Third School Year

# PISTON PUMPS

***Pumps*** are machines, which transport liquids to higher and more distant places or make ***pressure*** in ***fluids***. ***Pumps suck*** a certain volume of liquid into a closed ***cylinder*** area and then push it out. The mechanical work supplied by a motor directly changes the liquid into ***pressure*** energy. ***Pumps*** are used for smaller volume ***flows***, but also for high ***pressures***.

## The function of piston pumps

In the ***cylinder*** the ***piston*** moves back in a direct line. The ***piston*** is put into motion by a ***crank*** mechanism. The liquid enters the ***cylinder*** and leaves the ***cylinder*** through openings. The openings are closed by ***valves***. A ***suction tube*** is led into the ***suction valve***. A ***pressure tube*** leads from the ***pressure valve***. On the ***bottom*** part of the ***suction tube*** there is a ***suction basket*** with a non-return ***valve***. The ***suction basket*** prevents ***impurities*** from forming. After stopping the ***pump*** from running, the non-return ***valve*** automatically closes and retains water in the ***suction tube***. It is not needed to ***fill*** the ***pump*** again by another ***release***.

In the ***piston*** motion in a direction away from the ***cylinder*** the interior area is ***increased***. ***Pressure*** in the ***valve drops***, the ***pressure valve*** is closed and the ***suction valve*** is opened. Due to the effects of ***underpressure***, the ***cylinder*** is ***filled*** with liquid.

While the ***piston*** moves in the opposite direction, ***pressure*** in the ***valve*** increases. The ***suction valve*** is closed, and the ***pressure valve*** is opened. Due to the effects of ***overpressure***, the liquid is delivered into the ***piping***.

During every ***suction*** and ***delivery*** liquid moves in the ***piping***. That is why ***air chambers*** are formed in the ***piping***. They are ***vessels filled*** with water and air. The air in them is compressed and the ***impact*** of the liquid is reduced. It then ***flows uniformly*** in the ***piping***. ***Air chambers*** are located close to the ***valves***.

## Kinds of piston pumps

**1) *Single-acting***

The working area is only on one side of the ***piston***. In one ***stroke*** of the ***pump piston***, the liquid only is ***sucked*** in, and only ***forced out*** in the return ***stroke***. This ***pump*** delivers liquid only once every two ***strokes***.

**2) *Double-acting***

In every ***stroke*** one side of the ***pump sucks*** liquid in and on the other side the liquid is ***forced out***. It works more ***uniformly*** than a ***single-acting pump***.

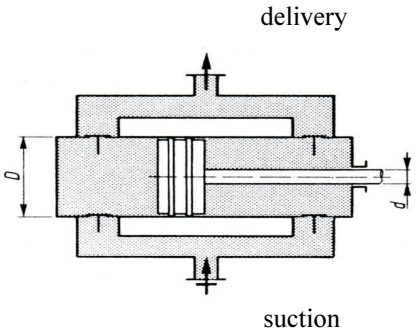


**Diagram of a double-acting pump**

**3) *Differential***

The ***pump*** has a ***piston*** with two spacing diameters. It ***sucks*** as a ***single-acting pump*** and ***forces*** liquid ***out*** as a ***double-acting*** one.

**4) *Lift***

They are used for pumping water from ***deep wells***.

**Specific *pump* energy**

Total specific energy is calculated as the sum of the specific ***suction*** and ***delivery*** energy (from Bernoulli´s ***equation***).

$Y_C = Y_S + Y_V$ [ J kg$^{-1}$ ]

*Sources: Rudolf Kříž abd co.: Machine Construction and Operation I., Jan Leinveber, Pavel Vávra: Mechanical Tables*
*A. Drost, J.Ouwehand: Machines for Energy Conversion*

## VOCABULARY

**air chamber** – vzdušník
**basket** – koš
**bottom** – spodní
**crank** – klikový
**cylinder** – válec
**deep** – hluboký
**delivery** – vytlačování
**diameter** – průměr
**differential** – diferenciální
**double-acting** – dvojčinný
**drop** – klesat
**equation** – rovnice
**fill** – plnit
**flow** – průtok
**fluid** – kapalina
**force out** – vytlačit
**impact** - náraz
**impurity** – nečistota
**increased** – zvýšený
**lift** – zdvižný
**losses** - ztráty
**overpressure** – přetlak
**piping** – potrubí
**piston** – pístový
**pressure** – tlak
**pump** – čerpadlo
**release** – spuštění
**single-acting** – jednočinný
**spacing** – rozestup, vzdálenost
**stroke** – zdvih
**suck** – nasát
**suction** – sání
**tube** – potrubí
**underpressure** – podtlak
**uniformly** - rovnoměrně
**valve** – ventil
**vessel** – nádoba
**well** – studna

## COMPREHENSION QUESTIONS

1. What are pumps?
2. What is the function of piston pumps?
3. Why do we form the air chambers in the piping?
4. What kinds of piston pumps do you know?
5. What is the difference between single-acting a double-acting piston pump?
6. Can you describe the differential piston pump?

## EXERCISES

### 1. Translate the expressions into Czech

| | | |
|---|---|---|
| **1** | lift | _____ |
| **2** | valve | _____ |
| **3** | suction | _____ |
| **4** | overpressure | _____ |
| **5** | liquid | _____ |
| **6** | double-acting | _____ |
| **7** | uniformly | _____ |
| **8** | pump | _____ |
| **9** | impact | _____ |
| **10** | piping | _____ |
| **11** | fluid | _____ |
| **12** | stroke | _____ |
| **13** | well | _____ |
| **14** | basket | _____ |
| **15** | piston | _____ |

### 2. Match the words with their definitions

| | | | |
|---|---|---|---|
| **1** | cylinder | **a** | a machine that is used to force liquid, gas or air into or out of sth |
| **2** | diameter | **b** | a long hollow pipe made of metal, plastic, rubber, etc. through which liquids or gases move from one place to another |
| **3** | pump | **c** | a dirty substance |
| **4** | well | **d** | a straight line going from one side of a circle or any other round object to the other side |
| **5** | losses | **e** | having a large distance from the top to the bottom |
| **6** | deep | **f** | a solid or hollow figure with round ends and long straight sides |
| **7** | impurity | **g** | money that has been lost by a business or an organization |
| **8** | tube | **h** | a deep hole in the ground from which people obtain water |

**KEY – for teachers only**

**1.**

| | | |
|---|---|---|
| **1** | lift | ***zdvižný*** |
| **2** | valve | ***ventil*** |
| **3** | suction | ***sání*** |
| **4** | overpressure | ***přetlak*** |
| **5** | liquid | ***kapalina*** |
| **6** | double-acting | ***dvojčinný*** |
| **7** | uniformly | ***rovnoměrně*** |
| **8** | pump | ***čerpadlo*** |
| **9** | impact | ***náraz*** |
| **10** | piping | ***potrubí*** |
| **11** | fluid | ***kapalina*** |
| **12** | stroke | ***zdvih*** |
| **13** | well | ***studna*** |
| **14** | basket | ***koš*** |
| **15** | piston | ***pístový*** |

**2.**

**1f 2d 3a 4h 5g 6e 7c 8b**