ISSN 0934-934 X · K 30285 F

VULKAN-VERLAG

2007

Industrial Valves

International Edition of Industriearmaturen

Published in Industrial Valves
International Edition of Industriearmaturen 2007

Vulkan-Verlag GmbH, Essen, Germany

http://www.industriearmaturen.de

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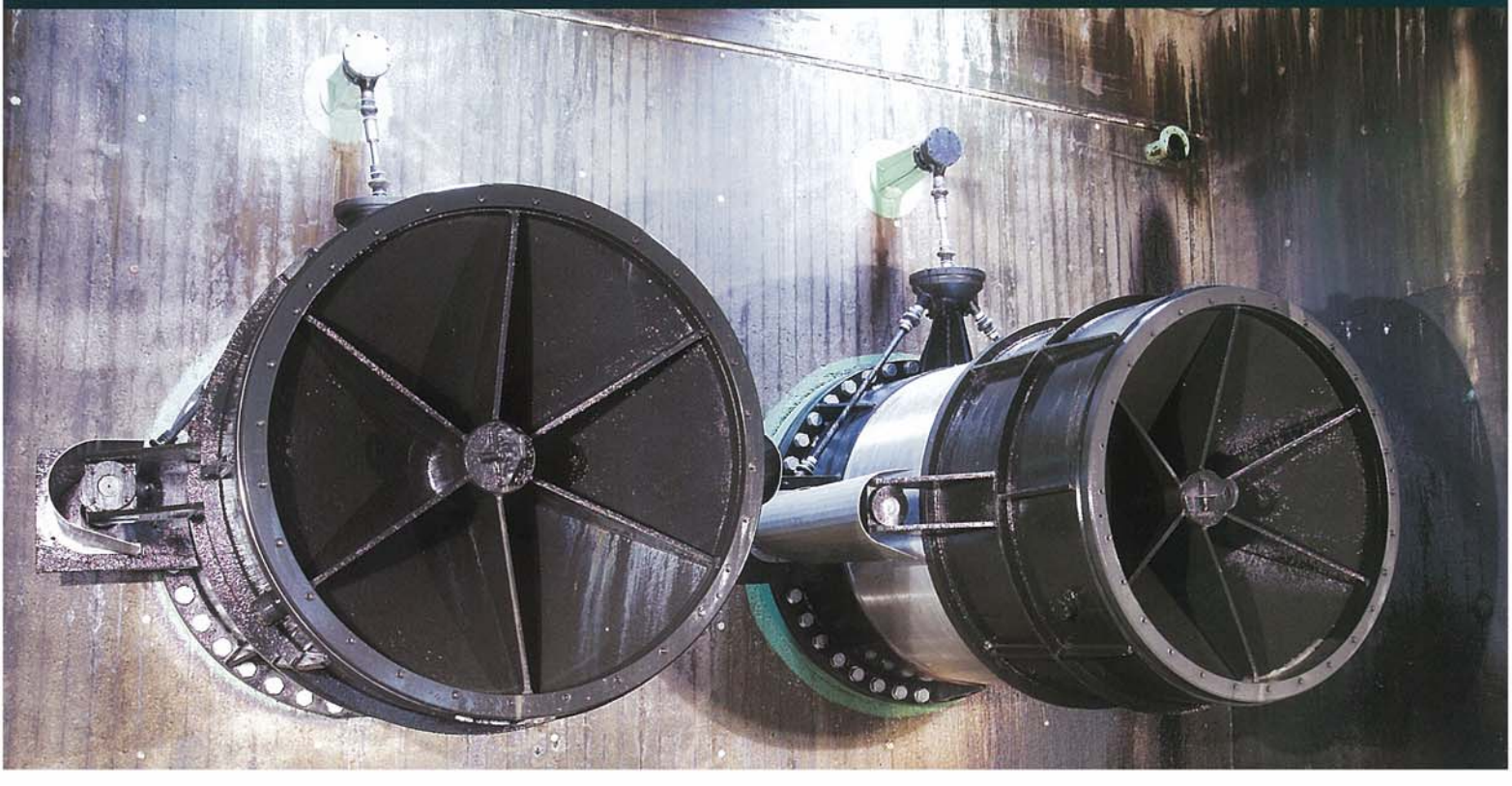
VAG



Control valves for bottom outlets in dams and in hydro-power plants

By Peter Oppinger

Normally butterfly valves are used as on-off valves and are usually installed in a valve chamber on the water side of bottom outlet lines in dams or in gravity lines leading to water treatment plants or hydro-power plants. In the best case the butterfly valves are assembled with brake and lift cylinders, working as pipe brake devices for emergency quick closing by lever and weight in case of pipe bursts. In dam applications, control valves such as plunger valves (or needle valves) or hollow-jet valves (or Howell Bunger valves or Fixed Cone valves) are installed after the butterfly valves on the air side. These valves always work as flow regulating or control valves. Plunger valves or hollow-jet valves are designed to perform regulating or control functions in water supply systems. Unlike butterfly valves or gate valves assuming only shut-off functions in pipeline systems, plunger valves and hollow-jet valves can meet the requirements of regulating operations.

Technical details of control valves

Previously, only the term of *needle valve* was used for valves having a controlling function. Today, the term *plunger valve* is very common due to the design features shown in **Figure 1**:

- The cross-section of the flow is annular in each position of the valve
- The axially movable closing device is shaped like a piston or a plunger

The compact and single-piece body is made of high quality ductile cast iron (GGG-40) with an inner body which is connected to the outer body by cast ribs. On the upstream side, the inner body has a spherical shape and the shape of the annular space results in a continuous narrowing towards the seat on the downstream side. Depending on the hydraulic conditions, there are different outlet parts available (**Figure 2**).

Figure 3 shows the cross-section during the closing process of a plunger valve. The cross-section is reduced in its flow, which is symmetrical to the axis, until the fully closed position of the piston is reached and the valve is absolutely drop-tight. The piston or plunger is normally made of stainless steel and is operated by an internal piston-drive made of ductile cast iron or stainless steel.

An essential advantage of the new VAG RIKO Plunger valve is its piston guiding which is made as bronze welding. The piston-drive is connected by a stainless steel shaft to a gear box as-

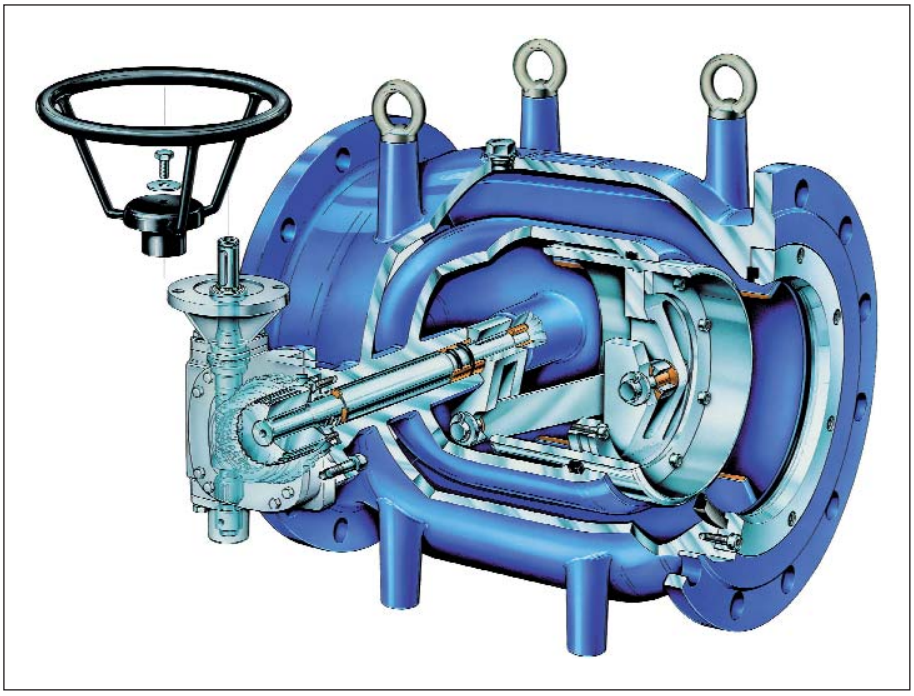


Fig. 1: Cross section through the VAG Plunger valve in standard version

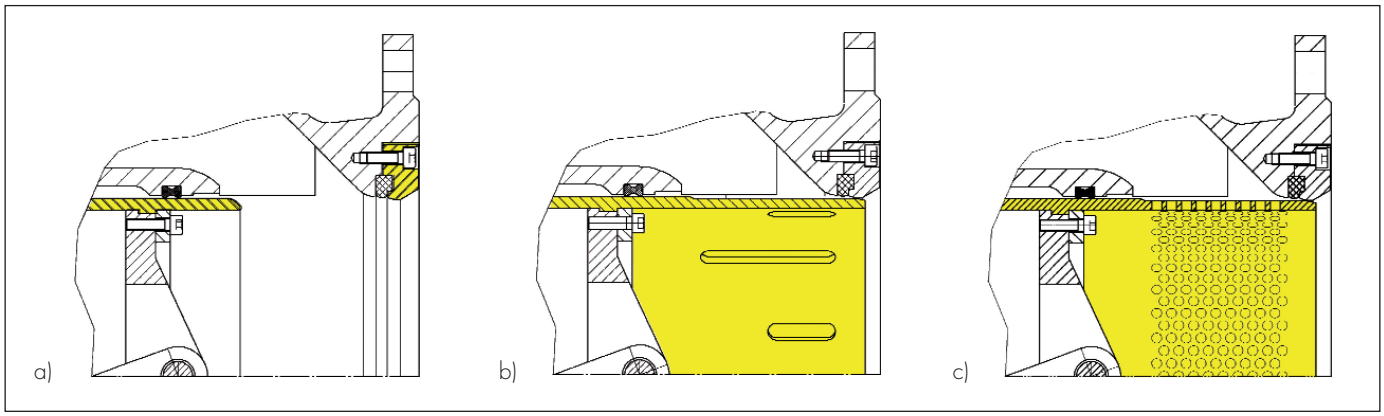


Fig. 2: a) standard seat ring of a VAG Plunger Valve, b) version with slotted cylinder, c) version with orifice cylinder

sembled to a connecting flange on the outside of the body. On the gearbox there can be assembled an electric actuator for automatic operation or the valve can be operated by a pneumatic actuator without gearbox. These valves are available in nominal widths ranging from DN 150 up to DN 1600, and in special versions up to pressure rates of PN 100 (**Figure 4**). Plunger valves are suitable for inline installation and for installation at the end of pipelines.

Fig. 4: VAG Plunger valve with PN 100 pressure rating for a hydro-power project in Spain

For bigger dimensions and higher flow capacities, hollow-jet valves are available. Hollow-jet valves can only be installed at the end of pipelines. Due to their design and usually made of manufactured steel, these valves can be produced in nearly any dimension. As a rule, hollow-jet valves are normally not used for dimensions smaller than DN 400. Depending on the design of the stilling basin, hollow-jet valves can be used in a standard version (**Figure 5**) or in a special version assembled with a hood pipe as a jet-guide pipe to concentrate the water flow after the valve (**Figure 6**). The advantage of using a hollow-jet valve in combination with a hood pipe is that the water flow after the valve is concentrated nearly in the same diameter of the hood pipe.

Fig. 3: Closing process of a VAG Plunger valve DN 800 installed in the bottom outlet of the Glör dam, Germany

Fig. 5: VAG Hollow Jet valve DN 1000 in standard version installed in the bottom outlet of the dam La Copa, Colombia

The main functions of control valves are as follows:

- control the flow capacity
- control the water level
- control the pressure in case of a following pipeline

Special project: Thirty-six dams in Algeria fitted with VAG flow control valves

Algeria is situated between the Atlas Mountains in the north of Africa and the Sahara desert in the south of the country. Most of the country's water is supplied from dams. The dams are operated by the government, while the pipelines and water treatment plants are operated by the municipalities.

The amount of water supplied from the dams was usually different from the amount which the municipalities received. This metering and documentation problem was solved thanks to the wide range of valves offered by VAG-Armaturen GmbH, a German company with more than 130 years of experience in the design and manufacturing of heavy-duty valves for water applications. VAG-Armaturen GmbH has been making butterfly valves and special control valves particularly for dam applications for more than 50 years. Due to their considerable experience, VAG's technicians and engineers were closely involved in this project – a € 15 million project that is yet to be equalled in type, size and cost.

Project overview

Water was to be metered and documented at thirty-six of Algeria's major dams. For this purpose, a tender for the equipment of the pressure pipelines with flow meters and flow control valves was drafted in 2003. In August 2003, a delegation of eight people, including engineers from VAG, visited all of the dams during a two weeks' trip through Algeria. During this period, all the specifications required for the calculation, dimensioning and designing of the valves were collected. Working on behalf of the government, the delegation was under constant military protection. At the end of August 2003, the contract was awarded to VAG by AWE, the contracting company. A total of more than fifty plunger valves in nominal diameters between DN 300 and DN 1600 PN 10, several hollow-jet valves, butterfly valves, gate valves and air release valves were to be delivered by VAG and installed by AWE.

Fig. 6: 2 pc. VAG Hollow Jet valves DN 1800 with hood pipe (diameter 3600 mm) installed in the two bottom outlets of the RUR dam, Germany

Dimensioning and designing

All the valves were calculated and dimensioned for extreme situations. To ensure the accuracy of the special valves design, VAG used its own calculation program, VAG UseCAD. Due to the hydraulic conditions, VAG had to design venting systems for some of the control valves to avoid cavitation in each operating position. VAG created flow characteristic and cavitation curves, technical data sheets with all important outer dimensions including spare parts lists, operating and maintenance instructions for each of the control valves. All these curves had been checked and approved by the contractor and by the Algerian government.

Challenges: quantity, size and time

The tight schedule was particularly challenging for VAG's design, manufacturing and logistics teams. More than fifty plunger valves, fifteen of which had nominal diameters between DN 1200 and DN 1600 and weighed between 8 to 12 tons had to be manufactured and delivered within a very short period of time. To guarantee a reliable supply of water, the valves had to be of the highest quality and reliability. This is one of the reasons why the contract was awarded to the German manufacturer VAG whose expert advice before and during the project the customer had

Project: dams in Algeria

Project: Manufacturing and supply of different valves for the bottom outlets and pressure pipelines of 36 dams in Algeria

Valves:
VAG Plunger valves in dimensions ranging from DN 300 up to DN 1600 and with a pressure rating of PN 10
VAG DN 800 Hollow-Jet valves with a pressure rating of PN 10
VAG DN 2000 EKN butterfly valves with a pressure rating of PN 10
VAG EKO gate valves ranging from DN 50 up to DN 200, with a pressure rating of PN 10
VAG Duojet air release valves ranging from DN 50 up to DN 200, with a pressure rating of PN 10
Including the necessary pipeline flanges, dismantling pieces, connecting screws and flange seals

Actuators: All control valves are equipped with electric actuators and control panels made by German supplier AUMA

Project duration: 2003 to 2004

Executed by: VAG-Armaturen GmbH, Mannheim, Germany

Contracted by: Algerian Water Enterprises (AWE)

Table 1: Information about special project in Algeria

Fig. 7: VAG Plunger valve DN 800 including an inductive flow meter at SMBA dam, Algeria

come to have confidence in. VAG actively participated in pre-project discussions and provided solutions for problems that were not always related to valves only.

Logistics excellence

VAG delivered the complete material in six batches between December 2003 and December 2004. Everything down to the completeness check of the shipping container was meticulously planned. Each of the valves including all the connecting parts was clearly marked with the name of the dam and the place of installation of the specific parts. One missing screw would have delayed resuming the supply of water. But nothing failed in this big project.

Fig. 8: Installation of two VAG Plunger valves DN 1200 at the Beni Bahdel dam, Algeria

Installation

Most of the thirty-six dams are miles away from civilization. Two mobile installation teams from AWE carried out all of the installation works. They were equipped with the necessary devices and tools, including kitchen and accommodation containers. Right after the completing of one dam, the teams went on to the next.

First the roller gate on the water side was closed, special tools used to cut open the dam's pipelines, and the valves were installed with cranes. The flow meters were installed at the specified distance from the control valves, and the installation was accepted and released for testing (**Figure 7**).

Each building site brought new challenges for the installation teams, all of which the teams were able to deal with thanks to their know-how and experience. One of the challenges at the site consisted of bringing in bulldozers to build roads for truck-mounted cranes which were necessary to install the heavy-duty valves in the pipelines (**Figure 8**).

The result

The operator of the dams, ANB (Agence Nationale des Barrages, Algiers) and the contracting company, AWE, highly appreciated the solution provider's competence and excellent product quality of each of the VAG valves. The supply of water plays an important role in confirming the government's good reputation in the Algerian population and around the world. VAG was able to fulfil each of the customer's requirements.

Literature

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