W. R. KING.

Hydrostatic Compensatory Apparatus for Metallic Bridges.

No. 166,930. Patented Aug. 24, 1875.

Fig. 1.

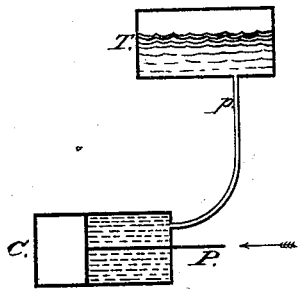

Fig. 2.

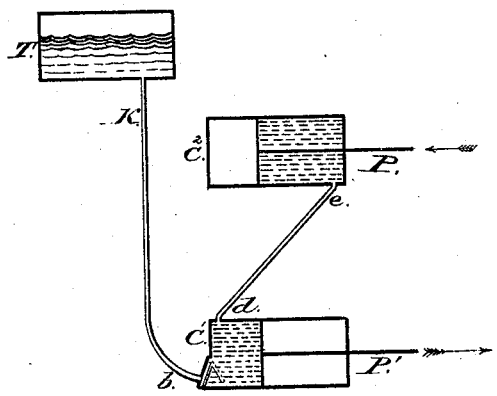

Fig. 3.

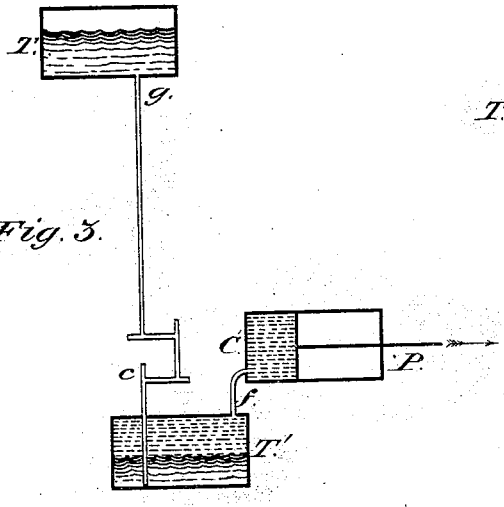

Fig. 4.

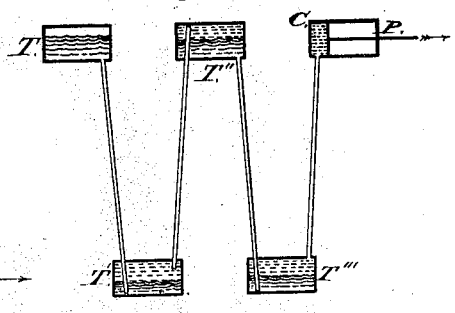

Fig. 5.

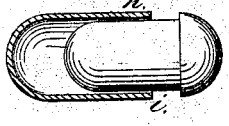

Fig. 6.

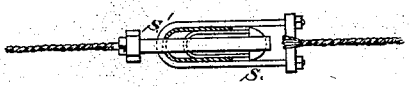

Fig. 7.

Witnesses:

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WILLIAM R. KING, OF WILLETT'S POINT, NEAR WHITESTONE, NEW YORK.

IMPROVEMENT IN HYDROSTATIC COMPENSATORY APPARATUS FOR METALLIC BRIDGES.

Specification forming part of Letters Patent No. **166,930**, dated August 24, 1875; application filed February 18, 1873.

To all whom it may concern:

Be it known that I, WILLIAM R. KING, of Willett's Point, in the county of Queens and State of New York, have invented certain new and useful Improvements in the Art of Constructing Bridges, of which the following is a specification:

My invention relates to the means of connecting the fixed portions of a bridge, or other similar structure, with those parts the dimensions of which are liable to be varied by changes of temperature, or of connecting two movable parts of a structure.

The objects of my invention are so to combine these parts that the slow movements of the movable parts, due to expansion and contraction, may be compensated; to oppose a resistance, the degree of which may be regulated at pleasure, as well as its direction, to compensate either permanent or sudden strains; and to maintain the parallelism and steadiness of the several parts of the structure under the varying strains to which it may be subjected.

The essential features of my improvement are, first, a light strong cylinder or vessel secured either upon the fixed portion of the structure, or upon one of its movable parts; secondly, a plunger or piston working in said vessel, and connected with another fixed or movable part of the structure, as circumstances may require; thirdly, a tank or vessel containing fluid, and elevated at such height above the working-cylinder as to exert thereon a pressure sufficient to compensate the strain to which the structure may be subjected; and, fourthly, a pipe connecting the tank and cylinder, these parts being so combined that the fluid, while resisting, by its hydrostatic pressure alone, sudden strain on the piston, will gradually flow into or out of the cylinder, as required, to accommodate the slight play of the piston occasioned by the expansion or contraction of the parts to which it is connected.

The accompanying drawings represent so much only of my improved apparatus as is necessary to illustrate the invention claimed. Sundry modifications of the devices employed are shown, but the essential features in all cases remain the same.

A strong cylinder, of suitable material and dimensions, is firmly attached to one of the parts of the structure to be connected, while the piston is attached to the other part of said structure. A tank filled with oil, mercury, or other heavy liquid, is placed above the cylinder, and connected therewith by a small pipe, so as to allow the liquid to flow into the cylinder by its own gravity, and produce any desired degree of hydrostatic pressure, which latter is, of course, regulated by the weight of the fluid employed, the height of its column, and the area of the piston-head upon which the pressure is exerted.

Figure 1 represents the apparatus in its simplest form, arranged to resist the extension or separation of the connected parts of a structure.

As the cylinder C is mounted on one of these parts, and the piston P attached to the other, they will necessarily be drawn together by a force equal to the weight of a cylindrical column of the liquid employed, the base of which is the area of the piston-head, and whose altitude equals that of the top of the liquid in the tank T, which is connected with the cylinder by the pipe *p*.

In addition to this normal pressure, the piston will oppose any sudden separation of the parts by a force equal to the ultimate strength of the cylinder and piston, or of the parts themselves, should they be weaker than the cylinder or piston, the orifice through which the liquid enters the cylinder being made so small as to allow the piston to move only fast enough to accommodate the slow movements due to expansion and contraction of the parts connected. The flow of the liquid from the cylinder under sudden strains may be still further retarded by providing the supply-pipe with a number of short elbows, as in Fig. 3.

The only change necessary to adapt the parts to resist compression, instead of expansion, is to connect the supply-pipe with the other end of the cylinder, so as to exert the hydrostatic pressure on the other side of the piston. The arrows in the drawings indicate the direction of the force exerted by the piston.

Fig. 2 represents an arrangement of my apparatus whereby the movement of one set of connections is communicated to or compensated by that of another.

Two cylinders and their respective pistons, in this instance, are pressed in opposite di-

rections by the same column of liquid, which acts first upon the piston P′ of the cylinder C¹. A pipe, *d e*, connects this cylinder with a second one, C². A check-valve, *b*, in the supply-pipe K prevents the return of the liquid to the tank. Consequently, any excess of pressure upon one set of connections is transmitted to the other. As the opposite ends of the cylinders are connected by the pipe, they can necessarily only move in the same direction while their connections are expanding and contracting.

Both chambers of the cylinders may, if preferred, be filled with the liquid, thus preventing a sudden movement in either direction, while accommodating a gradual one. In this case the pressure on each side of the piston, when at rest, is equal, the pressure only coming into play when the piston moves.

Both supply-pipes may lead from the same tank; but should it be desired to have an excess of pressure on one side of the piston-head, this end may be obtained by using separate tanks placed at different heights or containing liquids of differing specific gravities.

Should it be desired to use liquid, such as oil, in the cylinder, and another one of different specific gravity, such as mercury, in the tank, to produce the pressure, it may be done by using an additional tank, T′, Fig. 3, into the bottom of which the heavier liquid may be admitted through a pipe, *c g*, leading from the upper tank, thus forcing the lighter liquid, through the small pipe *f*, into the cylinder C¹.

A sufficient pressure may be obtained without greatly elevating the tank by combining a number of tanks and pipes, as shown in Fig. 4. In this case the upper tanks, T′ T″, are filled with heavy liquid, and the lower ones, T′ T‴, with a lighter one. The pipe leading from the first upper tank T to the lower one T′ descends nearly to the bottom of the latter, while the pipe leading upward from the first lower tank T′ to the second upper one T″ leads from the top of the lower one, and so on. Consequently, the heavier liquid of the upper tanks will descend the first and third pipes and occupy the bottom of the lower tanks, displace and force up, through the second and fourth pipes, the lighter liquid, thus producing an augmented pressure in the cylinder, which pressure may be increased at pleasure by increasing the numbers of pairs of tanks and their connecting-pipes.

It is obvious that the details of my invention may be varied in various well-known ways without departing from its spirit. For example, a solid piston with stationary packing, like the ordinary hydraulic jack, may be used, (see Fig. 8,) or a corrugated flexible-sided cylinder without piston or packing, (see Fig. 9;) and they might be placed between two links or straps. (See Fig. 10.)

I disclaim regulating the strain on bridge-couplings by means of a hydraulic ram having a weighted piston acting on a column of liquid.

My invention contemplates the use of hydrostatic pressure only, and dispenses with pumps and weights.

What I claim as of my own invention, and desire to secure by Letters Patent, is—

1. The combination, in a bridge or other analogous structure, of the cylinder secured upon one part of the structure, the piston of said cylinder connected with another part of the structure, the elevated tank containing liquid, and a pipe connecting the tank directly with the cylinder, these members being constructed and operating, substantially as hereinbefore set forth, to cause the hydrostatic pressure to act directly upon the movable parts of the structure, and to compensate said movement by the simple influx or efflux of the liquid into or out of the cylinder.

2. In a bridge or other analogous structure, the combination, substantially as hereinbefore set forth, of a series of cylinders, each connected with its respective portion of the structure; a series of pistons correspondingly connected and working in the cylinders; an elevated tank containing liquid; a supply-pipe connecting this tank with one of the cylinders, and provided with a check-valve to prevent the return of the fluid to the tank; and a pipe connecting the forcing-chambers of the two cylinders, whereby an excess of strain upon a movement of one set of connections is transferred to or compensated by the other.

3. In a bridge or other analogous structure, the combination, substantially as hereinbefore set forth, of a cylinder connected with one part of the structure, a piston connected with another part of the structure, an elevated tank containing heavy liquid, a lower tank containing lighter liquid, and pipes connecting the upper tank with the lower and the latter with the cylinder, whereby the pressure is transmitted from the heavier liquid to the cylinder, through the lighter liquid.

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Witnesses:
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JAS. MERCUR.