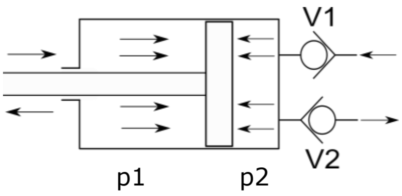
Work Principle of Hydraulic Transformers

Principally, any hydraulic cylinder can transform hydraulic primary pressure p1 (of e.g. its left ring area towards its right bottom area as shown below) to achieve a secondary pressure p2 (at its right bottom area as shown below).

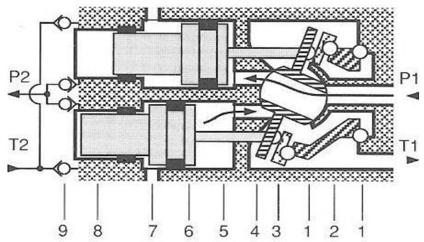
Once the piston is pulled to the left, secondary fluid will be sucked in via suction valve V1. Once the piston is pushed to the right, this fluid will be displaced via pressure valve V2.



However, such a system works discontinuously and stops, once the piston has come to an end of either cylinder side.

In practical use, a continuous flow will be desired, which can be reached by arranging a multitude of said cylinders (e.g. three of them) and providing an (e.g. 120°) phase shift of their movements/ displacements, thus in the end producing a rather continuous flow. Such a system is shown within European Patent EP 329.208 and can be described as follows:

Hydraulic oil is passed into Oil Pressure Port P1, from where it is distributed by Control Disk 4 into the ring areas of Oil Pistons 6 which consequently are moving out, while simultaneously driving the synchronizing system of Rotating Ring 2 and Wobbling Thrust Disk 3, which in turn are causing the movement of Control Disk 4 by Synchronizing Rods 5, to continuously ensure the oil distribution and the movement of Oil Pistons 6 and secondary water fluid pistons 8.



P1= Oil Pressure Port (primary)
T1= Oil Return Port
T2= Secondary Flow Inlet
P2= Secondary Pressure Port
1= Bearing
2= Rotating Ring
3= Wobbling Thrust Disk
4= Control Disk
5= Synchronizing Rod
6= Sealed Oil Piston (primary)
7= Aeration Port
8= Sealed Water Piston (secondary)
9= Non-Return Valves

Multistage Hydraulic Transformers are achieved by varying the effective diameters of oil pistons 6 and/or the diameters of secondary pistons 8, so pressure and flow can be varied rather extensively, while very high pressures can be achieved by using small diameters of secondary pistons 8, and large flows can be achieved from large secondary diameters, while only small drive oil flow is required.

Such transformers consequently can replace centrifugal pumps the flow of which is difficult to control, while hydraulic transformers ensure rather exact transmission ratios.

This, too, allows to use all necessary hydraulic control elements on the driving (primary) oil side, to transform the effect successively to another (secondary) fluid like water.

Dual Fluid Transformers have a primary drive system safely sealed against the driven secondary system. Therefore, oil hydraulics can pressurize any other low viscosity fluid. In case of food industry, driving oil may be biologically admissible, natural oil as of olives, rape seed etc.

Most important secondary fluid is water since this is

1. anywhere available in good quality and quantity,
2. easily serviced and changed,
3. environmentally accepted and non-inflammable,
4. most important however: available at no or only little costs.

Water therefore has a prominent place in fire prevention and fire fighting applications though some care must be taken to compensate the disadvantages of water as there are the necessity to use anti-corrosive materials, small compressibility and resulting pressure surges etc.

Combinations of hydraulic motors and hydraulic pumps by definition are not hydraulic transformers but hydraulic gears, though in advertising this often is mixed up. Due to the dual power transformation, such gear arrangements show higher power losses, while real hydraulic transformers as described aboe due to their direct power transmission reach efficiencies of 95% and over.

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