be so devised and caused to operate as to allow the expansion-tube to be entirely relieved of all strain other than that due to the internal steam-pressure and that of opening of the valve under contraction.

On the accompanying drawings, Figure 1 illustrates a longitudinal section, and Fig. 2 a plan, of an expansion steam-trap embodying one form of my invention. Figs. 3 and 4 illustrate diagram views of modifications thereof. Figs. 5 and 6 illustrate like views of an expansion steam-trap embodying another form of my invention; and Figs. 7 and 8 illustrate two further traps, but embodying a part of my invention only. Fig. 9 illustrates another modification in diagram.

Referring to Figs. 1 and 2, 1 is the trap-body, fitted with the valve 2 for controlling the discharge of water of condensation. 3 is the expansion-tube, fitting at one end into the trap-body and at the other end into a coupling or union 4. Upon this latter are studs or trunnions 5, and bearing against such studs is a saddle-piece 6, held thereon by a rod 7, abutting against the valve-body, and a rod 8, abutting against the claw-like arm $9^{\times}$ of a lever 9, mounted axially between fixed brackets 10. In an opening in the body of the trap and upon the pressure side of the valve is a piston 11 of about equal area to that of the valve, and introduced between such piston and the valve 2 is an arrangement of multiple springs hereinafter more fully explained. In the example shown there are two springs 12 13, one longer and surrounded by the other, and such springs are introduced between the longer arm of the lever 9 and the arm of a further lever 14, this latter in turn (through a set-screw 15) being in direct contact with the valve-stem 16.

The action is as follows: With the trap cool and the tube 3 at its shortest length the piston is in its lowest position, and the valve 2 may open and allow the water of condensation to pass, the springs offering little or no resistance. When steam enters the trap, the tube 3 lengthens. Simultaneously the piston 11 rises and pressing against lever 9 causes such lever to move upward and through the springs and lever 14 close valve 2 and hold it closed against the steam-pressure, the proportions of the lever and areas of the valve and piston being such that the valve and piston under the steam-pressure are in equilibrium, or nearly so. With the lever 9 thus rising and the tube 3 expanding the claw-like arm $9^{\times}$ follows the rod 8, and thus maintains the support of the rod, but exerting no pressure thereon, and therefore putting no strain on the tube, the rate of movement of the claw-like arm due to the springs being in sympathy with the rate of expansion. When the pressure of the steam increases, a further elongation of the tube 3 and a further retirement of rod 8 takes place, owing to the increase of temperature. Simultaneously the lever 9 rises and through the springs puts a further load on the valve 2 sufficient to hold it closed against the increased steam-pressure. In so compressing the springs the lever 9

again follows the rod 8 at a rate in sympathy with the rate of expansion due to increased pressure, and thus maintains its support without putting any strain on the rod or tube. With a decrease of pressure the tube contracts, the piston lowers, and, due to the springs, the claw-like arm $9^{\times}$ retires at a rate in sympathy with the rate of contraction. With a cooling of the trap, due, say, to the presence of water of condensation, without a reduction of pressure the tube 3 contracts and forcing the rod 8 against the lever 9 disturbs the equilibrium or balance of the valve and piston, and thereby allows the valve to open and the water to escape. With a rise of temperature the tube elongates and the steam-pressure through the piston 11 again closes the valve. I would here observe that the balancing or loading of the valve is determined only by the steam-pressure on the piston and not by the springs which are introduced between the valve and piston for the purpose of giving an automatic adjustment of the claw-like arm $9^{\times}$, variable in the same ratio as the elongations or contractions of the tube 3 under an increase and decrease of temperature due to pressure. I would also observe that the total degree of compression of the springs represents the total increase of temperature, while the total force of compression represents the total pressure of steam. A single spring while giving a fairly good result for a small range of pressures would not suit for a wide range, since the degree of compression would be in direct proportion, whereas a series of springs coming into play one after the other give a degree of compression not directly proportionate to the pressure, but approximating to the variations of temperature.

In Figs. 3 and 4 I show by diagrams how the levers may be variously formed and mounted, also how the springs may be placed in relation to such levers. In Fig. 3 the lever 9 is reversed or the claw-like arm is above instead of below the fulcrum. In Fig. 4 the lever 9 has an extra arm and the lever 14 is of bell-crank formation with the springs between.

In Figs. 5 and 6 I show how one of the levers may be dispensed with and how the springs may be placed directly above the valve 2. The springs are inclosed in a sliding cap or cover 17, having studs on either side on which the bifurcated end of lever $9^{\times\times}$ bears in compressing the springs, a rod 18 being provided to guide the cap as it moves up or down the valve-stem 16 and a disk 19 being mounted on the stem to receive the thrust of the springs, as shown. The action of the trap is precisely the same as that of the trap shown in Figs. 1 and 2.

In Figs. 7 and 8 I show how the multiple springs alone may be applied to expansion-traps, the springs serving to exert a force on the valve in proportion to the steam-pressure while being compressed in proportion to the temperature. In Fig. 7 the rod $8^{\times}$ is positively linked to the lever $9^{\times\times\times}$ and compresses the springs under the elongation of the tube 3. In this example the tube is obviously not relieved of all strain as in the case of the tube shown in Fig. 1. In Fig. 8 the expansion-tube is adjustably mounted within the expansion-frame, having bent bars 20, which straighten out and close the valve under the elongation of the tube; but as this construction of trap is well known it needs no further description, the introduction of multiple springs between the valves 2 and the bars 20 being all that my invention consists of in this class of trap. For still further approximating the range of movements I prefer to cause the bars 20 to act upon the springs through long and short armed levers 21; but any suitable devices may be employed.

In lieu of a piston 11 I may use a diaphragm, and when not requiring a trap to work at varying pressures I may omit the springs and use only the piston, as shown in Fig. 9, the piston acting directly against the lever 14.

What I claim is—

1. In an expansion steam-trap, a valve-body and valve, means on the pressure side of the said valve for allowing the valve to be balanced by the steam-pressure, a series of springs intermediate of the said means and valve, an expanding and contracting element, a thrust member for such element to lie against, and a device intermediate of the springs and the thrust member held in contact with the thrust member in sympathy with the movements of the rod under changes of temperature due to changes of pressure, as set forth.

2. In an expansion steam-trap, a series of springs so arranged as to be compressed and to elongate approximately in proportion to changes of temperature when subjected to the pressures equal or proportionate to the steam-pressures corresponding to such temperatures, as set forth.

In witness whereof I have hereunto set my hand in the presence of two witnesses.

CHARLES FLETCHER.

Witnesses:
WALTER GUNN,
JOHN CAMP.