R. HEINDL.

HYDRAULIC POWER TRANSFORMER.

APPLICATION FILED FEB. 4, 1913.

1,072,718. Patented Sept. 9, 1913.

Fig. 1

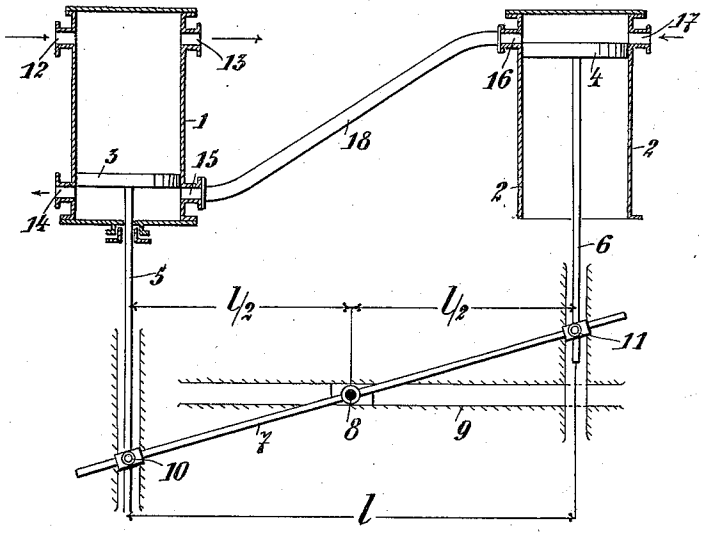
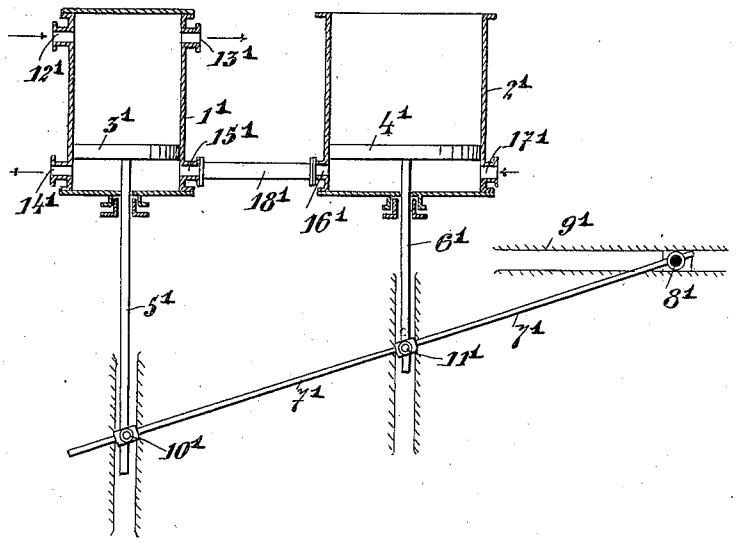


Fig. 2.



Witnesses
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UNITED STATES PATENT OFFICE.

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HYDRAULIC-POWER TRANSFORMER.

1,072,718. Specification of Letters Patent. Patented Sept. 9, 1913.

Application filed February 4, 1913. Serial No. 746,122.

To all whom it may concern:

Be it known that I, RICHARD HEINDL, a subject of the Emperor of Austria-Hungary, residing at Vienna, in Austria-Hungary, have invented a certain new and useful Improvement in Hydraulic-Power Transformers, of which the following is a specification.

The object of this invention is to provide improved apparatus whereby a source of hydraulic power furnishing water at a given pressure is utilized for producing a stream of water at a lower pressure.

To this end I use two cylinders, which I will call a power cylinder and an auxiliary cylinder respectively, with pistons in these cylinders and a variable lever system connecting said pistons whereby the piston in the power cylinder is enabled to actuate the piston in the auxiliary cylinder, the stroke of the latter piston depending on the adjustment of the lever system, and I provide the cylinders with supply and delivery ports and connect the delivery port of the auxiliary cylinder to an auxiliary supply port of the power cylinder, said auxiliary supply port being on the same side of the piston as the delivery port of the power cylinder, so that both pistons coact in expelling water through the delivery port of the power cylinder, the quantity of water thus expelled exceeding the quantity of water which enters the power cylinder for actuating the piston in said power cylinder. Accordingly, a given quantity of water at what may be called the primary pressure, serves to propel a larger quantity of water at a lower, secondary pressure.

Two embodiments of the invention are illustrated in the accompanying drawing in Figures 1 and 2 respectively, the figures being sectional elevations of the apparatus.

Referring in the first instance to Fig. 1, the apparatus shown therein comprises two cylinders 1 and 2, with pistons 3 and 4 respectively, 1 being the power cylinder and 2 the auxiliary cylinder. The two piston rods 5 and 6 are connected to each other by a double armed lever 7, the fulcrum 8 of which is adjustable in a guide 9 between the paths of the piston rods, so that the ratio of the two lever-arms engaging the rods can be varied. The lever is engaged with the rods by means of sleeves 10 and 11 pivoted to the rods, the ends of the lever being slidable in the said sleeves. The cylinder 1 has two ports 12 and 13 on one side of the piston, and two ports 14 and 15 on the other side of the piston. The port 12 serves for the inlet of water under pressure, as for example from an accumulator, and the port 13 serves for the discharge of spent water. The port 14 serves for the discharge of water at a pressure differing from the pressure of the water admitted at 12. The port 15 is an auxiliary inlet port and is connected by a pipe 18 to a port 16 of the cylinder 2, the latter having also a suction port 17 for the inlet of water. The port 16 is a delivery port and it will be seen that the two pistons move in opposite directions toward the delivery ports 14 and 16 respectively. The ports 12, 13, 14 and 17 are controlled by means of suitable valves.

Admission of water under pressure through the port 12 causes the piston 3 to recede from that port and expel water through the port 14 to the consuming apparatus. At the same time the piston 4, moved by the lever 7, advances toward the ports 16 and 17, expelling water through port 16 and pipe 18 to the cylinder 1, whence such water flows through the port 14.

If the pressures of the water admitted at 12 and discharged at 14 are designated as p_1 and p_2 respectively, the areas of the pistons 3 and 4 as F_1 and F_2 respectively, the strokes of the pistons as s_1 and s_2, and the quantity of water delivered as Q_2, then (frictional losses and cross-section of piston rods being neglected)

$$p_2 = p_1 \frac{F_1 \times s_1}{F_1 \times s_1 + F_2 \times s_2}$$

$$Q_2 = F_1 \times s_1 + F_2 \times s_2 = \frac{p_1}{p_2} \times F_1 \times s.$$

If the fulcrum of the lever 7 is midway between the paths of the two piston rods (as indicated in Fig. 1, wherein l indicates the distance between the paths and $\frac{1}{2}$ the distances between the fulcrum and the paths)

$$s_1 = s_2$$

$$p_2 = \frac{p_1}{2}$$

$$Q_2 = 2F_1 \times s_1 = 2F_2 \times s_2.$$

During the delivery stroke of the piston 3 as much water is expelled by the piston 4 as is expelled by the piston 3, the total quantity being equal to twice the quantity of

water under pressure admitted to the cylinder 1 behind the piston 3, and the pressure of the water delivered at 14 is equal to half the pressure of the water admitted at 12.

The apparatus shown in Fig. 2 comprises a cylinder 1^1, similar to the cylinder 1 in Fig. 1, with ports 12^1, 13^1, 14^1, 15^1, piston 3^1, and piston rod 5^1. A pipe 18^1 connects the port 15^1 of the cylinder 1^1 to a port 16^1 of a cylinder 2^1, the latter having also a port 17^1 and containing a piston 4^1 which has a rod 6^1. A lever 7^1 is engaged with the rods 5^1 and 6^1 by means of sleeves 10^1 and 11^1 pivoted to these rods. The fulcrum 8^1 of this lever is adjustable in a guide 9^1 outside the space between the paths of the two connecting rods. The action is in all respects similar to that of the apparatus shown in Fig. 1, except that the two pistons move in the same direction toward the delivery ports 14^1 and 16^1, and in all cases the stroke of the piston 4^1 is shorter than that of the piston 3^1, for which reason the cylinder 2^1 is preferably of larger diameter than the cylinder 1^1, as shown.

The return stroke of the piston 3 or 3^1, after delivery, may be produced by mechanical means or by means of water introduced at a pressure adequate for the purpose. A double acting power cylinder may of course be used, instead of a single acting power cylinder, and two or more single or double acting power cylinders may be combined to deliver to a conduit common to all.

What I claim as my invention and desire to secure by Letters Patent of the United States is:—

Hydraulic apparatus comprising a power cylinder, a piston in said cylinder, said cylinder having on one side of said piston an inlet port and on the other side of said piston a delivery port and a second inlet-port; an auxiliary cylinder having an inlet port and a delivery port; a piston in said auxiliary cylinder; a conduit connecting the second inlet port of the power cylinder to the delivery port of the auxiliary cylinder; and a variable lever system operatively connecting the piston in the power cylinder to the piston in the auxiliary cylinder, whereby a delivery stroke variable by adjustment of said lever system can be imparted to the last-mentioned piston simultaneously with the delivery stroke of the piston in the power cylinder.

In witness whereof I have signed this specification in the presence of two witnesses.

RICHARD HEINDL.

Witnesses:
HANS PAPPENHEIM,
JOSEF VON KUTSCHERG.

Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D. C."